ANALYSIS OF SEISMIC SLOPE STABILITY OF FLY ASH POND EASTERN DIKE UPPER SECTION SPORN FLY ASH POND PHILIP SPORN POWER PLANT NEW HAVEN, WEST VIRGINIA NPDES NO. WV0001058

Prepared For:

American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43215

Prepared By:

Geo/Environmental Associates, Inc.
3502 Overlook Circle
Knoxville, Tennessee 37909

GA File No. 09-387
January 18, 2010

GA

REFERENCES

Cedergren, Harry. *Seepage, Drainage, and Flow Nets.* 3rd ed. New York: John Wiley & Sons, 1989. Print

Craig, R. *Soil Mechanics.* 5th ed. London: Chapman & Hall, 1992. Print

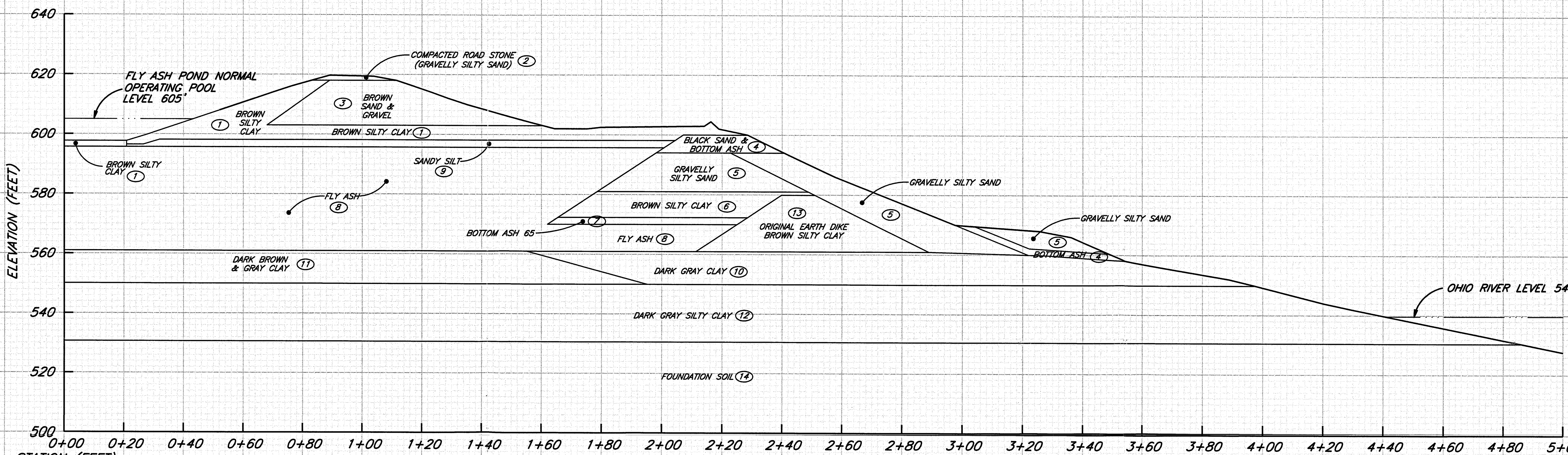
Dam Safety Rules. West Virginia Department of Environmental Protection, Water Resources.

Forrester, Kevin. *Subsurface Drainage for Slope Stabilization.* Reston: American Society of Civil Engineers, 2001. Print

Holtz, Robert D., and William D. Kovacs. *An Introduction to Geotechnical Engineering.* Englewood Cliffs: Prentice-Hall, 1981. Print

Lambe, T. William, and Robert V. Whitman. *Soil Mechanics.* New York: John Wiley & Sons, 1969. Print

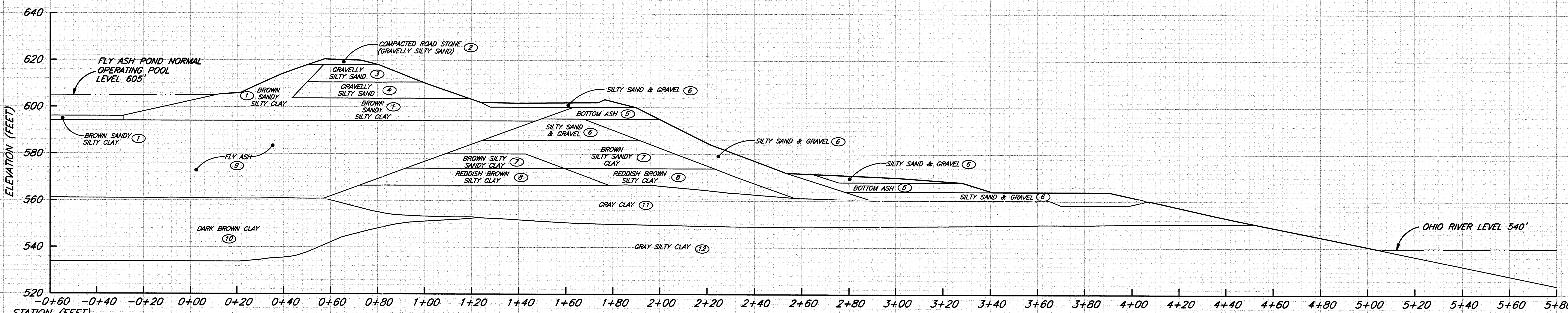
Seepage Modeling with SEEP/W 2007 an Engineering Methodology. 4th ed. Calgary: Geo-Slope International, 2008. Print



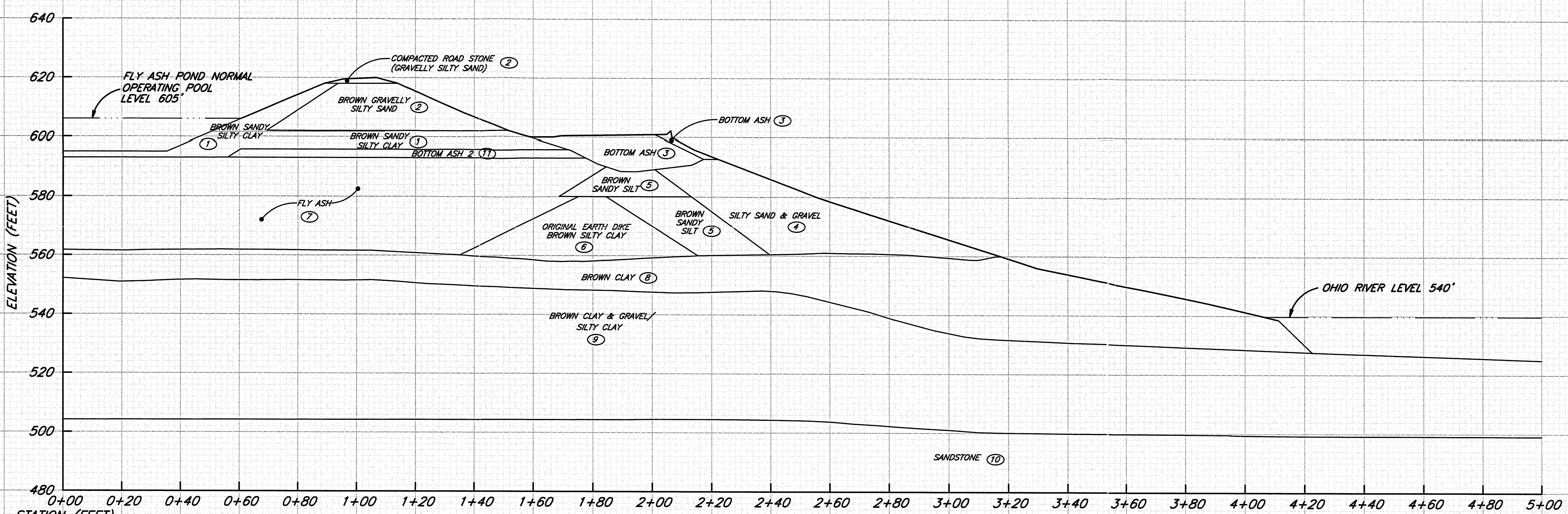
PROFILE K-K

NOTES

1. AS-BUILT PROFILE ADAPTED FROM TOPOGRAPHIC MAPPING PREPARED BY HENDERSON AERIAL SURVEYS, INC. DATED 5-22-07 AND PROVIDED BY AEP.



PROFILE L-L



PROFILE M-M

THESE DRAWINGS ARE PART OF A SET OF DESIGN DOCUMENTS WHICH ALSO CONTAINS A WRITTEN TEXT. THAT TEXT EXPLAINS SOME OF THE DETAILS SHOWN HEREIN AND THEREFORE THESE DRAWINGS SHOULD ONLY BE USED IN CONJUNCTION WITH THE TEXT.

DATE	REVISIONS	BY

EASTERN DIKE SECTIONS

FLY ASH POND
PHILIP SPORN PLANT
NEW HAVEN, WEST VIRGINIA

SCALE: AS SHOWN | DR. RWC | CHK. RWC | REV. SWF

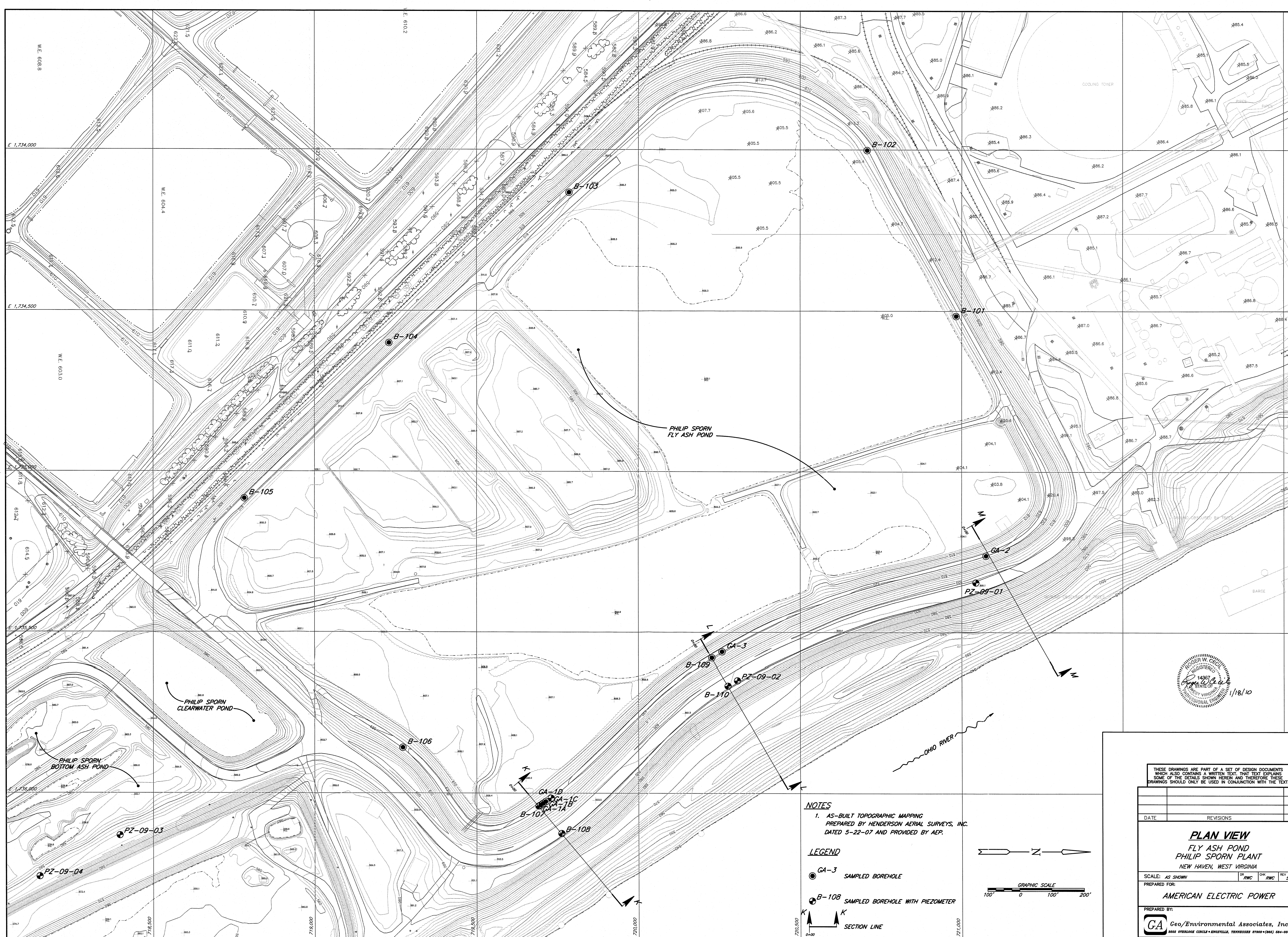
PREPARED FOR:
AMERICAN ELECTRIC POWER

PREPARED BY:
GA Geo/Environmental Associates, Inc.
3502 OVERLOOK CIRCLE • KNOXVILLE, TENNESSEE 37909 • (865) 584-0344

PROJ: 09-387 | DATE: 1-18-10 | SHEET 2 OF 2

1/18/10

SPP00003618



NOTES

1. AS-BUILT TOPOGRAPHIC MAPPING PREPARED BY HENDERSON AERIAL SURVEYS, INC. DATED 5-22-07 AND PROVIDED BY AEP.

LEGEND

GA-3 SAMPLED BOREHOLE

B-108 SAMPLED BOREHOLE WITH PIEZOMETER

K K SECTION LINE

N

GRAPHIC SCALE
100' 0 100' 200'

THESE DRAWINGS ARE PART OF A SET OF DESIGN DOCUMENTS WHICH ALSO CONTAINS A WRITTEN TEXT. THAT TEXT EXPLAINS SOME OF THE DETAILS SHOWN HEREIN AND THEREFORE THESE DRAWINGS SHOULD ONLY BE USED IN CONJUNCTION WITH THE TEXT.

DATE	REVISIONS	BY

PLAN VIEW
FLY ASH POND
PHILIP SPORN PLANT
NEW HAVEN, WEST VIRGINIA

SCALE: AS SHOWN | DR RWC | CHK RWC | REV SWF

PREPARED FOR:
AMERICAN ELECTRIC POWER

PREPARED BY:
GA Geo/Environmental Associates, Inc.
3502 OVERLOOK CIRCLE • KNOXVILLE, TENNESSEE 37909 • (865) 584-0344

PROJ: 09-387 | DATE: 1-18-10 | SHEET 1 OF 2

SLOPE/W Analysis

File Information

Title: Sporn Fly Ash Pond
Comments: Section M-M Upstream Seismic (Circular)
Created By: Roger W. Cecil, P.E.
Revision Number: 47
Last Edited By: Roger Cecil
Date: 1/17/2010
Time: 11:55:29 PM
File Name: SECTION M-M UPSTREAM SEISMIC_CIRCLE.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/17/2010
Last Solved Time: 11:55:56 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Sporn Fly Ash Pond Section M-M Upstream (Circular)
Kind: SLOPE/W
Parent: Steady-State Seepage
Method: Morgenstern-Price
Settings
  Side Function
    Interslice force function option: Half-Sine
  PWP Conditions Source: Parent Analysis
SlipSurface
  Direction of movement: Right to Left
  Use Passive Mode: No
  Slip Surface Option: Entry and Exit
  Critical slip surfaces saved: 1
  Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 50
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 20 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Sandy Silty Clay (1)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Gravelly Silty Sand (2)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Bottom Ash (3)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 36 °
Phi-B: 0 °

Silty Sand and Gravel (4)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Unit Wt. Above Water Table: 115 pcf

Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Sandy Silt (5)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Silty Clay (6)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Fly Ash (7)

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °

Brown Clay (8)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 37 °
Phi-B: 0 °

Silty Clay (9)

Model: Mohr-Coulomb
Unit Weight: 126 pcf
Unit Wt. Above Water Table: 122 pcf
Cohesion: 170 psf
Phi: 31.2 °
Phi-B: 0 °

Sandstone (10)

Model: Bedrock (Impenetrable)

Bottom Ash 2 (11)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-93.52681, 595.12028) ft
Left-Zone Right Coordinate: (34.90988, 595.1075) ft
Left-Zone Increment: 20
Right Projection: Range
Right-Zone Left Coordinate: (89.08286, 617.98267) ft
Right-Zone Right Coordinate: (110.91718, 618.81797) ft
Right-Zone Increment: 10
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-100, 595.12092) ft
Right Coordinate: (550, 524.91002) ft

Seismic Loads

Horz Seismic Load: 0.06
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Sandy Silty Clay (1)	108,2,3,109	201.13421
Region 2	Sandy Silty Clay	2,110,5,6,7,8,9,10,11,12,13,14,3	962.07207

	(1)		
Region 3	Gravelly Silty Sand (2)	7,15,16,17,8	31.119887
Region 4	Gravelly Silty Sand (2)	9,10,17,8	819.48221
Region 5	Bottom Ash (3)	11,18,19,20,21,22,23,24,25,26,27,28,12	423.64067
Region 6	Bottom Ash (3)	20,29,30,31,32,33,21	32.648671
Region 7	Sandy Silt (5)	26,34,35,36,37,23,24,25	282.19505
Region 8	Silty Sand and Gravel (4)	23,22,21,33,38,39,40,41,42,43,44,45,46,47,37	1565.2892
Region 9	Sandy Silt (5)	36,37,47,48	531.21818
Region 10	Silty Clay (6)	36,48,49,50,51,52,53,54,55,35	989.52619
Regio	Fly Ash	4,56,57,58,59,60,61,62,55,35,34,26,27,28,14,3,109	8370.9742

n 11	(7)		
Region 12	Brown Clay (8)	56,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,111,93,94,95,96,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,62,61,60,59,58,57	6985.7443
Region 13	Silty Clay (9)	91,97,98,99,100,101,102,103,104,105,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90	25156.343
Region 14	Sandstone (10)	105,106,107,98,99,100,101,102,103,104	34015.546
Region 15	Fly Ash (7)	1,108,109,4	70.533781
Region 16	Bottom Ash 2 (11)	12,28,14,13	324.85555

Points

	X (ft)	Y (ft)
Point 1	-100	595.12092
Point 2	35.36015	595.10746
Point 3	35.37077	593.10938
Point 4	-100	593.10516
Point 5	60.72629	605.9827
Point 6	74.8905	612.04606
Point 7	89.08286	617.98267
Point 8	93.72016	617.98376
Point 9	69.42633	602.00461
Point 10	151.61692	602.00605
Point 11	158.87128	599.99208

Point 12	171.82425	595.91741
Point 13	60.47732	595.91216
Point 14	56.0411	593.12487
Point 15	95.74708	619.48275
Point 16	106.57718	619.95406
Point 17	114.07579	617.99114
Point 18	166.70528	600.0213
Point 19	169.58045	600.43082
Point 20	200.94364	600.90024
Point 21	217.30273	592.80917
Point 22	213.38189	590.83858
Point 23	200.88583	589.29528
Point 24	195.25394	588.59744
Point 25	189.42126	588.62008
Point 26	184.5	590.20374
Point 27	181.51772	591.16693
Point 28	177.65846	593.12697
Point 29	204.98541	600.97594
Point 30	206.35442	602.21331
Point 31	206.71422	599.99306
Point 32	214.00828	595.98847
Point 33	222.27612	592.82454
Point 34	168.66722	580.09858
Point 35	175.21974	580.09858
Point 36	184.51087	580.09817
Point 37	213.24737	580.09272
Point 38	255.42934	580.07172
Point 39	317.48058	559.92079
Point 40	315.59736	559.88781
Point 41	309.9739	558.80103
Point 42	307.4465	558.76312
Point 43	287.58173	560.34006
Point 44	273.69358	560.81173
Point 45	259.80542	560.94275
Point 46	255.45555	560.94275
Point 47	239.61428	560.44981

Point 48	215.41971	560.03735
Point 49	206.90911	559.67804
Point 50	185.33019	558.38907
Point 51	177.08328	558.01754
Point 52	173.62075	558.106
Point 53	169.80438	558.01754
Point 54	164.66112	558.14391
Point 55	135.13429	560.09691
Point 56	-100	561.74545
Point 57	20.16974	561.49271
Point 58	28.34588	561.72018
Point 59	50.65765	561.88173
Point 60	61.94724	561.81622
Point 61	89.85457	561.6852
Point 62	105.36228	561.59785
Point 63	-100	552.17166
Point 64	19.23461	550.94335
Point 65	32.24565	551.32246
Point 66	41.85988	551.67124
Point 67	47.10676	551.74706
Point 68	56.64516	551.4741
Point 69	78.08761	551.61058
Point 70	95.40534	551.48927
Point 71	105.51999	551.66113
Point 72	114.75208	551.07983
Point 73	124.43302	550.29735
Point 74	142.61209	549.56582
Point 75	165.69351	548.62684
Point 76	187.96697	548.08092
Point 77	205.85125	547.44765
Point 78	216.92246	547.535
Point 79	233.69307	548.10276
Point 80	236.99041	548.14643
Point 81	242.18755	547.92806
Point 82	246.77327	547.31663
Point 83	252.65171	546.21606

Point 84	273.24811	541.09055
Point 85	281.07788	538.66929
Point 86	297.9009	534.10978
Point 87	305.69923	532.66332
Point 88	316.39049	531.68853
Point 89	338.77924	530.77663
Point 90	389.87718	528.88993
Point 91	422.60496	527.57608
Point 92	411.3282	538.58079
Point 93	401.8504	540.81657
Point 94	388.80805	543.92059
Point 95	352.80366	551.31013
Point 96	329.44346	556.01129
Point 97	550	524.91002
Point 98	550	499.15439
Point 99	396.01919	499.3174
Point 100	313.20998	500.09985
Point 101	256.3846	503.93603
Point 102	240.95296	504.37072
Point 103	191.37067	504.40695
Point 104	86.37793	504.45549
Point 105	-100	504.13087
Point 106	-100	449.97963
Point 107	550	450.03403
Point 108	-64.96913	595.11744
Point 109	-64.96913	593.10625
Point 110	58.47531	605
Point 111	405.33383	539.99484

Critical Slip Surfaces

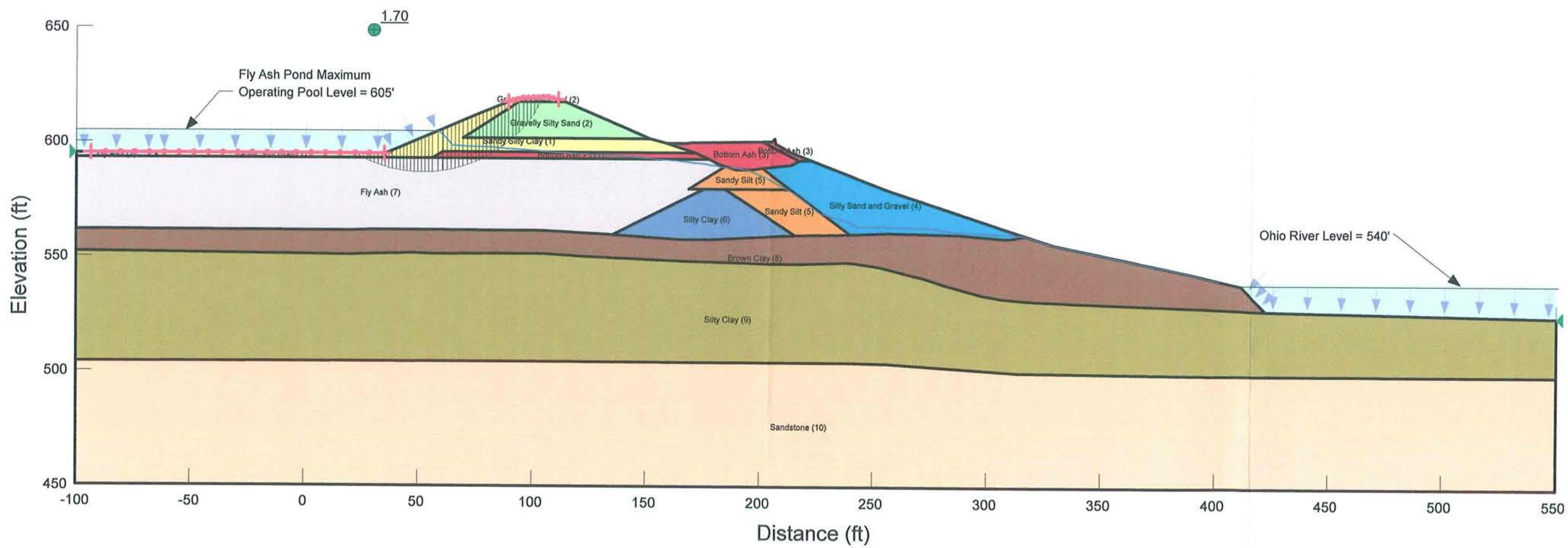
	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	2262	1.70	(51.854, 645.376)	58.43	(104.418, 619.86)	(22.0662, 595.109)

Slices of Slip Surface: 2262

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	2262	22.98308	594.5876	591.00035	725.21518	90.529042	0
2	2262	24.816825	593.58775	535.04915	935.07912	269.82362	0
3	2262	26.535905	592.72335	524.44349	1060.2449	273.00448	0
4	2262	28.140315	591.98135	560.98068	1171.7929	311.22437	0
5	2262	29.74472	591.29715	594.3545	1274.7294	346.66835	0
6	2262	31.349125	590.6685	624.66587	1368.5103	379.00765	0
7	2262	32.953535	590.09355	652.04788	1452.5994	407.90139	0
8	2262	34.557945	589.5707	676.49106	1526.7635	433.23543	0
9	2262	36.160475	589.0989	696.26945	1669.9033	496.09122	0
10	2262	37.75581	588.67805	712.93425	1783.892	545.68022	0
11	2262	39.345835	588.30615	726.94813	1884.7941	589.95199	0
12	2262	40.93586	587.98065	738.44511	1972.894	628.98314	0
13	2262	42.525885	587.70085	747.38388	2048.1969	662.79733	0
14	2262	44.11591	587.46605	753.79203	2110.892	691.47695	0
15	2262	45.705935	587.2757	757.64541	2161.3596	715.2281	0
16	2262	47.29596	587.1294	758.92619	2200.0959	734.31266	0
17	2262	48.885985	587.02675	757.56243	2227.6519	749.04798	0
18	2262	50.47601	586.96755	753.61466	2244.6852	759.73839	0
19	2262	52.066035	586.9517	746.96422	2252.0245	766.86651	0
20	2262	53.65606	586.97915	737.56131	2250.4641	770.86246	0
21	2262	55.246085	587.04995	725.42888	2240.7678	772.10375	0
22	2262	57.258205	587.20925	708.71827	2185.9987	752.71196	0
23	2262	59.476315	587.45405	686.33646	2126.9051	734.0064	0
24	2262	60.601805	587.60465	673.32967	2116.491	735.32742	0
25	2262	61.596295	587.77065	659.7088	2124.1921	746.1915	0
26	2262	63.336305	588.0922	633.99453	2133.1315	763.84845	0
27	2262	65.07631	588.46875	604.86094	2135.5706	779.93552	0
28	2262	66.816315	588.9014	572.153	2132.0046	794.7841	0
29	2262	68.556325	589.39145	535.79807	2122.9808	808.70998	0
30	2262	70.337025	589.9547	494.72582	2105.767	820.86648	0
31	2262	72.158415	590.596	448.7195	2080.636	831.50297	0

32	2262	73.979805	591.30625	398.50792	2050.7208	841.84449	0
33	2262	75.66933	592.02655	348.07348	2018.0934	850.91764	0
34	2262	77.22699	592.7497	297.87411	1983.3986	858.81763	0
35	2262	78.831265	593.55495	242.66	1925.2581	1051.404	0
36	2262	80.48216	594.4487	182.04629	1888.6834	1066.4252	0
37	2262	82.133055	595.41295	117.05352	1847.8045	1081.4933	0
38	2262	83.724045	596.4115	58.105546	1772.9444	1156.6734	0
39	2262	85.255135	597.44325	7.4098644	1695.888	1138.8929	0
40	2262	86.786225	598.54775	-44.304526	1620.8015	1093.2444	0
41	2262	88.317315	599.73035	-96.971794	1542.9859	1040.7571	0
42	2262	90.04526	601.17345	-157.99596	1431.7524	965.72916	0
43	2262	91.685785	602.637	-231.67416	1300.5275	910.63918	0
44	2262	93.042035	603.9431	-314.49507	1198.4101	839.13581	0
45	2262	94.73362	605.71285	-426.3663	1065.7985	746.28014	0
46	2262	96.519085	607.7243	-553.18776	909.80435	637.05186	0
47	2262	98.06309	609.6383	-673.58478	752.98854	527.24825	0
48	2262	99.607095	611.7323	-804.57056	587.2481	411.19555	0
49	2262	101.1511	614.0427	-948.38728	410.96319	287.75952	0
50	2262	102.6951	616.6223	-1108.2104	222.35309	155.69331	0
51	2262	103.94265	618.9237	-1251.0063	62.486045	43.7532	0

Title: Sporn Fly Ash Pond
Comments: Section M-M Upstream Seismic (Circular)
Created By: Roger W. Cecil, P.E.
File Name: SECTION M-M UPSTREAM SEISMIC_CIRCLE.gsz
Date: 1/17/2010
Horz Seismic Load: 0.06



SPP00003554

SLOPE/W Analysis

File Information

Title: Sporn Fly Ash Pond
Comments: Section M-M Upstream Seismic (Block)
Created By: Roger W. Cecil, P.E.
Revision Number: 52
Last Edited By: Roger Cecil
Date: 1/18/2010
Time: 12:01:01 AM
File Name: SECTION M-M UPSTREAM SEISMIC_BLOCK.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/18/2010
Last Solved Time: 12:01:28 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Sporn Fly Ash Pond Section M-M Upstream (Block)
Kind: SLOPE/W
Parent: Steady-State Seepage
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Parent Analysis

SlipSurface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Block
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Restrict Block Crossing: Yes
Advanced
Number of Slices: 50
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 20 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Sandy Silty Clay (1)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Gravelly Silty Sand (2)
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Bottom Ash (3)
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 36 °
Phi-B: 0 °

Silty Sand and Gravel (4)
Model: Mohr-Coulomb
Unit Weight: 120 pcf

Unit Wt. Above Water Table: 115 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Sandy Silt (5)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Silty Clay (6)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Fly Ash (7)
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °

Brown Clay (8)
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 37 °
Phi-B: 0 °

Silty Clay (9)
Model: Mohr-Coulomb
Unit Weight: 126 pcf
Unit Wt. Above Water Table: 122 pcf
Cohesion: 170 psf
Phi: 31.2 °
Phi-B: 0 °

Sandstone (10)
Model: Bedrock (Impenetrable)

Bottom Ash 2 (11)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (-100, 595.12092) ft
Right Coordinate: (550, 524.91002) ft

Slip Surface Block

Left Grid
- Upper Left: (-10.0354, 594.076) ft
- Lower Left: (-10.0354, 585.279) ft
- Lower Right: (50.1084, 585.728) ft
- X Increments: 8
- Y Increments: 3
- Starting Angle: 135 °
- Ending Angle: 180 °
- Angle Increments: 2

Right Grid
- Upper Left: (54.507, 600.091) ft
- Lower Left: (54.507, 584.83) ft
- Lower Right: (125.602, 584.561) ft
- X Increments: 8
- Y Increments: 3
- Starting Angle: 45 °
- Ending Angle: 65 °
- Angle Increments: 2

Seismic Loads

Horz Seismic Load: 0.06
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region	Sandy	108,2,3,109	201.13421

n 1	Silty Clay (1)		
Region 2	Sandy Silty Clay (1)	2,110,5,6,7,8,9,10,11,12,13,14,3	962.07207
Region 3	Gravelly Silty Sand (2)	7,15,16,17,8	31.119887
Region 4	Gravelly Silty Sand (2)	9,10,17,8	819.48221
Region 5	Bottom Ash (3)	11,18,19,20,21,22,23,24,25,26,27,28,12	423.64067
Region 6	Bottom Ash (3)	20,29,30,31,32,33,21	32.648671
Region 7	Sandy Silt (5)	26,34,35,36,37,23,24,25	282.19505
Region 8	Silty Sand and Gravel (4)	23,22,21,33,38,39,40,41,42,43,44,45,46,47,37	1565.2892
Region	Sandy Silt	36,37,47,48	531.21818

9	(5)		
Region 10	Silty Clay (6)	36,48,49,50,51,52,53,54,55,35	989.52619
Region 11	Fly Ash (7)	4,56,57,58,59,60,61,62,55,35,34,26,27,28,14,3,109	8370.9742
Region 12	Brown Clay (8)	56,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,111,93,94,95,96,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,62,61,60,59,58,57	6985.7443
Region 13	Silty Clay (9)	91,97,98,99,100,101,102,103,104,105,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90	25156.343
Region 14	Sandstone (10)	105,106,107,98,99,100,101,102,103,104	34015.546
Region 15	Fly Ash (7)	1,108,109,4	70.533781
Region 16	Bottom Ash 2 (11)	12,28,14,13	324.85555

Points

	X (ft)	Y (ft)
Point 1	-100	595.12092
Point 2	35.36015	595.10746
Point 3	35.37077	593.10938
Point 4	-100	593.10516
Point 5	60.72629	605.9827

Point 6	74.8905	612.04606
Point 7	89.08286	617.98267
Point 8	93.72016	617.98376
Point 9	69.42633	602.00461
Point 10	151.61692	602.00605
Point 11	158.87128	599.99208
Point 12	171.82425	595.91741
Point 13	60.47732	595.91216
Point 14	56.0411	593.12487
Point 15	95.74708	619.48275
Point 16	106.57718	619.95406
Point 17	114.07579	617.99114
Point 18	166.70528	600.0213
Point 19	169.58045	600.43082
Point 20	200.94364	600.90024
Point 21	217.30273	592.80917
Point 22	213.38189	590.83858
Point 23	200.88583	589.29528
Point 24	195.25394	588.59744
Point 25	189.42126	588.62008
Point 26	184.5	590.20374
Point 27	181.51772	591.16693
Point 28	177.65846	593.12697
Point 29	204.98541	600.97594
Point 30	206.35442	602.21331
Point 31	206.71422	599.99306
Point 32	214.00828	595.98847
Point 33	222.27612	592.82454
Point 34	168.66722	580.09858
Point 35	175.21974	580.09858
Point 36	184.51087	580.09817
Point 37	213.24737	580.09272
Point 38	255.42934	580.07172
Point 39	317.48058	559.92079
Point 40	315.59736	559.88781
Point 41	309.9739	558.80103

Point 42	307.4465	558.76312
Point 43	287.58173	560.34006
Point 44	273.69358	560.81173
Point 45	259.80542	560.94275
Point 46	255.45555	560.94275
Point 47	239.61428	560.44981
Point 48	215.41971	560.03735
Point 49	206.90911	559.67804
Point 50	185.33019	558.38907
Point 51	177.08328	558.01754
Point 52	173.62075	558.106
Point 53	169.80438	558.01754
Point 54	164.66112	558.14391
Point 55	135.13429	560.09691
Point 56	-100	561.74545
Point 57	20.16974	561.49271
Point 58	28.34588	561.72018
Point 59	50.65765	561.88173
Point 60	61.94724	561.81622
Point 61	89.85457	561.6852
Point 62	105.36228	561.59785
Point 63	-100	552.17166
Point 64	19.23461	550.94335
Point 65	32.24565	551.32246
Point 66	41.85988	551.67124
Point 67	47.10676	551.74706
Point 68	56.64516	551.4741
Point 69	78.08761	551.61058
Point 70	95.40534	551.48927
Point 71	105.51999	551.66113
Point 72	114.75208	551.07983
Point 73	124.43302	550.29735
Point 74	142.61209	549.56582
Point 75	165.69351	548.62684
Point 76	187.96697	548.08092
Point 77	205.85125	547.44765

Point 78	216.92246	547.535
Point 79	233.69307	548.10276
Point 80	236.99041	548.14643
Point 81	242.18755	547.92806
Point 82	246.77327	547.31663
Point 83	252.65171	546.21606
Point 84	273.24811	541.09055
Point 85	281.07788	538.66929
Point 86	297.9009	534.10978
Point 87	305.69923	532.66332
Point 88	316.39049	531.68853
Point 89	338.77924	530.77663
Point 90	389.87718	528.88993
Point 91	422.60496	527.57608
Point 92	411.3282	538.58079
Point 93	401.8504	540.81657
Point 94	388.80805	543.92059
Point 95	352.80366	551.31013
Point 96	329.44346	556.01129
Point 97	550	524.91002
Point 98	550	499.15439
Point 99	396.01919	499.3174
Point 100	313.20998	500.09985
Point 101	256.3846	503.93603
Point 102	240.95296	504.37072
Point 103	191.37067	504.40695
Point 104	86.37793	504.45549
Point 105	-100	504.13087
Point 106	-100	449.97963
Point 107	550	450.03403
Point 108	-64.96913	595.11744
Point 109	-64.96913	593.10625
Point 110	58.47531	605
Point 111	405.33383	539.99484

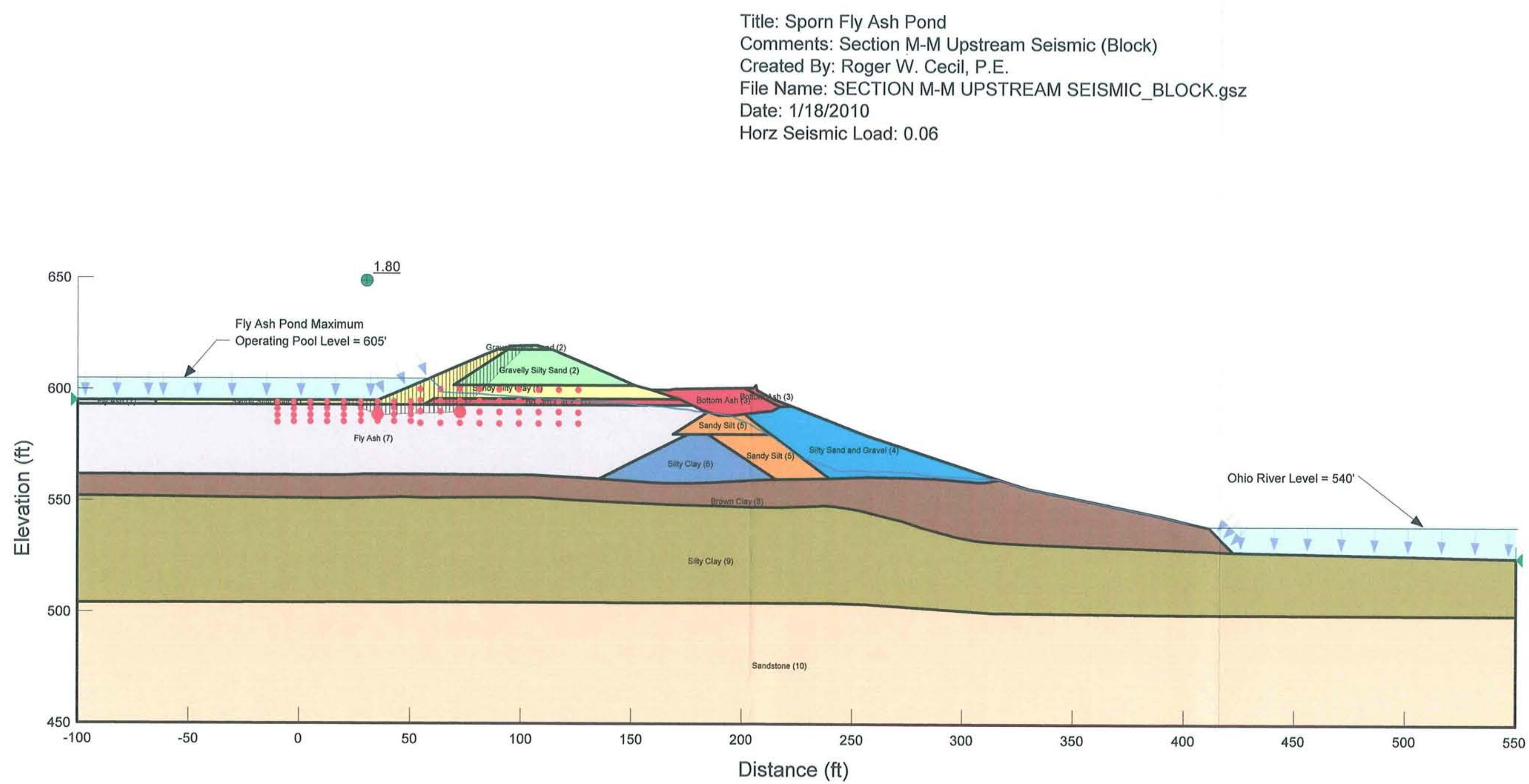
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	1978	1.80	(30.101, 648.756)	43.964	(102.194, 619.763)	(19.2328, 595.109)

Slices of Slip Surface: 1978

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	1978	20.037595	594.77575	602.25611	678.19824	51.223614	0
2	1978	21.6471	594.10905	569.68078	805.45727	159.03325	0
3	1978	23.256605	593.44235	532.50185	941.21172	275.67829	0
4	1978	24.847865	592.78325	527.84625	1038.2253	260.0511	0
5	1978	26.420875	592.1317	559.15687	1144.0036	297.9943	0
6	1978	27.99389	591.4801	590.67894	1252.9535	337.44577	0
7	1978	29.566905	590.82855	622.33609	1364.8989	378.35463	0
8	1978	31.139915	590.177	654.16943	1479.6046	420.58024	0
9	1978	32.71293	589.5254	686.17898	1596.8359	464.00289	0
10	1978	34.285945	588.87385	718.36473	1716.1229	508.38317	0
11	1978	35.2163	588.5531	733.09342	1492.1008	386.73356	0
12	1978	36.226725	588.58845	725.92215	1565.3832	427.72675	0
13	1978	37.954565	588.6489	713.63052	1613.1531	458.32964	0
14	1978	39.67709	588.70915	701.27253	1658.8138	487.89166	0
15	1978	41.399615	588.76945	688.85651	1702.4439	516.44858	0
16	1978	43.122145	588.8297	676.4405	1744.0434	543.97083	0
17	1978	44.84467	588.88995	663.90846	1783.6121	570.51752	0
18	1978	46.567195	588.9502	651.31839	1821.1503	596.05911	0
19	1978	48.289725	589.01045	638.72832	1856.7158	620.59559	0
20	1978	50.012255	589.07075	626.02222	1890.3666	644.21565	0
21	1978	51.734785	589.131	613.31611	1922.2189	666.91929	0
22	1978	53.45731	589.19125	600.49397	1952.2726	688.76563	0
23	1978	55.179835	589.2515	587.67183	1980.7598	709.81379	0
24	1978	57.258205	589.3242	575.48162	1980.7045	715.99683	0
25	1978	59.476315	589.4018	563.63832	1988.0344	725.76603	0

26	1978	60.601805	589.44115	557.63775	2015.1949	742.66248	0
27	1978	61.596295	589.47595	552.3149	2061.1439	768.7868	0
28	1978	63.336305	589.53685	543.02177	2140.5778	813.99543	0
29	1978	65.07631	589.59775	533.7229	2218.8629	858.6217	0
30	1978	66.816315	589.6586	524.42978	2295.9992	902.65973	0
31	1978	68.556325	589.71945	515.13665	2371.9295	946.0832	0
32	1978	70.139935	589.77485	506.67223	2437.5334	983.8229	0
33	1978	71.567145	589.8248	499.07463	2493.0624	1015.9875	0
34	1978	72.933185	590.5022	452.29363	1656.0889	613.3643	0
35	1978	74.23806	591.80705	366.19175	1601.4657	629.40353	0
36	1978	75.223355	592.79235	301.19439	1560.5685	641.68315	0
37	1978	76.253155	593.82215	233.81893	1486.6058	782.82814	0
38	1978	77.64705	595.21605	143.05506	1445.3634	813.77255	0
39	1978	79.105485	596.6745	58.984094	1366.3286	881.81503	0
40	1978	80.628455	598.19745	-15.628649	1288.5592	869.14413	0
41	1978	82.151425	599.7204	-86.507528	1222.072	824.298	0
42	1978	83.67439	601.2434	-153.73751	1155.7707	779.57715	0
43	1978	85.21037	602.7794	-235.34986	1082.8942	758.2507	0
44	1978	86.759365	604.3284	-333.85206	1020.4459	714.52391	0
45	1978	88.30836	605.8774	-432.01646	957.58672	670.50944	0
46	1978	89.855745	607.42475	-529.86125	880.49463	616.52898	0
47	1978	91.40151	608.9705	-627.38902	788.54771	552.14705	0
48	1978	92.947275	610.5163	-724.8253	694.90825	486.57999	0
49	1978	94.73362	612.30265	-837.29345	586.49962	410.67146	0
50	1978	96.52543	614.09445	-949.84806	464.40852	325.18235	0
51	1978	98.082135	615.65115	-1046.8724	341.28848	238.97277	0
52	1978	99.638845	617.20785	-1143.6241	214.9025	150.47635	0
53	1978	101.30575	618.87475	-1247.4281	75.678872	52.990916	0


Title: Sporn Fly Ash Pond
Comments: Section M-M Upstream Seismic (Block)
Created By: Roger W. Cecil, P.E.
File Name: SECTION M-M UPSTREAM SEISMIC_BLOCK.gsz
Date: 1/18/2010
Horz Seismic Load: 0.06
1.80
Fly Ash Pond Maximum
Operating Pool Level = 605'
Gravelly Silty Sand (2)
Bottom Ash (3)
Sandy Silt (5)
Silty Sand and Gravel (4)
Fly Ash (7)
Silty Clay (6)
Brown Clay (8)
Silty Clay (9)
Sandstone (10)
Ohio River Level = 540'
Elevation (ft)
650
600
550
500
450
-100
-50
0
50
100
150
200
250
300
350
400
450
500
550
Distance (ft)

SLOPE/W Analysis

File Information

Title: Sporn Fly Ash Pond
Comments: Section M-M Downstream Seismic (Global - Circular)
Created By: Roger W. Cecil, P.E.
Revision Number: 41
Last Edited By: Roger Cecil
Date: 1/17/2010
Time: 11:43:17 PM
File Name: SECTION M-M DOWNSTREAM SEISMIC_GLOBAL CIRCLE.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/17/2010
Last Solved Time: 11:44:42 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Sporn Fly Ash Pond Section M-M (Global-Circular)
Kind: SLOPE/W
Parent: Steady-State Seepage
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Parent Analysis

SlipSurface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 100
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 20 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Sandy Silty Clay (1)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Gravelly Silty Sand (2)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Bottom Ash (3)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 36 °
Phi-B: 0 °

Silty Sand and Gravel (4)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Unit Wt. Above Water Table: 115 pcf

Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Sandy Silt (5)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Silty Clay (6)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Fly Ash (7)

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °

Brown Clay (8)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 37 °
Phi-B: 0 °

Silty Clay (9)

Model: Mohr-Coulomb
Unit Weight: 126 pcf
Unit Wt. Above Water Table: 122 pcf
Cohesion: 170 psf
Phi: 31.2 °
Phi-B: 0 °

Sandstone (10)

Model: Bedrock (Impenetrable)

Bottom Ash 2 (11)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (77.76371, 613.24791) ft
Left-Zone Right Coordinate: (112.15782, 618.49321) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (316.5702, 560.21643) ft
Right-Zone Right Coordinate: (550, 524.91002) ft
Right-Zone Increment: 30
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-100, 595.12092) ft
Right Coordinate: (550, 524.91002) ft

Seismic Loads

Horz Seismic Load: 0.06
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Sandy Silty Clay (1)	108,2,3,109	201.13421
Region 2	Sandy Silty Clay	2,110,5,6,7,8,9,10,11,12,13,14,3	962.07207

	(1)		
Region 3	Gravelly Silty Sand (2)	7,15,16,17,8	31.119887
Region 4	Gravelly Silty Sand (2)	9,10,17,8	819.48221
Region 5	Bottom Ash (3)	11,18,19,20,21,22,23,24,25,26,27,28,12	423.64067
Region 6	Bottom Ash (3)	20,29,30,31,32,33,21	32.648671
Region 7	Sandy Silt (5)	26,34,35,36,37,23,24,25	282.19505
Region 8	Silty Sand and Gravel (4)	23,22,21,33,38,39,40,41,42,43,44,45,46,47,37	1565.2892
Region 9	Sandy Silt (5)	36,37,47,48	531.21818
Region 10	Silty Clay (6)	36,48,49,50,51,52,53,54,55,35	989.52619
Regio	Fly Ash	4,56,57,58,59,60,61,62,55,35,34,26,27,28,14,3,109	8370.9742

n 11	(7)		
Region 12	Brown Clay (8)	56,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,111,93,94,95,96,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,62,61,60,59,58,57	6985.7443
Region 13	Silty Clay (9)	91,97,98,99,100,101,102,103,104,105,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90	25156.343
Region 14	Sandstone (10)	105,106,107,98,99,100,101,102,103,104	34015.546
Region 15	Fly Ash (7)	1,108,109,4	70.533781
Region 16	Bottom Ash 2 (11)	12,28,14,13	324.85555

Points

	X (ft)	Y (ft)
Point 1	-100	595.12092
Point 2	35.36015	595.10746
Point 3	35.37077	593.10938
Point 4	-100	593.10516
Point 5	60.72629	605.9827
Point 6	74.8905	612.04606
Point 7	89.08286	617.98267
Point 8	93.72016	617.98376
Point 9	69.42633	602.00461
Point 10	151.61692	602.00605
Point 11	158.87128	599.99208

Point 12	171.82425	595.91741
Point 13	60.47732	595.91216
Point 14	56.0411	593.12487
Point 15	95.74708	619.48275
Point 16	106.57718	619.95406
Point 17	114.07579	617.99114
Point 18	166.70528	600.0213
Point 19	169.58045	600.43082
Point 20	200.94364	600.90024
Point 21	217.30273	592.80917
Point 22	213.38189	590.83858
Point 23	200.88583	589.29528
Point 24	195.25394	588.59744
Point 25	189.42126	588.62008
Point 26	184.5	590.20374
Point 27	181.51772	591.16693
Point 28	177.65846	593.12697
Point 29	204.98541	600.97594
Point 30	206.35442	602.21331
Point 31	206.71422	599.99306
Point 32	214.00828	595.98847
Point 33	222.27612	592.82454
Point 34	168.66722	580.09858
Point 35	175.21974	580.09858
Point 36	184.51087	580.09817
Point 37	213.24737	580.09272
Point 38	255.42934	580.07172
Point 39	317.48058	559.92079
Point 40	315.59736	559.88781
Point 41	309.9739	558.80103
Point 42	307.4465	558.76312
Point 43	287.58173	560.34006
Point 44	273.69358	560.81173
Point 45	259.80542	560.94275
Point 46	255.45555	560.94275
Point 47	239.61428	560.44981

Point 48	215.41971	560.03735
Point 49	206.90911	559.67804
Point 50	185.33019	558.38907
Point 51	177.08328	558.01754
Point 52	173.62075	558.106
Point 53	169.80438	558.01754
Point 54	164.66112	558.14391
Point 55	135.13429	560.09691
Point 56	-100	561.74545
Point 57	20.16974	561.49271
Point 58	28.34588	561.72018
Point 59	50.65765	561.88173
Point 60	61.94724	561.81622
Point 61	89.85457	561.6852
Point 62	105.36228	561.59785
Point 63	-100	552.17166
Point 64	19.23461	550.94335
Point 65	32.24565	551.32246
Point 66	41.85988	551.67124
Point 67	47.10676	551.74706
Point 68	56.64516	551.4741
Point 69	78.08761	551.61058
Point 70	95.40534	551.48927
Point 71	105.51999	551.66113
Point 72	114.75208	551.07983
Point 73	124.43302	550.29735
Point 74	142.61209	549.56582
Point 75	165.69351	548.62684
Point 76	187.96697	548.08092
Point 77	205.85125	547.44765
Point 78	216.92246	547.535
Point 79	233.69307	548.10276
Point 80	236.99041	548.14643
Point 81	242.18755	547.92806
Point 82	246.77327	547.31663
Point 83	252.65171	546.21606

Point 84	273.24811	541.09055
Point 85	281.07788	538.66929
Point 86	297.9009	534.10978
Point 87	305.69923	532.66332
Point 88	316.39049	531.68853
Point 89	338.77924	530.77663
Point 90	389.87718	528.88993
Point 91	422.60496	527.57608
Point 92	411.3282	538.58079
Point 93	401.8504	540.81657
Point 94	388.80805	543.92059
Point 95	352.80366	551.31013
Point 96	329.44346	556.01129
Point 97	550	524.91002
Point 98	550	499.15439
Point 99	396.01919	499.3174
Point 100	313.20998	500.09985
Point 101	256.3846	503.93603
Point 102	240.95296	504.37072
Point 103	191.37067	504.40695
Point 104	86.37793	504.45549
Point 105	-100	504.13087
Point 106	-100	449.97963
Point 107	550	450.03403
Point 108	-64.96913	595.11744
Point 109	-64.96913	593.10625
Point 110	58.47531	605
Point 111	405.33383	539.99484

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	1599	1.35	(369.63, 930.496)	418.325	(91.048, 618.425)	(477.881, 526.419)

Slices of Slip Surface: 1599

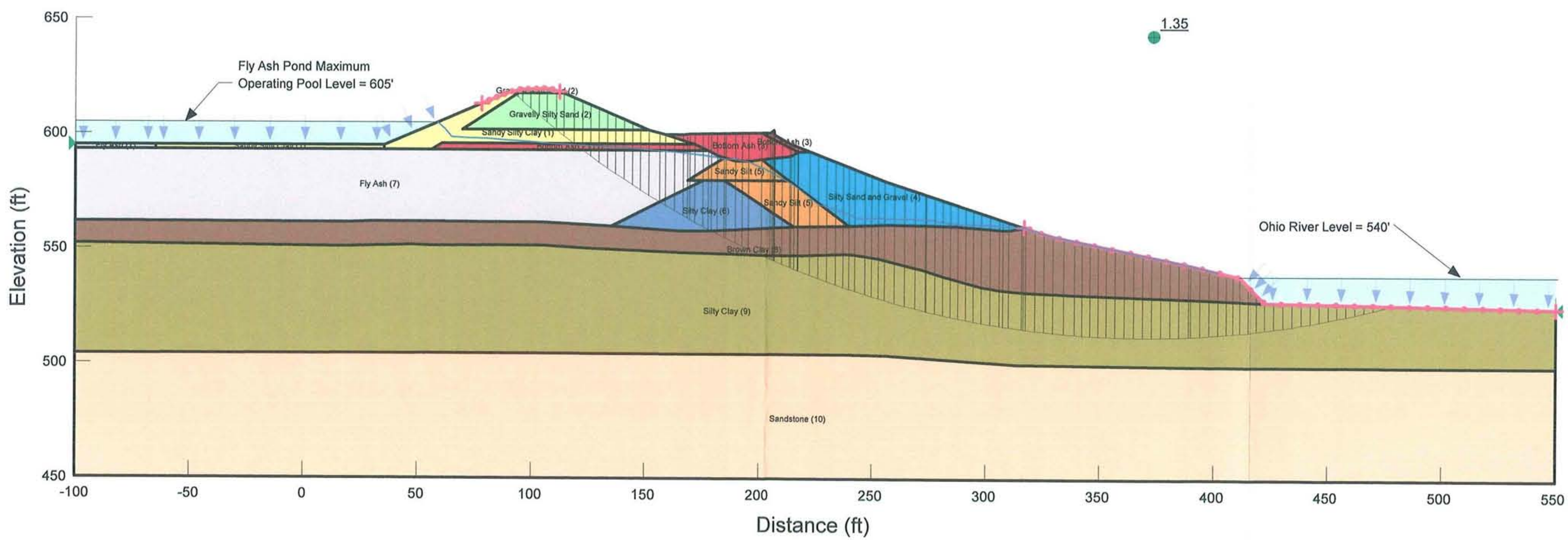
	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	1599	91.295805	618.2041	-1202.764	23.626932	16.543756	0
2	1599	92.006785	617.5723	-1164.2415	93.772435	63.250306	0
3	1599	93.09505	616.6107	-1104.5446	195.92404	137.18749	0
4	1599	94.73362	615.17645	-1016.2348	349.0497	244.40723	0
5	1599	97.552095	612.74735	-866.61308	584.26475	409.10658	0
6	1599	101.16211	609.69125	-678.766	862.0957	603.64591	0
7	1599	104.77215	606.7042	-495.91108	1135.6705	795.20501	0
8	1599	108.5948	603.6165	-307.80689	1367.2861	957.38406	0
9	1599	112.3441	600.65455	-169.34212	1562.9023	1054.1909	0
10	1599	116.30235	597.60935	-79.398096	1722.505	1161.8443	0
11	1599	120.40875	594.52045	50.113722	1860.0332	1130.9632	0
12	1599	124.12165	591.79735	207.4322	2020.1681	923.63508	0
13	1599	127.7877	589.1699	360.71763	2114.6729	893.68485	0
14	1599	131.4537	586.6016	510.132	2201.8041	861.94998	0
15	1599	135.11975	584.09115	654.1955	2281.6203	829.21435	0
16	1599	138.7858	581.6373	792.9521	2354.6524	795.72603	0
17	1599	142.45185	579.23885	928.34065	2421.0014	760.54863	0
18	1599	146.1179	576.89465	1074.3093	2483.5031	718.02007	0
19	1599	149.7839	574.6037	1221.0436	2540.205	672.14634	0
20	1599	153.9564	572.0637	1382.2289	2628.2475	634.87818	0
21	1599	157.5836	569.8988	1464.2396	2696.7286	800.38772	0
22	1599	160.8298	568.01345	1447.8002	2849.3211	910.15831	0
23	1599	164.7468	565.78505	1426.6963	3060.4816	1060.9925	0
24	1599	167.68625	564.14405	1408.5362	3227.6481	1181.3451	0
25	1599	169.12385	563.35395	1400.1344	3322.9766	1248.7083	0
26	1599	170.7024	562.49815	1391.2913	3427.9078	1322.5942	0
27	1599	173.522	560.99065	1386.0823	3625.8426	1454.5174	0
28	1599	176.4391	559.4547	1389.0591	3833.8061	1587.6372	0
29	1599	178.35265	558.4629	1390.0348	3955.77	1666.2079	0
30	1599	180.28225	557.47885	1393.1011	4023.4398	1982.1024	0
31	1599	183.00885	556.10845	1410.6672	4183.6559	2089.5969	0

32	1599	184.9151	555.1609	1427.5703	4292.3297	2158.7511	0
33	1599	187.37575	553.9665	1449.8831	4402.7392	2225.1367	0
34	1599	190.87945	552.2872	1485.2807	4574.8876	2328.1858	0
35	1599	193.79575	550.92255	1520.8504	4734.8258	2421.9041	0
36	1599	198.09875	548.96805	1582.7101	4981.8163	2561.4102	0
37	1599	202.9645	546.8112	1658.5962	5287.0478	2197.4684	170
38	1599	205.4183	545.7486	1690.985	5441.6595	2271.4892	170
39	1599	206.1028	545.45695	1701.2495	5521.8077	2313.8123	170
40	1599	206.5343	545.27395	1707.8263	5477.3393	2282.8983	170
41	1599	206.81165	545.1566	1712.0324	5404.2787	2236.1039	170
42	1599	208.49365	544.454	1737.1232	5417.39	2228.8488	170
43	1599	211.73005	543.1193	1784.6661	5442.0979	2215.0194	170
44	1599	213.6951	542.3202	1813.0732	5458.7739	2207.9148	170
45	1599	214.714	541.91305	1827.3597	5483.9877	2214.5326	170
46	1599	216.1711	541.3354	1847.5666	5525.5521	2227.4672	170
47	1599	217.1126	540.96465	1860.5729	5552.4321	2235.8694	170
48	1599	219.7894	539.93615	1894.7404	5594.8627	2240.8737	170
49	1599	224.17895	538.2765	1950.3782	5639.6984	2234.3317	170
50	1599	227.9846	536.8861	1999.9169	5652.5196	2212.0948	170
51	1599	231.79025	535.53725	2047.5315	5661.469	2188.6783	170
52	1599	235.34175	534.31435	2090.9298	5666.3456	2165.3488	170
53	1599	238.30235	533.3217	2125.607	5667.6341	2145.1279	170
54	1599	240.9009	532.4718	2154.7373	5675.3433	2132.1548	170
55	1599	244.4804	531.3368	2194.001	5694.5395	2120.0015	170
56	1599	248.2429	530.1723	2234.6698	5711.7815	2105.8137	170
57	1599	251.1821	529.2928	2264.7047	5722.3724	2094.038	170
58	1599	254.0405	528.4596	2292.543	5730.1465	2081.8867	170
59	1599	257.61735	527.4522	2325.2199	5750.1911	2074.2363	170
60	1599	262.04585	526.24785	2363.4493	5781.9213	2070.3002	170
61	1599	266.52675	525.08185	2398.816	5808.5476	2065.0069	170
62	1599	271.00765	523.96855	2431.6457	5829.4868	2057.8057	170
63	1599	273.47085	523.3724	2449.495	5839.07	2052.7996	170
64	1599	275.53965	522.89365	2462.9187	5844.4376	2047.9206	170
65	1599	279.2318	522.0589	2485.9447	5851.3817	2038.1811	170
66	1599	282.70385	521.3049	2505.7663	5854.1275	2027.8396	170
67	1599	285.95575	520.62755	2522.2974	5853.2726	2017.3103	170

68	1599	289.3016	519.9591	2537.9249	5848.015	2004.6618	170
69	1599	292.74135	519.301	2553.1379	5838.2421	1989.5299	170
70	1599	296.18105	518.67265	2566.3408	5824.2668	1973.0701	170
71	1599	299.8505	518.0361	2578.0293	5804.4223	1953.973	170
72	1599	303.74965	517.39535	2589.1251	5778.2343	1931.3932	170
73	1599	306.57285	516.9512	2596.091	5755.701	1913.5278	170
74	1599	308.7102	516.632	2600.1376	5737.4168	1900.0038	170
75	1599	312.78565	516.06035	2605.4811	5699.1486	1873.5916	170
76	1599	315.99395	515.6234	2610.3784	5666.6568	1850.948	170
77	1599	316.93555	515.5029	2611.2011	5655.13	1843.4689	170
78	1599	319.4744	515.1929	2612.6568	5617.6852	1819.9099	170
79	1599	323.462	514.73075	2613.3212	5552.404	1779.9718	170
80	1599	327.44965	514.3073	2611.4918	5479.7166	1737.0587	170
81	1599	331.77745	513.89315	2605.6523	5431.4826	1711.3837	170
82	1599	336.4453	513.49535	2595.7541	5406.3439	1702.1537	170
83	1599	340.53225	513.18735	2584.4629	5376.9713	1691.2032	170
84	1599	344.0384	512.9577	2573.1036	5345.2004	1678.8415	170
85	1599	347.54455	512.7576	2560.9783	5307.8865	1663.5867	170
86	1599	351.05065	512.58695	2547.0371	5264.4656	1645.7332	170
87	1599	354.8039	512.43805	2530.1005	5210.3383	1623.2097	170
88	1599	358.80435	512.31535	2509.6031	5144.1491	1595.5378	170
89	1599	362.80485	512.23095	2486.9158	5069.9572	1564.3454	170
90	1599	366.80535	512.1848	2461.4937	4987.778	1529.9722	170
91	1599	370.80585	512.1769	2433.3934	4897.6329	1492.3965	170
92	1599	374.80635	512.20725	2404.8476	4799.2973	1450.1303	170
93	1599	378.80685	512.2759	2374.2637	4692.5478	1404.0027	170
94	1599	382.80735	512.38285	2340.7023	4577.6687	1354.755	170
95	1599	386.8078	512.5281	2304.1486	4454.9454	1302.5688	170
96	1599	389.3426	512.63555	2279.7876	4371.1267	1266.56	170
97	1599	391.87275	512.76705	2253.3438	4273.747	1223.5997	170
98	1599	395.8638	512.9987	2209.9829	4114.8353	1153.6196	170
99	1599	399.85485	513.26865	2163.9212	3947.9879	1080.4692	170
100	1599	403.5921	513.55505	2118.3891	3786.0157	1009.9506	170
101	1599	406.8324	513.8307	2076.8613	3667.8644	963.5457	170
102	1599	409.8296	514.1092	2042.3955	3582.0547	932.45073	170
103	1599	413.20765	514.45075	2001.0409	3416.0757	856.97554	170

104	1599	416.96655	514.86165	1948.0231	3134.8957	718.79557	170
105	1599	420.7255	515.307	1889.6685	2840.2985	575.72198	170
106	1599	424.5791	515.7999	1825.2075	2510.5831	415.07818	170
107	1599	428.52735	516.34225	1760.3583	2427.661	404.13291	170
108	1599	432.47565	516.92295	1693.8122	2338.169	390.23633	170
109	1599	436.4239	517.54225	1625.6691	2242.2082	373.38936	170
110	1599	440.37215	518.2003	1556.9524	2139.783	352.97474	170
111	1599	444.32045	518.89725	1489.8258	2030.7515	327.59623	170
112	1599	448.26875	519.63335	1420.6928	1915.8495	299.87752	170
113	1599	452.217	520.40875	1349.6324	1795.2393	269.86912	170
114	1599	456.16525	521.2237	1277.171	1669.0373	237.32267	170
115	1599	460.11355	522.0785	1203.7569	1537.3864	202.05325	170
116	1599	464.0618	522.97335	1128.1346	1400.6812	165.06008	170
117	1599	468.01005	523.90845	1050.3896	1259.1185	126.41072	170
118	1599	471.95835	524.88415	970.68304	1112.8989	86.129008	170
119	1599	475.9066	525.90075	888.85699	962.19963	44.417884	170

Title: Sporn Fly Ash Pond
Comments: Section M-M Downstream Seismic (Global - Circular)
Created By: Roger W. Cecil, P.E.
File Name: SECTION M-M DOWNSTREAM SEISMIC_GLOBAL CIRCLE.gsz
Date: 1/17/2010
Horz Seismic Load: 0.06



SPP00003580

SLOPE/W Analysis

File Information

Title: Sporn Fly Ash Pond
Comments: Section M-M Downstream Seismic (Global Block)
Created By: Roger W. Cecil, P.E.
Revision Number: 67
Last Edited By: Roger Cecil
Date: 1/18/2010
Time: 12:31:15 AM
File Name: SECTION M-M DOWNSTREAM SEISMIC_GLOBAL BLOCK.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/18/2010
Last Solved Time: 4:05:36 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Sporn Fly Ash Pond Section M-M Downstream (Global-Block)
Kind: SLOPE/W
Parent: Steady-State Seepage
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Parent Analysis

SlipSurface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Block
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Restrict Block Crossing: Yes
Advanced
Number of Slices: 50
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 20 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Sandy Silty Clay (1)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Gravelly Silty Sand (2)
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Bottom Ash (3)
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 36 °
Phi-B: 0 °

Silty Sand and Gravel (4)
Model: Mohr-Coulomb
Unit Weight: 120 pcf

Unit Wt. Above Water Table: 115 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Sandy Silt (5)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Silty Clay (6)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Fly Ash (7)
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °

Brown Clay (8)
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 37 °
Phi-B: 0 °

Silty Clay (9)
Model: Mohr-Coulomb
Unit Weight: 126 pcf
Unit Wt. Above Water Table: 122 pcf
Cohesion: 170 psf
Phi: 31.2 °
Phi-B: 0 °

Sandstone (10)
Model: Bedrock (Impenetrable)

Bottom Ash 2 (11)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (-100, 595.12092) ft
Right Coordinate: (550, 524.91002) ft

Slip Surface Block

Left Grid
- Upper Left: (86.0086, 598) ft
- Lower Left: (85.6112, 510) ft
- Lower Right: (180, 510) ft
- X Increments: 10
- Y Increments: 10
- Starting Angle: 115 °
- Ending Angle: 135 °
- Angle Increments: 2

Right Grid
- Upper Left: (232.39688, 568.79556) ft
- Lower Left: (234.59056, 503.17596) ft
- Lower Right: (299.73327, 500.02851) ft
- X Increments: 8
- Y Increments: 8
- Starting Angle: 0 °
- Ending Angle: 45 °
- Angle Increments: 2

Seismic Loads

Horz Seismic Load: 0.06
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Regio	Sandy	108,2,3,109	201.13421

n 1	Silty Clay (1)		
Region 2	Sandy Silty Clay (1)	2,110,5,6,7,8,9,10,11,12,13,14,3	962.07207
Region 3	Gravelly Silty Sand (2)	7,15,16,17,8	31.119887
Region 4	Gravelly Silty Sand (2)	9,10,17,8	819.48221
Region 5	Bottom Ash (3)	11,18,19,20,21,22,23,24,25,26,27,28,12	423.64067
Region 6	Bottom Ash (3)	20,29,30,31,32,33,21	32.648671
Region 7	Sandy Silt (5)	26,34,35,36,37,23,24,25	282.19505
Region 8	Silty Sand and Gravel (4)	23,22,21,33,38,39,40,41,42,43,44,45,46,47,37	1565.2892
Region n	Sandy Silt	36,37,47,48	531.21818

9	(5)		
Region 10	Silty Clay (6)	36,48,49,50,51,52,53,54,55,35	989.52619
Region 11	Fly Ash (7)	4,56,57,58,59,60,61,62,55,35,34,26,27,28,14,3,109	8370.9742
Region 12	Brown Clay (8)	56,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,111,93,94,95,96,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,62,61,60,59,58,57	6985.7443
Region 13	Silty Clay (9)	91,97,98,99,100,101,102,103,104,105,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90	25156.343
Region 14	Sandstone (10)	105,106,107,98,99,100,101,102,103,104	34015.546
Region 15	Fly Ash (7)	1,108,109,4	70.533781
Region 16	Bottom Ash 2 (11)	12,28,14,13	324.85555

Points

	X (ft)	Y (ft)
Point 1	-100	595.12092
Point 2	35.36015	595.10746
Point 3	35.37077	593.10938
Point 4	-100	593.10516
Point 5	60.72629	605.9827

Point 6	74.8905	612.04606
Point 7	89.08286	617.98267
Point 8	93.72016	617.98376
Point 9	69.42633	602.00461
Point 10	151.61692	602.00605
Point 11	158.87128	599.99208
Point 12	171.82425	595.91741
Point 13	60.47732	595.91216
Point 14	56.0411	593.12487
Point 15	95.74708	619.48275
Point 16	106.57718	619.95406
Point 17	114.07579	617.99114
Point 18	166.70528	600.0213
Point 19	169.58045	600.43082
Point 20	200.94364	600.90024
Point 21	217.30273	592.80917
Point 22	213.38189	590.83858
Point 23	200.88583	589.29528
Point 24	195.25394	588.59744
Point 25	189.42126	588.62008
Point 26	184.5	590.20374
Point 27	181.51772	591.16693
Point 28	177.65846	593.12697
Point 29	204.98541	600.97594
Point 30	206.35442	602.21331
Point 31	206.71422	599.99306
Point 32	214.00828	595.98847
Point 33	222.27612	592.82454
Point 34	168.66722	580.09858
Point 35	175.21974	580.09858
Point 36	184.51087	580.09817
Point 37	213.24737	580.09272
Point 38	255.42934	580.07172
Point 39	317.48058	559.92079
Point 40	315.59736	559.88781
Point 41	309.9739	558.80103

Point 42	307.4465	558.76312
Point 43	287.58173	560.34006
Point 44	273.69358	560.81173
Point 45	259.80542	560.94275
Point 46	255.45555	560.94275
Point 47	239.61428	560.44981
Point 48	215.41971	560.03735
Point 49	206.90911	559.67804
Point 50	185.33019	558.38907
Point 51	177.08328	558.01754
Point 52	173.62075	558.106
Point 53	169.80438	558.01754
Point 54	164.66112	558.14391
Point 55	135.13429	560.09691
Point 56	-100	561.74545
Point 57	20.16974	561.49271
Point 58	28.34588	561.72018
Point 59	50.65765	561.88173
Point 60	61.94724	561.81622
Point 61	89.85457	561.6852
Point 62	105.36228	561.59785
Point 63	-100	552.17166
Point 64	19.23461	550.94335
Point 65	32.24565	551.32246
Point 66	41.85988	551.67124
Point 67	47.10676	551.74706
Point 68	56.64516	551.4741
Point 69	78.08761	551.61058
Point 70	95.40534	551.48927
Point 71	105.51999	551.66113
Point 72	114.75208	551.07983
Point 73	124.43302	550.29735
Point 74	142.61209	549.56582
Point 75	165.69351	548.62684
Point 76	187.96697	548.08092
Point 77	205.85125	547.44765

Point 78	216.92246	547.535
Point 79	233.69307	548.10276
Point 80	236.99041	548.14643
Point 81	242.18755	547.92806
Point 82	246.77327	547.31663
Point 83	252.65171	546.21606
Point 84	273.24811	541.09055
Point 85	281.07788	538.66929
Point 86	297.9009	534.10978
Point 87	305.69923	532.66332
Point 88	316.39049	531.68853
Point 89	338.77924	530.77663
Point 90	389.87718	528.88993
Point 91	422.60496	527.57608
Point 92	411.3282	538.58079
Point 93	401.8504	540.81657
Point 94	388.80805	543.92059
Point 95	352.80366	551.31013
Point 96	329.44346	556.01129
Point 97	550	524.91002
Point 98	550	499.15439
Point 99	396.01919	499.3174
Point 100	313.20998	500.09985
Point 101	256.3846	503.93603
Point 102	240.95296	504.37072
Point 103	191.37067	504.40695
Point 104	86.37793	504.45549
Point 105	-100	504.13087
Point 106	-100	449.97963
Point 107	550	450.03403
Point 108	-64.96913	595.11744
Point 109	-64.96913	593.10625
Point 110	58.47531	605
Point 111	405.33383	539.99484

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	5086	1.50	(233.736, 659.943)	181.108	(88.2484, 617.634)	(469.102, 526.603)

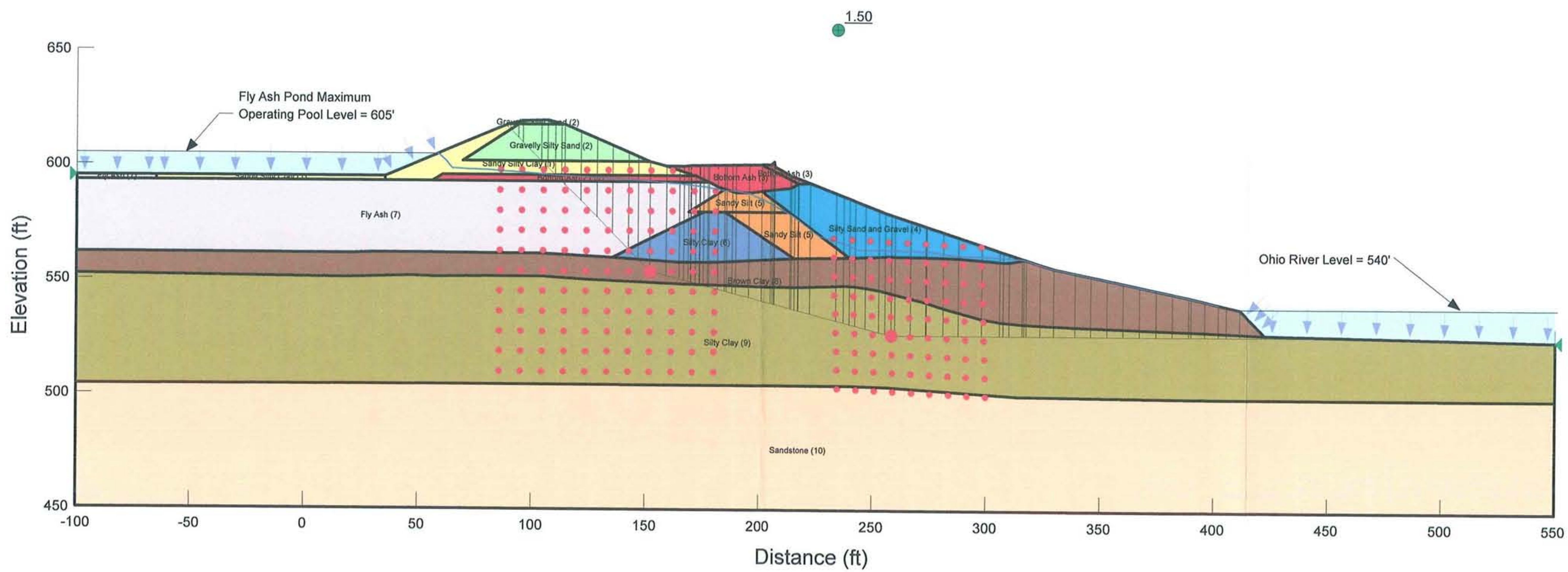
Slices of Slip Surface: 5086

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	5086	88.665645	617.2164	-1143.1593	53.040389	35.776194	0
2	5086	89.645555	616.2365	-1081.5345	167.10911	112.71652	0
3	5086	91.964205	613.91785	-936.23442	402.60959	281.91027	0
4	5086	94.73362	611.14845	-765.39387	682.15642	477.65106	0
5	5086	99.81194	606.0701	-452.54379	1130.9681	791.91237	0
6	5086	105.227	600.65505	-158.34356	1606.9768	1083.9195	0
7	5086	108.2724	597.6097	-58.213902	1826.7761	1232.176	0
8	5086	111.3619	594.52015	79.718785	2037.1536	1223.141	0
9	5086	113.416	592.46605	201.45571	2244.0114	1040.7341	0
10	5086	117.5963	588.2858	451.9028	2443.5973	1014.819	0
11	5086	124.6373	581.2448	872.29151	2751.7082	957.61065	0
12	5086	131.67825	574.2038	1301.3371	3047.065	889.49279	0
13	5086	138.7192	567.1628	1748.0377	3333.0819	807.62036	0
14	5086	144.3896	561.4924	1986.8913	3496.7116	980.48879	0
15	5086	149.0782	556.8038	2027.4312	3650.4345	1223.0208	0
16	5086	155.2441	553.232	2041.394	4820.1716	2093.9591	0
17	5086	161.7662	551.4529	2005.8552	4995.3203	2252.7235	0
18	5086	165.6832	550.4435	1989.2048	5108.6149	2350.6441	0
19	5086	167.68625	549.9273	1977.0616	5177.5955	2411.7752	0
20	5086	169.12385	549.55685	1973.8818	5241.629	2462.4242	0
21	5086	169.69245	549.41035	1972.7485	5270.1475	2484.7684	0
22	5086	170.81435	549.1212	1970.65	5317.2313	2521.8299	0
23	5086	172.64845	548.64855	1967.7374	5403.6112	2589.1166	0
24	5086	173.54665	548.4171	1966.4155	5453.2695	2111.7138	170
25	5086	174.4202	548.19195	1965.0806	5499.7184	2140.6528	170

26	5086	176.1515	547.7458	1962.7701	5583.4918	2192.787	170
27	5086	177.3709	547.4316	1961.3739	5636.9717	2226.0212	170
28	5086	179.5881	546.86025	1959.3541	5716.1941	2275.2232	170
29	5086	183.00885	545.9787	1957.4882	5839.8318	2351.2308	170
30	5086	184.9151	545.48745	1957.1624	5905.0806	2390.9442	170
31	5086	186.6486	545.04075	1957.1968	5940.6704	2412.4774	170
32	5086	188.69415	544.5136	1966.9038	5982.4797	2431.9192	170
33	5086	192.3376	543.5747	1983.9834	6091.742	2487.7471	170
34	5086	198.09875	542.09005	2001.1624	6292.4798	2598.9142	170
35	5086	202.9645	540.83615	2014.6312	6458.8377	2691.5071	170
36	5086	205.4183	540.20385	2023.761	6563.9423	2749.6315	170
37	5086	206.1028	540.02745	2027.4868	6634.9916	2790.404	170
38	5086	206.5343	539.91625	2029.8755	6573.4583	2751.6916	170
39	5086	210.04805	539.01075	2049.2324	6427.5605	2651.6097	170
40	5086	213.6951	538.0709	2069.5538	6367.5844	2602.9799	170
41	5086	214.714	537.80835	2075.2747	6370.4511	2601.2513	170
42	5086	216.1711	537.43285	2083.4555	6380.9208	2602.6375	170
43	5086	217.1126	537.1902	2088.8041	6387.6773	2603.4902	170
44	5086	219.7894	536.5004	2104.024	6372.6264	2585.1575	170
45	5086	227.9846	534.38855	2153.7835	6256.5151	2484.7026	170
46	5086	235.34175	532.49265	2203.9227	6128.2237	2376.6412	170
47	5086	238.30235	531.7297	2224.9098	6076.5584	2332.6413	170
48	5086	240.9009	531.06005	2242.9572	6040.6271	2299.9506	170
49	5086	244.4804	530.1376	2269.0141	6004.1765	2262.0948	170
50	5086	249.7125	528.7893	2308.7095	5951.0837	2205.9002	170
51	5086	254.0405	527.674	2341.7083	5907.1753	2159.3236	170
52	5086	256.81285	526.95955	2363.0722	5888.3454	2134.9814	170
53	5086	259.0009	526.603	2366.9121	7000.1131	2805.9663	170
54	5086	263.1661	526.603	2331.3786	6842.8268	2732.2302	170
55	5086	269.88745	526.603	2273.8009	6583.6525	2610.139	170
56	5086	273.47085	526.603	2243.7201	6442.8581	2543.0884	170
57	5086	277.38575	526.603	2210.6361	6285.7685	2467.9879	170
58	5086	284.3298	526.603	2151.9561	6002.7522	2332.125	170
59	5086	292.7413	526.603	2081.1751	5650.7452	2161.8085	170
60	5086	301.80005	526.603	2004.5317	5263.6911	1973.8171	170
61	5086	306.57285	526.603	1964.3787	5057.2035	1873.0813	170

62	5086	308.7102	526.603	1946.348	4965.1816	1828.2706	170
63	5086	312.78565	526.603	1911.4566	4792.2453	1744.6676	170
64	5086	315.99395	526.603	1883.55	4656.2354	1679.198	170
65	5086	316.93555	526.603	1875.1663	4615.3987	1659.5438	170
66	5086	320.4713	526.603	1843.8704	4455.1145	1581.4256	170
67	5086	326.45275	526.603	1790.7059	4180.933	1447.573	170
68	5086	334.11135	526.603	1722.0843	3911.9388	1326.223	170
69	5086	342.28535	526.603	1651.5478	3679.4391	1228.1347	170
70	5086	349.2976	526.603	1587.374	3478.9317	1145.5681	170
71	5086	356.4041	526.603	1521.8977	3272.7953	1060.3813	170
72	5086	363.60495	526.603	1454.406	3061.5711	973.3338	170
73	5086	370.80585	526.603	1386.4282	2850.3469	886.58068	170
74	5086	378.00675	526.603	1317.4782	2639.6781	800.75271	170
75	5086	385.2076	526.603	1247.2229	2429.9815	716.30404	170
76	5086	389.3426	526.603	1206.4015	2307.5772	666.89572	170
77	5086	392.8705	526.603	1173.6692	2189.7201	615.34225	170
78	5086	398.8571	526.603	1118.4627	1990.9431	528.39292	170
79	5086	403.5921	526.603	1074.5156	1835.6046	460.93184	170
80	5086	408.331	526.603	1026.8469	1731.9585	427.03078	170
81	5086	416.9666	526.603	929.07892	1380.1837	273.19875	170
82	5086	426.4797	526.603	859.06398	931.01719	43.57641	170
83	5086	434.22915	526.603	853.05068	913.62247	36.683585	170
84	5086	441.97865	526.603	848.0826	896.16324	29.11867	170
85	5086	449.72815	526.603	843.992	878.74272	21.045781	170
86	5086	457.47765	526.603	840.45628	861.46414	12.722811	170
87	5086	465.2271	526.603	837.38511	844.40493	4.2513571	170

Title: Sporn Fly Ash Pond
Comments: Section M-M Downstream Seismic (Global Block)
Created By: Roger W. Cecil, P.E.
File Name: SECTION M-M DOWNSTREAM SEISMIC_GLOBAL BLOCK.gsz
Date: 1/18/2010
Horz Seismic Load: 0.06



SLOPE/W Analysis

File Information

Title: Sporn Fly Ash Pond
Comments: Section M-M Downstream Seismic (Upper Dike - Circular)
Created By: Roger W. Cecil, P.E.
Revision Number: 45
Last Edited By: Roger Cecil
Date: 1/17/2010
Time: 11:51:41 PM
File Name: SECTION M-M DOWNSTREAM SEISMIC_UPPER DIKE CIRCLE.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/17/2010
Last Solved Time: 11:52:00 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Sporn Fly Ash Pond Section M-M (Upper Dike-Circular)
Kind: SLOPE/W
Parent: Steady-State Seepage
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Parent Analysis

SlipSurface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 50
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 20 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Sandy Silty Clay (1)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Gravelly Silty Sand (2)
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Bottom Ash (3)
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 36 °
Phi-B: 0 °

Silty Sand and Gravel (4)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Unit Wt. Above Water Table: 115 pcf

Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Sandy Silt (5)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Silty Clay (6)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Fly Ash (7)

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °

Brown Clay (8)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 37 °
Phi-B: 0 °

Silty Clay (9)

Model: Mohr-Coulomb
Unit Weight: 126 pcf
Unit Wt. Above Water Table: 122 pcf
Cohesion: 170 psf
Phi: 31.2 °
Phi-B: 0 °

Sandstone (10)

Model: Bedrock (Impenetrable)

Bottom Ash 2 (11)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (77.76371, 613.24791) ft
Left-Zone Right Coordinate: (112.15782, 618.49321) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (160.36884, 599.99767) ft
Right-Zone Right Coordinate: (204.33315, 600.96372) ft
Right-Zone Increment: 10
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-100, 595.12092) ft
Right Coordinate: (550, 524.91002) ft

Seismic Loads

Horz Seismic Load: 0.06
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Sandy Silty Clay (1)	108,2,3,109	201.13421
Region 2	Sandy Silty Clay	2,110,5,6,7,8,9,10,11,12,13,14,3	962.07207

	(1)		
Region 3	Gravelly Silty Sand (2)	7,15,16,17,8	31.119887
Region 4	Gravelly Silty Sand (2)	9,10,17,8	819.48221
Region 5	Bottom Ash (3)	11,18,19,20,21,22,23,24,25,26,27,28,12	423.64067
Region 6	Bottom Ash (3)	20,29,30,31,32,33,21	32.648671
Region 7	Sandy Silt (5)	26,34,35,36,37,23,24,25	282.19505
Region 8	Silty Sand and Gravel (4)	23,22,21,33,38,39,40,41,42,43,44,45,46,47,37	1565.2892
Region 9	Sandy Silt (5)	36,37,47,48	531.21818
Region 10	Silty Clay (6)	36,48,49,50,51,52,53,54,55,35	989.52619
Regio	Fly Ash	4,56,57,58,59,60,61,62,55,35,34,26,27,28,14,3,109	8370.9742

n 11	(7)		
Region 12	Brown Clay (8)	56,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,111,93,94,95,96,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,62,61,60,59,58,57	6985.7443
Region 13	Silty Clay (9)	91,97,98,99,100,101,102,103,104,105,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90	25156.343
Region 14	Sandstone (10)	105,106,107,98,99,100,101,102,103,104	34015.546
Region 15	Fly Ash (7)	1,108,109,4	70.533781
Region 16	Bottom Ash 2 (11)	12,28,14,13	324.85555

Points

	X (ft)	Y (ft)
Point 1	-100	595.12092
Point 2	35.36015	595.10746
Point 3	35.37077	593.10938
Point 4	-100	593.10516
Point 5	60.72629	605.9827
Point 6	74.8905	612.04606
Point 7	89.08286	617.98267
Point 8	93.72016	617.98376
Point 9	69.42633	602.00461
Point 10	151.61692	602.00605
Point 11	158.87128	599.99208

Point 12	171.82425	595.91741
Point 13	60.47732	595.91216
Point 14	56.0411	593.12487
Point 15	95.74708	619.48275
Point 16	106.57718	619.95406
Point 17	114.07579	617.99114
Point 18	166.70528	600.0213
Point 19	169.58045	600.43082
Point 20	200.94364	600.90024
Point 21	217.30273	592.80917
Point 22	213.38189	590.83858
Point 23	200.88583	589.29528
Point 24	195.25394	588.59744
Point 25	189.42126	588.62008
Point 26	184.5	590.20374
Point 27	181.51772	591.16693
Point 28	177.65846	593.12697
Point 29	204.98541	600.97594
Point 30	206.35442	602.21331
Point 31	206.71422	599.99306
Point 32	214.00828	595.98847
Point 33	222.27612	592.82454
Point 34	168.66722	580.09858
Point 35	175.21974	580.09858
Point 36	184.51087	580.09817
Point 37	213.24737	580.09272
Point 38	255.42934	580.07172
Point 39	317.48058	559.92079
Point 40	315.59736	559.88781
Point 41	309.9739	558.80103
Point 42	307.4465	558.76312
Point 43	287.58173	560.34006
Point 44	273.69358	560.81173
Point 45	259.80542	560.94275
Point 46	255.45555	560.94275
Point 47	239.61428	560.44981

Point 48	215.41971	560.03735
Point 49	206.90911	559.67804
Point 50	185.33019	558.38907
Point 51	177.08328	558.01754
Point 52	173.62075	558.106
Point 53	169.80438	558.01754
Point 54	164.66112	558.14391
Point 55	135.13429	560.09691
Point 56	-100	561.74545
Point 57	20.16974	561.49271
Point 58	28.34588	561.72018
Point 59	50.65765	561.88173
Point 60	61.94724	561.81622
Point 61	89.85457	561.6852
Point 62	105.36228	561.59785
Point 63	-100	552.17166
Point 64	19.23461	550.94335
Point 65	32.24565	551.32246
Point 66	41.85988	551.67124
Point 67	47.10676	551.74706
Point 68	56.64516	551.4741
Point 69	78.08761	551.61058
Point 70	95.40534	551.48927
Point 71	105.51999	551.66113
Point 72	114.75208	551.07983
Point 73	124.43302	550.29735
Point 74	142.61209	549.56582
Point 75	165.69351	548.62684
Point 76	187.96697	548.08092
Point 77	205.85125	547.44765
Point 78	216.92246	547.535
Point 79	233.69307	548.10276
Point 80	236.99041	548.14643
Point 81	242.18755	547.92806
Point 82	246.77327	547.31663
Point 83	252.65171	546.21606

Point 84	273.24811	541.09055
Point 85	281.07788	538.66929
Point 86	297.9009	534.10978
Point 87	305.69923	532.66332
Point 88	316.39049	531.68853
Point 89	338.77924	530.77663
Point 90	389.87718	528.88993
Point 91	422.60496	527.57608
Point 92	411.3282	538.58079
Point 93	401.8504	540.81657
Point 94	388.80805	543.92059
Point 95	352.80366	551.31013
Point 96	329.44346	556.01129
Point 97	550	524.91002
Point 98	550	499.15439
Point 99	396.01919	499.3174
Point 100	313.20998	500.09985
Point 101	256.3846	503.93603
Point 102	240.95296	504.37072
Point 103	191.37067	504.40695
Point 104	86.37793	504.45549
Point 105	-100	504.13087
Point 106	-100	449.97963
Point 107	550	450.03403
Point 108	-64.96913	595.11744
Point 109	-64.96913	593.10625
Point 110	58.47531	605
Point 111	405.33383	539.99484

Critical Slip Surfaces

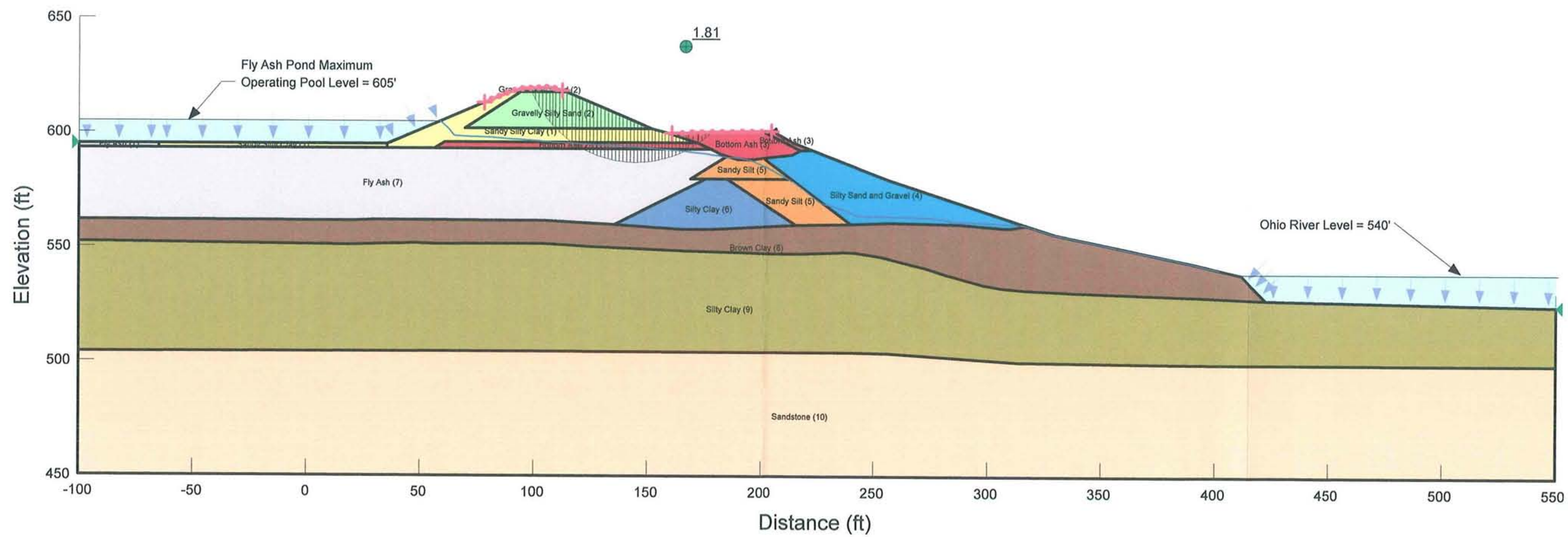
	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	778	1.81	(144.307, 636.528)	49.244	(98.0701, 619.584)	(177.938, 600.556)

Slices of Slip Surface: 778

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	778	98.378825	618.7847	-1241.2148	50.330862	35.242049	0
2	778	99.476525	616.242	-1083.8469	222.57725	155.85027	0
3	778	101.05445	613.0452	-886.62846	461.63825	323.24258	0
4	778	102.63235	610.3366	-719.65518	680.03216	476.16364	0
5	778	104.2103	607.9733	-574.22016	881.62279	617.31892	0
6	778	105.78825	605.874	-445.25632	1069.7912	749.07583	0
7	778	107.23055	604.13475	-338.6446	1216.9112	852.09038	0
8	778	108.53725	602.6961	-250.69544	1324.7304	927.58619	0
9	778	110.0048	601.2144	-183.97293	1452.5778	979.7761	0
10	778	111.6332	599.7011	-137.23448	1577.0367	1063.7247	0
11	778	113.2616	598.3172	-95.027794	1695.1342	1143.3824	0
12	778	115.267	596.78525	-49.303154	1814.4022	1223.8297	0
13	778	117.2222	595.41155	5.0615436	1917.4402	1194.9868	0
14	778	118.75015	594.4443	60.274966	1963.3137	1189.1506	0
15	778	120.2781	593.55315	110.33467	2004.9321	1183.8758	0
16	778	121.8467	592.71355	157.38857	2075.3437	977.24694	0
17	778	123.4559	591.92495	201.67026	2118.3146	976.57909	0
18	778	125.0651	591.20715	241.45984	2157.5401	976.29164	0
19	778	126.6743	590.5569	276.96807	2193.128	976.33226	0
20	778	128.2835	589.97135	308.38224	2225.0505	976.59127	0
21	778	129.8927	589.44805	335.84699	2253.2011	976.94071	0
22	778	131.5019	588.985	359.50273	2277.3967	977.21578	0
23	778	133.1111	588.5804	379.1302	2297.2563	977.33408	0
24	778	134.7203	588.2328	394.51982	2312.3219	977.16899	0
25	778	136.3295	587.941	406.32813	2322.1203	976.14487	0
26	778	137.9387	587.7039	414.62009	2325.9296	973.86085	0
27	778	139.5479	587.5208	419.46519	2323.0225	969.91087	0
28	778	141.1571	587.3911	420.91006	2312.6115	963.87005	0
29	778	142.7663	587.3143	418.98371	2293.7395	955.2358	0
30	778	144.3755	587.2902	413.72629	2265.5922	943.5728	0
31	778	145.9847	587.31875	405.13944	2227.0776	928.32385	0

32	778	147.5939	587.4	393.24181	2177.3947	909.0713	0
33	778	149.2031	587.5342	377.59335	2115.5492	885.53273	0
34	778	150.8123	587.72185	357.71132	2040.8	857.57651	0
35	778	152.34235	587.9491	335.75754	1971.8003	833.60544	0
36	778	153.79325	588.2115	312.00417	1910.2241	814.33371	0
37	778	155.2441	588.5192	285.42167	1837.1769	790.65876	0
38	778	156.69495	588.87305	255.94861	1752.3297	762.44427	0
39	778	158.14585	589.27405	223.52691	1655.434	729.59309	0
40	778	159.6547	589.7435	186.87032	1565.1769	702.28228	0
41	778	161.2215	590.28705	144.89348	1480.9429	680.75118	0
42	778	162.7883	590.89085	98.290636	1383.4045	654.7982	0
43	778	164.3551	591.55735	46.920907	1272.7347	624.58332	0
44	778	165.9219	592.28935	-8.3896466	1147.082	584.46749	0
45	778	167.1397	592.89945	-53.538763	1039.1421	529.46935	0
46	778	168.5773	593.6952	-109.92871	984.63166	615.26615	0
47	778	170.7024	594.9763	-196.5584	785.33076	490.72912	0
48	778	171.9231	595.75595	-247.41628	655.32831	409.49457	0
49	778	172.7614	596.34655	-288.86016	611.39096	444.20154	0
50	778	174.2404	597.43645	-367.23784	450.81763	327.53818	0
51	778	175.7194	598.6154	-451.67951	278.88618	202.62267	0
52	778	177.19835	599.892	-542.36892	95.291906	69.233622	0

Title: Sporn Fly Ash Pond
Comments: Section M-M Downstream Seismic (Upper Dike - Circular)
Created By: Roger W. Cecil, P.E.
File Name: SECTION M-M DOWNSTREAM SEISMIC_UPPER DIKE CIRCLE.gsz
Date: 1/17/2010
Horz Seismic Load: 0.06



SLOPE/W Analysis

File Information

Title: Sporn Fly Ash Pond
Comments: Section M-M Downstream Seismic (Upper Dike-Block)
Created By: Roger W. Cecil, P.E.
Revision Number: 64
Last Edited By: Roger Cecil
Date: 1/18/2010
Time: 12:25:31 AM
File Name: SECTION M-M DOWNSTREAM SEISMIC_UPPER DIKE BLOCK.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/18/2010
Last Solved Time: 12:25:56 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Sporn Fly Ash Pond Section M-M Downstream Upper Dike-Block)
Kind: SLOPE/W
Parent: Steady-State Seepage
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Parent Analysis

SlipSurface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Block
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Restrict Block Crossing: Yes
Advanced
Number of Slices: 50
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 20 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Sandy Silty Clay (1)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Gravelly Silty Sand (2)
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Bottom Ash (3)
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 36 °
Phi-B: 0 °

Silty Sand and Gravel (4)
Model: Mohr-Coulomb
Unit Weight: 120 pcf

Unit Wt. Above Water Table: 115 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Sandy Silt (5)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Silty Clay (6)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Fly Ash (7)

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °

Brown Clay (8)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 37 °
Phi-B: 0 °

Silty Clay (9)

Model: Mohr-Coulomb
Unit Weight: 126 pcf
Unit Wt. Above Water Table: 122 pcf
Cohesion: 170 psf
Phi: 31.2 °
Phi-B: 0 °

Sandstone (10)

Model: Bedrock (Impenetrable)

Bottom Ash 2 (11)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (-100, 595.12092) ft
Right Coordinate: (550, 524.91002) ft

Slip Surface Block

Left Grid
- Upper Left: (86.0086, 605) ft
- Lower Left: (85.6112, 587) ft
- Lower Right: (140, 587) ft
- X Increments: 5
- Y Increments: 7
- Starting Angle: 115 °
- Ending Angle: 135 °
- Angle Increments: 2

Right Grid
- Upper Left: (145, 598) ft
- Lower Left: (145, 587) ft
- Lower Right: (180, 587) ft
- X Increments: 5
- Y Increments: 5
- Starting Angle: 0 °
- Ending Angle: 45 °
- Angle Increments: 2

Seismic Loads

Horz Seismic Load: 0.06
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Regio	Sandy	108,2,3,109	201.13421

n 1	Silty Clay (1)		
Region 2	Sandy Silty Clay (1)	2,110,5,6,7,8,9,10,11,12,13,14,3	962.07207
Region 3	Gravelly Silty Sand (2)	7,15,16,17,8	31.119887
Region 4	Gravelly Silty Sand (2)	9,10,17,8	819.48221
Region 5	Bottom Ash (3)	11,18,19,20,21,22,23,24,25,26,27,28,12	423.64067
Region 6	Bottom Ash (3)	20,29,30,31,32,33,21	32.648671
Region 7	Sandy Silt (5)	26,34,35,36,37,23,24,25	282.19505
Region 8	Silty Sand and Gravel (4)	23,22,21,33,38,39,40,41,42,43,44,45,46,47,37	1565.2892
Region	Sandy Silt	36,37,47,48	531.21818

9	(5)		
Region 10	Silty Clay (6)	36,48,49,50,51,52,53,54,55,35	989.52619
Region 11	Fly Ash (7)	4,56,57,58,59,60,61,62,55,35,34,26,27,28,14,3,109	8370.9742
Region 12	Brown Clay (8)	56,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,111,93,94,95,96,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,62,61,60,59,58,57	6985.7443
Region 13	Silty Clay (9)	91,97,98,99,100,101,102,103,104,105,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90	25156.343
Region 14	Sandstone (10)	105,106,107,98,99,100,101,102,103,104	34015.546
Region 15	Fly Ash (7)	1,108,109,4	70.533781
Region 16	Bottom Ash 2 (11)	12,28,14,13	324.85555

Points

	X (ft)	Y (ft)
Point 1	-100	595.12092
Point 2	35.36015	595.10746
Point 3	35.37077	593.10938
Point 4	-100	593.10516
Point 5	60.72629	605.9827

Point 6	74.8905	612.04606
Point 7	89.08286	617.98267
Point 8	93.72016	617.98376
Point 9	69.42633	602.00461
Point 10	151.61692	602.00605
Point 11	158.87128	599.99208
Point 12	171.82425	595.91741
Point 13	60.47732	595.91216
Point 14	56.0411	593.12487
Point 15	95.74708	619.48275
Point 16	106.57718	619.95406
Point 17	114.07579	617.99114
Point 18	166.70528	600.0213
Point 19	169.58045	600.43082
Point 20	200.94364	600.90024
Point 21	217.30273	592.80917
Point 22	213.38189	590.83858
Point 23	200.88583	589.29528
Point 24	195.25394	588.59744
Point 25	189.42126	588.62008
Point 26	184.5	590.20374
Point 27	181.51772	591.16693
Point 28	177.65846	593.12697
Point 29	204.98541	600.97594
Point 30	206.35442	602.21331
Point 31	206.71422	599.99306
Point 32	214.00828	595.98847
Point 33	222.27612	592.82454
Point 34	168.66722	580.09858
Point 35	175.21974	580.09858
Point 36	184.51087	580.09817
Point 37	213.24737	580.09272
Point 38	255.42934	580.07172
Point 39	317.48058	559.92079
Point 40	315.59736	559.88781
Point 41	309.9739	558.80103

Point 42	307.4465	558.76312
Point 43	287.58173	560.34006
Point 44	273.69358	560.81173
Point 45	259.80542	560.94275
Point 46	255.45555	560.94275
Point 47	239.61428	560.44981
Point 48	215.41971	560.03735
Point 49	206.90911	559.67804
Point 50	185.33019	558.38907
Point 51	177.08328	558.01754
Point 52	173.62075	558.106
Point 53	169.80438	558.01754
Point 54	164.66112	558.14391
Point 55	135.13429	560.09691
Point 56	-100	561.74545
Point 57	20.16974	561.49271
Point 58	28.34588	561.72018
Point 59	50.65765	561.88173
Point 60	61.94724	561.81622
Point 61	89.85457	561.6852
Point 62	105.36228	561.59785
Point 63	-100	552.17166
Point 64	19.23461	550.94335
Point 65	32.24565	551.32246
Point 66	41.85988	551.67124
Point 67	47.10676	551.74706
Point 68	56.64516	551.4741
Point 69	78.08761	551.61058
Point 70	95.40534	551.48927
Point 71	105.51999	551.66113
Point 72	114.75208	551.07983
Point 73	124.43302	550.29735
Point 74	142.61209	549.56582
Point 75	165.69351	548.62684
Point 76	187.96697	548.08092
Point 77	205.85125	547.44765

Point 78	216.92246	547.535
Point 79	233.69307	548.10276
Point 80	236.99041	548.14643
Point 81	242.18755	547.92806
Point 82	246.77327	547.31663
Point 83	252.65171	546.21606
Point 84	273.24811	541.09055
Point 85	281.07788	538.66929
Point 86	297.9009	534.10978
Point 87	305.69923	532.66332
Point 88	316.39049	531.68853
Point 89	338.77924	530.77663
Point 90	389.87718	528.88993
Point 91	422.60496	527.57608
Point 92	411.3282	538.58079
Point 93	401.8504	540.81657
Point 94	388.80805	543.92059
Point 95	352.80366	551.31013
Point 96	329.44346	556.01129
Point 97	550	524.91002
Point 98	550	499.15439
Point 99	396.01919	499.3174
Point 100	313.20998	500.09985
Point 101	256.3846	503.93603
Point 102	240.95296	504.37072
Point 103	191.37067	504.40695
Point 104	86.37793	504.45549
Point 105	-100	504.13087
Point 106	-100	449.97963
Point 107	550	450.03403
Point 108	-64.96913	595.11744
Point 109	-64.96913	593.10625
Point 110	58.47531	605
Point 111	405.33383	539.99484

Critical Slip Surfaces

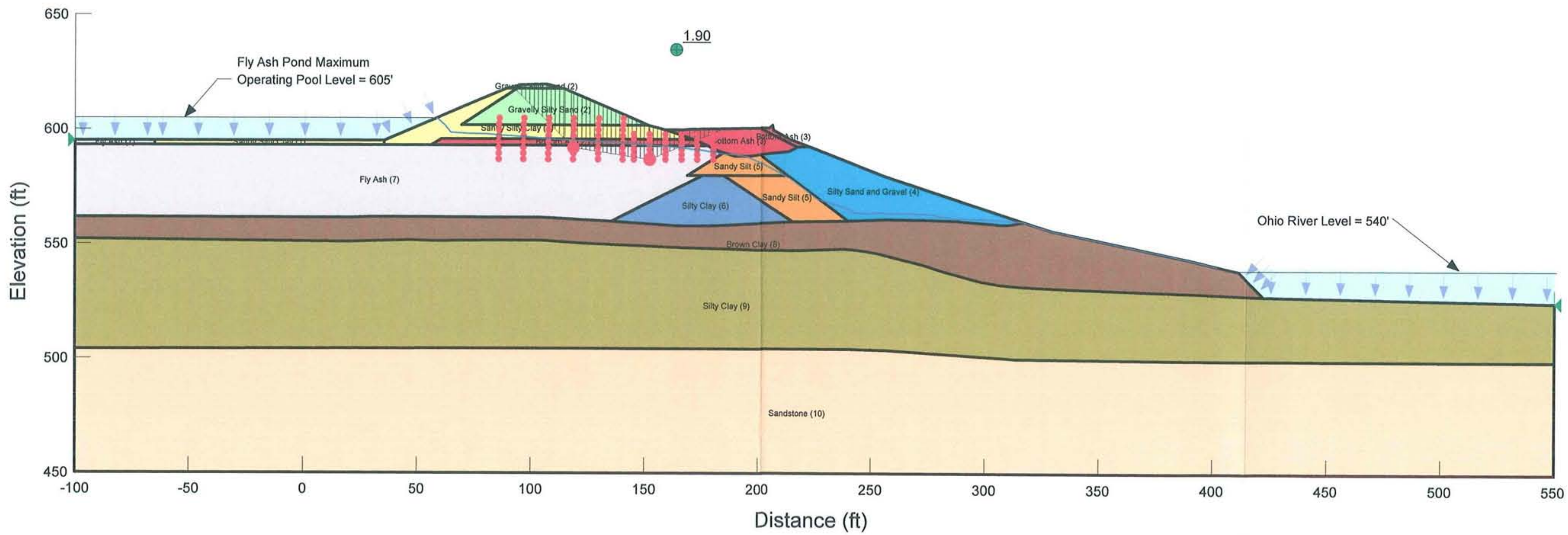
	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	1823	1.90	(163.61, 635.136)	44.281	(91.887, 618.614)	(184.981, 600.661)

Slices of Slip Surface: 1823

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	1823	92.202205	618.2987	-1209.0739	35.174078	24.629155	0
2	1823	92.755925	617.74495	-1175.1005	98.420111	66.385203	0
3	1823	93.357305	617.14355	-1137.8662	163.50858	114.48994	0
4	1823	94.73362	615.76725	-1052.9922	311.24738	217.93776	0
5	1823	96.64959	613.8513	-934.78263	498.69177	349.18773	0
6	1823	98.454605	612.0463	-823.48779	655.07649	458.6895	0
7	1823	100.2596	610.2413	-712.38883	807.42624	565.36594	0
8	1823	102.0646	608.43625	-601.44656	956.13275	669.49136	0
9	1823	103.86965	606.6312	-490.70016	1101.5486	771.31264	0
10	1823	105.6747	604.8262	-380.13005	1244.0655	871.10408	0
11	1823	107.5364	602.9645	-266.32904	1363.86	954.98507	0
12	1823	109.42565	601.07525	-178.64814	1474.6436	994.65963	0
13	1823	111.2857	599.2152	-120.48124	1575.4976	1062.6865	0
14	1823	113.14575	597.35515	-62.477809	1676.0475	1130.5083	0
15	1823	114.331	596.1699	-25.605977	1736.6677	1171.3972	0
16	1823	115.9806	594.5203	64.605544	1802.1853	1085.7604	0
17	1823	117.8665	592.6344	176.09478	1908.9762	882.94719	0
18	1823	119.28185	592.00165	211.21004	2669.724	1252.6754	0
19	1823	121.1296	591.71915	222.68565	2616.9201	1219.9234	0
20	1823	122.97735	591.4367	234.16125	2564.2233	1187.2259	0
21	1823	124.82505	591.15425	245.62616	2511.6334	1154.5884	0
22	1823	126.67275	590.8718	257.08572	2459.0971	1121.9808	0
23	1823	128.52045	590.58935	268.53993	2406.5607	1089.376	0
24	1823	130.36815	590.30685	279.98344	2354.0244	1056.7766	0
25	1823	132.2159	590.0244	291.4216	2301.488	1024.18	0

26	1823	134.06365	589.74195	301.96096	2249.0052	992.06858	0
27	1823	135.91135	589.45945	312.34519	2196.4153	959.98169	0
28	1823	137.75905	589.177	322.65451	2143.8255	927.93296	0
29	1823	139.60675	588.89455	332.89428	2091.1286	895.86515	0
30	1823	141.45445	588.6121	343.05381	2038.3248	863.78371	0
31	1823	143.3022	588.32965	353.12773	1985.4139	831.69136	0
32	1823	145.14995	588.04715	363.11606	1932.3426	799.56086	0
33	1823	146.99765	587.7647	373.00809	1879.1108	767.39764	0
34	1823	148.84535	587.48225	382.65402	1825.7719	735.3053	0
35	1823	150.69305	587.1998	390.95711	1772.2191	703.78812	0
36	1823	151.80845	587.0293	395.96904	1743.0379	686.36587	0
37	1823	152.8589	587.35575	370.24129	2319.8905	993.39589	0
38	1823	154.5767	588.0673	317.05081	2118.9068	918.0915	0
39	1823	156.29455	588.77885	263.8657	1917.224	842.42812	0
40	1823	158.0124	589.4904	210.67521	1715.8101	766.90451	0
41	1823	159.85055	590.2518	153.89188	1533.0221	702.70197	0
42	1823	161.80905	591.06305	93.053095	1368.8136	650.03243	0
43	1823	163.76755	591.8743	30.859041	1206.3976	598.9668	0
44	1823	165.72605	592.6855	-31.686923	1039.736	529.77196	0
45	1823	168.1429	593.6866	-106.85198	907.9832	567.37087	0
46	1823	170.7024	594.7468	-183.40888	733.73432	458.48809	0
47	1823	172.21975	595.3753	-227.61669	627.73008	392.24929	0
48	1823	173.4985	595.90495	-268.01287	576.99539	419.21169	0
49	1823	175.2651	596.6367	-327.14535	476.21862	345.99308	0
50	1823	177.0317	597.36845	-386.85833	379.96033	276.05734	0
51	1823	178.7983	598.1002	-446.85895	288.16822	209.36647	0
52	1823	180.5649	598.83195	-507.03738	200.7377	145.84448	0
53	1823	182.3315	599.5637	-567.3204	117.51712	85.381182	0
54	1823	184.0981	600.29545	-627.72371	38.316615	27.83865	0

Title: Sporn Fly Ash Pond
Comments: Section M-M Downstream Seismic (Upper Dike-Block)
Created By: Roger W. Cecil, P.E.
File Name: SECTION M-M DOWNSTREAM SEISMIC_UPPER DIKE BLOCK.gsz
Date: 1/18/2010
Horz Seismic Load: 0.06



SLOPE/W Analysis

File Information

Title: Sporn Fly Ash Pond - Seismic Stability Analyses
Comments: Section L-L Upstream (Circular)
Created By: Roger W. Cecil, P.E.
Revision Number: 37
Last Edited By: Jeff Gateley
Date: 1/19/2010
Time: 10:27:28 AM
File Name: SECTION L-L UPSTREAM SEISMIC_CIRCLE.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/19/2010
Last Solved Time: 10:27:42 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Sporn Fly Ash Pond Section L-L Upstream (Circle)
Kind: SLOPE/W
Parent: Steady-State Seepage
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Parent Analysis

SlipSurface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 50
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 20 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Sandy Silty Clay (1)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Road Fill (2)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Gravelly Silty Sand (3)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Gravelly Silty Sand (4)

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Unit Wt. Above Water Table: 100 pcf

Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Bottom Ash (5)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Silty Sand & Gravel (6)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Unit Wt. Above Water Table: 115 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Silty Sandy Clay (7)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Silty Clay (8)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Fly Ash (9)

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °

Clay Foundation (10)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf

Cohesion: 0 psf
Phi: 39 °
Phi-B: 0 °

Clay Foundation (11)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 37 °
Phi-B: 0 °

Silty Clay Foundation (12)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-129, 596.07809) ft
Left-Zone Right Coordinate: (21.40993, 606) ft
Left-Zone Increment: 20
Right Projection: Range
Right-Zone Left Coordinate: (57, 620.30893) ft
Right-Zone Right Coordinate: (98, 611.14947) ft
Right-Zone Increment: 10
Radius Increments: 20

Slip Surface Limits

Left Coordinate: (-150, 596.07556) ft
Right Coordinate: (620, 522) ft

Seismic Loads

Horz Seismic Load: 0.06
Ignore seismic load in strength: No

Regions

	Materia	Points	Area (ft^2)

	I		
Region 1	Sandy Silty Clay (1)	105,2,3,106	198.64495
Region 2	Sandy Silty Clay (1)	2,5,6,7,8,9,10,11,12,99,13,14,15,16,17,18,19,3	1797.2287
Region 3	Road Fill (2)	11,20,21,22,12	50.839704
Region 4	Road Fill (2)	15,24,25,26,27,17,16	116.203
Region 5	Bottom Ash (5)	17,27,28,29,18	191.73337
Region 6	Silty Sand & Gravel (6)	19,18,29,30,31	391.82116
Region 7	Silty Sand & Gravel (6)	29,28,32,33,34,35,36,102,101,37,38,100,30	923.61928
Region 8	Silty Sandy Clay (7)	39,49,41,40	312.45828
Region 9	Silty Clay (8)	49,50,42,41	623.99905
Region 10	Fly Ash (9)	50,51,52,4,106,3,19,31,39,49	8353.7652
Region 11	Clay Foundation (10)	52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,51	5937.0151
Region 12	Clay Foundation (11)	51,50,42,43,44,45,46,47,48,38,37,76,77,78,79,80,81,82,83,84,85,86,87,88,89,69,70,71,72,73,74,75	4582.5269
Region on	Silty Sand &	103,90,91,92,104	107.81573

13	Gravel (6)		
Region 14	Silty Clay Foundation (12)	53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,89,88,87,86,85,84,83,95,96,107,108,97,98	32386.101
Region 15	Gravelly Silty Sand (3)	12,22,23,99	270.1759
Region 16	Gravelly Silty Sand (4)	23,14,13,99	428.27559
Region 17	Silty Clay (8)	100,38,48,47,46,45,44,43,42,41	583.66388
Region 18	Silty Sandy Clay (7)	100,41,40,39,31,30	875.82886
Region 19	Bottom Ash (5)	103,104,92,93,101,102,36	285.90427
Region 20	Silty Sand & Gravel (6)	101,93,94,79,78,77,76,37	493.02893
Region 21	Fly Ash (9)	1,105,106,4	41.39401

Points

	X (ft)	Y (ft)
Point 1	-150	596.07556
Point 2	-28.73928	596.09012
Point 3	-28.7343	594.10387
Point 4	-150	594.10335

Point 5	10.87106	605.00492
Point 6	12.47008	605.36299
Point 7	21.58957	606.0128
Point 8	27.88941	608.93894
Point 9	34.84064	612.1236
Point 10	39.1222	614.02931
Point 11	50.19567	618.00197
Point 12	57.04232	618.00197
Point 13	43.46173	603.74724
Point 14	118.92142	603.75291
Point 15	123.93504	601.99213
Point 16	127.87795	600.00591
Point 17	163.14756	600.01118
Point 18	149.56535	595.01063
Point 19	147.06988	594.09744
Point 20	57.38569	620.4397
Point 21	72.81546	619.98477
Point 22	80.84007	617.99987
Point 23	99.3055	610.6283
Point 24	139.17652	601.67587
Point 25	173.72543	602.00845
Point 26	176.45339	603.29228
Point 27	189.71063	600.00886
Point 28	199.68996	595.00886
Point 29	167.47087	595.01
Point 30	191.72441	585.79626
Point 31	124.59213	585.79827
Point 32	210.5102	589.59755
Point 33	218.12189	585.75717
Point 34	221.75303	584.00508
Point 35	243.39222	575.85019
Point 36	253.50591	571.98819
Point 37	289.84961	560.28268
Point 38	256.97717	561.34945
Point 39	108.92713	580.01604
Point 40	142.96147	580.0084

Point 41	159.35433	573.84449
Point 42	178.27362	566.74311
Point 43	185.14195	566.8803
Point 44	197.25818	566.77308
Point 45	199.06388	566.49447
Point 46	214.43065	565.09473
Point 47	230.53524	563.39632
Point 48	234.91774	563.19918
Point 49	92.17246	573.83178
Point 50	72.44646	566.50502
Point 51	57.05752	560.85717
Point 52	-150	561.11382
Point 53	-150	533.82575
Point 54	21.33315	533.86583
Point 55	28.78186	534.53132
Point 56	34.71071	535.25795
Point 57	39.46011	535.53175
Point 58	42.85104	535.87926
Point 59	45.71543	536.46899
Point 60	49.77857	537.76077
Point 61	59.1159	541.81514
Point 62	64.62858	544.24532
Point 63	75.01429	546.95559
Point 64	83.26625	548.88905
Point 65	88.53588	549.98847
Point 66	93.23684	550.64559
Point 67	106.0002	551.53018
Point 68	116.47627	552.07357
Point 69	122.52939	552.65487
Point 70	120.68438	552.98343
Point 71	113.2235	552.91166
Point 72	98.93865	553.2756
Point 73	88.31144	553.78513
Point 74	81.74223	554.71319
Point 75	77.73883	555.51387
Point 76	364.93178	560.3689

Point 77	369.84787	558.28744
Point 78	398.62803	558.25568
Point 79	406.56907	560.14614
Point 80	407.16945	560.17165
Point 81	432.46006	554.51883
Point 82	442.14574	552.40143
Point 83	451.7179	550.43805
Point 84	378.61552	549.7332
Point 85	292.87496	549.02254
Point 86	215.96602	549.23217
Point 87	183.76122	549.91347
Point 88	163.4328	550.32461
Point 89	134.5598	552.09884
Point 90	274.22203	571.1344
Point 91	301.03752	569.99889
Point 92	328.15873	568.01175
Point 93	341.0609	563.99026
Point 94	390.16826	564.00289
Point 95	504	540
Point 96	580	523.86886
Point 97	580	500.03246
Point 98	-150	499.99472
Point 99	49.98781	610.59727
Point 100	223.72901	573.80581
Point 101	278.12773	564.05804
Point 102	265.81244	568.02452
Point 103	264.70006	571.52684
Point 104	275.69963	568.00897
Point 105	-129.04534	596.07808
Point 106	-129.00866	594.10293
Point 107	620	522
Point 108	620	500

Critical Slip Surfaces

	Slip	FOS	Center (ft)	Radius	Entry (ft)	Exit (ft)

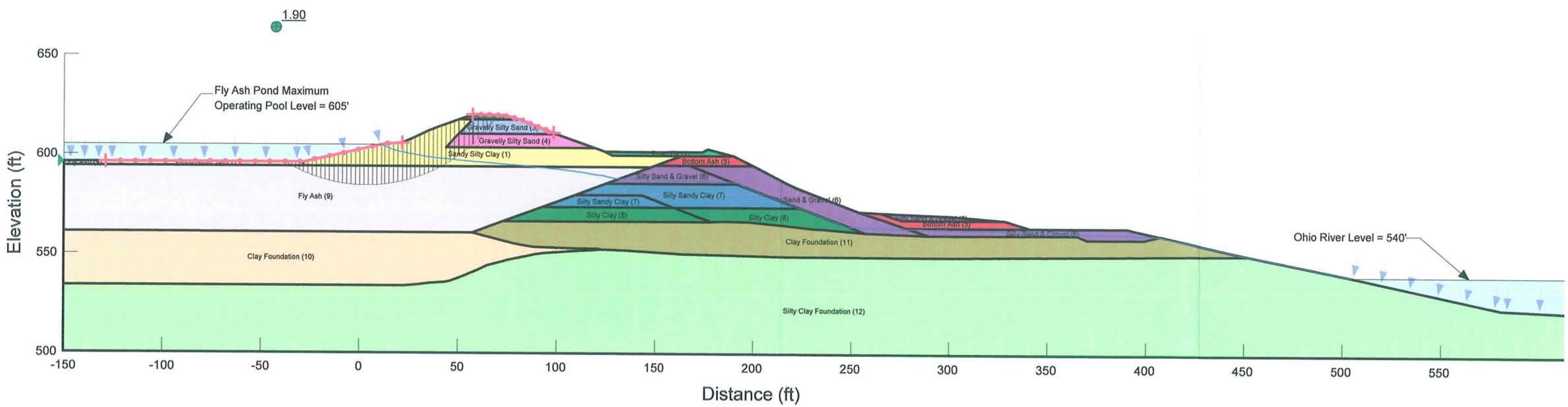
	Surface			(ft)		
1	2846	1.90	(3.266, 664.513)	79.968	(69.7492, 620.075)	(-38.1222, 596.089)

Slices of Slip Surface: 2846

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	2846	-37.253315	595.5783	543.32727	649.83966	71.843512	0
2	2846	-35.51555	594.5857	515.46962	833.16559	214.28863	0
3	2846	-33.662105	593.59115	526.697	967.31533	224.50625	0
4	2846	-31.692975	592.5999	576.71597	1102.3693	267.83373	0
5	2846	-29.723845	591.67535	623.26524	1228.859	308.56545	0
6	2846	-27.63664	590.7674	668.48845	1384.8217	364.99	0
7	2846	-25.43385	589.8823	712.23138	1548.4139	426.05629	0
8	2846	-23.233555	589.0728	752.15794	1699.3341	482.61035	0
9	2846	-21.03326	588.33545	789.08137	1837.1775	534.03165	0
10	2846	-18.83296	587.66815	822.02431	1961.7641	580.72642	0
11	2846	-16.63266	587.0691	850.88026	2072.9257	622.66324	0
12	2846	-14.432365	586.53675	875.91933	2170.4965	659.61999	0
13	2846	-12.23207	586.06975	897.12671	2254.5207	691.62681	0
14	2846	-10.03177	585.66685	914.55066	2325.2541	718.78932	0
15	2846	-7.831471	585.3271	928.2572	2382.9799	741.21824	0
16	2846	-5.631173	585.04975	938.23748	2428.0446	759.09464	0
17	2846	-3.4308755	584.83415	944.63269	2461.0811	772.66906	0
18	2846	-1.230578	584.67975	947.23439	2482.5936	782.30458	0
19	2846	0.96972005	584.5862	946.20901	2493.3162	788.29047	0
20	2846	3.170018	584.55325	941.41751	2493.9338	791.04655	0
21	2846	5.3703155	584.5809	932.91414	2485.1662	790.91195	0
22	2846	7.570613	584.6692	920.71955	2467.7172	788.23466	0
23	2846	9.770911	584.8183	904.68632	2442.3179	783.4624	0
24	2846	11.67057	584.9926	888.03783	2427.1002	784.19147	0
25	2846	13.610015	585.22585	867.47753	2399.0571	780.37875	0
26	2846	15.889885	585.55685	839.77563	2342.181	765.51375	0
27	2846	18.16976	585.9554	807.74233	2279.5537	749.92533	0
28	2846	20.449635	586.4225	771.3265	2211.5129	733.81164	0

29	2846	22.639545	586.93555	732.15175	2191.4193	743.53396	0
30	2846	24.73949	587.4905	690.49382	2217.6718	778.13607	0
31	2846	26.839435	588.1072	644.8777	2237.5054	811.48434	0
32	2846	29.04795	588.82585	592.19968	2250.6121	845.00332	0
33	2846	31.365025	589.65535	532.37611	2256.4973	878.48364	0
34	2846	33.6821	590.56675	467.38316	2255.0938	910.88408	0
35	2846	35.91103	591.52205	399.78816	2245.493	940.4336	0
36	2846	38.05181	592.518	329.68466	2228.0685	967.27489	0
37	2846	40.14761	593.56825	256.10863	2195.2477	988.04072	0
38	2846	42.317375	594.7418	179.05162	2079.8995	1282.1381	0
39	2846	44.54941	596.0381	98.03003	1969.1434	1262.0819	0
40	2846	46.72477	597.3982	12.682889	1829.6405	1225.5534	0
41	2846	48.90013	598.8585	-81.58597	1693.5864	1142.3385	0
42	2846	50.09174	599.6896	-146.04584	1619.8066	1092.5734	0
43	2846	51.45933	600.71935	-222.85147	1531.9598	1033.3199	0
44	2846	53.986645	602.71105	-363.66606	1364.7418	920.52994	0
45	2846	56.14631	604.53815	-483.90283	1248.2441	779.98949	0
46	2846	57.214005	605.4851	-544.39821	1190.7152	744.04145	0
47	2846	58.621995	606.8284	-629.94589	1083.8758	677.28075	0
48	2846	61.09461	609.3099	-787.44775	881.94818	551.10239	0
49	2846	63.32825	611.7401	-941.59528	668.20009	450.70665	0
50	2846	65.322915	614.103	-1090.7847	472.50058	318.70567	0
51	2846	67.31758	616.6659	-1252.3943	265.8345	179.30763	0
52	2846	69.03203	619.0381	-1401.1174	78.710495	55.113682	0

Title: Sporn Fly Ash Pond - Seismic Stability Analyses
Comments: Section L-L Upstream (Circular)
Created By: Roger W. Cecil, P.E.
File Name: SECTION L-L UPSTREAM SEISMIC_CIRCLE.gsz
Date: 1/19/2010
Horz Seismic Load: 0.06



SLOPE/W Analysis

File Information

Title: Sporn Fly Ash Pond - Seismic Stability Analyses
Comments: Section L-L Upstream (Block)
Created By: Roger W. Cecil, P.E.
Revision Number: 43
Last Edited By: Jeff Gateley
Date: 1/19/2010
Time: 10:27:21 AM
File Name: SECTION L-L UPSTREAM SEISMIC_BLOCK.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/19/2010
Last Solved Time: 10:27:29 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Sporn Fly Ash Pond Section L-L Upstream (Block)
Kind: SLOPE/W
Parent: Steady-State Seepage
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Parent Analysis

SlipSurface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Block
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Restrict Block Crossing: Yes
Advanced
Number of Slices: 50
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 20 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Sandy Silty Clay (1)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Road Fill (2)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Gravelly Silty Sand (3)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Gravelly Silty Sand (4)
Model: Mohr-Coulomb
Unit Weight: 105 pcf

Unit Wt. Above Water Table: 100 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Bottom Ash (5)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Silty Sand & Gravel (6)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Unit Wt. Above Water Table: 115 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Silty Sandy Clay (7)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Silty Clay (8)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Fly Ash (9)

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °

Clay Foundation (10)

Model: Mohr-Coulomb
Unit Weight: 125 pcf

Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 39 °
Phi-B: 0 °

Clay Foundation (11)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 37 °
Phi-B: 0 °

Silty Clay Foundation (12)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (-150, 596.07556) ft
Right Coordinate: (620, 522) ft

Slip Surface Block

Left Grid
- Upper Left: (-84, 595) ft
- Lower Left: (-84, 580) ft
- Lower Right: (0, 580) ft
- X Increments: 5
- Y Increments: 5
- Starting Angle: 135 °
- Ending Angle: 180 °
- Angle Increments: 2

Right Grid
- Upper Left: (16, 603) ft
- Lower Left: (16, 580) ft
- Lower Right: (91, 580) ft
- X Increments: 5
- Y Increments: 5
- Starting Angle: 45 °
- Ending Angle: 65 °
- Angle Increments: 3

Seismic Loads

Horz Seismic Load: 0.06
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Sandy Silty Clay (1)	105,2,3,106	198.64495
Region 2	Sandy Silty Clay (1)	2,5,6,7,8,9,10,11,12,99,13,14,15,16,17,18,19,3	1797.2287
Region 3	Road Fill (2)	11,20,21,22,12	50.839704
Region 4	Road Fill (2)	15,24,25,26,27,17,16	116.203
Region 5	Bottom Ash (5)	17,27,28,29,18	191.73337
Region 6	Silty Sand & Gravel (6)	19,18,29,30,31	391.82116
Region 7	Silty Sand & Gravel (6)	29,28,32,33,34,35,36,102,101,37,38,100,30	923.61928
Region 8	Silty Sandy Clay (7)	39,49,41,40	312.45828
Region 9	Silty Clay (8)	49,50,42,41	623.99905
Region 10	Fly Ash (9)	50,51,52,4,106,3,19,31,39,49	8353.7652
Region 11	Clay Foundation	52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,51	5937.0151

	(10)		
Region 12	Clay Foundation (11)	51,50,42,43,44,45,46,47,48,38,37,76,77,78,79,80,81,82,83,84,85,86,87,88,89,69,70,71,72,73,74,75	4582.5269
Region 13	Silty Sand & Gravel (6)	103,90,91,92,104	107.81573
Region 14	Silty Clay Foundation (12)	53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,89,88,87,86,85,84,83,95,96,107,108,97,98	32386.101
Region 15	Gravelly Silty Sand (3)	12,22,23,99	270.1759
Region 16	Gravelly Silty Sand (4)	23,14,13,99	428.27559
Region 17	Silty Clay (8)	100,38,48,47,46,45,44,43,42,41	583.66388
Region 18	Silty Sandy Clay (7)	100,41,40,39,31,30	875.82886
Region 19	Bottom Ash (5)	103,104,92,93,101,102,36	285.90427
Region 20	Silty Sand & Gravel (6)	101,93,94,79,78,77,76,37	493.02893
Region 21	Fly Ash (9)	1,105,106,4	41.39401

Points

	X (ft)	Y (ft)
Point 1	-150	596.07556
Point 2	-28.73928	596.09012
Point 3	-28.7343	594.10387
Point 4	-150	594.10335
Point 5	10.87106	605.00492
Point 6	12.47008	605.36299
Point 7	21.58957	606.0128
Point 8	27.88941	608.93894
Point 9	34.84064	612.1236
Point 10	39.1222	614.02931
Point 11	50.19567	618.00197
Point 12	57.04232	618.00197
Point 13	43.46173	603.74724
Point 14	118.92142	603.75291
Point 15	123.93504	601.99213
Point 16	127.87795	600.00591
Point 17	163.14756	600.01118
Point 18	149.56535	595.01063
Point 19	147.06988	594.09744
Point 20	57.38569	620.4397
Point 21	72.81546	619.98477
Point 22	80.84007	617.99987
Point 23	99.3055	610.6283
Point 24	139.17652	601.67587
Point 25	173.72543	602.00845
Point 26	176.45339	603.29228
Point 27	189.71063	600.00886
Point 28	199.68996	595.00886
Point 29	167.47087	595.01
Point 30	191.72441	585.79626
Point 31	124.59213	585.79827
Point 32	210.5102	589.59755
Point 33	218.12189	585.75717

Point 34	221.75303	584.00508
Point 35	243.39222	575.85019
Point 36	253.50591	571.98819
Point 37	289.84961	560.28268
Point 38	256.97717	561.34945
Point 39	108.92713	580.01604
Point 40	142.96147	580.0084
Point 41	159.35433	573.84449
Point 42	178.27362	566.74311
Point 43	185.14195	566.8803
Point 44	197.25818	566.77308
Point 45	199.06388	566.49447
Point 46	214.43065	565.09473
Point 47	230.53524	563.39632
Point 48	234.91774	563.19918
Point 49	92.17246	573.83178
Point 50	72.44646	566.50502
Point 51	57.05752	560.85717
Point 52	-150	561.11382
Point 53	-150	533.82575
Point 54	21.33315	533.86583
Point 55	28.78186	534.53132
Point 56	34.71071	535.25795
Point 57	39.46011	535.53175
Point 58	42.85104	535.87926
Point 59	45.71543	536.46899
Point 60	49.77857	537.76077
Point 61	59.1159	541.81514
Point 62	64.62858	544.24532
Point 63	75.01429	546.95559
Point 64	83.26625	548.88905
Point 65	88.53588	549.98847
Point 66	93.23684	550.64559
Point 67	106.0002	551.53018
Point 68	116.47627	552.07357
Point 69	122.52939	552.65487

Point 70	120.68438	552.98343
Point 71	113.2235	552.91166
Point 72	98.93865	553.2756
Point 73	88.31144	553.78513
Point 74	81.74223	554.71319
Point 75	77.73883	555.51387
Point 76	364.93178	560.3689
Point 77	369.84787	558.28744
Point 78	398.62803	558.25568
Point 79	406.56907	560.14614
Point 80	407.16945	560.17165
Point 81	432.46006	554.51883
Point 82	442.14574	552.40143
Point 83	451.7179	550.43805
Point 84	378.61552	549.7332
Point 85	292.87496	549.02254
Point 86	215.96602	549.23217
Point 87	183.76122	549.91347
Point 88	163.4328	550.32461
Point 89	134.5598	552.09884
Point 90	274.22203	571.1344
Point 91	301.03752	569.99889
Point 92	328.15873	568.01175
Point 93	341.0609	563.99026
Point 94	390.16826	564.00289
Point 95	504	540
Point 96	580	523.86886
Point 97	580	500.03246
Point 98	-150	499.99472
Point 99	49.98781	610.59727
Point 100	223.72901	573.80581
Point 101	278.12773	564.05804
Point 102	265.81244	568.02452
Point 103	264.70006	571.52684
Point 104	275.69963	568.00897
Point 105	-129.04534	596.07808

Point 106	-129.00866	594.10293
Point 107	620	522
Point 108	620	500

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	1613	1.96	(-43, 664)	50.536	(62.1007, 620.301)	(-41.1561, 596.089)

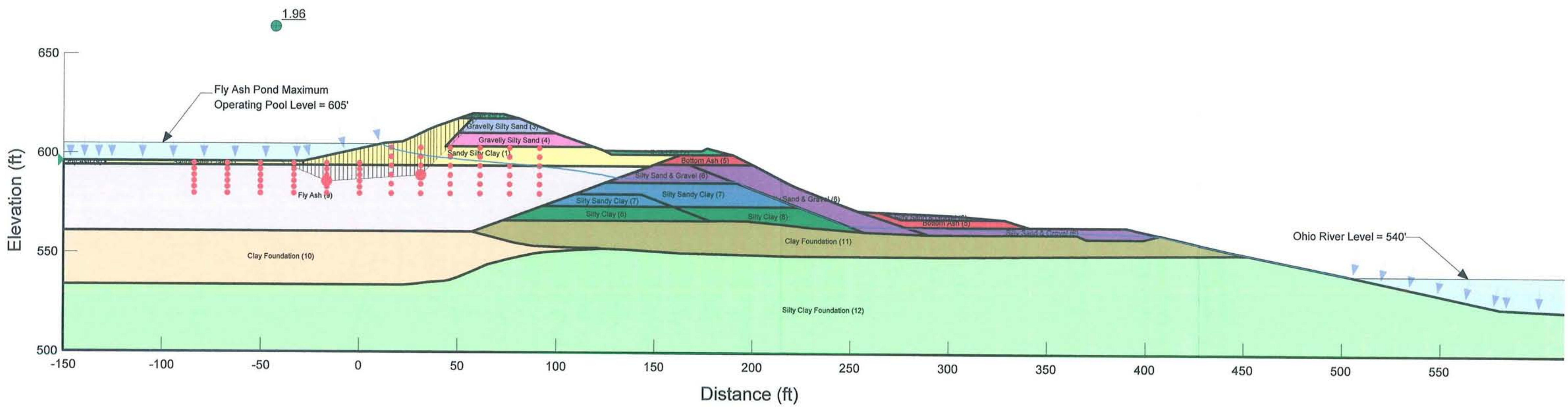
Slices of Slip Surface: 1613

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	1613	-39.958155	595.5924	545.17263	639.29955	63.489409	0
2	1613	-37.56225	594.6	519.49114	811.85914	197.20471	0
3	1613	-35.411175	593.709	524.30166	938.87703	211.2367	0
4	1613	-33.50492	592.9194	563.84965	1050.5419	247.98211	0
5	1613	-31.598665	592.1298	602.86452	1164.7271	286.28327	0
6	1613	-29.69241	591.3402	642.02478	1281.3355	325.74507	0
7	1613	-27.742265	590.53245	682.05732	1436.7173	384.51847	0
8	1613	-25.750725	589.70755	723.01401	1603.6735	448.71842	0
9	1613	-23.761675	588.88365	764.72457	1772.8382	513.65953	0
10	1613	-21.772625	588.05975	807.31765	1944.0001	579.16863	0
11	1613	-19.783575	587.23585	850.09652	2116.7877	645.4114	0
12	1613	-17.794525	586.41195	892.92184	2290.6901	712.1985	0
13	1613	-15.73573	586.07125	907.13577	2004.8207	559.2984	0
14	1613	-13.607185	586.21375	892.65123	2016.7739	572.76914	0
15	1613	-11.47864	586.35625	877.9323	2027.9303	585.95326	0
16	1613	-9.350099	586.49875	863.1665	2038.243	598.73136	0
17	1613	-7.2215565	586.64125	848.2132	2047.7118	611.17507	0
18	1613	-5.0930135	586.78375	833.16614	2056.3838	623.26052	0
19	1613	-2.96447	586.92625	818.02534	2064.3526	635.03548	0
20	1613	-0.8359267	587.06875	802.74391	2071.5715	646.49994	0
21	1613	1.2926163	587.21125	787.36873	2078.1809	657.70167	0

22	1613	3.4211595	587.35375	771.80604	2084.181	668.68844	0
23	1613	5.5497025	587.49625	756.24336	2089.6654	679.41249	0
24	1613	7.6782455	587.63875	740.49317	2094.6811	689.99323	0
25	1613	9.8067885	587.78125	724.69611	2099.2749	700.38289	0
26	1613	11.67057	587.906	710.78292	2115.5011	715.73968	0
27	1613	13.610015	588.0358	696.15611	2125.5365	728.30571	0
28	1613	15.889885	588.18845	678.91304	2118.1404	733.32297	0
29	1613	18.16976	588.3411	661.53868	2110.4817	738.27334	0
30	1613	20.449635	588.4937	644.07679	2102.5604	743.13451	0
31	1613	22.639545	588.6403	627.18356	2149.244	775.52854	0
32	1613	24.73949	588.7809	610.88629	2250.3061	835.32612	0
33	1613	26.839435	588.9215	594.49399	2350.9881	894.97844	0
34	1613	28.667055	589.04385	580.10901	2437.5536	946.41527	0
35	1613	30.22235	589.14795	567.83014	2510.2388	989.70665	0
36	1613	31.96016	590.16015	499.08994	1830.8802	678.58102	0
37	1613	33.88048	592.08045	373.45213	1759.003	705.97342	0
38	1613	35.371075	593.57105	275.64652	1702.8696	727.2065	0
39	1613	36.70668	594.9067	194.97009	1571.4145	928.42345	0
40	1613	38.317025	596.51705	102.21417	1485.8335	933.263	0
41	1613	40.207085	598.4071	-8.2903402	1377.4107	929.07527	0
42	1613	42.37685	600.57685	-172.51364	1268.498	855.61269	0
43	1613	44.504565	602.70455	-343.64238	1141.7226	770.10165	0
44	1613	46.6575	604.8575	-495.08798	1027.5345	642.0748	0
45	1613	48.877705	607.0777	-637.96122	908.42035	567.64403	0
46	1613	50.09174	608.29175	-715.33931	843.21455	526.89893	0
47	1613	51.29723	609.49725	-792.15503	779.86236	487.31209	0
48	1613	53.55967	611.7597	-937.20858	638.07419	430.38647	0
49	1613	55.881435	614.08145	-1085.7098	494.41537	333.48738	0

50	1613	57.214005	615.414	-1169.7936	412.39831	278.16617	0
51	1613	58.59371	616.7937	-1256.8807	302.00843	203.70726	0
52	1613	60.951205	619.1512	-1405.2896	99.307459	69.535831	0

Title: Sporn Fly Ash Pond - Seismic Stability Analyses
Comments: Section L-L Upstream (Block)
Created By: Roger W. Cecil, P.E.
File Name: SECTION L-L UPSTREAM SEISMIC_BLOCK.gsz
Date: 1/19/2010
Horz Seismic Load: 0.06



SLOPE/W Analysis

File Information

Title: Sporn Fly Ash Pond - Seismic Stability Analyses
Comments: Section L-L Downstream (Global - Circular)
Created By: Roger W. Cecil, P.E.
Revision Number: 28
Last Edited By: Jeff Gateley
Date: 1/19/2010
Time: 10:15:14 AM
File Name: SECTION L-L DOWNSTREAM SEISMIC_GLOBAL CIRCLE.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/19/2010
Last Solved Time: 10:16:48 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Sporn Fly Ash Pond Section L-L Downstream (Global-Circle)
Kind: SLOPE/W
Parent: Steady-State Seepage
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Parent Analysis

SlipSurface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 150
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 20 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Sandy Silty Clay (1)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Road Fill (2)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Gravelly Silty Sand (3)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Gravelly Silty Sand (4)
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Unit Wt. Above Water Table: 100 pcf

Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Bottom Ash (5)
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Silty Sand & Gravel (6)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Unit Wt. Above Water Table: 115 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Silty Sandy Clay (7)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Silty Clay (8)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Fly Ash (9)
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °

Clay Foundation (10)
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf

Cohesion: 0 psf
Phi: 39 °
Phi-B: 0 °

Clay Foundation (11)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 37 °
Phi-B: 0 °

Silty Clay Foundation (12)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (21.40993, 606) ft
Left-Zone Right Coordinate: (72.94705, 619.95222) ft
Left-Zone Increment: 15
Right Projection: Range
Right-Zone Left Coordinate: (254.27547, 571.95647) ft
Right-Zone Right Coordinate: (620, 522) ft
Right-Zone Increment: 40
Radius Increments: 20

Slip Surface Limits

Left Coordinate: (-150, 596.07556) ft
Right Coordinate: (620, 522) ft

Seismic Loads

Horz Seismic Load: 0.06
Ignore seismic load in strength: No

Regions

	Materia	Points	Area (ft^2)

SPP00003492

	I		
Regi on 1	Sandy Silty Clay (1)	105,2,3,106	198.6449 5
Regi on 2	Sandy Silty Clay (1)	2,5,6,7,8,9,10,11,12,99,13,14,15,16,17,18,19,3	1797.228 7
Regi on 3	Road Fill (2)	11,20,21,22,12	50.83970 4
Regi on 4	Road Fill (2)	15,24,25,26,27,17,16	116.203
Regi on 5	Bottom Ash (5)	17,27,28,29,18	191.7333 7
Regi on 6	Silty Sand & Gravel (6)	19,18,29,30,31	391.8211 6
Regi on 7	Silty Sand & Gravel (6)	29,28,32,33,34,35,36,102,101,37,38,100,30	923.6192 8
Regi on 8	Silty Sandy Clay (7)	39,49,41,40	312.4582 8
Regi on 9	Silty Clay (8)	49,50,42,41	623.9990 5
Regi on 10	Fly Ash (9)	50,51,52,4,106,3,19,31,39,49	8353.765 2
Regi on 11	Clay Founda tion (10)	52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73, 74,75,51	5937.015 1
Regi on 12	Clay Founda tion (11)	51,50,42,43,44,45,46,47,48,38,37,76,77,78,79,80,81,82,83,84,85,86, 87,88,89,69,70,71,72,73,74,75	4582.526 9
Regi on	Silty Sand &	103,90,91,92,104	107.8157 3

13	Gravel (6)		
Region 14	Silty Clay Foundation (12)	53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,89,88,87,86,85,84,83,95,96,107,108,97,98	32386.101
Region 15	Gravelly Silty Sand (3)	12,22,23,99	270.1759
Region 16	Gravelly Silty Sand (4)	23,14,13,99	428.27559
Region 17	Silty Clay (8)	100,38,48,47,46,45,44,43,42,41	583.66388
Region 18	Silty Sandy Clay (7)	100,41,40,39,31,30	875.82886
Region 19	Bottom Ash (5)	103,104,92,93,101,102,36	285.90427
Region 20	Silty Sand & Gravel (6)	101,93,94,79,78,77,76,37	493.02893
Region 21	Fly Ash (9)	1,105,106,4	41.39401

Points

	X (ft)	Y (ft)
Point 1	-150	596.07556
Point 2	-28.73928	596.09012
Point 3	-28.7343	594.10387
Point 4	-150	594.10335

Point 5	10.87106	605.00492
Point 6	12.47008	605.36299
Point 7	21.58957	606.0128
Point 8	27.88941	608.93894
Point 9	34.84064	612.1236
Point 10	39.1222	614.02931
Point 11	50.19567	618.00197
Point 12	57.04232	618.00197
Point 13	43.46173	603.74724
Point 14	118.92142	603.75291
Point 15	123.93504	601.99213
Point 16	127.87795	600.00591
Point 17	163.14756	600.01118
Point 18	149.56535	595.01063
Point 19	147.06988	594.09744
Point 20	57.38569	620.4397
Point 21	72.81546	619.98477
Point 22	80.84007	617.99987
Point 23	99.3055	610.6283
Point 24	139.17652	601.67587
Point 25	173.72543	602.00845
Point 26	176.45339	603.29228
Point 27	189.71063	600.00886
Point 28	199.68996	595.00886
Point 29	167.47087	595.01
Point 30	191.72441	585.79626
Point 31	124.59213	585.79827
Point 32	210.5102	589.59755
Point 33	218.12189	585.75717
Point 34	221.75303	584.00508
Point 35	243.39222	575.85019
Point 36	253.50591	571.98819
Point 37	289.84961	560.28268
Point 38	256.97717	561.34945
Point 39	108.92713	580.01604
Point 40	142.96147	580.0084

Point 41	159.35433	573.84449
Point 42	178.27362	566.74311
Point 43	185.14195	566.8803
Point 44	197.25818	566.77308
Point 45	199.06388	566.49447
Point 46	214.43065	565.09473
Point 47	230.53524	563.39632
Point 48	234.91774	563.19918
Point 49	92.17246	573.83178
Point 50	72.44646	566.50502
Point 51	57.05752	560.85717
Point 52	-150	561.11382
Point 53	-150	533.82575
Point 54	21.33315	533.86583
Point 55	28.78186	534.53132
Point 56	34.71071	535.25795
Point 57	39.46011	535.53175
Point 58	42.85104	535.87926
Point 59	45.71543	536.46899
Point 60	49.77857	537.76077
Point 61	59.1159	541.81514
Point 62	64.62858	544.24532
Point 63	75.01429	546.95559
Point 64	83.26625	548.88905
Point 65	88.53588	549.98847
Point 66	93.23684	550.64559
Point 67	106.0002	551.53018
Point 68	116.47627	552.07357
Point 69	122.52939	552.65487
Point 70	120.68438	552.98343
Point 71	113.2235	552.91166
Point 72	98.93865	553.2756
Point 73	88.31144	553.78513
Point 74	81.74223	554.71319
Point 75	77.73883	555.51387
Point 76	364.93178	560.3689

Point 77	369.84787	558.28744
Point 78	398.62803	558.25568
Point 79	406.56907	560.14614
Point 80	407.16945	560.17165
Point 81	432.46006	554.51883
Point 82	442.14574	552.40143
Point 83	451.7179	550.43805
Point 84	378.61552	549.7332
Point 85	292.87496	549.02254
Point 86	215.96602	549.23217
Point 87	183.76122	549.91347
Point 88	163.4328	550.32461
Point 89	134.5598	552.09884
Point 90	274.22203	571.1344
Point 91	301.03752	569.99889
Point 92	328.15873	568.01175
Point 93	341.0609	563.99026
Point 94	390.16826	564.00289
Point 95	504	540
Point 96	580	523.86886
Point 97	580	500.03246
Point 98	-150	499.99472
Point 99	49.98781	610.59727
Point 100	223.72901	573.80581
Point 101	278.12773	564.05804
Point 102	265.81244	568.02452
Point 103	264.70006	571.52684
Point 104	275.69963	568.00897
Point 105	-129.04534	596.07808
Point 106	-129.00866	594.10293
Point 107	620	522
Point 108	620	500

Critical Slip Surfaces

	Slip	FOS	Center (ft)	Radius	Entry (ft)	Exit (ft)

	Surface			(ft)		
1	6830	1.71	(438.172, 1257.23)	752.302	(44.6963, 616.029)	(601.484, 522.865)

Slices of Slip Surface: 6830

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	6830	47.445975	614.3578	-1076.1452	278.09935	187.58038	0
2	6830	50.76255	612.34605	-971.33477	610.2919	411.64708	0
3	6830	52.506745	611.30255	-907.41388	751.20086	506.69138	0
4	6830	55.36319	609.60705	-802.23856	967.42341	604.51324	0
5	6830	57.214005	608.5137	-734.70526	1098.8685	686.64927	0
6	6830	59.400875	607.23855	-656.38961	1208.4009	755.09266	0
7	6830	63.431245	604.90655	-514.21188	1398.0384	873.59136	0
8	6830	67.288685	602.705	-389.4984	1578.6551	1064.8163	0
9	6830	70.9732	600.6308	-290.17737	1788.4875	1206.35	0
10	6830	74.82161	598.49395	-191.58017	1964.2282	1324.8886	0
11	6830	78.833915	596.29665	-78.568452	2105.596	1420.2424	0
12	6830	81.86855	594.65285	-0.36105068	2196.3445	1481.4531	0
13	6830	84.94809	593.00905	82.458583	2336.1579	1148.3172	0
14	6830	89.050205	590.84375	196.32718	2390.1996	1117.8338	0
15	6830	93.15232	588.71065	308.71599	2440.7431	1086.3221	0
16	6830	97.25444	586.6094	424.16435	2487.7471	1051.4479	0
17	6830	101.0616	584.6865	534.04706	2542.4061	1023.31	0
18	6830	104.57375	582.9375	635.88286	2604.8306	1003.229	0
19	6830	108.0859	581.2112	746.76032	2665.7401	977.76905	0
20	6830	110.1909	580.1847	806.89135	2645.6173	1240.2363	0
21	6830	112.6352	579.0099	851.05797	2718.0419	1259.2966	0
22	6830	116.826	577.0142	931.88071	2841.0366	1287.7419	0
23	6830	121.2753	574.931	1021.5129	2950.7805	1301.3074	0
24	6830	123.7821	573.7674	1071.2687	3011.2813	1259.8589	0
25	6830	124.26355	573.54625	1080.7253	3030.6668	1266.3068	0
26	6830	126.23505	572.64675	1118.9307	3123.6343	1301.8697	0
27	6830	129.76105	571.05175	1185.8453	3298.5221	1371.9883	0

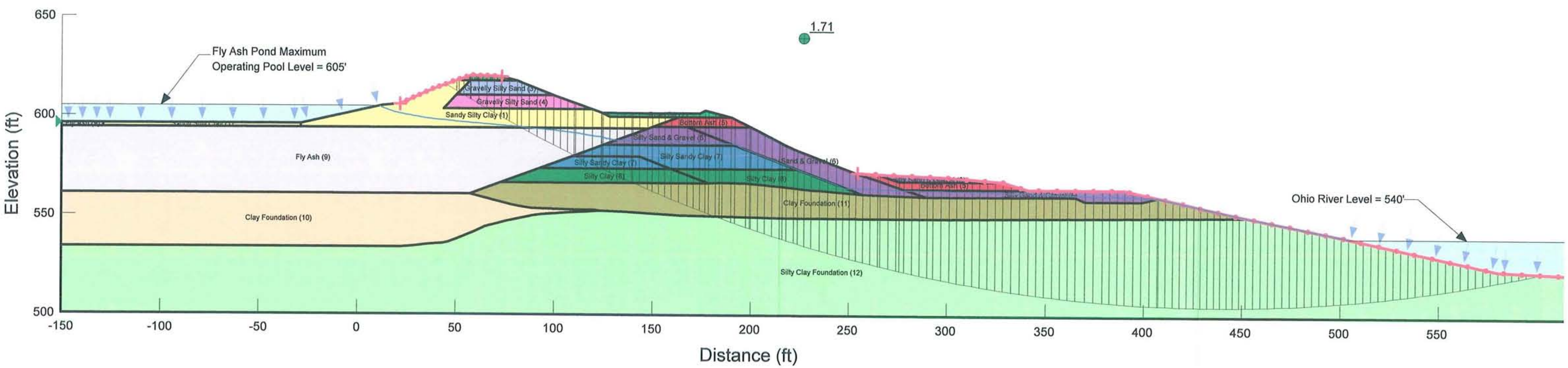
28	6830	133.5272	569.3714	1255.3669	3494.265	1453.9575	0
29	6830	137.2934	567.71565	1322.9763	3687.6293	1535.6237	0
30	6830	139.45105	566.77515	1360.8001	3798.4252	1583.0123	0
31	6830	141.34355	565.96165	1390.3536	3858.1654	1859.6295	0
32	6830	145.0157	564.3977	1444.8815	4045.4529	1959.6711	0
33	6830	148.31765	563.00755	1491.7624	4205.2309	2044.7452	0
34	6830	151.19685	561.8133	1530.406	4316.537	2099.5003	0
35	6830	154.4598	560.4757	1573.6832	4428.1572	2151.0004	0
36	6830	157.7228	559.15595	1615.7374	4538.636	2202.5621	0
37	6830	161.25095	557.7496	1659.2723	4656.2475	2258.3828	0
38	6830	165.30925	556.1574	1707.4407	4816.5383	2342.8731	0
39	6830	169.0345	554.71705	1752.1145	4984.286	2435.6159	0
40	6830	172.16175	553.5269	1789.2112	5124.0391	2512.9731	0
41	6830	175.0894	552.42665	1823.5381	5315.9339	2631.709	0
42	6830	177.3635	551.58115	1850.0149	5455.5883	2716.9944	0
43	6830	180.0418	550.59885	1880.7496	5504.4775	2730.6748	0
44	6830	182.7856	549.6008	1912.6792	5599.6375	2303.8672	0
45	6830	184.4516	549.0014	1932.351	5630.2112	2310.6795	0
46	6830	187.4263	547.9465	1967.0149	5683.9276	2322.5848	0
47	6830	190.7175	546.7882	2005.7755	5728.1746	2326.0131	0
48	6830	194.4913	545.4902	2049.7097	5728.2111	2298.5828	0
49	6830	198.16105	544.239	2093.2007	5724.666	2269.1913	0
50	6830	199.37695	543.8303	2107.4688	5723.2152	2259.3691	0
51	6830	201.49335	543.1278	2132.1751	5695.7308	2226.7568	0
52	6830	205.1001	541.94245	2174.3606	5640.0724	2165.6171	0
53	6830	208.70685	540.77725	2216.5851	5582.1919	2103.0645	0
54	6830	212.47045	539.5832	2260.6131	5518.0704	2035.4852	0
55	6830	215.19835	538.72845	2292.3556	5469.6928	1985.4206	0
56	6830	217.04395	538.1587	2313.4045	5436.0284	1951.232	0
57	6830	219.93745	537.27685	2346.0993	5386.2401	1899.6908	0
58	6830	222.741	536.4312	2377.8226	5350.6948	1857.6567	0
59	6830	225.43055	535.63425	2407.7956	5334.6539	1828.904	0
60	6830	228.83365	534.63965	2445.6612	5312.9366	1791.6725	0
61	6830	232.72645	533.52465	2487.8893	5284.844	1747.7313	0
62	6830	237.03635	532.31475	2533.1344	5250.4719	1697.9809	0
63	6830	241.2736	531.1524	2576.601	5214.0182	1648.0412	0

64	6830	245.07785	530.13025	2615.1878	5177.6246	1601.1882	0
65	6830	248.4491	529.2433	2648.4599	5142.0331	1558.1575	0
66	6830	251.8203	528.373	2680.22	5104.4968	1514.8562	0
67	6830	255.24155	527.5069	2711.705	5116.1451	1502.4609	0
68	6830	258.9079	526.5981	2744.4834	5186.9025	1526.1929	0
69	6830	262.76935	525.6615	2778.222	5265.0732	1553.9571	0
70	6830	265.25625	525.06725	2799.3442	5318.8939	1574.3894	0
71	6830	267.9148	524.4474	2821.0718	5391.2633	1606.0339	0
72	6830	272.1196	523.4831	2854.0108	5504.3624	1656.1235	0
73	6830	274.9608	522.8431	2875.6299	5579.886	1689.8068	0
74	6830	276.91365	522.4125	2889.9602	5619.7358	1705.7531	0
75	6830	280.08135	521.72615	2912.5237	5690.4308	1735.829	0
76	6830	283.98865	520.8971	2939.3537	5789.5298	1780.9877	0
77	6830	287.89595	520.08975	2964.8952	5886.9082	1825.8763	0
78	6830	291.3623	519.3905	2986.3298	5972.1408	1865.7418	0
79	6830	294.9156	518.6937	3006.9621	6058.1832	1906.6145	0
80	6830	298.99685	517.91375	3029.4012	6155.3598	1953.3158	0
81	6830	302.97475	517.17565	3050.0825	6241.0786	1993.9557	0
82	6830	306.8492	516.4783	3068.7133	6315.3229	2028.7069	0
83	6830	310.72365	515.8019	3086.0146	6387.7349	2063.1438	0
84	6830	314.59815	515.1463	3101.9822	6457.7954	2096.9448	0
85	6830	318.4726	514.51145	3116.6119	6526.0034	2130.4242	0
86	6830	322.34705	513.89735	3129.8996	6592.0945	2163.4195	0
87	6830	326.2215	513.304	3141.8418	6655.8042	2195.7674	0
88	6830	330.3091	512.70095	3153.0584	6679.8263	2203.7691	0
89	6830	334.60985	512.09055	3163.2429	6662.9618	2186.8671	0
90	6830	338.91055	511.50545	3171.95	6642.8405	2168.8531	0
91	6830	343.05015	510.96565	3178.7706	6676.1913	2185.431	0
92	6830	347.02865	510.4693	3183.8791	6763.4663	2236.7744	0
93	6830	351.0071	509.99445	3187.6512	6848.4071	2287.4941	0
94	6830	354.98555	509.5411	3190.0851	6931.0032	2337.5851	0
95	6830	358.96405	509.10915	3190.928	7010.9933	2387.0417	0
96	6830	362.94255	508.6986	3190.6782	7088.3674	2435.5465	0
97	6830	367.38985	508.2664	3188.743	7166.47	2485.5597	0
98	6830	372.0398	507.84065	3184.8306	7244.9443	2537.0406	0
99	6830	376.4236	507.4667	3179.5996	7320.3996	2587.459	0

100	6830	380.54095	507.13825	3173.0102	7388.1556	2633.9152	0
101	6830	384.39185	506.8523	3165.6725	7448.7327	2676.353	0
102	6830	388.2428	506.58625	3157.2077	7506.5625	2717.7785	0
103	6830	392.2832	506.32895	3146.6977	7502.0482	2721.5251	0
104	6830	396.51305	506.0824	3134.5121	7434.6406	2687.0185	0
105	6830	400.6133	505.86585	3121.1341	7367.6675	2653.5286	0
106	6830	404.58385	505.67785	3106.8192	7301.5786	2621.1766	0
107	6830	406.86925	505.5766	3098.3504	7272.2534	2608.1441	0
108	6830	408.9759	505.49395	3089.8855	7242.6451	2594.9322	0
109	6830	412.58885	505.36235	3074.3824	7172.268	2560.6431	0
110	6830	416.2018	505.2481	3058.2495	7098.3813	2524.5546	0
111	6830	419.81475	505.1512	3040.6583	7021.5439	2487.5334	0
112	6830	423.4277	505.0717	3022.4389	6941.4811	2448.8894	0
113	6830	427.04065	505.00955	3003.0387	6858.1977	2408.9707	0
114	6830	430.6536	504.96475	2982.4598	6771.4236	2367.6074	0
115	6830	434.07435	504.9379	2962.2673	6687.7119	2327.9161	0
116	6830	437.3029	504.92725	2942.3626	6606.9662	2289.8985	0
117	6830	440.53145	504.93045	2921.6596	6523.9288	2250.9476	0
118	6830	443.7411	504.9473	2900.3635	6441.3172	2212.6335	0
119	6830	446.93185	504.9777	2878.4344	6359.8894	2175.4545	0
120	6830	450.12255	505.02165	2855.7345	6275.8471	2137.1235	0
121	6830	453.5851	505.08525	2830.3554	6180.8943	2093.6491	0
122	6830	457.31955	505.17105	2801.925	6074.7191	2045.0687	0
123	6830	461.054	505.2754	2772.6299	5965.2092	1994.945	0
124	6830	464.7884	505.3983	2742.2042	5852.1051	1943.2818	0
125	6830	468.52285	505.5398	2711.1858	5735.4168	1889.7493	0
126	6830	472.2573	505.6999	2679.0431	5615.6917	1835.0217	0
127	6830	475.9917	505.8786	2645.939	5492.4042	1778.6688	0
128	6830	479.72615	506.0759	2611.9569	5365.8333	1720.813	0
129	6830	483.4606	506.2918	2577.1266	5235.7238	1661.276	0
130	6830	487.19505	506.52635	2541.3973	5102.6216	1600.4305	0
131	6830	490.9295	506.77955	2504.8262	4966.0051	1537.9153	0
132	6830	494.6639	507.0514	2467.444	4826.1566	1473.8872	0
133	6830	498.39835	507.34195	2429.36	4683.0875	1408.2853	0
134	6830	502.1328	507.65125	2390.4177	4537.0792	1341.3829	0
135	6830	505.9	507.98235	2350.2854	4411.2243	1287.8176	0

136	6830	509.7	508.33555	2309.0447	4306.1929	1247.9567	0
137	6830	513.5	508.70825	2267.1538	4197.4825	1206.2033	0
138	6830	517.3	509.10045	2224.4344	4085.3701	1162.8417	0
139	6830	521.1	509.5121	2180.8647	3969.869	1117.8939	0
140	6830	524.9	509.9433	2136.554	3850.9938	1071.3009	0
141	6830	528.7	510.39415	2091.2453	3728.7591	1023.2322	0
142	6830	532.5	510.8646	2044.6041	3603.1798	973.90614	0
143	6830	536.3	511.35465	1997.3152	3474.5333	923.06827	0
144	6830	540.1	511.86445	1949.3055	3342.5754	870.61166	0
145	6830	543.9	512.394	1900.5532	3207.322	816.55974	0
146	6830	547.7	512.9433	1851.2728	3069.0524	760.95313	0
147	6830	551.5	513.5124	1801.2859	2927.7823	703.91306	0
148	6830	555.3	514.1014	1750.7813	2783.2721	645.17182	0
149	6830	559.1	514.71035	1698.9059	2635.799	585.43574	0
150	6830	562.9	515.3392	1645.7458	2485.4353	524.69625	0
151	6830	566.7	515.98805	1592.9668	2332.0956	461.85889	0
152	6830	570.5	516.657	1537.957	2176.0091	398.69924	0
153	6830	574.3	517.3461	1482.2269	2017.1433	334.25289	0
154	6830	578.1	518.05535	1426.7914	1855.3899	267.81807	0
155	6830	581.79035	518.7632	1372.5267	1712.7867	212.61809	0
156	6830	585.37105	519.4686	1317.9192	1600.9154	176.83564	0
157	6830	588.95175	520.1921	1262.9998	1486.7013	139.78423	0
158	6830	592.53245	520.9337	1208.1012	1370.1599	101.26551	0
159	6830	596.11315	521.69345	1152.8726	1251.3345	61.525829	0
160	6830	599.6939	522.4715	1097.1827	1130.2687	20.6744	0

Title: Sporn Fly Ash Pond - Seismic Stability Analyses
Comments: Section L-L Downstream (Global - Circular)
Created By: Roger W. Cecil, P.E.
File Name: SECTION L-L DOWNSTREAM SEISMIC_GLOBAL CIRCLE.gsz
Date: 1/19/2010
Horz Seismic Load: 0.06



SLOPE/W Analysis

File Information

Title: Sporn Fly Ash Pond - Seismic Stability Analyses
Comments: Section L-L Downstream (Global-Block)
Created By: Roger W. Cecil, P.E.
Revision Number: 49
Last Edited By: Jeff Gateley
Date: 1/19/2010
Time: 10:13:34 AM
File Name: SECTION L-L DOWNSTREAM SEISMIC_GLOBAL BLOCK.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/19/2010
Last Solved Time: 10:14:37 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Sporn Fly Ash Pond Section L-L Downstream (Global-Block)
Kind: SLOPE/W
Parent: Steady-State Seepage
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Parent Analysis

SlipSurface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Block
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Restrict Block Crossing: Yes
Advanced
Number of Slices: 150
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 20 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Sandy Silty Clay (1)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Road Fill (2)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Gravelly Silty Sand (3)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Gravelly Silty Sand (4)

Model: Mohr-Coulomb
Unit Weight: 105 pcf

Unit Wt. Above Water Table: 100 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Bottom Ash (5)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Silty Sand & Gravel (6)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Unit Wt. Above Water Table: 115 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Silty Sandy Clay (7)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Silty Clay (8)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Fly Ash (9)

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °

Clay Foundation (10)

Model: Mohr-Coulomb
Unit Weight: 125 pcf

Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 39 °
Phi-B: 0 °

Clay Foundation (11)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 37 °
Phi-B: 0 °

Silty Clay Foundation (12)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (-150, 596.07556) ft
Right Coordinate: (620, 522) ft

Slip Surface Block

Left Grid
- Upper Left: (0, 595) ft
- Lower Left: (0, 530) ft
- Lower Right: (150, 530) ft
- X Increments: 10
- Y Increments: 8
- Starting Angle: 135 °
- Ending Angle: 180 °
- Angle Increments: 2

Right Grid
- Upper Left: (200, 560) ft
- Lower Left: (200, 510) ft
- Lower Right: (400, 510) ft
- X Increments: 10
- Y Increments: 8
- Starting Angle: 0 °
- Ending Angle: 45 °
- Angle Increments: 3

Seismic Loads

Horz Seismic Load: 0.06
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Sandy Silty Clay (1)	105,2,3,106	198.64495
Region 2	Sandy Silty Clay (1)	2,5,6,7,8,9,10,11,12,99,13,14,15,16,17,18,19,3	1797.2287
Region 3	Road Fill (2)	11,20,21,22,12	50.839704
Region 4	Road Fill (2)	15,24,25,26,27,17,16	116.203
Region 5	Bottom Ash (5)	17,27,28,29,18	191.73337
Region 6	Silty Sand & Gravel (6)	19,18,29,30,31	391.82116
Region 7	Silty Sand & Gravel (6)	29,28,32,33,34,35,36,102,101,37,38,100,30	923.61928
Region 8	Silty Sandy Clay (7)	39,49,41,40	312.45828
Region 9	Silty Clay (8)	49,50,42,41	623.99905
Region 10	Fly Ash (9)	50,51,52,4,106,3,19,31,39,49	8353.7652
Region 11	Clay Foundation	52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,51	5937.0151

	(10)		
Region 12	Clay Foundation (11)	51,50,42,43,44,45,46,47,48,38,37,76,77,78,79,80,81,82,83,84,85,86,87,88,89,69,70,71,72,73,74,75	4582.5269
Region 13	Silty Sand & Gravel (6)	103,90,91,92,104	107.81573
Region 14	Silty Clay Foundation (12)	53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,89,88,87,86,85,84,83,95,96,107,108,97,98	32386.101
Region 15	Gravelly Silty Sand (3)	12,22,23,99	270.1759
Region 16	Gravelly Silty Sand (4)	23,14,13,99	428.27559
Region 17	Silty Clay (8)	100,38,48,47,46,45,44,43,42,41	583.66388
Region 18	Silty Sandy Clay (7)	100,41,40,39,31,30	875.82886
Region 19	Bottom Ash (5)	103,104,92,93,101,102,36	285.90427
Region 20	Silty Sand & Gravel (6)	101,93,94,79,78,77,76,37	493.02893
Region 21	Fly Ash (9)	1,105,106,4	41.39401

Points

	X (ft)	Y (ft)
Point 1	-150	596.07556
Point 2	-28.73928	596.09012
Point 3	-28.7343	594.10387
Point 4	-150	594.10335
Point 5	10.87106	605.00492
Point 6	12.47008	605.36299
Point 7	21.58957	606.0128
Point 8	27.88941	608.93894
Point 9	34.84064	612.1236
Point 10	39.1222	614.02931
Point 11	50.19567	618.00197
Point 12	57.04232	618.00197
Point 13	43.46173	603.74724
Point 14	118.92142	603.75291
Point 15	123.93504	601.99213
Point 16	127.87795	600.00591
Point 17	163.14756	600.01118
Point 18	149.56535	595.01063
Point 19	147.06988	594.09744
Point 20	57.38569	620.4397
Point 21	72.81546	619.98477
Point 22	80.84007	617.99987
Point 23	99.3055	610.6283
Point 24	139.17652	601.67587
Point 25	173.72543	602.00845
Point 26	176.45339	603.29228
Point 27	189.71063	600.00886
Point 28	199.68996	595.00886
Point 29	167.47087	595.01
Point 30	191.72441	585.79626
Point 31	124.59213	585.79827
Point 32	210.5102	589.59755
Point 33	218.12189	585.75717

Point 34	221.75303	584.00508
Point 35	243.39222	575.85019
Point 36	253.50591	571.98819
Point 37	289.84961	560.28268
Point 38	256.97717	561.34945
Point 39	108.92713	580.01604
Point 40	142.96147	580.0084
Point 41	159.35433	573.84449
Point 42	178.27362	566.74311
Point 43	185.14195	566.8803
Point 44	197.25818	566.77308
Point 45	199.06388	566.49447
Point 46	214.43065	565.09473
Point 47	230.53524	563.39632
Point 48	234.91774	563.19918
Point 49	92.17246	573.83178
Point 50	72.44646	566.50502
Point 51	57.05752	560.85717
Point 52	-150	561.11382
Point 53	-150	533.82575
Point 54	21.33315	533.86583
Point 55	28.78186	534.53132
Point 56	34.71071	535.25795
Point 57	39.46011	535.53175
Point 58	42.85104	535.87926
Point 59	45.71543	536.46899
Point 60	49.77857	537.76077
Point 61	59.1159	541.81514
Point 62	64.62858	544.24532
Point 63	75.01429	546.95559
Point 64	83.26625	548.88905
Point 65	88.53588	549.98847
Point 66	93.23684	550.64559
Point 67	106.0002	551.53018
Point 68	116.47627	552.07357
Point 69	122.52939	552.65487

Point 70	120.68438	552.98343
Point 71	113.2235	552.91166
Point 72	98.93865	553.2756
Point 73	88.31144	553.78513
Point 74	81.74223	554.71319
Point 75	77.73883	555.51387
Point 76	364.93178	560.3689
Point 77	369.84787	558.28744
Point 78	398.62803	558.25568
Point 79	406.56907	560.14614
Point 80	407.16945	560.17165
Point 81	432.46006	554.51883
Point 82	442.14574	552.40143
Point 83	451.7179	550.43805
Point 84	378.61552	549.7332
Point 85	292.87496	549.02254
Point 86	215.96602	549.23217
Point 87	183.76122	549.91347
Point 88	163.4328	550.32461
Point 89	134.5598	552.09884
Point 90	274.22203	571.1344
Point 91	301.03752	569.99889
Point 92	328.15873	568.01175
Point 93	341.0609	563.99026
Point 94	390.16826	564.00289
Point 95	504	540
Point 96	580	523.86886
Point 97	580	500.03246
Point 98	-150	499.99472
Point 99	49.98781	610.59727
Point 100	223.72901	573.80581
Point 101	278.12773	564.05804
Point 102	265.81244	568.02452
Point 103	264.70006	571.52684
Point 104	275.69963	568.00897
Point 105	-129.04534	596.07808

Point 106	-129.00866	594.10293
Point 107	620	522
Point 108	620	500

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	9773	1.71	(-43, 664)	237.306	(48.7623, 617.488)	(609.298, 522.5)

Slices of Slip Surface: 9773

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	9773	49.47897	616.771	-1242.7885	90.753699	61.214143	0
2	9773	51.47367	614.7763	-1124.5377	335.54373	226.32711	0
3	9773	54.20042	612.04955	-956.3458	631.16187	425.72406	0
4	9773	56.345745	609.90425	-821.68697	852.85108	532.9205	0
5	9773	57.214005	609.036	-767.63005	934.55808	583.9767	0
6	9773	59.94351	606.3065	-598.59506	1136.4128	710.10953	0
7	9773	64.10941	602.1406	-352.12831	1434.039	967.27155	0
8	9773	67.325575	598.9244	-188.92599	1714.295	1156.3066	0
9	9773	70.54174	595.70825	-9.2530421	1992.4183	1343.9031	0
10	9773	72.48264	593.76735	98.869993	2326.3215	1134.9433	0
11	9773	74.82161	591.42835	235.00878	2494.2477	1151.1397	0
12	9773	78.833915	587.41605	473.1193	2769.7023	1170.1675	0
13	9773	82.75872	583.49125	715.14139	3012.2952	1170.4583	0
14	9773	86.59602	579.65395	963.41113	3222.9181	1151.2763	0
15	9773	90.433315	575.81665	1221.7421	3432.804	1126.5923	0
16	9773	94.1069	572.1431	1439.6691	3543.1159	1365.9943	0
17	9773	97.58367	568.66635	1613.2606	3783.9253	1409.6462	0
18	9773	99.4946	566.7554	1709.7625	3916.9282	1433.3502	0
19	9773	101.99455	564.25545	1834.2768	4011.2661	1640.4791	0
20	9773	106.61625	559.63375	2070.1976	4336.5369	1707.8092	0
21	9773	111.13215	555.11785	2312.3867	4653.6342	1764.2565	0
22	9773	113.8135	552.4365	2457.5202	4794.7885	1892.6825	0

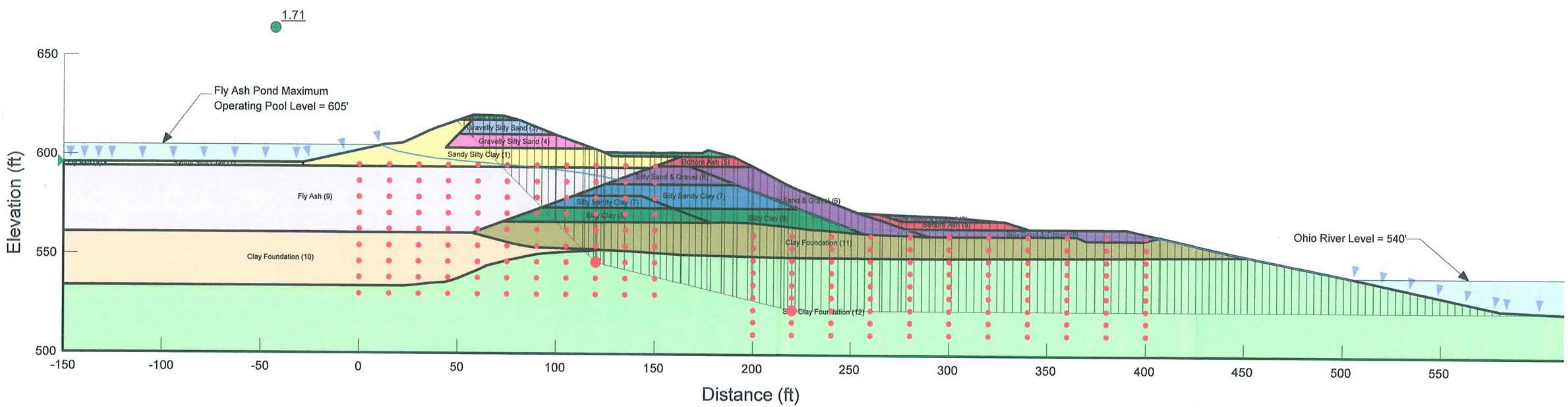
23	9773	115.38305	550.86695	2528.3628	5062.6116	1583.5744	0
24	9773	117.69885	548.55115	2623.4223	5224.7507	1625.4904	0
25	9773	119.4607	546.7893	2696.0511	5344.1786	1654.7337	0
26	9773	120.3422	546.16875	2720.7194	6497.7114	2360.1265	0
27	9773	121.6069	545.8684	2725.4208	6488.3188	2351.3196	0
28	9773	123.2322	545.48235	2731.6145	6475.9993	2339.7513	0
29	9773	124.26355	545.2374	2735.6945	6478.6921	2338.8844	0
30	9773	126.23505	544.7692	2743.4703	6522.5264	2361.4163	0
31	9773	129.54845	543.98225	2756.6378	6606.2739	2405.5196	0
32	9773	132.88935	543.18875	2770.1212	6702.667	2457.3274	0
33	9773	136.86815	542.2438	2787.0621	6817.291	2518.3665	0
34	9773	141.069	541.24615	2805.7445	6944.8282	2586.3865	0
35	9773	145.0157	540.3088	2824.5022	7071.7938	2654.0023	0
36	9773	148.31765	539.52455	2840.7122	7169.9121	2705.1844	0
37	9773	151.19685	538.84075	2855.1851	7226.222	2731.327	0
38	9773	154.4598	538.0658	2871.9723	7276.0169	2751.9525	0
39	9773	157.7228	537.2908	2889.2067	7326.11	2772.4849	0
40	9773	161.25095	536.4529	2908.1168	7380.071	2794.3871	0
41	9773	163.2902	535.9686	2919.5601	7413.3374	2808.0237	0
42	9773	165.45185	535.4552	2931.7699	7476.6396	2839.9498	0
43	9773	169.0345	534.6043	2952.2109	7581.8172	2892.8991	0
44	9773	172.16175	533.86155	2970.6599	7673.5955	2938.7203	0
45	9773	175.0894	533.16625	2988.2925	7827.1172	3023.6333	0
46	9773	177.3635	532.62615	3002.199	7936.4485	3083.2613	0
47	9773	181.0174	531.75835	3024.8691	7943.628	3073.5816	0
48	9773	184.4516	530.94275	3046.6403	7950.6066	3064.3382	0
49	9773	187.4263	530.23625	3065.9548	7956.7457	3056.1054	0
50	9773	190.7175	529.4546	3087.599	7948.1263	3037.1946	0
51	9773	194.4913	528.55835	3112.8581	7888.6031	2984.2167	0
52	9773	198.16105	527.68675	3137.8911	7827.8899	2930.6365	0
53	9773	199.37695	527.39795	3146.255	7808.1391	2913.0685	0
54	9773	201.49335	526.8953	3160.9844	7748.7009	2866.7234	0
55	9773	205.1001	526.0387	3186.3414	7639.7201	2782.7799	0
56	9773	208.70685	525.1821	3212.2378	7531.009	2698.6677	0
57	9773	212.47045	524.28825	3239.6063	7416.5492	2610.0436	0
58	9773	215.19835	523.6404	3259.5981	7332.9709	2545.3258	0

59	9773	217.04395	523.2021	3273.2086	7277.1565	2501.9444	0
60	9773	219.06095	522.72305	3288.2086	7217.8546	2455.5153	0
61	9773	220.8765	522.5	3288.5347	7953.0869	2914.7357	0
62	9773	222.741	522.5	3274.4765	7853.3184	2861.178	0
63	9773	225.43055	522.5	3254.0775	7725.8629	2794.2817	0
64	9773	228.83365	522.5	3228.5127	7564.2463	2709.267	0
65	9773	232.72645	522.5	3199.5436	7377.7524	2610.8346	0
66	9773	237.03635	522.5	3167.628	7169.9975	2500.958	0
67	9773	241.2736	522.5	3136.4756	6965.3831	2392.5669	0
68	9773	245.07785	522.5	3108.6577	6779.7213	2293.9352	0
69	9773	248.4491	522.5	3084.0376	6613.3132	2205.3362	0
70	9773	251.8203	522.5	3059.7141	6446.3119	2116.1812	0
71	9773	255.24155	522.5	3035.2091	6337.4682	2063.4805	0
72	9773	258.9079	522.5	3009.2362	6291.4272	2050.9406	0
73	9773	262.76935	522.5	2982.0443	6248.6971	2041.2312	0
74	9773	265.25625	522.5	2964.6344	6226.1098	2037.996	0
75	9773	267.9148	522.5	2946.1603	6220.5173	2046.0453	0
76	9773	272.1196	522.5	2917.1458	6211.7178	2058.6771	0
77	9773	274.9608	522.5	2897.6719	6205.4683	2066.9406	0
78	9773	276.91365	522.5	2884.3128	6187.9659	2064.3515	0
79	9773	280.08135	522.5	2862.8516	6167.6972	2065.0967	0
80	9773	283.98865	522.5	2836.4906	6157.9718	2075.4918	0
81	9773	287.89595	522.5	2810.3856	6147.9904	2085.567	0
82	9773	291.3623	522.5	2787.4461	6139.1244	2094.3611	0
83	9773	294.9156	522.5	2764.0838	6130.1846	2103.3732	0
84	9773	298.99685	522.5	2737.3765	6119.8938	2113.6314	0
85	9773	302.97475	522.5	2711.3463	6101.2389	2118.24	0
86	9773	306.8492	522.5	2686.3105	6074.6546	2117.2723	0
87	9773	310.72365	522.5	2661.5329	6047.8121	2115.9821	0
88	9773	314.59815	522.5	2636.7552	6020.4534	2114.3693	0
89	9773	318.4726	522.5	2611.9776	5992.8367	2112.5952	0
90	9773	322.34705	522.5	2587.458	5964.7037	2110.3373	0
91	9773	326.2215	522.5	2562.9643	5936.0546	2107.7407	0
92	9773	330.3091	522.5	2537.2478	5860.1775	2076.3969	0
93	9773	334.60985	522.5	2510.0431	5736.4773	2016.0999	0
94	9773	338.91055	522.5	2483.0709	5612.3122	1955.367	0

95	9773	343.05015	522.5	2456.9434	5553.8799	1935.1807	0
96	9773	347.02865	522.5	2431.8835	5561.1691	1955.3946	0
97	9773	351.0071	522.5	2406.7986	5567.9556	1975.3101	0
98	9773	354.98555	522.5	2381.6633	5574.2394	1994.9429	0
99	9773	358.96405	522.5	2356.4527	5580.2719	2014.4658	0
100	9773	362.94255	522.5	2331.1415	5585.8016	2033.7373	0
101	9773	367.38985	522.5	2302.643	5585.5365	2051.3795	0
102	9773	372.0398	522.5	2272.8553	5585.077	2069.7058	0
103	9773	376.4236	522.5	2244.5239	5589.4111	2090.1175	0
104	9773	380.54095	522.5	2217.7598	5592.6997	2108.8965	0
105	9773	384.39185	522.5	2192.5969	5595.5562	2126.4049	0
106	9773	388.2428	522.5	2167.2003	5597.8933	2143.7349	0
107	9773	392.2832	522.5	2140.4128	5534.6658	2120.9647	0
108	9773	396.51305	522.5	2112.1851	5405.8207	2058.092	0
109	9773	400.6133	522.5	2084.6136	5283.4389	1998.8479	0
110	9773	404.58385	522.5	2057.7154	5167.3332	1943.1049	0
111	9773	406.86925	522.5	2042.2066	5111.0963	1917.6551	0
112	9773	408.9759	522.5	2027.7646	5058.2018	1893.6273	0
113	9773	412.58885	522.5	2002.9095	4948.5959	1840.6692	0
114	9773	416.2018	522.5	1977.9161	4839.2668	1787.9704	0
115	9773	419.81475	522.5	1952.8396	4729.6609	1735.1506	0
116	9773	423.4277	522.5	1927.5693	4620.055	1682.4518	0
117	9773	427.04065	522.5	1902.133	4510.4491	1629.8568	0
118	9773	430.6536	522.5	1876.5583	4400.8432	1577.3483	0
119	9773	434.07435	522.5	1852.4358	4298.2011	1528.2838	0
120	9773	437.3029	522.5	1829.4844	4202.4928	1482.8202	0
121	9773	440.53145	522.5	1806.5329	4106.4747	1437.1631	0
122	9773	443.7411	522.5	1783.6413	4014.4544	1393.9667	0
123	9773	446.93185	522.5	1760.8565	3925.7597	1352.7817	0
124	9773	450.12255	522.5	1738.0717	3837.065	1311.5966	0
125	9773	453.5851	522.5	1713.4314	3740.0561	1266.3756	0
126	9773	457.31955	522.5	1686.8678	3635.0871	1217.3825	0
127	9773	461.054	522.5	1660.3578	3530.1181	1168.3559	0
128	9773	464.7884	522.5	1634.062	3425.4169	1119.3627	0
129	9773	468.52285	522.5	1608.1143	3320.7156	1070.1521	0
130	9773	472.2573	522.5	1581.9256	3216.2822	1021.2593	0

131	9773	475.9917	522.5	1556.1654	3111.8488	972.09886	0
132	9773	479.72615	522.5	1530.9407	3007.6831	922.77107	0
133	9773	483.4606	522.5	1506.1444	2903.7852	873.34288	0
134	9773	487.19505	522.5	1481.8034	2799.8873	823.63024	0
135	9773	490.9295	522.5	1458.1318	2696.525	773.83393	0
136	9773	494.6639	522.5	1434.2996	2593.1091	724.10456	0
137	9773	498.39835	522.5	1411.5384	2490.0413	673.9234	0
138	9773	502.1328	522.5	1389.4735	2387.2413	623.47452	0
139	9773	505.9	522.5	1367.8947	2308.0789	587.4923	0
140	9773	509.7	522.5	1347.2105	2252.3158	565.57254	0
141	9773	513.5	522.5	1327.5	2196.3421	542.9128	0
142	9773	517.3	522.5	1308.2105	2140.2368	519.90774	0
143	9773	521.1	522.5	1289.3421	2084	496.55736	0
144	9773	524.9	522.5	1271.7368	2027.5526	472.28612	0
145	9773	528.7	522.5	1255.3421	1970.9737	447.17624	0
146	9773	532.5	522.5	1239.7895	1914.2632	421.45793	0
147	9773	536.3	522.5	1225.1842	1857.4211	395.06543	0
148	9773	540.1	522.5	1211.7632	1800.4474	367.85072	0
149	9773	543.9	522.5	1197.7895	1743.4474	340.9649	0
150	9773	547.7	522.5	1185.0789	1686.3158	313.20754	0
151	9773	551.5	522.5	1173.2895	1629.1316	284.84176	0
152	9773	555.3	522.5	1162.3421	1571.8421	255.884	0
153	9773	559.1	522.5	1152.3684	1514.5	226.28493	0
154	9773	562.9	522.5	1143.2895	1457.1053	196.09387	0
155	9773	566.7	522.5	1133.7895	1399.7105	166.16592	0
156	9773	570.5	522.5	1124.9474	1342.2632	135.79398	0
157	9773	574.3	522.5	1117	1284.8158	104.86294	0
158	9773	578.1	522.5	1109.6053	1227.3421	73.570144	0
159	9773	581.83115	522.5	1104.4741	1184.3149	49.890096	0
160	9773	585.49345	522.5	1101.8528	1171.9183	43.781801	0
161	9773	589.15575	522.5	1099.7776	1159.5217	37.33226	0
162	9773	592.818	522.5	1098.0027	1147.1797	30.729159	0
163	9773	596.48025	522.5	1096.419	1134.8649	24.023685	0
164	9773	600.14255	522.5	1095.0264	1122.5502	17.198774	0
165	9773	603.80485	522.5	1093.7704	1110.3174	10.339739	0
166	9773	607.46715	522.5	1092.569	1098.0846	3.4465798	0

Title: Sporn Fly Ash Pond - Seismic Stability Analyses
Comments: Section L-L Downstream (Global-Block)
Created By: Roger W. Cecil, P.E.
File Name: SECTION L-L DOWNSTREAM SEISMIC_GLOBAL BLOCK.gsz
Date: 1/19/2010
Horz Seismic Load: 0.06



SLOPE/W Analysis

File Information

Title: Sporn Fly Ash Pond - Seismic Stability Analyses
Comments: Section L-L Downstream (Upper Dike - Circular)
Created By: Roger W. Cecil, P.E.
Revision Number: 35
Last Edited By: Jeff Gateley
Date: 1/19/2010
Time: 10:13:51 AM
File Name: SECTION L-L DOWNSTREAM SEISMIC_UPPER DIKE CIRCLE.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/19/2010
Last Solved Time: 10:14:10 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Sporn Fly Ash Pond Section L-L Downstream (Upper Dike-Circle)
Kind: SLOPE/W
Parent: Steady-State Seepage
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Parent Analysis

SlipSurface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 50
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 20 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Sandy Silty Clay (1)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Road Fill (2)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Gravelly Silty Sand (3)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Gravelly Silty Sand (4)
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Unit Wt. Above Water Table: 100 pcf

Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Bottom Ash (5)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Silty Sand & Gravel (6)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Unit Wt. Above Water Table: 115 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Silty Sandy Clay (7)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Silty Clay (8)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Fly Ash (9)

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °

Clay Foundation (10)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf

Cohesion: 0 psf
Phi: 39 °
Phi-B: 0 °

Clay Foundation (11)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 37 °
Phi-B: 0 °

Silty Clay Foundation (12)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (41.82792, 615) ft
Left-Zone Right Coordinate: (73, 619.93912) ft
Left-Zone Increment: 15
Right Projection: Range
Right-Zone Left Coordinate: (124, 601.99078) ft
Right-Zone Right Coordinate: (189.72831, 600) ft
Right-Zone Increment: 20
Radius Increments: 20

Slip Surface Limits

Left Coordinate: (-150, 596.07556) ft
Right Coordinate: (620, 522) ft

Seismic Loads

Horz Seismic Load: 0.06
Ignore seismic load in strength: No

Regions

	Materia	Points	Area (ft^2)

	I		
Regi on 1	Sandy Silty Clay (1)	105,2,3,106	198.6449 5
Regi on 2	Sandy Silty Clay (1)	2,5,6,7,8,9,10,11,12,99,13,14,15,16,17,18,19,3	1797.228 7
Regi on 3	Road Fill (2)	11,20,21,22,12	50.83970 4
Regi on 4	Road Fill (2)	15,24,25,26,27,17,16	116.203
Regi on 5	Bottom Ash (5)	17,27,28,29,18	191.7333 7
Regi on 6	Silty Sand & Gravel (6)	19,18,29,30,31	391.8211 6
Regi on 7	Silty Sand & Gravel (6)	29,28,32,33,34,35,36,102,101,37,38,100,30	923.6192 8
Regi on 8	Silty Sandy Clay (7)	39,49,41,40	312.4582 8
Regi on 9	Silty Clay (8)	49,50,42,41	623.9990 5
Regi on 10	Fly Ash (9)	50,51,52,4,106,3,19,31,39,49	8353.765 2
Regi on 11	Clay Founda tion (10)	52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73, 74,75,51	5937.015 1
Regi on 12	Clay Founda tion (11)	51,50,42,43,44,45,46,47,48,38,37,76,77,78,79,80,81,82,83,84,85,86, 87,88,89,69,70,71,72,73,74,75	4582.526 9
Regi on	Silty Sand &	103,90,91,92,104	107.8157 3

13	Gravel (6)		
Region 14	Silty Clay Foundation (12)	53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,89,88,87,86,85,84,83,95,96,107,108,97,98	32386.101
Region 15	Gravelly Silty Sand (3)	12,22,23,99	270.1759
Region 16	Gravelly Silty Sand (4)	23,14,13,99	428.27559
Region 17	Silty Clay (8)	100,38,48,47,46,45,44,43,42,41	583.66388
Region 18	Silty Sandy Clay (7)	100,41,40,39,31,30	875.82886
Region 19	Bottom Ash (5)	103,104,92,93,101,102,36	285.90427
Region 20	Silty Sand & Gravel (6)	101,93,94,79,78,77,76,37	493.02893
Region 21	Fly Ash (9)	1,105,106,4	41.39401

Points

	X (ft)	Y (ft)
Point 1	-150	596.07556
Point 2	-28.73928	596.09012
Point 3	-28.7343	594.10387
Point 4	-150	594.10335

Point 5	10.87106	605.00492
Point 6	12.47008	605.36299
Point 7	21.58957	606.0128
Point 8	27.88941	608.93894
Point 9	34.84064	612.1236
Point 10	39.1222	614.02931
Point 11	50.19567	618.00197
Point 12	57.04232	618.00197
Point 13	43.46173	603.74724
Point 14	118.92142	603.75291
Point 15	123.93504	601.99213
Point 16	127.87795	600.00591
Point 17	163.14756	600.01118
Point 18	149.56535	595.01063
Point 19	147.06988	594.09744
Point 20	57.38569	620.4397
Point 21	72.81546	619.98477
Point 22	80.84007	617.99987
Point 23	99.3055	610.6283
Point 24	139.17652	601.67587
Point 25	173.72543	602.00845
Point 26	176.45339	603.29228
Point 27	189.71063	600.00886
Point 28	199.68996	595.00886
Point 29	167.47087	595.01
Point 30	191.72441	585.79626
Point 31	124.59213	585.79827
Point 32	210.5102	589.59755
Point 33	218.12189	585.75717
Point 34	221.75303	584.00508
Point 35	243.39222	575.85019
Point 36	253.50591	571.98819
Point 37	289.84961	560.28268
Point 38	256.97717	561.34945
Point 39	108.92713	580.01604
Point 40	142.96147	580.0084

Point 41	159.35433	573.84449
Point 42	178.27362	566.74311
Point 43	185.14195	566.8803
Point 44	197.25818	566.77308
Point 45	199.06388	566.49447
Point 46	214.43065	565.09473
Point 47	230.53524	563.39632
Point 48	234.91774	563.19918
Point 49	92.17246	573.83178
Point 50	72.44646	566.50502
Point 51	57.05752	560.85717
Point 52	-150	561.11382
Point 53	-150	533.82575
Point 54	21.33315	533.86583
Point 55	28.78186	534.53132
Point 56	34.71071	535.25795
Point 57	39.46011	535.53175
Point 58	42.85104	535.87926
Point 59	45.71543	536.46899
Point 60	49.77857	537.76077
Point 61	59.1159	541.81514
Point 62	64.62858	544.24532
Point 63	75.01429	546.95559
Point 64	83.26625	548.88905
Point 65	88.53588	549.98847
Point 66	93.23684	550.64559
Point 67	106.0002	551.53018
Point 68	116.47627	552.07357
Point 69	122.52939	552.65487
Point 70	120.68438	552.98343
Point 71	113.2235	552.91166
Point 72	98.93865	553.2756
Point 73	88.31144	553.78513
Point 74	81.74223	554.71319
Point 75	77.73883	555.51387
Point 76	364.93178	560.3689

Point 77	369.84787	558.28744
Point 78	398.62803	558.25568
Point 79	406.56907	560.14614
Point 80	407.16945	560.17165
Point 81	432.46006	554.51883
Point 82	442.14574	552.40143
Point 83	451.7179	550.43805
Point 84	378.61552	549.7332
Point 85	292.87496	549.02254
Point 86	215.96602	549.23217
Point 87	183.76122	549.91347
Point 88	163.4328	550.32461
Point 89	134.5598	552.09884
Point 90	274.22203	571.1344
Point 91	301.03752	569.99889
Point 92	328.15873	568.01175
Point 93	341.0609	563.99026
Point 94	390.16826	564.00289
Point 95	504	540
Point 96	580	523.86886
Point 97	580	500.03246
Point 98	-150	499.99472
Point 99	49.98781	610.59727
Point 100	223.72901	573.80581
Point 101	278.12773	564.05804
Point 102	265.81244	568.02452
Point 103	264.70006	571.52684
Point 104	275.69963	568.00897
Point 105	-129.04534	596.07808
Point 106	-129.00866	594.10293
Point 107	620	522
Point 108	620	500

Critical Slip Surfaces

	Slip	FOS	Center (ft)	Radius	Entry (ft)	Exit (ft)

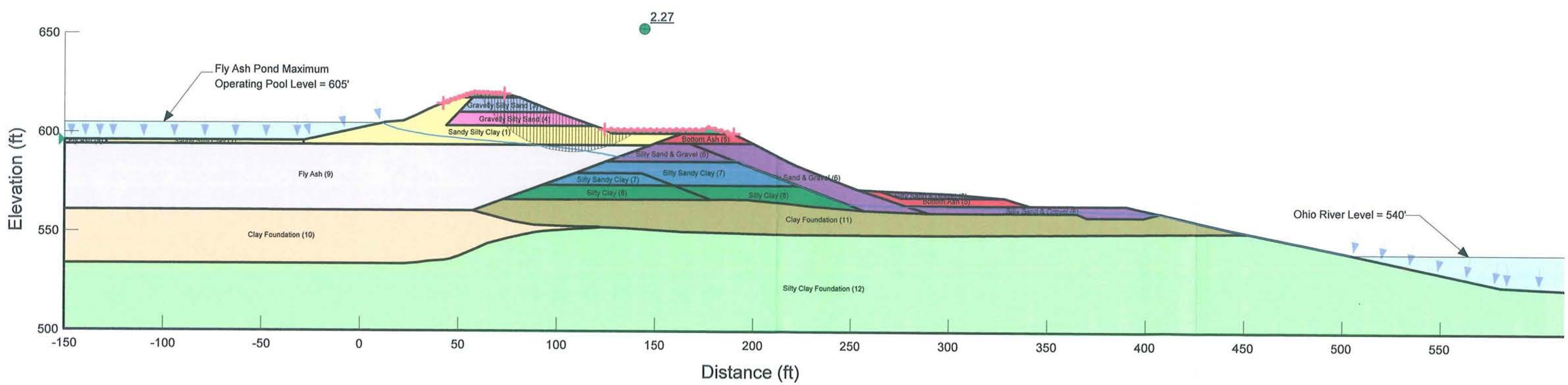
	Surface			(ft)		
1	4087	2.27	(108.154, 644.496)	53.715	(60.1676, 620.358)	(140.602, 601.69)

Slices of Slip Surface: 4087

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	4087	60.797425	619.17965	-1407.0347	83.150955	58.222926	0
2	4087	62.26895	616.61625	-1247.0975	273.03141	184.16201	0
3	4087	63.95243	614.0105	-1084.3406	470.6049	317.42701	0
4	4087	65.63591	611.69885	-940.32707	649.97143	438.41126	0
5	4087	67.269875	609.6774	-815.2761	817.28125	510.69401	0
6	4087	68.854325	607.89655	-705.59027	949.47571	593.29827	0
7	4087	70.43878	606.2644	-605.30523	1073.5272	670.81422	0
8	4087	72.023235	604.7625	-513.31716	1191.0004	744.21965	0
9	4087	72.98437	603.8958	-460.28879	1257.4932	785.76898	0
10	4087	73.92196	603.11365	-420.60138	1301.9462	878.17377	0
11	4087	75.45932	601.88795	-362.55162	1401.0268	945.00453	0
12	4087	76.996675	600.75065	-310.34264	1495.4197	1008.6733	0
13	4087	78.53403	599.695	-263.96537	1585.9192	1069.716	0
14	4087	80.07139	598.71525	-221.41997	1673.0421	1128.4811	0
15	4087	81.71267	597.75015	-173.10386	1750.4896	1180.7202	0
16	4087	83.457875	596.80475	-128.01569	1817.8848	1226.1788	0
17	4087	85.20308	595.94045	-88.767022	1881.5397	1269.1145	0
18	4087	86.948285	595.153	-54.613251	1941.4711	1309.5388	0
19	4087	88.69349	594.43875	-25.335871	1997.7634	1347.5084	0
20	4087	90.37771	593.81485	1.4799007	2050.712	1044.1359	0
21	4087	92.000945	593.27425	26.43076	2079.6319	1046.1582	0
22	4087	93.62418	592.79025	47.557565	2105.1489	1048.3952	0
23	4087	95.247415	592.3613	65.002903	2126.8567	1050.567	0
24	4087	96.87065	591.986	78.829887	2144.5126	1052.5179	0
25	4087	98.493885	591.6632	88.743824	2157.5706	1054.1199	0
26	4087	100.12285	591.3912	95.430444	2172.8164	1058.481	0
27	4087	101.7575	591.16955	98.841334	2190.0222	1065.5099	0
28	4087	103.39215	590.99875	96.915403	2201.4207	1072.299	0

29	4087	105.0268	590.87835	91.64322	2206.1917	1077.4163	0
30	4087	106.66145	590.808	83.09836	2203.5833	1080.4411	0
31	4087	108.29615	590.78745	71.048153	2192.8639	1081.1191	0
32	4087	109.9308	590.81665	55.867852	2173.2059	1078.8376	0
33	4087	111.56545	590.89575	37.608183	2143.6316	1073.0725	0
34	4087	113.2001	591.0249	15.373428	2103.6296	1064.0197	0
35	4087	114.83475	591.2045	-10.190257	2051.3446	1045.2123	0
36	4087	116.46945	591.4351	-38.638038	1985.1168	1011.4675	0
37	4087	118.1041	591.71725	-67.840648	1905.7902	971.04859	0
38	4087	119.757	592.0562	-98.216377	1803.4282	918.89256	0
39	4087	121.4282	592.45425	-131.95796	1677.0877	854.51887	0
40	4087	123.0994	592.9095	-167.95484	1536.4394	782.85495	0
41	4087	124.63565	593.3775	-202.92019	1424.8426	725.99355	0
42	4087	126.03695	593.8508	-237.34573	1345.4369	685.53436	0
43	4087	127.3078	594.31585	-269.81215	1322.8447	892.27004	0
44	4087	128.7427	594.8924	-309.91259	1211.2502	816.99861	0
45	4087	130.47215	595.6464	-360.37765	1069.6205	721.46815	0
46	4087	132.20165	596.4745	-413.53531	912.52197	615.50384	0
47	4087	133.9311	597.3806	-468.58887	740.95041	499.77736	0
48	4087	135.66055	598.3694	-527.85268	555.81214	374.90002	0
49	4087	137.39005	599.4463	-591.92548	358.06545	241.51819	0
50	4087	138.71565	600.32635	-647.67482	207.85938	145.54471	0
51	4087	139.88945	601.1674	-707.36435	78.36909	54.874628	0

Title: Sporn Fly Ash Pond - Seismic Stability Analyses
Comments: Section L-L Downstream (Upper Dike - Circular)
Created By: Roger W. Cecil, P.E.
File Name: SECTION L-L DOWNSTREAM SEISMIC_UPPER DIKE CIRCLE.gsz
Date: 1/19/2010
Horz Seismic Load: 0.06



SPP00003530

SLOPE/W Analysis

File Information

Title: Sporn Fly Ash Pond - Seismic Stability Analyses
Comments: Section L-L Downstream (Upper Dike-Block)
Created By: Roger W. Cecil, P.E.
Revision Number: 59
Last Edited By: Jeff Gateley
Date: 1/19/2010
Time: 10:14:04 AM
File Name: SECTION L-L DOWNSTREAM SEISMIC_UPPER DIKE BLOCK.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/19/2010
Last Solved Time: 10:14:16 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Sporn Fly Ash Pond Section L-L Downstream (Upper Dike-Block)
Kind: SLOPE/W
Parent: Steady-State Seepage
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Parent Analysis

SlipSurface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Block
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Restrict Block Crossing: Yes
Advanced
Number of Slices: 50
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 20 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Sandy Silty Clay (1)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Road Fill (2)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Gravelly Silty Sand (3)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Gravelly Silty Sand (4)
Model: Mohr-Coulomb
Unit Weight: 105 pcf

Unit Wt. Above Water Table: 100 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Bottom Ash (5)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Silty Sand & Gravel (6)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Unit Wt. Above Water Table: 115 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Silty Sandy Clay (7)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Silty Clay (8)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Fly Ash (9)

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °

Clay Foundation (10)

Model: Mohr-Coulomb
Unit Weight: 125 pcf

Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 39 °
Phi-B: 0 °

Clay Foundation (11)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 37 °
Phi-B: 0 °

Silty Clay Foundation (12)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (-150, 596.07556) ft
Right Coordinate: (620, 522) ft

Slip Surface Block

Left Grid
- Upper Left: (56, 599) ft
- Lower Left: (56, 588) ft
- Lower Right: (119, 588) ft
- X Increments: 5
- Y Increments: 4
- Starting Angle: 115 °
- Ending Angle: 135 °
- Angle Increments: 3

Right Grid
- Upper Left: (125, 600) ft
- Lower Left: (125, 587) ft
- Lower Right: (190, 587) ft
- X Increments: 5
- Y Increments: 5
- Starting Angle: 0 °
- Ending Angle: 45 °
- Angle Increments: 3

Seismic Loads

Horz Seismic Load: 0.06
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Sandy Silty Clay (1)	105,2,3,106	198.64495
Region 2	Sandy Silty Clay (1)	2,5,6,7,8,9,10,11,12,99,13,14,15,16,17,18,19,3	1797.2287
Region 3	Road Fill (2)	11,20,21,22,12	50.839704
Region 4	Road Fill (2)	15,24,25,26,27,17,16	116.203
Region 5	Bottom Ash (5)	17,27,28,29,18	191.73337
Region 6	Silty Sand & Gravel (6)	19,18,29,30,31	391.82116
Region 7	Silty Sand & Gravel (6)	29,28,32,33,34,35,36,102,101,37,38,100,30	923.61928
Region 8	Silty Sandy Clay (7)	39,49,41,40	312.45828
Region 9	Silty Clay (8)	49,50,42,41	623.99905
Region 10	Fly Ash (9)	50,51,52,4,106,3,19,31,39,49	8353.7652
Region 11	Clay Foundation	52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,51	5937.0151

	(10)		
Region 12	Clay Foundation (11)	51,50,42,43,44,45,46,47,48,38,37,76,77,78,79,80,81,82,83,84,85,86,87,88,89,69,70,71,72,73,74,75	4582.5269
Region 13	Silty Sand & Gravel (6)	103,90,91,92,104	107.81573
Region 14	Silty Clay Foundation (12)	53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,89,88,87,86,85,84,83,95,96,107,108,97,98	32386.101
Region 15	Gravelly Silty Sand (3)	12,22,23,99	270.1759
Region 16	Gravelly Silty Sand (4)	23,14,13,99	428.27559
Region 17	Silty Clay (8)	100,38,48,47,46,45,44,43,42,41	583.66388
Region 18	Silty Sandy Clay (7)	100,41,40,39,31,30	875.82886
Region 19	Bottom Ash (5)	103,104,92,93,101,102,36	285.90427
Region 20	Silty Sand & Gravel (6)	101,93,94,79,78,77,76,37	493.02893
Region 21	Fly Ash (9)	1,105,106,4	41.39401

Points

	X (ft)	Y (ft)
Point 1	-150	596.07556
Point 2	-28.73928	596.09012
Point 3	-28.7343	594.10387
Point 4	-150	594.10335
Point 5	10.87106	605.00492
Point 6	12.47008	605.36299
Point 7	21.58957	606.0128
Point 8	27.88941	608.93894
Point 9	34.84064	612.1236
Point 10	39.1222	614.02931
Point 11	50.19567	618.00197
Point 12	57.04232	618.00197
Point 13	43.46173	603.74724
Point 14	118.92142	603.75291
Point 15	123.93504	601.99213
Point 16	127.87795	600.00591
Point 17	163.14756	600.01118
Point 18	149.56535	595.01063
Point 19	147.06988	594.09744
Point 20	57.38569	620.4397
Point 21	72.81546	619.98477
Point 22	80.84007	617.99987
Point 23	99.3055	610.6283
Point 24	139.17652	601.67587
Point 25	173.72543	602.00845
Point 26	176.45339	603.29228
Point 27	189.71063	600.00886
Point 28	199.68996	595.00886
Point 29	167.47087	595.01
Point 30	191.72441	585.79626
Point 31	124.59213	585.79827
Point 32	210.5102	589.59755
Point 33	218.12189	585.75717

Point 34	221.75303	584.00508
Point 35	243.39222	575.85019
Point 36	253.50591	571.98819
Point 37	289.84961	560.28268
Point 38	256.97717	561.34945
Point 39	108.92713	580.01604
Point 40	142.96147	580.0084
Point 41	159.35433	573.84449
Point 42	178.27362	566.74311
Point 43	185.14195	566.8803
Point 44	197.25818	566.77308
Point 45	199.06388	566.49447
Point 46	214.43065	565.09473
Point 47	230.53524	563.39632
Point 48	234.91774	563.19918
Point 49	92.17246	573.83178
Point 50	72.44646	566.50502
Point 51	57.05752	560.85717
Point 52	-150	561.11382
Point 53	-150	533.82575
Point 54	21.33315	533.86583
Point 55	28.78186	534.53132
Point 56	34.71071	535.25795
Point 57	39.46011	535.53175
Point 58	42.85104	535.87926
Point 59	45.71543	536.46899
Point 60	49.77857	537.76077
Point 61	59.1159	541.81514
Point 62	64.62858	544.24532
Point 63	75.01429	546.95559
Point 64	83.26625	548.88905
Point 65	88.53588	549.98847
Point 66	93.23684	550.64559
Point 67	106.0002	551.53018
Point 68	116.47627	552.07357
Point 69	122.52939	552.65487

Point 70	120.68438	552.98343
Point 71	113.2235	552.91166
Point 72	98.93865	553.2756
Point 73	88.31144	553.78513
Point 74	81.74223	554.71319
Point 75	77.73883	555.51387
Point 76	364.93178	560.3689
Point 77	369.84787	558.28744
Point 78	398.62803	558.25568
Point 79	406.56907	560.14614
Point 80	407.16945	560.17165
Point 81	432.46006	554.51883
Point 82	442.14574	552.40143
Point 83	451.7179	550.43805
Point 84	378.61552	549.7332
Point 85	292.87496	549.02254
Point 86	215.96602	549.23217
Point 87	183.76122	549.91347
Point 88	163.4328	550.32461
Point 89	134.5598	552.09884
Point 90	274.22203	571.1344
Point 91	301.03752	569.99889
Point 92	328.15873	568.01175
Point 93	341.0609	563.99026
Point 94	390.16826	564.00289
Point 95	504	540
Point 96	580	523.86886
Point 97	580	500.03246
Point 98	-150	499.99472
Point 99	49.98781	610.59727
Point 100	223.72901	573.80581
Point 101	278.12773	564.05804
Point 102	265.81244	568.02452
Point 103	264.70006	571.52684
Point 104	275.69963	568.00897
Point 105	-129.04534	596.07808

Point 106	-129.00866	594.10293
Point 107	620	522
Point 108	620	500

Critical Slip Surfaces

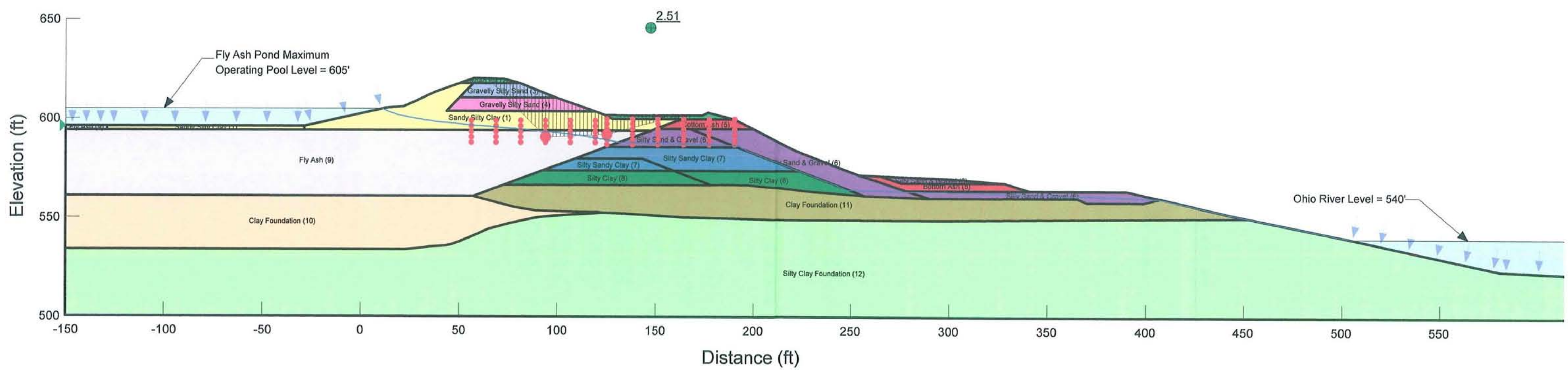
	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	2090	2.51	(147, 646)	45.185	(64.3146, 620.235)	(161.154, 601.887)

Slices of Slip Surface: 2090

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	2090	65.43173	619.11825	-1404.8598	96.181782	67.347209	0
2	2090	67.5933	616.9567	-1270.6751	279.63179	188.61403	0
3	2090	69.682165	614.86785	-1140.9909	449.511	303.199	0
4	2090	71.77103	612.77895	-1011.9837	613.35114	413.71057	0
5	2090	73.37656	611.1734	-913.27711	725.25318	489.18944	0
6	2090	74.795445	609.75455	-826.19353	808.88242	505.44583	0
7	2090	76.51102	608.039	-720.96669	891.02777	556.77595	0
8	2090	78.226595	606.3234	-615.90471	971.44202	607.02435	0
9	2090	79.962225	604.58775	-509.68235	1051.3835	656.97731	0
10	2090	81.80111	602.74885	-413.31937	1127.3116	760.38125	0
11	2090	83.723195	600.8268	-330.66285	1223.3665	825.1711	0
12	2090	85.64528	598.90475	-253.91826	1318.5384	889.36541	0
13	2090	87.567365	596.98265	-157.14597	1413.269	953.26196	0
14	2090	89.48945	595.06055	-62.930495	1507.9995	1017.1585	0
15	2090	91.287865	593.26215	31.287392	1646.3426	822.91175	0
16	2090	92.96262	591.5874	126.94314	1717.5703	810.46502	0
17	2090	94.717585	590.79265	166.17614	2560.4919	1219.9648	0
18	2090	96.55275	590.87795	149.72128	2483.4703	1189.1045	0
19	2090	98.387915	590.96325	132.85273	2405.2512	1157.8448	0
20	2090	100.2863	591.05145	115.48045	2332.5758	1129.6665	0
21	2090	102.2479	591.1426	96.877898	2265.356	1104.8948	0

22	2090	104.2095	591.2338	76.426803	2196.9141	1080.4422	0
23	2090	106.1711	591.32495	55.914598	2126.9445	1055.2424	0
24	2090	108.1327	591.4161	34.693531	2055.5999	1029.7032	0
25	2090	110.0943	591.50725	12.991232	1982.7785	1003.6567	0
26	2090	112.05585	591.5984	-8.8185164	1907.8183	972.08199	0
27	2090	114.0174	591.6896	-30.92668	1830.3628	932.61645	0
28	2090	115.979	591.78075	-53.414228	1751.5324	892.45035	0
29	2090	117.9406	591.8719	-74.995837	1671.378	851.60962	0
30	2090	119.757	591.95635	-92.671293	1588.1555	809.20563	0
31	2090	121.4282	592.034	-108.92344	1502.2026	765.41046	0
32	2090	123.0994	592.11165	-124.45831	1415.5923	721.28028	0
33	2090	124.4675	592.17525	-136.39318	1364.5884	695.29253	0
34	2090	126.439	592.58555	-176.55807	1462.3727	745.11611	0
35	2090	128.92935	593.25285	-233.23587	1347.0103	686.33603	0
36	2090	131.03205	593.8163	-281.26299	1259.041	641.51342	0
37	2090	132.97005	594.33555	-323.2039	1219.4431	822.52476	0
38	2090	134.74335	594.8107	-358.23967	1126.7334	759.99128	0
39	2090	136.5166	595.28585	-393.6404	1034.1871	697.56802	0
40	2090	138.28985	595.761	-427.72293	942.18553	635.51216	0
41	2090	140.11215	596.2493	-462.22443	852.43052	574.97164	0
42	2090	141.98345	596.7507	-498.44525	765.09175	516.0609	0
43	2090	143.8547	597.2521	-533.22074	679.04344	458.02059	0
44	2090	145.72595	597.7535	-569.19894	594.5437	401.02479	0
45	2090	147.59725	598.2549	-607.49998	511.70092	345.14663	0
46	2090	149.46855	598.7563	-645.64617	430.70608	290.51492	0
47	2090	151.3398	599.2577	-683.99884	351.65727	237.19582	0
48	2090	153.21105	599.7591	-722.45474	274.62158	185.2346	0
49	2090	155.0226	600.2445	-760.13718	206.63094	144.68454	0
50	2090	156.7744	600.7139	-797.74153	145.59279	101.94517	0
51	2090	158.52625	601.1833	-835.18047	86.186743	60.348607	0
52	2090	160.2781	601.6527	-871.07553	28.379705	19.871683	0

Title: Sporn Fly Ash Pond - Seismic Stability Analyses
Comments: Section L-L Downstream (Upper Dike-Block)
Created By: Roger W. Cecil, P.E.
File Name: SECTION L-L DOWNSTREAM SEISMIC_UPPER DIKE BLOCK.gsz
Date: 1/19/2010
Horz Seismic Load: 0.06



Slope Stability

File Information

Title: Sporn Fly Ash Pond
Comments: Section K-K Upstream Seismic Stability Analysis (Circular)
Created By: Roger W. Cecil, P.E.
Revision Number: 63
Last Edited By: Jeff Gateley
Date: 1/19/2010
Time: 9:25:46 AM
File Name: SECTION K-K UPSTREAM SEISMIC_CIRCLE.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/19/2010
Last Solved Time: 9:26:01 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability

Description: Sporn Fly Ash Pond Section K-K (Upstream - Circle)
Kind: SLOPE/W
Parent: Steady-State Seepage
Method: Morgenstern-Price
Settings
  Side Function
    Interslice force function option: Half-Sine
  PWP Conditions Source: Parent Analysis
SlipSurface
  Direction of movement: Right to Left
  Use Passive Mode: No
  Slip Surface Option: Entry and Exit
  Critical slip surfaces saved: 1
  Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 50
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 20 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Silty Clay (1)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Gravelly Silty Sand (2)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 108 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Sand and Gravel (3)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Unit Wt. Above Water Table: 114 pcf
Cohesion: 0 psf
Phi: 36 °
Phi-B: 0 °

Bottom Ash (4)

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Unit Wt. Above Water Table: 100 pcf

Cohesion: 0 psf
Phi: 31 °
Phi-B: 0 °

Gravelly Silty Sand (5)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Silty Clay (6)

Model: Mohr-Coulomb
Unit Weight: 128 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Bottom Ash 65 (7)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 29 °
Phi-B: 0 °

Fly Ash (8)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 80 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °

Sandy Silt (9)

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Unit Wt. Above Water Table: 100 pcf
Cohesion: 0 psf
Phi: 31 °
Phi-B: 0 °

Clay Foundation (10)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf

Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Clay Foundation (11)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 39 °
Phi-B: 0 °

Silty Clay Foundation (12)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 37 °
Phi-B: 0 °

Original Dike (13)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Foundation Soil (14)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-150, 597.74003) ft
Left-Zone Right Coordinate: (21, 597.77848) ft
Left-Zone Increment: 30
Right Projection: Range
Right-Zone Left Coordinate: (75, 615.65667) ft
Right-Zone Right Coordinate: (104, 619.37864) ft
Right-Zone Increment: 10
Radius Increments: 15

Slip Surface Limits

Left Coordinate: (-150, 597.74003) ft
Right Coordinate: (580, 525) ft

Seismic Loads

Horz Seismic Load: 0.06
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Silty Clay (1)	65,2,25,3,64	203.89047
Region 2	Silty Clay (1)	2,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25	1176.8788
Region 3	Gravelly Silty Sand (2)	10,26,27,28,11	33.408658
Region 4	Sand and Gravel (3)	11,12,13,29,30,28	841.1626
Region 5	Sandy Silt (9)	3,31,22,23,24,25	425.72956
Region 6	Bottom Ash (4)	31,22,21,20,32,33,34	190.90717
Region 7	Silty Clay (6)	35,37,38,39,40,36	554.67017
Region 8	Bottom Ash 65 (7)	37,41,42,38	147.83552
Region 9	Original Dike (13)	42,38,39,40,43,44	841.25177
Region 10	Fly Ash (8)	4,45,62,44,42,41,37,35,34,31,3,64	11842.621
Region 11	Gravelly Silty Sand (5)	33,32,46,47,66,43,40,36,35,34	1406.9906
Region 12	Silty Clay Foundation (12)	52,55,56,57,58,53,63	11477.383

Region 13	Foundation Soil (14)	56,59,71,72,60,61,55	21838.358
Region 14	Clay Foundation (11)	45,62,63,52	3563.0574
Region 15	Clay Foundation (10)	62,44,43,66,51,70,50,54,53,63	2091.4421
Region 16	Silty Clay (1)	1,65,64,4	141.5511
Region 17	Bottom Ash (4)	47,67,68,69,70,51,66	102.11485
Region 18	Gravelly Silty Sand (5)	67,48,49,69,68	161.58666
Region 19	Bottom Ash (4)	69,70,50	5.722693

Points

	X (ft)	Y (ft)
Point 1	-150	597.74003
Point 2	20.87006	597.74003
Point 3	20.88514	595.7195
Point 4	-150	595.71741
Point 5	28.29932	599.9386
Point 6	43.4	605
Point 7	66.4449	612.83618
Point 8	71.00682	614.37347
Point 9	75.83799	615.92596
Point 10	83.12625	618.01207
Point 11	89.16676	618.0063
Point 12	67.99514	603.00606
Point 13	160.50996	603.01085
Point 14	164.36012	602.00265
Point 15	175.56909	602.00354
Point 16	179.88561	602.4977

Point 17	214.07092	602.96698
Point 18	216.26115	604.4504
Point 19	218.92113	601.99621
Point 20	228.49429	599.98195
Point 21	207.18559	599.99735
Point 22	204.40592	598.13958
Point 23	32.02668	598.14303
Point 24	26.54626	596.50886
Point 25	20.87931	596.50076
Point 26	89.27093	619.72571
Point 27	103.77188	619.42032
Point 28	111.47933	618.0121
Point 29	135.19671	609.9055
Point 30	123.47463	613.96956
Point 31	200.77083	595.72596
Point 32	240.76421	594.01059
Point 33	222.79049	594.01222
Point 34	198.17913	594.01083
Point 35	178.5748	580.99902
Point 36	248.77756	581.00098
Point 37	165.52362	572.33858
Point 38	228.39764	572.33563
Point 39	239.8063	579.91496
Point 40	250.94764	579.91496
Point 41	161.97373	569.98666
Point 42	224.86913	569.98596
Point 43	288.91143	560.96382
Point 44	211.29094	560.95827
Point 45	-150	560.99795
Point 46	257.89685	585.94071
Point 47	297.73567	569.9851
Point 48	325.50196	568.0018
Point 49	336.18826	565.99579
Point 50	354.42618	558.00394
Point 51	328.18785	559.80842
Point 52	-150	550.07288

Point 53	397.53591	549.83795
Point 54	388.85171	551.97178
Point 55	-150	530.60542
Point 56	486.17654	530.37993
Point 57	440.71606	539.69843
Point 58	420.04463	544.03139
Point 59	523	525
Point 60	523	500.03246
Point 61	-150	499.97967
Point 62	154.97895	560.96884
Point 63	194.99536	549.95765
Point 64	-80.00109	595.71827
Point 65	-80.00109	597.74003
Point 66	321.98827	559.99079
Point 67	304.18497	569.49578
Point 68	322.21879	562.20928
Point 69	349.0118	560.43036
Point 70	348.85409	558.38715
Point 71	580	525
Point 72	580	500

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	4890	1.93	(41.934, 647.797)	62.864	(98.0898, 619.54)	(3.90501, 597.74)

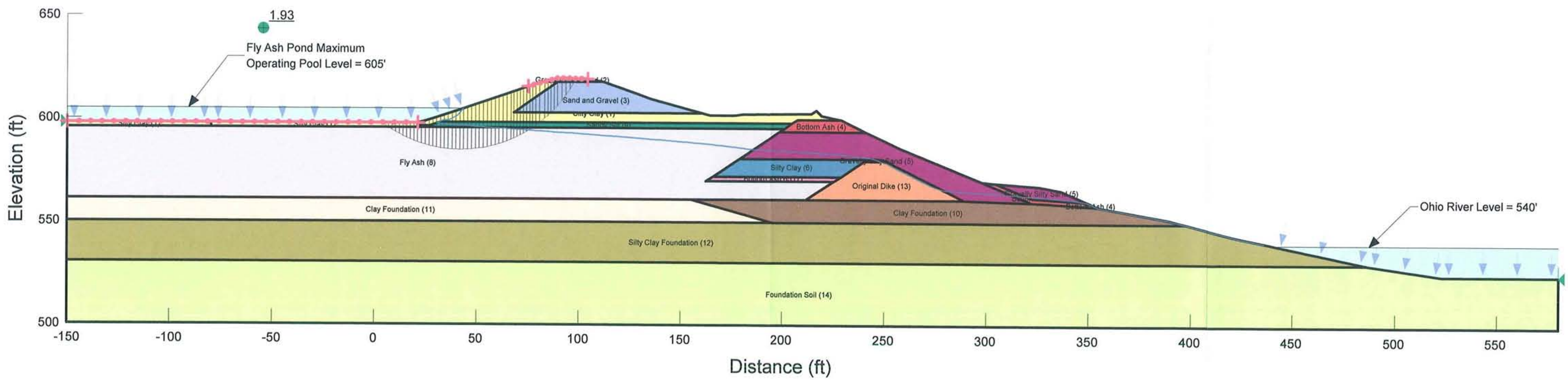
Slices of Slip Surface: 4890

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	4890	5.3139655	596.72965	325.3315	690.46067	246.28273	0
2	4890	7.607115	595.1429	223.6664	933.82239	361.84255	0
3	4890	9.3755055	594.03105	282.99404	1060.6774	396.24948	0
4	4890	11.1439	592.9988	337.63141	1179.3386	428.87126	0

5	4890	12.912295	592.04175	387.74769	1289.3657	459.3973	0
6	4890	14.680685	591.15605	433.83016	1390.4558	487.42511	0
7	4890	16.449075	590.3384	476.24955	1482.1673	512.54067	0
8	4890	18.21747	589.586	515.07385	1564.3624	534.6392	0
9	4890	19.985865	588.8963	550.23986	1636.8894	553.67559	0
10	4890	20.874685	588.56515	566.9611	1692.3269	573.40253	0
11	4890	21.825745	588.24395	582.87338	1724.194	581.53191	0
12	4890	23.7157	587.63865	612.52519	1826.7726	618.68995	0
13	4890	25.60274	587.09905	638.33348	1916.7915	651.40689	0
14	4890	27.42279	586.6372	659.64379	1984.5926	675.09513	0
15	4890	29.23116	586.23695	677.31893	2038.0526	693.32844	0
16	4890	31.09484	585.88155	692.11632	2082.0043	708.18329	0
17	4890	32.974455	585.5819	703.56345	2123.2745	723.37891	0
18	4890	34.87001	585.3382	711.66542	2161.993	738.97881	0
19	4890	36.765565	585.1528	716.14316	2190.3329	751.13718	0
20	4890	38.661115	585.0252	717.07493	2208.9659	760.15641	0
21	4890	40.55667	584.95505	714.55357	2218.6604	766.38069	0
22	4890	42.452225	584.9421	708.42332	2220.1731	770.27496	0
23	4890	44.360205	584.987	698.70541	2237.4391	784.02399	0
24	4890	46.280615	585.09065	685.34495	2270.0591	807.45216	0
25	4890	48.201025	585.2534	668.22969	2295.0998	828.93173	0
26	4890	50.12143	585.47575	647.47492	2312.9636	848.60886	0
27	4890	52.041835	585.75835	622.95385	2324.3204	866.88957	0
28	4890	53.962245	586.102	594.71574	2329.644	883.99012	0
29	4890	55.882655	586.5077	562.62611	2329.3056	900.16816	0
30	4890	57.803065	586.97675	526.52794	2323.8273	915.76975	0
31	4890	59.723475	587.51065	486.38271	2313.3732	930.89813	0
32	4890	61.64388	588.11105	442.03741	2298.3493	945.83815	0
33	4890	63.564285	588.78005	393.35519	2278.8532	960.70922	0
34	4890	65.484695	589.52	340.20345	2254.9233	975.59847	0
35	4890	67.22002	590.2486	288.35683	2229.5138	989.06887	0
36	4890	68.74806	590.9443	239.32095	2199.086	998.55015	0
37	4890	70.2539	591.67935	187.9621	2161.7657	1005.7032	0
38	4890	71.812015	592.49435	131.37127	2118.7892	1012.64	0
39	4890	73.422405	593.39545	69.167703	2069.7105	1019.3275	0
40	4890	75.032795	594.3602	2.9381053	2016.8064	1026.1171	0

41	4890	76.49326	595.2902	-60.618113	1969.4863	1003.5034	0
42	4890	77.98306	596.30575	-129.27982	1869.9437	1123.5755	0
43	4890	79.65212	597.51605	-210.3506	1790.4412	1075.8056	0
44	4890	81.80645	599.2255	-324.7085	1626.91	1097.3646	0
45	4890	83.85593	600.96205	-436.51345	1482.3434	999.85325	0
46	4890	85.31529	602.3111	-519.52186	1368.6478	923.16459	0
47	4890	86.82542	603.80335	-611.37122	1228.7064	892.70744	0
48	4890	88.386315	605.45595	-715.6421	1105.8315	803.4336	0
49	4890	89.218845	606.37165	-773.33919	1039.216	755.03465	0
50	4890	90.27363	607.63805	-853.02427	928.76722	674.78888	0
51	4890	92.279035	610.1872	-1013.3675	711.64925	517.04345	0
52	4890	94.28444	613.03965	-1192.7743	479.5921	348.44406	0
53	4890	96.28984	616.27915	-1396.2445	229.99765	167.10307	0
54	4890	97.691155	618.7742	-1552.5547	53.66035	34.847439	0

Title: Sporn Fly Ash Pond
Comments: Section K-K Upstream Seismic Stability Analysis (Circular)
Created By: Roger W. Cecil, P.E.
File Name: SECTION K-K UPSTREAM SEISMIC_CIRCLE.gsz
Date: 1/19/2010
Horz Seismic Load: 0.06



Slope Stability

File Information

Title: Sporn Fly Ash Pond
Comments: Section K-K Upstream Seismic Stability Analysis (Block)
Created By: Roger W. Cecil, P.E.
Revision Number: 88
Last Edited By: Jeff Gateley
Date: 1/19/2010
Time: 9:25:57 AM
File Name: SECTION K-K UPSTREAM SEISMIC_BLOCK.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability

Description: Sporn Fly Ash Pond Section K-K (Upstream - Block)
Kind: SLOPE/W
Parent: Steady-State Seepage
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Parent Analysis

SlipSurface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Block
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: (none)

FOS Distribution
    FOS Calculation Option: Constant
Restrict Block Crossing: Yes
Advanced
    Number of Slices: 50
    Optimization Tolerance: 0.01
    Minimum Slip Surface Depth: 20 ft
    Optimization Maximum Iterations: 2000
    Optimization Convergence Tolerance: 1e-007
    Starting Optimization Points: 8
    Ending Optimization Points: 16
    Complete Passes per Insertion: 1
    Driving Side Maximum Convex Angle: 5 °
    Resisting Side Maximum Convex Angle: 1 °

Materials

Silty Clay (1)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Gravelly Silty Sand (2)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 108 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Sand and Gravel (3)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Unit Wt. Above Water Table: 114 pcf
Cohesion: 0 psf
Phi: 36 °
Phi-B: 0 °

Bottom Ash (4)

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Unit Wt. Above Water Table: 100 pcf
Cohesion: 0 psf

Phi: 31 °
Phi-B: 0 °

Gravelly Silty Sand (5)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Silty Clay (6)

Model: Mohr-Coulomb
Unit Weight: 128 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Bottom Ash 65 (7)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 29 °
Phi-B: 0 °

Fly Ash (8)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 80 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °

Sandy Silt (9)

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Unit Wt. Above Water Table: 100 pcf
Cohesion: 0 psf
Phi: 31 °
Phi-B: 0 °

Clay Foundation (10)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf

Phi: 33 °
Phi-B: 0 °

Clay Foundation (11)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 39 °
Phi-B: 0 °

Silty Clay Foundation (12)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 37 °
Phi-B: 0 °

Original Dike (13)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Foundation Soil (14)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (-150, 597.74003) ft
Right Coordinate: (580, 525) ft

Slip Surface Block

Left Grid
- Upper Left: (-25, 597) ft
- Lower Left: (-25, 560) ft
- Lower Right: (40, 560) ft
- X Increments: 8

Y Increments: 8
Starting Angle: 135 °
Ending Angle: 180 °
Angle Increments: 3

Right Grid

Upper Left: (49, 604) ft
Lower Left: (49, 560) ft
Lower Right: (119, 560) ft
X Increments: 4
Y Increments: 8
Starting Angle: 45 °
Ending Angle: 65 °
Angle Increments: 3

Seismic Loads

Horz Seismic Load: 0.06
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Silty Clay (1)	65,2,25,3,64	203.89047
Region 2	Silty Clay (1)	2,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25	1176.8788
Region 3	Gravelly Silty Sand (2)	10,26,27,28,11	33.408658
Region 4	Sand and Gravel (3)	11,12,13,29,30,28	841.1626
Region 5	Sandy Silt (9)	3,31,22,23,24,25	425.72956
Region 6	Bottom Ash (4)	31,22,21,20,32,33,34	190.90717
Region 7	Silty Clay (6)	35,37,38,39,40,36	554.67017
Region 8	Bottom Ash 65 (7)	37,41,42,38	147.83552
Region 9	Original Dike (13)	42,38,39,40,43,44	841.25177
Regio	Fly Ash (8)	4,45,62,44,42,41,37,35,34,31,3,64	11842.621

n 10			
Region 11	Gravelly Silty Sand (5)	33,32,46,47,66,43,40,36,35,34	1406.9906
Region 12	Silty Clay Foundation (12)	52,55,56,57,58,53,63	11477.383
Region 13	Foundation Soil (14)	56,59,71,72,60,61,55	21838.358
Region 14	Clay Foundation (11)	45,62,63,52	3563.0574
Region 15	Clay Foundation (10)	62,44,43,66,51,70,50,54,53,63	2091.4421
Region 16	Fly Ash (8)	1,65,64,4	141.5511
Region 17	Bottom Ash (4)	47,67,68,69,70,51,66	102.11485
Region 18	Gravelly Silty Sand (5)	67,48,49,69,68	161.58666
Region 19	Bottom Ash (4)	69,70,50	5.722693

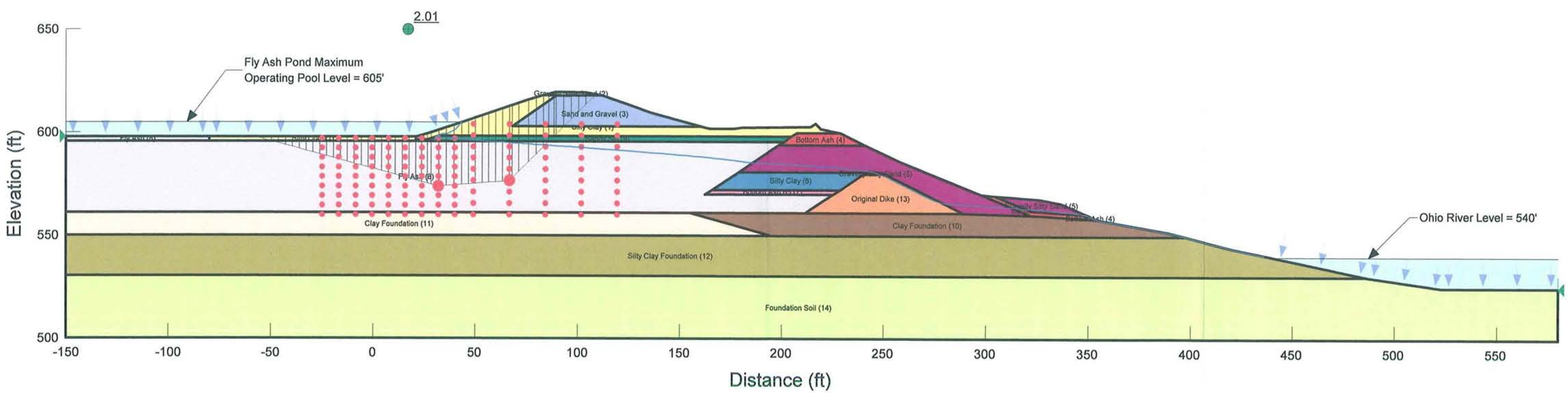
Points

	X (ft)	Y (ft)
Point 1	-150	597.74003
Point 2	20.87006	597.74003
Point 3	20.88514	595.7195
Point 4	-150	595.71741
Point 5	28.29932	599.9386
Point 6	43.4	605
Point 7	66.4449	612.83618
Point 8	71.00682	614.37347
Point 9	75.83799	615.92596
Point 10	83.12625	618.01207

Point 11	89.16676	618.0063
Point 12	67.99514	603.00606
Point 13	160.50996	603.01085
Point 14	164.36012	602.00265
Point 15	175.56909	602.00354
Point 16	179.88561	602.4977
Point 17	214.07092	602.96698
Point 18	216.26115	604.4504
Point 19	218.92113	601.99621
Point 20	228.49429	599.98195
Point 21	207.18559	599.99735
Point 22	204.40592	598.13958
Point 23	32.02668	598.14303
Point 24	26.54626	596.50886
Point 25	20.87931	596.50076
Point 26	89.27093	619.72571
Point 27	103.77188	619.42032
Point 28	111.47933	618.0121
Point 29	135.19671	609.9055
Point 30	123.47463	613.96956
Point 31	200.77083	595.72596
Point 32	240.76421	594.01059
Point 33	222.79049	594.01222
Point 34	198.17913	594.01083
Point 35	178.5748	580.99902
Point 36	248.77756	581.00098
Point 37	165.52362	572.33858
Point 38	228.39764	572.33563
Point 39	239.8063	579.91496
Point 40	250.94764	579.91496
Point 41	161.97373	569.98666
Point 42	224.86913	569.98596
Point 43	288.91143	560.96382
Point 44	211.29094	560.95827
Point 45	-150	560.99795
Point 46	257.89685	585.94071

Point 47	297.73567	569.9851
Point 48	325.50196	568.0018
Point 49	336.18826	565.99579
Point 50	354.42618	558.00394
Point 51	328.18785	559.80842
Point 52	-150	550.07288
Point 53	397.53591	549.83795
Point 54	388.85171	551.97178
Point 55	-150	530.60542
Point 56	486.17654	530.37993
Point 57	440.71606	539.69843
Point 58	420.04463	544.03139
Point 59	523	525
Point 60	523	500.03246
Point 61	-150	499.97967
Point 62	154.97895	560.96884
Point 63	194.99536	549.95765
Point 64	-80.00109	595.71827
Point 65	-80.00109	597.74003
Point 66	321.98827	559.99079
Point 67	304.18497	569.49578
Point 68	322.21879	562.20928
Point 69	349.0118	560.43036
Point 70	348.85409	558.38715
Point 71	580	525
Point 72	580	500

Title: Sporn Fly Ash Pond
Comments: Section K-K Upstream Seismic Stability Analysis (Block)
Created By: Roger W. Cecil, P.E.
File Name: SECTION K-K UPSTREAM SEISMIC_BLOCK.gsz
Date: 1/19/2010
Horz Seismic Load: 0.06



Slope Stability

File Information

Title: Sporn Fly Ash Pond
Comments: Section K-K Downstream Seismic Stability Analysis (Global-Circular)
Created By: Roger W. Cecil, P.E.
Revision Number: 54
Last Edited By: Jeff Gateley
Date: 1/19/2010
Time: 9:12:09 AM
File Name: SECTION K-K DOWNSTREAM SEISMIC_GLOBAL CIRCLE.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/19/2010
Last Solved Time: 9:15:45 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability

Kind: SLOPE/W
Parent: Steady-State Seepage
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Parent Analysis

SlipSurface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack

Tension Crack Option: (none)

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 150

Optimization Tolerance: 0.01

Minimum Slip Surface Depth: 20 ft

Optimization Maximum Iterations: 2000

Optimization Convergence Tolerance: 1e-007

Starting Optimization Points: 8

Ending Optimization Points: 16

Complete Passes per Insertion: 1

Driving Side Maximum Convex Angle: 5 °

Resisting Side Maximum Convex Angle: 1 °

Materials

Silty Clay (1)

Model: Mohr-Coulomb

Unit Weight: 130 pcf

Unit Wt. Above Water Table: 125 pcf

Cohesion: 0 psf

Phi: 34 °

Phi-B: 0 °

Gravelly Silty Sand (2)

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Unit Wt. Above Water Table: 108 pcf

Cohesion: 0 psf

Phi: 33 °

Phi-B: 0 °

Sand and Gravel (3)

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Unit Wt. Above Water Table: 114 pcf

Cohesion: 0 psf

Phi: 36 °

Phi-B: 0 °

Bottom Ash (4)

Model: Mohr-Coulomb

Unit Weight: 105 pcf

Unit Wt. Above Water Table: 100 pcf

Cohesion: 0 psf

Phi: 31 °
Phi-B: 0 °

Gravelly Silty Sand (5)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Silty Clay (6)
Model: Mohr-Coulomb
Unit Weight: 128 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Bottom Ash 65 (7)
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 29 °
Phi-B: 0 °

Fly Ash (8)
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 80 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °

Sandy Silt (9)
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Unit Wt. Above Water Table: 100 pcf
Cohesion: 0 psf
Phi: 31 °
Phi-B: 0 °

Clay Foundation (10)
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf

Phi: 33 °
Phi-B: 0 °

Clay Foundation (11)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 39 °
Phi-B: 0 °

Silty Clay Foundation (12)
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 37 °
Phi-B: 0 °

Original Dike (13)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Foundation Soil (14)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Slip Surface Entry and Exit
Left Projection: Range
Left-Zone Left Coordinate: (88.85, 619.60832) ft
Left-Zone Right Coordinate: (103.79055, 619.41691) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (350.55996, 559.73656) ft
Right-Zone Right Coordinate: (580, 525) ft
Right-Zone Increment: 40
Radius Increments: 20

Slip Surface Limits

Left Coordinate: (-150, 597.74003) ft
Right Coordinate: (580, 525) ft

Seismic Loads

Horz Seismic Load: 0.06
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Silty Clay (1)	65,2,25,3,64	203.89047
Region 2	Silty Clay (1)	2,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25	1176.8788
Region 3	Gravelly Silty Sand (2)	10,26,27,28,11	33.408658
Region 4	Sand and Gravel (3)	11,12,13,29,30,28	841.1626
Region 5	Sandy Silt (9)	3,31,22,23,24,25	425.72956
Region 6	Bottom Ash (4)	31,22,21,20,32,33,34	190.90717
Region 7	Silty Clay (6)	35,37,38,39,40,36	554.67017
Region 8	Bottom Ash 65 (7)	37,41,42,38	147.83552
Region 9	Original Dike (13)	42,38,39,40,43,44	841.25177
Region 10	Fly Ash (8)	4,45,62,44,42,41,37,35,34,31,3,64	11842.621
Region 11	Gravelly Silty Sand (5)	33,32,46,47,66,43,40,36,35,34	1406.9906
Region 12	Silty Clay Foundation (12)	52,55,56,57,58,53,63	11477.383

Region 13	Foundation Soil (14)	56,59,71,72,60,61,55	21838.358
Region 14	Clay Foundation (11)	45,62,63,52	3563.0574
Region 15	Clay Foundation (10)	62,44,43,66,51,70,50,54,53,63	2091.4421
Region 16	Silty Clay (1)	1,65,64,4	141.5511
Region 17	Bottom Ash (4)	47,67,68,69,70,51,66	102.11485
Region 18	Gravelly Silty Sand (5)	67,48,49,69,68	161.58666
Region 19	Bottom Ash (4)	69,70,50	5.722693

Points

	X (ft)	Y (ft)
Point 1	-150	597.74003
Point 2	20.87006	597.74003
Point 3	20.88514	595.7195
Point 4	-150	595.71741
Point 5	28.29932	599.9386
Point 6	43.4	605
Point 7	66.4449	612.83618
Point 8	71.00682	614.37347
Point 9	75.83799	615.92596
Point 10	83.12625	618.01207
Point 11	89.16676	618.0063
Point 12	67.99514	603.00606
Point 13	160.50996	603.01085
Point 14	164.36012	602.00265
Point 15	175.56909	602.00354
Point 16	179.88561	602.4977

Point 17	214.07092	602.96698
Point 18	216.26115	604.4504
Point 19	218.92113	601.99621
Point 20	228.49429	599.98195
Point 21	207.18559	599.99735
Point 22	204.40592	598.13958
Point 23	32.02668	598.14303
Point 24	26.54626	596.50886
Point 25	20.87931	596.50076
Point 26	89.27093	619.72571
Point 27	103.77188	619.42032
Point 28	111.47933	618.0121
Point 29	135.19671	609.9055
Point 30	123.47463	613.96956
Point 31	200.77083	595.72596
Point 32	240.76421	594.01059
Point 33	222.79049	594.01222
Point 34	198.17913	594.01083
Point 35	178.5748	580.99902
Point 36	248.77756	581.00098
Point 37	165.52362	572.33858
Point 38	228.39764	572.33563
Point 39	239.8063	579.91496
Point 40	250.94764	579.91496
Point 41	161.97373	569.98666
Point 42	224.86913	569.98596
Point 43	288.91143	560.96382
Point 44	211.29094	560.95827
Point 45	-150	560.99795
Point 46	257.89685	585.94071
Point 47	297.73567	569.9851
Point 48	325.50196	568.0018
Point 49	336.18826	565.99579
Point 50	354.42618	558.00394
Point 51	328.18785	559.80842
Point 52	-150	550.07288

Point 53	397.53591	549.83795
Point 54	388.85171	551.97178
Point 55	-150	530.60542
Point 56	486.17654	530.37993
Point 57	440.71606	539.69843
Point 58	420.04463	544.03139
Point 59	523	525
Point 60	523	500.03246
Point 61	-150	499.97967
Point 62	154.97895	560.96884
Point 63	194.99536	549.95765
Point 64	-80.00109	595.71827
Point 65	-80.00109	597.74003
Point 66	321.98827	559.99079
Point 67	304.18497	569.49578
Point 68	322.21879	562.20928
Point 69	349.0118	560.43036
Point 70	348.85409	558.38715
Point 71	580	525
Point 72	580	500

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	9266	1.33	(439.327, 1127.2)	608.63	(103.79, 619.417)	(527.549, 525)

Slices of Slip Surface: 9266

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	9266	104.8595	618.7138	-1550.636	44.13529	28.661792	0
2	9266	107.3162	617.10745	-1451.2833	144.23751	104.79468	0
3	9266	110.0916	615.31165	-1340.39	260.37483	189.17338	0
4	9266	112.97875	613.4666	-1226.8854	358.06207	260.14732	0

5	9266	115.9776	611.5738	-1110.6607	437.12806	317.59212	0
6	9266	118.9764	609.70535	-996.02627	514.38722	373.72419	0
7	9266	121.9752	607.86095	-882.96998	589.88917	428.57957	0
8	9266	125.1184	605.9538	-765.96244	665.69412	483.65509	0
9	9266	128.406	603.9861	-645.19604	741.6852	538.86584	0
10	9266	131.33655	602.25435	-569.66641	826.09506	557.20815	0
11	9266	133.91	600.7529	-542.52435	894.70638	603.48707	0
12	9266	136.8252	599.07365	-518.24639	981.82274	662.2478	0
13	9266	139.5263	597.5338	-475.4931	1079.7884	648.80233	0
14	9266	141.6715	596.3253	-411.96906	1125.2301	676.10648	0
15	9266	144.2246	594.9031	-336.1634	1197.883	610.35188	0
16	9266	147.1856	593.27225	-248.52639	1238.4396	631.01651	0
17	9266	150.14655	591.6628	-162.61762	1277.6547	650.99758	0
18	9266	153.1075	590.0745	-77.83922	1315.571	670.31692	0
19	9266	156.0685	588.5071	5.9676704	1352.949	686.32125	0
20	9266	159.0295	586.9605	86.693315	1397.9031	668.09476	0
21	9266	162.43505	585.2089	174.84445	1444.2466	646.79268	0
22	9266	165.7272	583.5374	269.29777	1524.311	639.46116	0
23	9266	168.4614	582.17	341.309	1632.6892	657.99105	0
24	9266	171.1956	580.8197	426.33891	1740.9468	669.82619	0
25	9266	173.92985	579.48635	506.43702	1847.1934	683.1495	0
26	9266	175.43305	578.75845	542.58997	1867.2433	893.48994	0
27	9266	177.07195	577.9754	610.48598	2007.6624	942.40743	0
28	9266	179.2302	576.948	698.0621	2189.781	1006.1771	0
29	9266	181.4406	575.9108	788.13108	2347.9666	1052.1223	0
30	9266	184.5506	574.4666	919.09167	2559.8721	1106.7204	0
31	9266	187.6606	573.04365	1053.3204	2770.082	1157.9704	0
32	9266	190.5363	571.74595	1158.4236	2974.9043	1006.8917	0
33	9266	193.1777	570.57035	1231.6125	3108.9983	1040.6519	0
34	9266	196.33875	569.1849	1318.1375	3280.0867	999.66305	0
35	9266	199.47495	567.8279	1402.9196	3429.3708	1032.5285	0
36	9266	202.58835	566.50485	1485.4435	3550.5883	1052.2438	0
37	9266	205.79575	565.15995	1569.2004	3643.7715	1057.0468	0
38	9266	208.66825	563.9753	1642.7607	3723.9862	1060.4374	0
39	9266	211.6336	562.77	1717.6442	3825.7787	1074.1482	0
40	9266	213.5936	561.98125	1754.6897	3880.7846	1380.7021	0

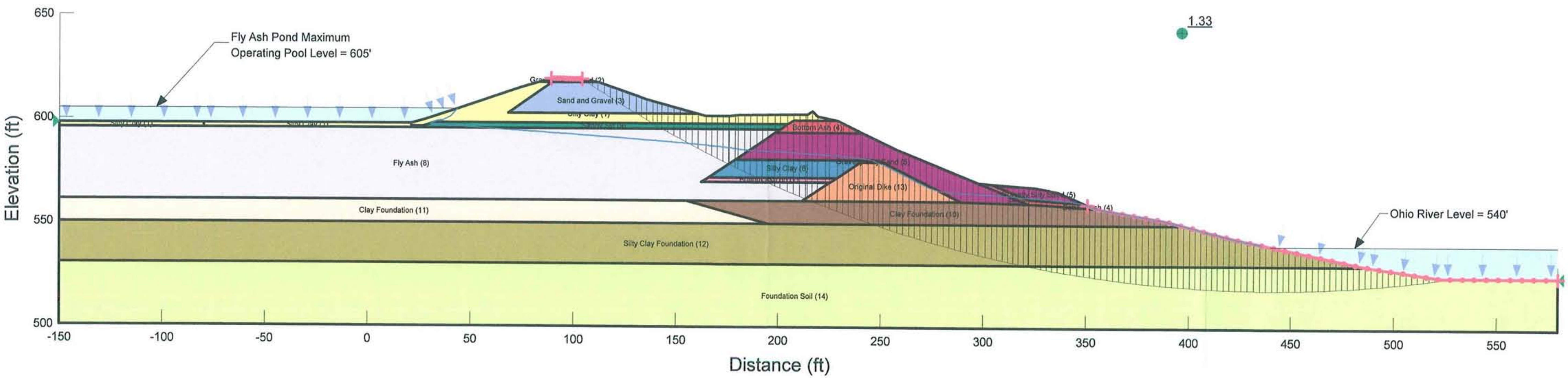
41	9266	215.166	561.35675	1754.199	4067.8605	1502.5093	0
42	9266	217.5911	560.4026	1739.184	4176.7585	1582.9794	0
43	9266	220.8558	559.13825	1713.4579	4211.1591	1622.0261	0
44	9266	223.8298	558.0007	1696.7782	4337.9807	1715.2169	0
45	9266	226.6817	556.93135	1683.1021	4458.0145	1802.0492	0
46	9266	229.9083	555.7373	1670.8988	4534.661	1859.749	0
47	9266	232.7363	554.70885	1668.883	4535.1708	1861.3891	0
48	9266	235.5643	553.6962	1671.0022	4534.5301	1859.5968	0
49	9266	238.3923	552.69925	1674.0738	4532.3992	1856.2182	0
50	9266	240.28525	552.03895	1677.4084	4530.1767	1852.6094	0
51	9266	242.1969	551.38275	1681.3701	4521.1399	1844.1681	0
52	9266	245.0623	550.40975	1689.4699	4504.9663	1828.4048	0
53	9266	247.6363	549.5485	1699.0374	4483.6691	2098.3705	0
54	9266	249.8626	548.81435	1708.6606	4464.5535	2076.7143	0
55	9266	252.6849	547.89915	1721.5502	4428.4478	2039.7937	0
56	9266	256.1595	546.79115	1738.9498	4380.6527	1990.6659	0
57	9266	259.3066	545.8064	1755.9789	4345.1407	1951.0733	0
58	9266	262.12615	544.94085	1772.1656	4322.4297	1921.7618	0
59	9266	264.94565	544.09025	1788.2786	4298.1617	1891.3326	0
60	9266	267.76515	543.2545	1804.6915	4271.6545	1858.99	0
61	9266	270.58465	542.4335	1821.2345	4243.2429	1825.1143	0
62	9266	273.40415	541.62725	1837.9407	4212.9214	1789.6763	0
63	9266	276.22365	540.83565	1854.6399	4180.6877	1752.8028	0
64	9266	279.04315	540.05865	1871.0916	4146.5382	1714.672	0
65	9266	281.86265	539.2962	1886.8823	4110.1255	1675.3339	0
66	9266	284.68215	538.54825	1902.2496	4071.7897	1634.8658	0
67	9266	287.50165	537.81475	1917.2936	4031.5268	1593.189	0
68	9266	290.3821	537.0804	1932.1235	3997.8152	1556.6103	0
69	9266	293.32355	536.3458	1946.8396	3971.4379	1525.6442	0
70	9266	296.265	535.62675	1960.8407	3942.8961	1493.5859	0
71	9266	299.348	534.89005	1974.6942	3962.909	1498.2273	0
72	9266	302.57265	534.1372	1988.2941	4032.6126	1540.5045	0
73	9266	305.48015	533.47345	1999.8652	4099.3037	1582.0404	0
74	9266	308.07045	532.89545	2009.5403	4162.8561	1622.6399	0
75	9266	310.66075	532.32925	2018.6233	4225.6837	1663.1393	0
76	9266	313.2511	531.77485	2027.0765	4287.4074	1703.2815	0

77	9266	315.84145	531.23225	2034.896	4348.3948	1743.3463	0
78	9266	318.43175	530.7014	2042.1197	4408.2665	1783.0195	0
79	9266	320.8576	530.21455	2048.3158	4430.3619	1488.4676	0
80	9266	322.10355	529.96755	2051.3506	4458.9951	1504.4633	0
81	9266	323.8604	529.6277	2055.1458	4499.5378	1527.4257	0
82	9266	326.84495	529.05795	2061.2016	4548.899	1554.4859	0
83	9266	329.5213	528.56085	2065.9139	4570.5113	1565.0462	0
84	9266	332.1881	528.07785	2069.9064	4590.0717	1574.7741	0
85	9266	334.8549	527.60705	2073.2321	4607.7161	1583.7214	0
86	9266	337.7715	527.1068	2076.021	4580.1313	1564.7418	0
87	9266	340.93795	526.57955	2078.2501	4506.8644	1517.5666	0
88	9266	344.1044	526.0694	2079.485	4430.2167	1468.9002	0
89	9266	347.3497	525.5645	2079.7618	4348.7712	1417.8345	0
90	9266	350.3654	525.1104	2079.2368	4273.2154	1370.95	0
91	9266	353.0726	524.7166	2078.0001	4206.1684	1329.8272	0
92	9266	355.8606	524.3242	2076.027	4174.1522	1311.0541	0
93	9266	358.7294	523.934	2073.2589	4176.8534	1314.4718	0
94	9266	361.5982	523.5577	2069.7464	4177.3841	1316.9982	0
95	9266	364.467	523.1952	2065.5236	4175.7416	1318.6105	0
96	9266	367.3358	522.84655	2060.5896	4172.2682	1319.5232	0
97	9266	370.20455	522.5117	2054.9089	4166.2684	1319.3239	0
98	9266	373.0733	522.19065	2048.4805	4158.4313	1318.4436	0
99	9266	375.9421	521.8834	2041.4432	4148.0628	1316.362	0
100	9266	378.8109	521.58985	2033.7271	4135.5064	1313.3375	0
101	9266	381.6797	521.31005	2025.4012	4120.76	1309.3254	0
102	9266	384.5485	521.04395	2016.3965	4103.8228	1304.3687	0
103	9266	387.4173	520.7915	2006.7128	4084.3459	1298.2493	0
104	9266	390.29905	520.55175	1996.37	4049.004	1282.628	0
105	9266	393.1938	520.32475	1985.3363	3997.1272	1257.1065	0
106	9266	396.08855	520.11165	1973.4562	3943.053	1230.7407	0
107	9266	398.9427	519.91505	1961.3775	3885.0218	1202.0264	0
108	9266	401.7563	519.7345	1948.6223	3822.6782	1171.0401	0
109	9266	404.5699	519.567	1935.4628	3758.0872	1138.9021	0
110	9266	407.3835	519.41255	1921.5801	3691.251	1105.8131	0
111	9266	410.1971	519.2712	1907.365	3621.8172	1071.3087	0
112	9266	413.01065	519.14295	1892.4986	3550.0372	1035.7451	0

113	9266	415.8242	519.0277	1877.1953	3475.8088	998.92457	0
114	9266	418.6378	518.92545	1861.313	3399.2406	961.00384	0
115	9266	421.52115	518.8344	1844.5493	3327.9672	926.94237	0
116	9266	424.47425	518.75515	1826.8814	3261.9135	896.70755	0
117	9266	427.4273	518.69025	1808.5228	3193.2953	865.30188	0
118	9266	430.38035	518.6397	1789.8808	3122.1505	832.4945	0
119	9266	433.3334	518.60345	1770.5848	3048.4508	798.49924	0
120	9266	436.28645	518.5815	1750.8393	2972.2684	763.23365	0
121	9266	439.23955	518.5739	1730.6449	2893.6754	726.74211	0
122	9266	442.1367	518.58025	1710.1971	2836.0158	703.48962	0
123	9266	444.97795	518.6	1689.9756	2799.2871	693.17478	0
124	9266	447.81925	518.633	1669.1553	2760.1065	681.70197	0
125	9266	450.66055	518.6793	1647.9853	2718.4085	668.87471	0
126	9266	453.50185	518.73885	1626.3959	2674.2659	654.78185	0
127	9266	456.3431	518.81165	1604.2128	2627.6469	639.51263	0
128	9266	459.18435	518.8978	1581.895	2578.5557	622.78271	0
129	9266	462.02565	518.9972	1558.8807	2527.0658	604.98919	0
130	9266	464.86695	519.10985	1535.8404	2473.1124	585.67254	0
131	9266	467.70825	519.23585	1512.1429	2416.7708	565.27423	0
132	9266	470.5495	519.37515	1488.1411	2358.0804	543.59842	0
133	9266	473.39075	519.52775	1463.7664	2297.0467	520.69134	0
134	9266	476.23205	519.6937	1438.7402	2233.7115	496.75318	0
135	9266	479.07335	519.87295	1413.275	2168.08	471.6545	0
136	9266	481.91465	520.06555	1387.1622	2100.2289	445.57351	0
137	9266	484.7559	520.27155	1361.3512	2030.0938	417.87672	0
138	9266	487.5928	520.49055	1334.5308	1958.6327	389.98217	0
139	9266	490.4254	520.72255	1307.0031	1893.7526	366.64178	0
140	9266	493.258	520.9679	1279.7493	1826.7716	341.81744	0
141	9266	496.09055	521.22655	1251.681	1757.8017	316.25926	0
142	9266	498.9231	521.49855	1223.7497	1686.8148	289.3552	0
143	9266	501.7557	521.78395	1195.9925	1613.8542	261.10896	0
144	9266	504.5883	522.08275	1167.8137	1538.9967	231.94088	0
145	9266	507.42085	522.39495	1137.4966	1462.3904	203.01617	0
146	9266	510.2534	522.7206	1106.9752	1383.9732	173.08757	0
147	9266	513.086	523.0597	1076.2172	1303.7189	142.15879	0
148	9266	515.9186	523.41225	1045.189	1221.7396	110.32102	0

149	9266	518.75115	523.7783	1013.5089	1138.0449	77.818735	0
150	9266	521.5837	524.1579	981.14491	1052.6783	44.699051	0
151	9266	524.13725	524.51115	952.93574	985.54488	20.376452	0
152	9266	526.41175	524.8356	929.1427	940.23863	6.9335064	0

Title: Sporn Fly Ash Pond
Comments: Section K-K Downstream Seismic Stability Analysis (Global-Circular)
Created By: Roger W. Cecil, P.E.
File Name: SECTION K-K DOWNSTREAM SEISMIC_GLOBAL CIRCLE.gsz
Date: 1/19/2010
Horz Seismic Load: 0.06



SPP00003423

Slope Stability

File Information

Title: Sporn Fly Ash Pond
Comments: Section K-K Downstream Seismic Stability Analysis (Global-Block)
Created By: Roger W. Cecil, P.E.
Revision Number: 93
Last Edited By: Jeff Gateley
Date: 1/19/2010
Time: 9:13:47 AM
File Name: SECTION K-K DOWNSTREAM SEISMIC_GLOBAL BLOCK.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/19/2010
Last Solved Time: 9:14:51 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability

- Description: Sporn Fly Ash Pond Section K-K (Global - Block)
- Kind: SLOPE/W
- Parent: Steady-State Seepage
- Method: Morgenstern-Price
- Settings
  - Side Function
    - Interslice force function option: Half-Sine
  - PWP Conditions Source: Parent Analysis
- SlipSurface
  - Direction of movement: Left to Right
  - Use Passive Mode: No
  - Slip Surface Option: Block
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Restrict Block Crossing: Yes
Advanced
Number of Slices: 150
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 20 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Silty Clay (1)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Gravelly Silty Sand (2)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 108 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Sand and Gravel (3)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Unit Wt. Above Water Table: 114 pcf
Cohesion: 0 psf
Phi: 36 °
Phi-B: 0 °

Bottom Ash (4)
Model: Mohr-Coulomb
Unit Weight: 105 pcf

Unit Wt. Above Water Table: 100 pcf
Cohesion: 0 psf
Phi: 31 °
Phi-B: 0 °

Gravelly Silty Sand (5)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Silty Clay (6)
Model: Mohr-Coulomb
Unit Weight: 128 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Bottom Ash 65 (7)
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 29 °
Phi-B: 0 °

Fly Ash (8)
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 80 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °

Sandy Silt (9)
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Unit Wt. Above Water Table: 100 pcf
Cohesion: 0 psf
Phi: 31 °
Phi-B: 0 °

Clay Foundation (10)
Model: Mohr-Coulomb
Unit Weight: 125 pcf

Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Clay Foundation (11)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 39 °
Phi-B: 0 °

Silty Clay Foundation (12)
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 37 °
Phi-B: 0 °

Original Dike (13)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Foundation Soil (14)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Slip Surface Limits
Left Coordinate: (-150, 597.74003) ft
Right Coordinate: (580, 525) ft

Slip Surface Block
Left Grid
Upper Left: (71, 600) ft
Lower Left: (70, 530) ft

Lower Right: (150, 530) ft
X Increments: 5
Y Increments: 4
Starting Angle: 115 °
Ending Angle: 135 °
Angle Increments: 3

Right Grid

Upper Left: (239, 567) ft
Lower Left: (235, 520) ft
Lower Right: (320, 520) ft
X Increments: 10
Y Increments: 10
Starting Angle: 0 °
Ending Angle: 45 °
Angle Increments: 2

Seismic Loads

Horz Seismic Load: 0.06
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Silty Clay (1)	65,2,25,3,64	203.89047
Region 2	Silty Clay (1)	2,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25	1176.8788
Region 3	Gravelly Silty Sand (2)	10,26,27,28,11	33.408658
Region 4	Sand and Gravel (3)	11,12,13,29,30,28	841.1626
Region 5	Sandy Silt (9)	3,31,22,23,24,25	425.72956
Region 6	Bottom Ash (4)	31,22,21,20,32,33,34	190.90717
Region 7	Silty Clay (6)	35,37,38,39,40,36	554.67017
Region 8	Bottom Ash 65 (7)	37,41,42,38	147.83552
Regio	Original	42,38,39,40,43,44	841.25177

n 9	Dike (13)		
Region 10	Fly Ash (8)	4,45,62,44,42,41,37,35,34,31,3,64	11842.621
Region 11	Gravelly Silty Sand (5)	33,32,46,47,66,43,40,36,35,34	1406.9906
Region 12	Silty Clay Foundation (12)	52,55,56,57,58,53,63	11477.383
Region 13	Foundation Soil (14)	56,59,71,72,60,61,55	21838.358
Region 14	Clay Foundation (11)	45,62,63,52	3563.0574
Region 15	Clay Foundation (10)	62,44,43,66,51,70,50,54,53,63	2091.4421
Region 16	Fly Ash (8)	1,65,64,4	141.5511
Region 17	Bottom Ash (4)	47,67,68,69,70,51,66	102.11485
Region 18	Gravelly Silty Sand (5)	67,48,49,69,68	161.58666
Region 19	Bottom Ash (4)	69,70,50	5.722693

Points

	X (ft)	Y (ft)
Point 1	-150	597.74003
Point 2	20.87006	597.74003
Point 3	20.88514	595.7195
Point 4	-150	595.71741
Point 5	28.29932	599.9386
Point 6	43.4	605
Point 7	66.4449	612.83618
Point 8	71.00682	614.37347

Point 9	75.83799	615.92596
Point 10	83.12625	618.01207
Point 11	89.16676	618.0063
Point 12	67.99514	603.00606
Point 13	160.50996	603.01085
Point 14	164.36012	602.00265
Point 15	175.56909	602.00354
Point 16	179.88561	602.4977
Point 17	214.07092	602.96698
Point 18	216.26115	604.4504
Point 19	218.92113	601.99621
Point 20	228.49429	599.98195
Point 21	207.18559	599.99735
Point 22	204.40592	598.13958
Point 23	32.02668	598.14303
Point 24	26.54626	596.50886
Point 25	20.87931	596.50076
Point 26	89.27093	619.72571
Point 27	103.77188	619.42032
Point 28	111.47933	618.0121
Point 29	135.19671	609.9055
Point 30	123.47463	613.96956
Point 31	200.77083	595.72596
Point 32	240.76421	594.01059
Point 33	222.79049	594.01222
Point 34	198.17913	594.01083
Point 35	178.5748	580.99902
Point 36	248.77756	581.00098
Point 37	165.52362	572.33858
Point 38	228.39764	572.33563
Point 39	239.8063	579.91496
Point 40	250.94764	579.91496
Point 41	161.97373	569.98666
Point 42	224.86913	569.98596
Point 43	288.91143	560.96382
Point 44	211.29094	560.95827

Point 45	-150	560.99795
Point 46	257.89685	585.94071
Point 47	297.73567	569.9851
Point 48	325.50196	568.0018
Point 49	336.18826	565.99579
Point 50	354.42618	558.00394
Point 51	328.18785	559.80842
Point 52	-150	550.07288
Point 53	397.53591	549.83795
Point 54	388.85171	551.97178
Point 55	-150	530.60542
Point 56	486.17654	530.37993
Point 57	440.71606	539.69843
Point 58	420.04463	544.03139
Point 59	523	525
Point 60	523	500.03246
Point 61	-150	499.97967
Point 62	154.97895	560.96884
Point 63	194.99536	549.95765
Point 64	-80.00109	595.71827
Point 65	-80.00109	597.74003
Point 66	321.98827	559.99079
Point 67	304.18497	569.49578
Point 68	322.21879	562.20928
Point 69	349.0118	560.43036
Point 70	348.85409	558.38715
Point 71	580	525
Point 72	580	500

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	1423	1.51	(273, 661)	112.019	(97.7018, 619.548)	(344.704, 562.3)

Slices of Slip Surface: 1423

	Slip	X (ft)	Y (ft)	PWP (psf)	Base	Frictional	Cohesiv

	Surfac e				Normal Stress (psf)	Strength (psf)	e Strengt h (psf)
1	1423	98.471465	618.77855	-1508.9978	60.409526	39.230405	0
2	1423	99.99619	617.2538	-1414.1047	175.79509	127.72261	0
3	1423	101.50645	615.74355	-1320.1838	293.70191	213.38693	0
4	1423	103.01675	614.23325	-1226.3097	410.61616	298.3301	0
5	1423	104.54265	612.70735	-1131.6076	518.21196	376.50303	0
6	1423	106.08415	611.16585	-1036.0111	616.51489	447.92429	0
7	1423	107.62565	609.6244	-940.46044	714.03801	518.77898	0
8	1423	109.1671	608.08295	-844.95568	810.73543	589.03377	0
9	1423	110.70855	606.54145	-749.40504	906.60717	658.68866	0
10	1423	112.16985	605.08015	-658.87391	987.97807	717.80809	0
11	1423	113.55095	603.69905	-573.32116	1055.0481	766.53735	0
12	1423	115.0527	602.1973	-493.11259	1156.6833	780.19275	0
13	1423	116.6751	600.5749	-419.34619	1246.1183	840.51739	0
14	1423	118.2975	598.9525	-346.93962	1334.8123	900.34226	0
15	1423	120.3178	596.9322	-238.87563	1466.5129	881.16987	0
16	1423	122.50075	594.74925	-107.97139	1597.0806	813.7532	0
17	1423	124.28	592.97	- 0.95387602	1645.3253	838.33511	0
18	1423	125.8908	591.3592	95.905607	1707.6615	821.23065	0
19	1423	127.50155	589.74845	194.53733	1769.6027	802.53587	0
20	1423	129.1123	588.1377	294.43772	1830.7975	782.81442	0
21	1423	130.7231	586.5269	394.44786	1891.1144	762.5897	0
22	1423	132.33385	584.91615	498.03136	1951.2996	740.47715	0
23	1423	133.9446	583.3054	605.45161	2011.3092	716.32022	0
24	1423	134.97335	582.45985	661.72725	2671.233	1023.8943	0
25	1423	136.0405	582.268	673.03974	2653.6079	1009.1499	0
26	1423	137.72805	581.9646	690.9447	2628.5876	987.27838	0
27	1423	139.4156	581.66115	709.02462	2603.4507	965.2583	0
28	1423	141.10315	581.3577	727.16287	2578.1971	943.14906	0
29	1423	142.7907	581.0543	745.41776	2552.8269	920.92096	0
30	1423	144.47825	580.7509	764.13923	2527.3401	898.39569	0
31	1423	146.1658	580.4475	783.56057	2501.7949	875.48411	0
32	1423	147.85335	580.1441	803.15687	2476.133	852.42394	0

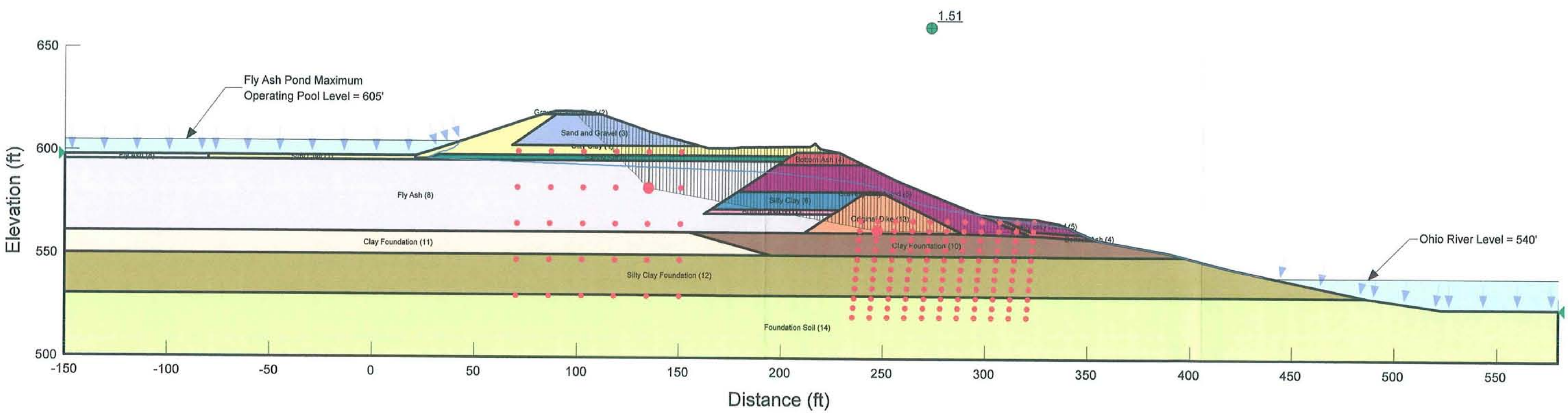
33	1423	149.5409	579.8407	822.92814	2450.3546	829.21518	0
34	1423	151.22845	579.53725	842.87438	2424.4595	805.85785	0
35	1423	152.916	579.2338	862.87894	2398.4477	782.41136	0
36	1423	154.60355	578.9304	883.17511	2372.4359	758.81629	0
37	1423	156.2911	578.627	903.35464	2346.2492	735.1915	0
38	1423	157.97865	578.3236	923.12591	2320.0625	711.77473	0
39	1423	159.6662	578.0202	943.94699	2293.7591	687.76362	0
40	1423	161.4725	577.69545	966.84574	2264.2217	661.04609	0
41	1423	163.39755	577.3493	990.67051	2231.501	632.23474	0
42	1423	165.19155	577.02675	1012.7525	2228.3395	619.37255	0
43	1423	166.85445	576.7278	1034.1783	2254.737	621.90577	0
44	1423	168.51735	576.4288	1056.2551	2281.1937	624.13742	0
45	1423	170.18025	576.1298	1077.3257	2307.6504	626.88174	0
46	1423	171.77125	575.84375	1098.6754	2372.4081	859.14353	0
47	1423	173.2904	575.57065	1121.2216	2445.489	893.22959	0
48	1423	174.80955	575.2975	1143.7031	2518.6994	927.44675	0
49	1423	176.3205	575.0258	1163.1661	2602.7651	971.02178	0
50	1423	177.82335	574.7556	1182.7476	2697.4635	1021.6888	0
51	1423	179.2302	574.50265	1201.4314	2780.7645	1065.2736	0
52	1423	180.699	574.23855	1221.7898	2850.5605	1098.6197	0
53	1423	182.3258	573.94605	1245.3846	2918.5016	1128.5316	0
54	1423	183.95265	573.65355	1269.524	2986.5031	1158.1171	0
55	1423	185.5795	573.3611	1294.1473	3054.4442	1187.3352	0
56	1423	187.2063	573.06865	1319.3152	3122.4458	1216.227	0
57	1423	188.8331	572.77615	1345.088	3190.4474	1244.7106	0
58	1423	190.4599	572.48365	1371.5263	3258.4489	1272.7454	0
59	1423	192.13655	572.1822	1394.7061	3298.5526	1055.3194	0
60	1423	193.863	571.8718	1414.2029	3358.2972	1077.6291	0
61	1423	195.58945	571.56135	1433.6997	3418.1559	1100.002	0
62	1423	197.3159	571.2509	1453.1965	3478.0715	1122.4065	0
63	1423	198.82705	570.97925	1470.1951	3526.3567	1139.749	0
64	1423	200.1229	570.7463	1484.7778	3562.9654	1151.9582	0
65	1423	201.6657	570.4689	1502.1584	3597.8993	1161.6881	0
66	1423	203.45545	570.1471	1522.2855	3631.1694	1168.9735	0
67	1423	205.07305	569.85625	1540.585	3639.0489	1069.2208	0
68	1423	206.4907	569.60135	1556.8082	3642.6083	1062.7682	0

69	1423	208.04625	569.32165	1574.5029	3660.1745	1062.7028	0
70	1423	209.7676	569.01215	1594.1148	3692.2512	1069.0539	0
71	1423	211.48895	568.7027	1613.7268	3724.3851	1075.4341	0
72	1423	213.21025	568.39325	1633.2815	3756.6333	1081.9018	0
73	1423	215.166	568.0416	1655.5156	3885.5029	1136.2353	0
74	1423	216.9261	567.72515	1675.4778	3931.8709	1149.6897	0
75	1423	218.2561	567.486	1690.6482	3799.1854	1074.3533	0
76	1423	219.71145	567.2243	1707.1893	3725.4674	1028.364	0
77	1423	221.64615	566.87645	1694.9976	3782.2236	1355.4604	0
78	1423	223.8298	566.48385	1654.5216	3839.3538	1418.8466	0
79	1423	225.75125	566.1384	1618.9282	3889.6116	1474.5991	0
80	1423	227.5155	565.8212	1587.1298	3935.6356	1525.1375	0
81	1423	228.44595	565.6539	1571.1853	3958.6659	1550.448	0
82	1423	229.3023	565.49995	1556.4162	3940.4037	1548.1796	0
83	1423	230.9183	565.2094	1528.6437	3903.7391	1542.405	0
84	1423	232.5343	564.91885	1500.2013	3867.0746	1537.0655	0
85	1423	234.1503	564.6283	1475.8395	3829.9837	1528.7991	0
86	1423	235.7663	564.33775	1452.0258	3792.8319	1520.1373	0
87	1423	237.3823	564.0472	1426.8722	3755.741	1512.3851	0
88	1423	238.9983	563.75665	1402.1449	3718.4674	1504.2374	0
89	1423	240.28525	563.52525	1382.8644	3688.0836	1497.0269	0
90	1423	241.5562	563.29675	1364.406	3654.5924	1487.2644	0
91	1423	243.14015	563.012	1341.7881	3610.91	1473.585	0
92	1423	244.7241	562.7272	1319.7295	3567.0412	1459.4213	0
93	1423	246.30805	562.4424	1298.1058	3523.1725	1444.9752	0
94	1423	247.9388	562.3	1267.4956	3904.4207	1712.4392	0
95	1423	249.8626	562.3	1221.7522	3782.349	1662.871	0
96	1423	251.81625	562.3	1175.5009	3650.6606	1607.3875	0
97	1423	253.55355	562.3	1134.5178	3532.2011	1557.0737	0
98	1423	255.29085	562.3	1093.8801	3413.4537	1506.3488	0
99	1423	257.02815	562.3	1053.5877	3294.5337	1455.2874	0
100	1423	258.7303	562.3	1014.1373	3185.549	1410.1312	0
101	1423	260.39725	562.3	975.74349	3086.4449	1370.7055	0
102	1423	262.0642	562.3	937.94955	2987.1609	1330.7734	0
103	1423	263.73115	562.3	900.51556	2887.7568	1290.5296	0
104	1423	265.39805	562.3	863.80145	2788.1128	1249.6624	0

105	1423	267.065	562.3	827.44728	2688.4088	1208.5225	0
106	1423	268.73195	562.3	790.97313	2588.6448	1167.4216	0
107	1423	270.39885	562.3	755.39883	2488.8208	1125.6974	0
108	1423	272.0658	562.3	720.84438	2388.8768	1083.2329	0
109	1423	273.73275	562.3	686.70985	2288.9329	1040.4958	0
110	1423	275.39965	562.3	653.41519	2189.0489	997.25217	0
111	1423	277.0666	562.3	620.42048	2089.1649	953.81377	0
112	1423	278.73355	562.3	587.35979	1989.5209	910.57406	0
113	1423	280.40045	562.3	556.42875	1889.7569	865.87341	0
114	1423	282.0674	562.3	526.49955	1790.0529	820.56112	0
115	1423	283.73435	562.3	496.41438	1690.6488	775.54492	0
116	1423	285.40125	562.3	470.22858	1591.0648	727.87955	0
117	1423	287.0562	562.3	456.05849	1507.312	736.09561	0
118	1423	288.6992	562.3	451.40235	1419.7278	678.02878	0
119	1423	290.3422	562.3	446.00366	1332.7523	620.90807	0
120	1423	291.9852	562.3	440.78756	1246.2637	564.00044	0
121	1423	293.6282	562.3	435.44365	1160.3837	507.6085	0
122	1423	295.2712	562.3	428.84593	1075.1124	452.52066	0
123	1423	296.9142	562.3	421.54826	990.5106	398.39172	0
124	1423	298.54185	562.3	413.9488	937.09395	366.31018	0
125	1423	300.15415	562.3	405.04861	914.57988	356.77763	0
126	1423	301.76645	562.3	396.18563	892.12783	347.26246	0
127	1423	303.3788	562.3	387.19861	869.7378	337.87758	0
128	1423	305.0564	562.3	377.33868	850.17825	331.08583	0
129	1423	306.7992	562.3	366.92447	833.48108	326.68646	0
130	1423	308.542	562.3	356.07992	816.8413	322.62859	0
131	1423	310.2848	562.3	344.85667	800.20151	318.83589	0
132	1423	312.0276	562.3	333.45555	783.50435	315.12756	0
133	1423	313.7704	562.3	321.50359	766.92194	311.88529	0
134	1423	315.5132	562.3	309.38524	750.28216	308.71935	0
135	1423	317.31955	562.3	294.17003	733.58002	264.02416	0
136	1423	319.18945	562.3	274.75157	724.54196	270.26133	0
137	1423	321.05935	562.3	255.03898	715.34346	276.57884	0
138	1423	322.8712	562.3	237.94523	705.59096	327.44907	0
139	1423	324.62505	562.3	222.98955	688.77081	326.14355	0
140	1423	326.3925	562.3	208.10758	659.38632	315.98878	0

141	1423	328.17355	562.3	192.8413	617.50091	297.34986	0
142	1423	329.9546	562.3	175.63797	575.89624	280.26386	0
143	1423	331.73565	562.3	158.87258	534.53861	263.04419	0
144	1423	333.5167	562.3	142.59566	493.34943	245.60043	0
145	1423	335.29775	562.3	123.09031	452.44098	230.61382	0
146	1423	337.03985	562.3	104.91303	388.15706	198.32961	0
147	1423	338.74295	562.3	88.408073	300.81174	148.72665	0
148	1423	340.44605	562.3	66.325138	214.15927	103.51457	0
149	1423	342.1492	562.3	41.359853	128.09982	60.735976	0
150	1423	343.85235	562.3	14.578495	42.583486	19.609306	0

Title: Sporn Fly Ash Pond
Comments: Section K-K Downstream Seismic Stability Analysis (Global-Block)
Created By: Roger W. Cecil, P.E.
File Name: SECTION K-K DOWNSTREAM SEISMIC_GLOBAL BLOCK.gsz
Date: 1/19/2010
Horz Seismic Load: 0.06



Slope Stability

File Information

Title: Sporn Fly Ash Pond
Comments: Section K-K Downstream Seismic Stability Analysis (Upper Dike-Circular)
Created By: Roger W. Cecil, P.E.
Revision Number: 58
Last Edited By: Jeff Gateley
Date: 1/19/2010
Time: 9:13:09 AM
File Name: SECTION K-K DOWNSTREAM SEISMIC_UPPER DIKE CIRCLE.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/19/2010
Last Solved Time: 9:15:21 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability

Description: Sporn Fly Ash Pond Section K-K (Upper Dike - Circle)
Kind: SLOPE/W
Parent: Steady-State Seepage
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Parent Analysis

SlipSurface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 50
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 20 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Silty Clay (1)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Gravelly Silty Sand (2)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 108 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Sand and Gravel (3)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Unit Wt. Above Water Table: 114 pcf
Cohesion: 0 psf
Phi: 36 °
Phi-B: 0 °

Bottom Ash (4)
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Unit Wt. Above Water Table: 100 pcf

Cohesion: 0 psf
Phi: 31 °
Phi-B: 0 °

Gravelly Silty Sand (5)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Silty Clay (6)

Model: Mohr-Coulomb
Unit Weight: 128 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Bottom Ash 65 (7)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 29 °
Phi-B: 0 °

Fly Ash (8)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 80 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °

Sandy Silt (9)

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Unit Wt. Above Water Table: 100 pcf
Cohesion: 0 psf
Phi: 31 °
Phi-B: 0 °

Clay Foundation (10)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf

Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Clay Foundation (11)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 39 °
Phi-B: 0 °

Silty Clay Foundation (12)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 37 °
Phi-B: 0 °

Original Dike (13)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Foundation Soil (14)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (88.85, 619.60832) ft
Left-Zone Right Coordinate: (103.79055, 619.41691) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (156.43845, 604.11982) ft
Right-Zone Right Coordinate: (223.8567, 600.95773) ft
Right-Zone Increment: 20
Radius Increments: 20

Slip Surface Limits

Left Coordinate: (-150, 597.74003) ft
Right Coordinate: (580, 525) ft

Seismic Loads

Horz Seismic Load: 0.06
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Silty Clay (1)	65,2,25,3,64	203.89047
Region 2	Silty Clay (1)	2,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25	1176.8788
Region 3	Gravelly Silty Sand (2)	10,26,27,28,11	33.408658
Region 4	Sand and Gravel (3)	11,12,13,29,30,28	841.1626
Region 5	Sandy Silt (9)	3,31,22,23,24,25	425.72956
Region 6	Bottom Ash (4)	31,22,21,20,32,33,34	190.90717
Region 7	Silty Clay (6)	35,37,38,39,40,36	554.67017
Region 8	Bottom Ash 65 (7)	37,41,42,38	147.83552
Region 9	Original Dike (13)	42,38,39,40,43,44	841.25177
Region 10	Fly Ash (8)	4,45,62,44,42,41,37,35,34,31,3,64	11842.621
Region 11	Gravelly Silty Sand (5)	33,32,46,47,66,43,40,36,35,34	1406.9906
Region 12	Silty Clay Foundation (12)	52,55,56,57,58,53,63	11477.383

Region 13	Foundation Soil (14)	56,59,71,72,60,61,55	21838.358
Region 14	Clay Foundation (11)	45,62,63,52	3563.0574
Region 15	Clay Foundation (10)	62,44,43,66,51,70,50,54,53,63	2091.4421
Region 16	Silty Clay (1)	1,65,64,4	141.5511
Region 17	Bottom Ash (4)	47,67,68,69,70,51,66	102.11485
Region 18	Gravelly Silty Sand (5)	67,48,49,69,68	161.58666
Region 19	Bottom Ash (4)	69,70,50	5.722693

Points

	X (ft)	Y (ft)
Point 1	-150	597.74003
Point 2	20.87006	597.74003
Point 3	20.88514	595.7195
Point 4	-150	595.71741
Point 5	28.29932	599.9386
Point 6	43.4	605
Point 7	66.4449	612.83618
Point 8	71.00682	614.37347
Point 9	75.83799	615.92596
Point 10	83.12625	618.01207
Point 11	89.16676	618.0063
Point 12	67.99514	603.00606
Point 13	160.50996	603.01085
Point 14	164.36012	602.00265
Point 15	175.56909	602.00354
Point 16	179.88561	602.4977

Point 17	214.07092	602.96698
Point 18	216.26115	604.4504
Point 19	218.92113	601.99621
Point 20	228.49429	599.98195
Point 21	207.18559	599.99735
Point 22	204.40592	598.13958
Point 23	32.02668	598.14303
Point 24	26.54626	596.50886
Point 25	20.87931	596.50076
Point 26	89.27093	619.72571
Point 27	103.77188	619.42032
Point 28	111.47933	618.0121
Point 29	135.19671	609.9055
Point 30	123.47463	613.96956
Point 31	200.77083	595.72596
Point 32	240.76421	594.01059
Point 33	222.79049	594.01222
Point 34	198.17913	594.01083
Point 35	178.5748	580.99902
Point 36	248.77756	581.00098
Point 37	165.52362	572.33858
Point 38	228.39764	572.33563
Point 39	239.8063	579.91496
Point 40	250.94764	579.91496
Point 41	161.97373	569.98666
Point 42	224.86913	569.98596
Point 43	288.91143	560.96382
Point 44	211.29094	560.95827
Point 45	-150	560.99795
Point 46	257.89685	585.94071
Point 47	297.73567	569.9851
Point 48	325.50196	568.0018
Point 49	336.18826	565.99579
Point 50	354.42618	558.00394
Point 51	328.18785	559.80842
Point 52	-150	550.07288

Point 53	397.53591	549.83795
Point 54	388.85171	551.97178
Point 55	-150	530.60542
Point 56	486.17654	530.37993
Point 57	440.71606	539.69843
Point 58	420.04463	544.03139
Point 59	523	525
Point 60	523	500.03246
Point 61	-150	499.97967
Point 62	154.97895	560.96884
Point 63	194.99536	549.95765
Point 64	-80.00109	595.71827
Point 65	-80.00109	597.74003
Point 66	321.98827	559.99079
Point 67	304.18497	569.49578
Point 68	322.21879	562.20928
Point 69	349.0118	560.43036
Point 70	348.85409	558.38715
Point 71	580	525
Point 72	580	500

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	1020	2.26	(142.286, 649.352)	58.542	(91.8254, 619.672)	(176.927, 602.159)

Slices of Slip Surface: 1020

	Slip Surfac e	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesiv e Strengt h (psf)
1	1020	92.33382	618.8396	- 1555.684 2	63.594089	41.298484	0
2	1020	93.75304	616.65535	-	229.63125	166.83687	0

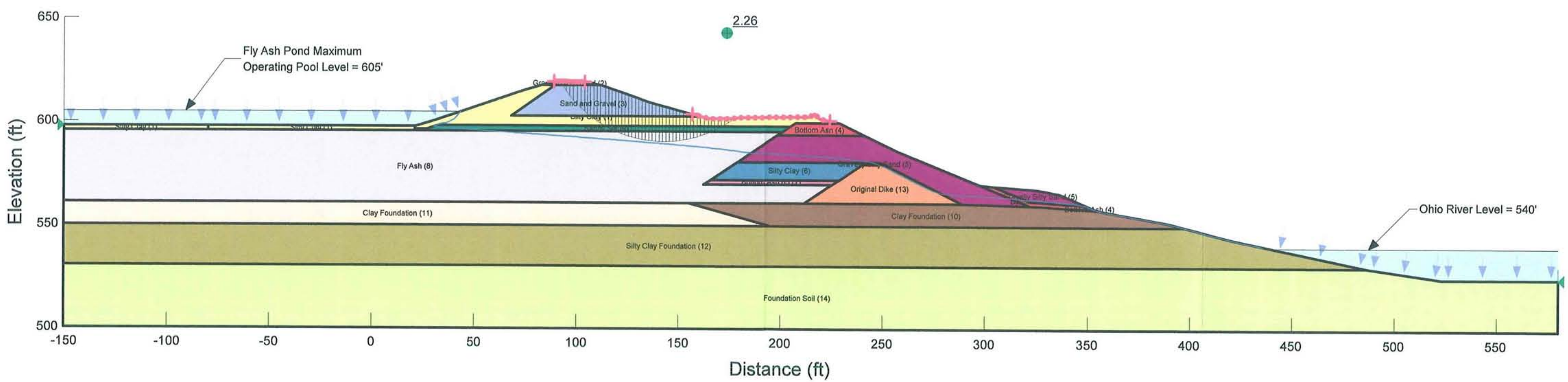
				1419.1957			
3	1020	95.574645	614.09665	-1259.5493	435.51449	316.4198	0
4	1020	97.396255	611.8011	-1116.7844	624.75256	453.9093	0
5	1020	99.21788	609.7225	-987.87643	800.23344	581.40363	0
6	1020	101.0395	607.82795	-870.60157	964.46592	700.72551	0
7	1020	102.8611	606.09315	-763.52603	1119.3621	813.26418	0
8	1020	104.4582	604.6819	-676.53627	1240.2146	901.06863	0
9	1020	105.83085	603.5544	-607.08588	1328.5098	965.21885	0
10	1020	107.34425	602.3927	-548.14387	1440.8603	971.87252	0
11	1020	108.9983	601.20555	-501.37627	1547.1451	1043.5626	0
12	1020	110.6523	600.1026	-460.51999	1649.267	1112.4446	0
13	1020	112.6996	598.8564	-417.90578	1750.7428	1180.8909	0
14	1020	114.735	597.70655	-372.09202	1841.7884	1106.6581	0
15	1020	116.36525	596.86915	-	1885.1747	1132.7272	0

				327.92701			
16	1020	117.9955	596.0948	-287.72024	1926.3203	1157.45	0
17	1020	119.58795	595.396	-251.57415	1971.3984	1004.4777	0
18	1020	121.14265	594.7679	-219.17976	1994.9425	1016.474	0
19	1020	122.6973	594.19075	-190.0561	2016.8799	1027.6516	0
20	1020	124.3119	593.64455	-163.129	2036.7825	1037.7925	0
21	1020	125.9865	593.13165	-138.55145	2054.3836	1046.7607	0
22	1020	127.6611	592.6729	-117.49536	2069.3523	1054.3877	0
23	1020	129.3357	592.26695	-99.736013	2081.3181	1060.4845	0
24	1020	131.01025	591.9126	-85.230785	2089.8389	1064.8261	0
25	1020	132.6848	591.609	-74.058671	2094.4018	1067.151	0
26	1020	134.3594	591.35535	-66.017809	2094.607	1067.2556	0
27	1020	136.0405	591.1504	-61.087484	2097.2898	1068.6225	0
28	1020	137.72805	590.994	-59.396617	2102.0991	1071.073	0
29	1020	139.4156	590.88665	-	2101.0522	1070.5396	0

				60.79018 4			
30	1020	141.10315	590.82815	- 65.28842 1	2093.5544	1066.7192	0
31	1020	142.7907	590.8184	- 73.00844 4	2078.9126	1059.2589	0
32	1020	144.47825	590.8573	- 83.77868 6	2056.4505	1047.8139	0
33	1020	146.1658	590.94495	- 97.64857	2025.5205	1032.0542	0
34	1020	147.85335	591.0816	- 114.7333 6	1985.5064	1011.6661	0
35	1020	149.5409	591.2676	- 134.8885 7	1935.8333	986.35631	0
36	1020	151.22845	591.50345	- 158.1816 3	1876.09	955.91559	0
37	1020	152.916	591.7897	- 184.6995 8	1805.8557	920.12942	0
38	1020	154.60355	592.12715	- 214.3551 1	1724.8281	878.84382	0
39	1020	156.2911	592.5167	- 247.2109 2	1632.8257	831.96623	0
40	1020	157.97865	592.9594	- 283.3007 5	1529.8526	779.49884	0
41	1020	159.6662	593.4566	- 322.6372 3	1416.1001	721.53902	0
42	1020	161.4725	594.05295	- 368.4865	1280.7835	652.59178	0

				8			
43	1020	163.39755	594.7591	-421.38382	1122.6211	572.00401	0
44	1020	165.06255	595.428	-470.4962	1004.9134	512.02896	0
45	1020	166.5791	596.0961	-518.03327	944.35244	567.42419	0
46	1020	168.20735	596.8696	-572.11703	833.83717	501.01992	0
47	1020	169.83565	597.706	-630.19347	714.12896	429.09197	0
48	1020	171.4697	598.61185	-685.01442	585.25966	394.76263	0
49	1020	173.10945	599.59125	-740.95541	412.69433	278.36584	0
50	1020	174.7492	600.64555	-805.94661	230.15302	155.24017	0
51	1020	176.2478	601.67545	-869.92524	68.205547	46.005222	0

Title: Sporn Fly Ash Pond
Comments: Section K-K Downstream Seismic Stability Analysis (Upper Dike-Circular)
Created By: Roger W. Cecil, P.E.
File Name: SECTION K-K DOWNSTREAM SEISMIC_UPPER DIKE CIRCLE.gsz
Date: 1/19/2010
Horz Seismic Load: 0.06



SPP00003450

Slope Stability

File Information

Title: Sporn Fly Ash Pond
Comments: Section K-K Downstream Seismic Stability Analysis (Upper Dike-Block)
Created By: Roger W. Cecil, P.E.
Revision Number: 96
Last Edited By: Jeff Gateley
Date: 1/19/2010
Time: 9:12:45 AM
File Name: SECTION K-K DOWNSTREAM SEISMIC_UPPER DIKE BLOCK.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/19/2010
Last Solved Time: 9:15:06 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability

Description: Sporn Fly Ash Pond Section K-K (Upper Dike - Block)
Kind: SLOPE/W
Parent: Steady-State Seepage
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Parent Analysis

SlipSurface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Block
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Restrict Block Crossing: Yes
Advanced
Number of Slices: 50
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 20 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Silty Clay (1)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Gravelly Silty Sand (2)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 108 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Sand and Gravel (3)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Unit Wt. Above Water Table: 114 pcf
Cohesion: 0 psf
Phi: 36 °
Phi-B: 0 °

Bottom Ash (4)

Model: Mohr-Coulomb
Unit Weight: 105 pcf

Unit Wt. Above Water Table: 100 pcf
Cohesion: 0 psf
Phi: 31 °
Phi-B: 0 °

Gravelly Silty Sand (5)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Unit Wt. Above Water Table: 110 pcf
Cohesion: 0 psf
Phi: 35 °
Phi-B: 0 °

Silty Clay (6)

Model: Mohr-Coulomb
Unit Weight: 128 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Bottom Ash 65 (7)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 65 pcf
Cohesion: 0 psf
Phi: 29 °
Phi-B: 0 °

Fly Ash (8)

Model: Mohr-Coulomb
Unit Weight: 90 pcf
Unit Wt. Above Water Table: 80 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °

Sandy Silt (9)

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Unit Wt. Above Water Table: 100 pcf
Cohesion: 0 psf
Phi: 31 °
Phi-B: 0 °

Clay Foundation (10)

Model: Mohr-Coulomb
Unit Weight: 125 pcf

Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Clay Foundation (11)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 39 °
Phi-B: 0 °

Silty Clay Foundation (12)
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 37 °
Phi-B: 0 °

Original Dike (13)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Foundation Soil (14)
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 125 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °

Slip Surface Limits
Left Coordinate: (-150, 597.74003) ft
Right Coordinate: (580, 525) ft

Slip Surface Block
Left Grid
Upper Left: (71, 600) ft
Lower Left: (70, 590) ft

Lower Right: (150, 590) ft
X Increments: 5
Y Increments: 3
Starting Angle: 115 °
Ending Angle: 135 °
Angle Increments: 3

Right Grid

Upper Left: (160, 601.5) ft
Lower Left: (160, 590) ft
Lower Right: (215, 590) ft
X Increments: 10
Y Increments: 3
Starting Angle: 0 °
Ending Angle: 45 °
Angle Increments: 2

Seismic Loads

Horz Seismic Load: 0.06
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Silty Clay (1)	65,2,25,3,64	203.89047
Region 2	Silty Clay (1)	2,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25	1176.8788
Region 3	Gravelly Silty Sand (2)	10,26,27,28,11	33.408658
Region 4	Sand and Gravel (3)	11,12,13,29,30,28	841.1626
Region 5	Sandy Silt (9)	3,31,22,23,24,25	425.72956
Region 6	Bottom Ash (4)	31,22,21,20,32,33,34	190.90717
Region 7	Silty Clay (6)	35,37,38,39,40,36	554.67017
Region 8	Bottom Ash 65 (7)	37,41,42,38	147.83552
Regio	Original	42,38,39,40,43,44	841.25177

n 9	Dike (13)		
Region 10	Fly Ash (8)	4,45,62,44,42,41,37,35,34,31,3,64	11842.621
Region 11	Gravelly Silty Sand (5)	33,32,46,47,66,43,40,36,35,34	1406.9906
Region 12	Silty Clay Foundation (12)	52,55,56,57,58,53,63	11477.383
Region 13	Foundation Soil (14)	56,59,71,72,60,61,55	21838.358
Region 14	Clay Foundation (11)	45,62,63,52	3563.0574
Region 15	Clay Foundation (10)	62,44,43,66,51,70,50,54,53,63	2091.4421
Region 16	Fly Ash (8)	1,65,64,4	141.5511
Region 17	Bottom Ash (4)	47,67,68,69,70,51,66	102.11485
Region 18	Gravelly Silty Sand (5)	67,48,49,69,68	161.58666
Region 19	Bottom Ash (4)	69,70,50	5.722693

Points

	X (ft)	Y (ft)
Point 1	-150	597.74003
Point 2	20.87006	597.74003
Point 3	20.88514	595.7195
Point 4	-150	595.71741
Point 5	28.29932	599.9386
Point 6	43.4	605
Point 7	66.4449	612.83618
Point 8	71.00682	614.37347

Point 9	75.83799	615.92596
Point 10	83.12625	618.01207
Point 11	89.16676	618.0063
Point 12	67.99514	603.00606
Point 13	160.50996	603.01085
Point 14	164.36012	602.00265
Point 15	175.56909	602.00354
Point 16	179.88561	602.4977
Point 17	214.07092	602.96698
Point 18	216.26115	604.4504
Point 19	218.92113	601.99621
Point 20	228.49429	599.98195
Point 21	207.18559	599.99735
Point 22	204.40592	598.13958
Point 23	32.02668	598.14303
Point 24	26.54626	596.50886
Point 25	20.87931	596.50076
Point 26	89.27093	619.72571
Point 27	103.77188	619.42032
Point 28	111.47933	618.0121
Point 29	135.19671	609.9055
Point 30	123.47463	613.96956
Point 31	200.77083	595.72596
Point 32	240.76421	594.01059
Point 33	222.79049	594.01222
Point 34	198.17913	594.01083
Point 35	178.5748	580.99902
Point 36	248.77756	581.00098
Point 37	165.52362	572.33858
Point 38	228.39764	572.33563
Point 39	239.8063	579.91496
Point 40	250.94764	579.91496
Point 41	161.97373	569.98666
Point 42	224.86913	569.98596
Point 43	288.91143	560.96382
Point 44	211.29094	560.95827

Point 45	-150	560.99795
Point 46	257.89685	585.94071
Point 47	297.73567	569.9851
Point 48	325.50196	568.0018
Point 49	336.18826	565.99579
Point 50	354.42618	558.00394
Point 51	328.18785	559.80842
Point 52	-150	550.07288
Point 53	397.53591	549.83795
Point 54	388.85171	551.97178
Point 55	-150	530.60542
Point 56	486.17654	530.37993
Point 57	440.71606	539.69843
Point 58	420.04463	544.03139
Point 59	523	525
Point 60	523	500.03246
Point 61	-150	499.97967
Point 62	154.97895	560.96884
Point 63	194.99536	549.95765
Point 64	-80.00109	595.71827
Point 65	-80.00109	597.74003
Point 66	321.98827	559.99079
Point 67	304.18497	569.49578
Point 68	322.21879	562.20928
Point 69	349.0118	560.43036
Point 70	348.85409	558.38715
Point 71	580	525
Point 72	580	500

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	2081	2.43	(189, 650)	41.563	(91.9984, 619.668)	(180.953, 602.512)

Slices of Slip Surface: 2081

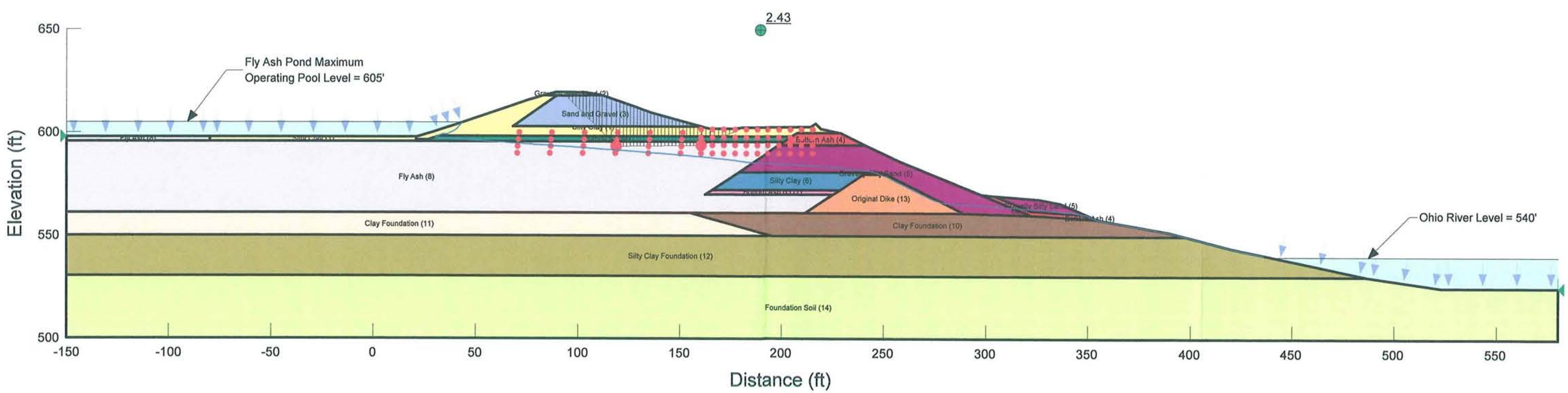
	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	2081	92.8288	618.8379	-1555.6505	72.928836	47.36054	0
2	2081	94.501925	617.16475	-1451.2612	214.63914	155.94447	0
3	2081	96.18737	615.4793	-1346.2511	357.62143	259.82718	0
4	2081	97.872815	613.79385	-1241.4928	496.10209	360.43926	0
5	2081	99.55827	612.1084	-1136.9024	630.39577	458.00933	0
6	2081	101.2437	610.42295	-1032.5636	760.87166	552.80562	0
7	2081	102.92915	608.7375	-928.30874	887.90736	645.10246	0
8	2081	104.58635	607.08035	-825.9336	999.09923	725.88808	0
9	2081	106.2152	605.45145	-725.39422	1095.4278	795.87485	0
10	2081	107.84405	603.8226	-624.89826	1190.2369	864.75774	0
11	2081	109.3637	602.303	-546.66863	1298.2377	875.6724	0
12	2081	110.7741	600.89255	-492.4579	1388.6807	936.67695	0

				9			
13	2081	112.5023	599.16435	-429.21926	1484.9694	1001.6245	0
14	2081	114.73455	596.93215	-324.59568	1602.1612	962.6756	0
15	2081	117.13855	594.5281	-186.25622	1704.7225	868.5995	0
16	2081	119.1902	593.3436	-121.19221	2569.8864	1309.4225	0
17	2081	120.904	593.3642	-130.10761	2516.7908	1282.3689	0
18	2081	122.61775	593.38475	-139.1572	2462.6449	1254.7802	0
19	2081	124.3119	593.40505	-148.0979	2406.9342	1226.3943	0
20	2081	125.9865	593.42515	-156.9532	2349.7301	1197.2473	0
21	2081	127.6611	593.44525	-165.94584	2291.3317	1167.4918	0
22	2081	129.3357	593.46535	-174.93251	2231.6793	1137.0974	0
23	2081	131.01025	593.48545	-183.94306	2170.8924	1106.1249	0
24	2081	132.6848	593.50555	-193.09095	2108.7918	1074.4831	0
25	2081	134.3594	593.52565	-202.23884	2045.5567	1042.2632	0
26	2081	136.08255	593.54635	-211.6784	1987.5369	1012.7006	0

				7			
27	2081	137.8542	593.5676	-221.52726	1934.7654	985.81223	0
28	2081	139.62585	593.58885	-231.37605	1880.6394	958.23365	0
29	2081	141.39755	593.6101	-241.28128	1825.3282	930.05115	0
30	2081	143.1692	593.63135	-251.2881	1768.7752	901.23598	0
31	2081	144.94085	593.65265	-261.28928	1711.1499	871.87442	0
32	2081	146.71255	593.6739	-271.36383	1652.3958	841.93771	0
33	2081	148.4842	593.69515	-281.49483	1592.6258	811.48336	0
34	2081	150.25585	593.7164	-291.62582	1532.0091	780.59764	0
35	2081	152.0275	593.73765	-301.80761	1470.5459	749.28056	0
36	2081	153.79915	593.75895	-312.00633	1408.2925	717.56088	0
37	2081	155.57085	593.7802	-322.20505	1345.4747	685.55361	0
38	2081	157.3425	593.80145	-332.38683	1282.0361	653.23001	0
39	2081	159.11415	593.8227	-342.55169	1218.2024	620.70511	0

40	2081	160.255	593.93895	-355.43167	1418.6106	722.81821	0
41	2081	161.4725	594.4433	-392.60121	1292.1775	658.39734	0
42	2081	163.39755	595.2407	-451.04555	1095.0275	557.94437	0
43	2081	164.4631	595.68205	-483.27968	992.12971	505.51534	0
44	2081	165.53805	596.1273	-515.32967	947.96325	569.59379	0
45	2081	167.48195	596.9325	-572.69413	818.54864	491.83364	0
46	2081	169.42585	597.7377	-630.39129	693.4114	416.64361	0
47	2081	171.2597	598.4973	-678.80712	579.54531	390.90825	0
48	2081	172.98345	599.2113	-722.00637	452.23615	305.03714	0
49	2081	174.7072	599.9253	-769.81498	329.94367	222.54982	0
50	2081	176.64825	600.72925	-823.30087	216.91857	146.31342	0
51	2081	178.8065	601.6232	-885.67021	113.50619	76.560893	0
52	2081	180.4193	602.2913	-932.88475	31.662513	21.356635	0

Title: Sporn Fly Ash Pond
Comments: Section K-K Downstream Seismic Stability Analysis (Upper Dike-Block)
Created By: Roger W. Cecil, P.E.
File Name: SECTION K-K DOWNSTREAM SEISMIC_UPPER DIKE BLOCK.gsz
Date: 1/19/2010
Horz Seismic Load: 0.06



PHILIP SPORN FLY ASH POND
EASTERN DIKE ASSESSMENT
SLOPE STABILITY ANALYSIS SUMMARY
GA FILE NO. 09-387

GENERAL

Geo/Environmental Associates, Inc. (GA) has prepared seismic (pseudo-static) slope stability analyses on the upper dike of the Sporn Fly Ash Pond - Eastern Dike. Specifically, GA has evaluated three critical sections (i.e., Section K-K, Section L-L, and Section M-M) through the Eastern Dike using the computer program *SLOPE/W*. *SLOPE/W* is developed by GEO-SLOPE International, Ltd. of Calgary, Alberta, Canada.

The slope stability analyses provided herein are based on the Morgenstern-Price Limit Equilibrium Method (M-P LEM) provided in the *SLOPE/W* program. The M-P LEM is a robust method that satisfies both moment and force equilibrium conditions. Furthermore, the M-P LEM is capable of utilizing user defined functions to develop both shear and normal interslice forces. More specifically, the half-sine function was applied to the slope stability analyses provided herein to determine interslice forces.

The slope analyses were performed in both the upstream and downstream directions for each of the critical sections. At the request of the USEPA, both circular-type (slope) and block-type (i.e., base sliding) slip surfaces were modeled in the slope stability analyses for critical Eastern Dike Sections K-K, L-L, and M-M. The slope stability analyses were assessed for full height (i.e., labeled as Global) and partial height (i.e., labeled as Upper Dike) potential failure planes. The phreatic levels used in the analyses were imported into the program from *SEEP/W*. It should be noted that the modeled seepage phreatic levels are approximately equal to or higher than the actual piezometric levels measured in the field. Therefore, we believe that the seepage data applied in the stability analyses lend to a generally conservative analysis approach. At the recommendation of the USEPA, a horizontal pseudo-static acceleration of 0.06 *g* was applied in the slope stability analyses.

MATERIAL PARAMETERS

Strength parameters for the various embankment and foundation materials used in the slope stability analyses for critical Sections K-K, L-L, and M-M are provided in Tables IV-1, IV-2, and IV-3, respectively. In general, the strength parameters were selected based on previous parameters developed by AEP and based on laboratory testing conducted by GA in December 2009 and January 2010. Effective stress conditions were assumed; therefore, material parameters used in the slope stability analyses and presented herein are effective strength parameters. Additionally, the Mohr-Coulomb material model was used.

TABLE IV-1 SOIL MATERIAL PARAMETERS USED FOR SECTION K-K ANALYSES							
Soil Layer Number	Material Type	Location	Unit Weight (pcf)		Effective Strength Parameters		Material Parameter Source
			Moist	Saturated	c' (psf)	ϕ'	
1	Silty Clay	1972 Embankment Extension	125	130	0	34	From AEP K-K Stability Analyses in 1998 Report
2	Gravelly Silty Sand	1972 Embankment Extension	108	115	0	33	From AEP K-K Stability Analyses in 1998 Report
3	Sand & Gravel	1972 Embankment Extension	114	120	0	36	From AEP K-K Stability Analyses in 1998 Report
4	Bottom Ash (68)	1968 Embankment Extension	100	105	0	31	From AEP K-K Stability Analyses in 1998 Report
5	Gravelly Silty Sand	1968 Embankment Extension	110	115	0	35	From AEP K-K Stability Analyses in 1998 Report
6	Silty Clay	1965 Embankment Extension	120	128	0	34	From AEP K-K Stability Analyses in 1998 Report
7	Bottom Ash (65)	1965 Embankment Extension	65	90	0	29	From AEP K-K Stability Analyses in 1998 Report
8	Fly Ash	Fly Ash Pond	80	90	0	27	From AEP K-K Stability Analyses in 1998 Report
9	Sandy Silt	1972 Embankment Extension	100	105	0	31	From AEP K-K Stability Analyses in 1998 Report
10	Clay Foundation	Upper Foundation Soil	120	125	0	33	From AEP K-K Stability Analyses in 1998 Report
11	Clay Foundation	Upper Foundation Soil	125	130	0	39	From AEP K-K Stability Analyses in 1998 Report
12	Silty Clay Foundation	Mid-Level Foundation Soil	120	125	0	37	From AEP K-K Stability Analyses in 1998 Report
13	Silty Clay	Original Dike	125	130	0	33	From AEP K-K Stability Analyses in 1998 Report
14	Foundation Soil	Lower Foundation	125	130	0	32	From AEP K-K Stability Analyses in 1998 Report

TABLE IV-2 SOIL MATERIAL PARAMETERS USED FOR SECTION L-L ANALYSES							
Soil Layer Number	Material Type	Location	Unit Weight (pcf)		Effective Strength Parameters		Material Parameter Source
			Moist	Saturated	c' (psf)	ϕ'	
1	Sandy Silty Clay	1972 Embankment Extension	125	130	0	34	From AEP L-L Stability Analyses in 1998 Report
2	Road Fill	1972 Embankment Extension	108	115	0	33	From AEP L-L Stability Analyses in 1998 Report
3	Gravelly Silty Sand	1972 Embankment Extension	114	120	0	36	From AEP L-L Stability Analyses in 1998 Report
4	Gravelly Silty Sand	1972 Embankment Extension	100	105	0	31	From AEP L-L Stability Analyses in 1998 Report
5	Bottom Ash	1968 Embankment Extension	110	115	0	35	From AEP L-L Stability Analyses in 1998 Report
6	Silty Sand & Gravel	1968 Embankment Extension	120	128	0	34	From AEP L-L Stability Analyses in 1998 Report
7	Silty Sandy Clay	1965 Embankment Extension	65	90	0	29	From AEP L-L Stability Analyses in 1998 Report
8	Silty Clay	1965 Embankment Extension	80	90	0	33	From AEP L-L Stability Analyses in 1998 Report
9	Fly Ash	Fly Ash Pond	100	105	0	27	From AEP L-L Stability Analyses in 1998 Report
10	Clay Foundation	Upper Foundation Soil	120	125	0	33	From AEP L-L Stability Analyses in 1998 Report
11	Clay Foundation	Upper Foundation Soil	125	130	0	39	From AEP L-L Stability Analyses in 1998 Report
12	Silty Clay Foundation	Lower Foundation Soil	120	125	0	37	From AEP L-L Stability Analyses in 1998 Report

TABLE IV-3 SOIL MATERIAL PARAMETERS USED FOR SECTION M-M ANALYSES							
			Unit Weight (pcf)		Effective Strength Parameters		
Soil Layer Number	Material Type	Location	Moist	Saturated	c' (psf)	ϕ'	Material Parameter Source
1	Sandy Silty Clay	1972 Embankment Extension	125	130	0	34	From AEP M-M Stability Analyses in 2009 Report
2	Gravelly Silty Sand	1972 Embankment Extension	125	125	0	35	From AEP M-M Stability Analyses in 2009 Report
3	Bottom Ash	1995 Embankment Modifications	65	90	0	36	From M-M Stability Analyses in 1998 Report
4	Silty Sand w/ Gravel	1968 Embankment Extension	115	120	0	32	From AEP M-M Stability Analyses in 2009 Report
5	Sandy Silt	1965 Embankment Extension	125	130	0	34	From AEP M-M Stability Analyses in 2009 Report
6	Silty Clay	Original Soil Dike	125	130	0	33	From AEP M-M Stability Analyses in 2009 Report
7	Fly Ash	Fly Ash Pond	110	110	0	27	From AEP M-M Stability Analyses in 2009 Report
8	Brown Clay	Upper Foundation Soil	120	125	0	37	From AEP M-M Stability Analyses in 2009 Report
9	Silty Clay	Lower Foundation Soil	122	126	170	31.2	From Triaxial Testing on GA-1C ST-2
10	Sandstone	Foundation	Modeled as Impenetrable				
11	Bottom Ash 2	1972 Embankment Extension	65	90	0	32	From AEP M-M Stability Analyses in 2009 Report

SLOPE STABILITY ANALYSIS RESULTS

Graphical output from the *SLOPE/W* slope stability analyses are provided in this appendix. Specifically, the results show the critical slip surface and corresponding safety factor for each of the modeled conditions. The slope stability analysis results are tabulated in Table IV-4.

TABLE IV-4 SUMMARY OF *SLOPE/W* SLOPE STABILITY SAFETY FACTORS			
Critical Section	**Direction**	**Condition**	**Safety Factor**
K-K	Upstream	Circular-Type Slip	1.93
		Block-Type Slip	2.01
	Downstream	Global Circular-Type Slip	1.33
		Global Block-Type Slip	1.51
		Upper Dike Circular-Type Slip	2.26
		Upper Dike Block-Type Slip	2.43
L-L	Upstream	Circular-Type Slip	1.90
		Block-Type Slip	1.96
	Downstream	Global Circular-Type Slip	1.71
		Global Block-Type Slip	1.71
		Upper Dike Circular-Type Slip	2.27
		Upper Dike Block-Type Slip	2.51
M-M	Upstream	Circular-Type Slip	1.70
		Block-Type Slip	1.80
	Downstream	Global Circular-Type Slip	1.35
		Global Block-Type Slip	1.50
		Upper Dike Circular-Type Slip	1.81
		Upper Dike Block-Type Slip	1.90

SUMMARY OF RESULTS

Based on current engineering standard of practice and the West Virginia Department of Environmental Protection - Dam Safety Rule §47-34-7.4.b.1.D.1(d), the minimum recommended factor of safety for an embankment regarding seismic (pseudo-static) slope stability is 1.2. As shown in Table IV-4 and in the results provided herein, the seismic slope stability safety factors are in excess of 1.2 for the conservatively modeled conditions applied to the critical sections (i.e., Section K-K, Section L-L, and Section M-M) along the Fly Ash Pond - Eastern Dike. Therefore, we conclude that the upper dike of the Sporn Fly Ash Pond - Eastern Dike, in its as-built condition, meets and/or exceeds requirements for seismic slope stability.

Steady-State Seepage

File Information

Title: Sporn Fly Ash Pond
Comments: Section M-M Seepage Analysis
Created By: Roger W. Cecil, P.E.
Revision Number: 71
Last Edited By: Roger Cecil
Date: 1/18/2010
Time: 7:06:29 PM
File Name: SECTION M-M SEEPAGE.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/18/2010
Last Solved Time: 7:06:42 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Mass(M) Units: lbs
Mass Flux Units: lbs/sec
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Steady-State Seepage

Description: Sporn Fly Ash Pond Section M-M Seepage
Kind: SEEP/W
Method: Steady-State
Settings
- Include Air Flow: No

Control
- Apply Runoff: Yes

Convergence
- Convergence Type: Gauss Point K
- Convergence Settings
  - Maximum Number of Iterations: 500
  - Tolerance: 0.01
  - Maximum Change in K: 0.1

Rate of Change in K: 1.02
Minimum Change in K: 0.0001
Equation Solver: Parallel Direct
Potential Seepage Max # of Reviews: 10
Time
Starting Time: 0 sec
Duration: 0 sec
Ending Time: 0 sec

Materials

Sandy Silty Clay (1)
Model: Saturated / Unsaturated
Hydraulic
K-Function: Sandy Silty Clay
K-Ratio: 9
K-Direction: 90 °

Gravelly Silty Sand (2)
Model: Saturated / Unsaturated
Hydraulic
K-Function: Gravelly Silty Sand
K-Ratio: 9
K-Direction: 90 °

Bottom Ash (3)
Model: Saturated / Unsaturated
Hydraulic
K-Function: Bottom Ash
K-Ratio: 9
K-Direction: 90 °

Silty Sand and Gravel (4)
Model: Saturated / Unsaturated
Hydraulic
K-Function: Silty Sand with Gravel
K-Ratio: 9
K-Direction: 90 °

Sandy Silt (5)
Model: Saturated / Unsaturated
Hydraulic
K-Function: Sandy Silt
K-Ratio: 9
K-Direction: 90 °

Silty Clay (6)

Model: Saturated / Unsaturated
Hydraulic
K-Function: Silty Clay
K-Ratio: 9
K-Direction: 90 °

Fly Ash (7)

Model: Saturated / Unsaturated
Hydraulic
K-Function: Fly Ash
K-Ratio: 10
K-Direction: 90 °

Brown Clay (8)

Model: Saturated / Unsaturated
Hydraulic
K-Function: Brown Foundation Clay
K-Ratio: 9
K-Direction: 90 °

Silty Clay (9)

Model: Saturated / Unsaturated
Hydraulic
K-Function: Silty Clay
K-Ratio: 9
K-Direction: 90 °

Sandstone (10)

Model: Saturated Only
Hydraulic
K-Sat: 1e-008 ft/sec
Volumetric Water Content: 0 ft^3/ft^3
Mv: 0 /psf
K-Ratio: 9
K-Direction: 90 °

Bottom Ash 2 (11)

Model: Saturated / Unsaturated
Hydraulic
K-Function: Bottom Ash
K-Ratio: 9
K-Direction: 90 °

Boundary Conditions

Ohio River

Type: Head (H) 540

Potential Seepage Face

Review: true
Type: Unit Flux (q) 0

Fly Ash Pond

Type: Head (H) 605

Flux Sections

Flux Section 1

Coordinates
- Coordinate: (293, 585) ft
- Coordinate: (293, 473) ft
- Coordinate: (293, 437) ft

K Functions

Sandy Silty Clay

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
- Curve Fit to Data: 100 %
- Segment Curvature: 42 %

K-Saturation: 2e-007
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
- Data Point: (0.05, 2e-007)
- Data Point: (0.1, 2e-007)
- Data Point: (0.84851, 2e-007)
- Data Point: (7.1998, 1.282561e-007)
- Data Point: (61.091, 4.6544715e-008)
- Data Point: (410.04, 5.5146341e-009)
- Data Point: (4398.4, 7.9841463e-012)
- Data Point: (37321, 4.6784553e-014)
- Data Point: (316680, 7.4378049e-016)
- Data Point: (964730, 6.1280488e-017)
- Data Point: (2687000, 7.8504065e-018)

Estimation Properties
- Hydraulic K Sat: 0 ft/sec
- Hyd. K-Function Estimation Method: Van Genuchten Function
- Maximum: 1000

Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft³/ft³

Fly Ash

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 42 %
K-Saturation: 2.2e-006
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 2.2e-006)
Data Point: (0.1, 2.2e-006)
Data Point: (0.84851, 2.2e-006)
Data Point: (7.1998, 1.7835427e-006)
Data Point: (61.091, 1.2705671e-006)
Data Point: (518.37, 2.2124756e-007)
Data Point: (4398.4, 5.3366768e-010)
Data Point: (25333, 5.5729756e-013)
Data Point: (37321, 2.0299695e-013)
Data Point: (316680, 4.4452744e-016)
Data Point: (2415100, 2.5504573e-018)
Data Point: (2687000, 1.9977073e-018)
Estimation Properties
Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft³/ft³

Bottom Ash

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 42 %
K-Saturation: 9.5e-006
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 9.5e-006)
Data Point: (0.1, 9.5e-006)
Data Point: (0.84851, 9.5e-006)
Data Point: (7.1998, 8.4395035e-006)
Data Point: (61.091, 6.323766e-006)
Data Point: (518.37, 1.5704645e-008)
Data Point: (4398.4, 4.416422e-011)
Data Point: (25333, 2.5678972e-012)
Data Point: (37321, 1.4526241e-012)
Data Point: (316680, 4.5725993e-014)

Data Point: (2415100, 8.0258156e-016)
Data Point: (2687000, 6.4188333e-016)
Data Point: (4804900, 1.8231915e-016)

Estimation Properties

Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft³/ft³

Brown Foundation Clay

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 40 %
K-Saturation: 1.6e-008
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 1.6e-008)
Data Point: (0.1, 1.6e-008)
Data Point: (0.84851, 1.6e-008)
Data Point: (61.091, 9.0158049e-009)
Data Point: (518.37, 1.391122e-009)
Data Point: (4398.4, 3.163122e-011)
Data Point: (25333, 6.9640976e-013)
Data Point: (37321, 3.3350244e-013)
Data Point: (316680, 5.5125854e-015)
Data Point: (2415100, 7.6470244e-017)
Data Point: (2687000, 6.0554146e-017)
Data Point: (4804900, 1.6557073e-017)
Data Point: (7194700, 6.4148293e-018)

Estimation Properties

Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft³/ft³

Silty Clay

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 40 %
K-Saturation: 1.2e-008
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 1.2e-008)
Data Point: (0.1, 1.2e-008)

Data Point: (0.84851, 1.2e-008)
Data Point: (61.091, 6.7618537e 009)
Data Point: (518.37, 1.0433415e-009)
Data Point: (4398.4, 2.3723415e-011)
Data Point: (25333, 5.2230732e 013)
Data Point: (37321, 2.5012683e-013)
Data Point: (316680, 4.134439e-015)
Data Point: (2415100, 5.7352683e 017)
Data Point: (2687000, 4.541561e-017)
Data Point: (4804900, 1.2417805e-017)
Data Point: (7194700, 4.811122e 018)

Estimation Properties

Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Gravelly Silty Sand

Model: Data Point Function
Function: X-Conductivity vs. Pore Water Pressure

Curve Fit to Data: 100 %
Segment Curvature: 42 %

K-Saturation: 0.00021
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)

Data Point: (0.05, 0.00021)
Data Point: (0.1, 0.00021)
Data Point: (0.84851, 0.00021)
Data Point: (7.1998, 0.00021)
Data Point: (61.087, 0.00014519661)
Data Point: (518.37, 2.7604915e-007)
Data Point: (4398.4, 1.1747068e-010)
Data Point: (25333, 7.5777966e 013)
Data Point: (37321, 3.3240508e-013)
Data Point: (316680, 3.3684237e-015)
Data Point: (2415100, 2.8970508e 017)
Data Point: (2687000, 2.2525763e-017)

Estimation Properties

Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Silty Sand with Gravel

Model: Data Point Function

Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 40 %
K-Saturation: 6.6e-005
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 6.6e-005)
Data Point: (0.1, 6.6e-005)
Data Point: (0.84851, 6.6e-005)
Data Point: (7.1998, 4.9767745e-005)
Data Point: (61.091, 2.0882213e-006)
Data Point: (518.37, 6.4129532e-009)
Data Point: (4398.4, 2.6239915e-011)
Data Point: (25333, 2.8829362e-013)
Data Point: (37321, 1.2569021e-013)
Data Point: (316680, 1.4333702e-015)
Estimation Properties
Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Sandy Silt

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 42 %
K-Saturation: 1.3e-006
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 1.3e-006)
Data Point: (0.1, 1.3e-006)
Data Point: (0.84851, 1.3e-006)
Data Point: (7.1998, 1.2971847e-006)
Data Point: (61.087, 9.5007643e-007)
Data Point: (518.37, 5.7439299e-008)
Data Point: (4398.4, 4.9929936e-011)
Data Point: (25333, 6.0648726e-013)
Data Point: (37321, 2.1972484e-013)
Data Point: (316680, 1.6731911e-015)
Data Point: (2415100, 1.9197771e-017)
Data Point: (2687000, 1.5238153e-017)
Estimation Properties
Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20

Residual Water Content: 0 ft³/ft³

Regions

	Material	Points	Area (ft²)
Region 1	Sandy Silty Clay (1)	108,2,3,109	201.13421
Region 2	Sandy Silty Clay (1)	2,110,5,6,7,8,9,10,11,12,13,14,3	962.07207
Region 3	Gravelly Silty Sand (2)	7,15,16,17,8	31.119887
Region 4	Gravelly Silty Sand (2)	9,10,17,8	819.48221
Region 5	Bottom Ash (3)	11,18,19,20,21,22,23,24,25,26,27,28,12	423.64067
Region 6	Gravelly Silty Sand (2)	20,29,30,31,32,33,21	32.648671
Region 7	Sandy Silt (5)	26,34,35,36,37,23,24,25	282.19505
Re	Silty	23,22,21,33,38,39,40,41,42,43,44,45,46,47,37	1565.

gio n 8	Sand and Gravel (4)		2892
Region 9	Sandy Silt (5)	36,37,47,48	531.21818
Region 10	Silty Clay (6)	36,48,49,50,51,52,53,54,55,35	989.52619
Region 11	Fly Ash (7)	4,56,57,58,59,60,61,62,55,35,34,26,27,28,14,3,109	8370.9742
Region 12	Brown Clay (8)	56,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,111,93,94,95,96,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,62,61,60,59,58,57	6985.7443
Region 13	Silty Clay (9)	91,97,98,99,100,101,102,103,104,105,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90	25156.343
Region 14	Sandstone (10)	105,106,107,98,99,100,101,102,103,104	34015.546
Region 15	Fly Ash (7)	1,108,109,4	70.533781
Region 16	Bottom Ash 2 (11)	12,28,14,13	324.85555

Lines

	Start Point	End Point	Hydraulic Boundary
Line 1	2	3	
Line 2	5	6	
Line 3	6	7	
Line 4	7	8	
Line 5	8	9	
Line 6	9	10	
Line 7	10	11	
Line 8	11	12	
Line 9	12	13	
Line 10	13	14	
Line 11	14	3	
Line 12	7	15	
Line 13	15	16	
Line 14	16	17	
Line 15	17	8	
Line 16	10	17	
Line 17	11	18	
Line 18	18	19	
Line 19	19	20	
Line 20	20	21	
Line 21	21	22	
Line 22	22	23	
Line 23	23	24	
Line 24	24	25	
Line 25	25	26	
Line 26	26	27	
Line 27	27	28	
Line 28	28	14	
Line 29	20	29	
Line 30	29	30	
Line 31	30	31	
Line 32	31	32	Potential Seepage Face
Line 33	32	33	Potential Seepage Face

Line 34	33	21	
Line 35	26	34	
Line 36	34	35	
Line 37	35	36	
Line 38	36	37	
Line 39	37	23	
Line 40	33	38	Potential Seepage Face
Line 41	38	39	Potential Seepage Face
Line 42	39	40	
Line 43	40	41	
Line 44	41	42	
Line 45	42	43	
Line 46	43	44	
Line 47	44	45	
Line 48	45	46	
Line 49	46	47	
Line 50	47	37	
Line 51	47	48	
Line 52	48	36	
Line 53	48	49	
Line 54	49	50	
Line 55	50	51	
Line 56	51	52	
Line 57	52	53	
Line 58	53	54	
Line 59	54	55	
Line 60	55	35	
Line 61	4	56	
Line 62	56	57	
Line 63	57	58	
Line 64	58	59	
Line 65	59	60	
Line 66	60	61	
Line 67	61	62	
Line 68	62	55	
Line 69	56	63	

Line 70	63	64	
Line 71	64	65	
Line 72	65	66	
Line 73	66	67	
Line 74	67	68	
Line 75	68	69	
Line 76	69	70	
Line 77	70	71	
Line 78	71	72	
Line 79	72	73	
Line 80	73	74	
Line 81	74	75	
Line 82	75	76	
Line 83	76	77	
Line 84	77	78	
Line 85	78	79	
Line 86	79	80	
Line 87	80	81	
Line 88	81	82	
Line 89	82	83	
Line 90	83	84	
Line 91	84	85	
Line 92	85	86	
Line 93	86	87	
Line 94	87	88	
Line 95	88	89	
Line 96	89	90	
Line 97	90	91	
Line 98	91	92	Ohio River
Line 99	93	94	Potential Seepage Face
Line 100	94	95	Potential Seepage Face
Line 101	95	96	Potential Seepage Face
Line 102	96	39	Potential Seepage Face
Line 103	91	97	Ohio River
Line 104	97	98	
Line 105	98	99	

Line 106	99	100	
Line 107	100	101	
Line 108	101	102	
Line 109	102	103	
Line 110	103	104	
Line 111	104	105	
Line 112	105	63	
Line 113	105	106	
Line 114	106	107	
Line 115	107	98	
Line 116	108	2	Fly Ash Pond
Line 117	3	109	
Line 118	109	4	
Line 119	109	108	
Line 120	1	108	Fly Ash Pond
Line 121	4	1	
Line 122	2	110	Fly Ash Pond
Line 123	110	5	
Line 124	92	111	Ohio River
Line 125	111	93	Potential Seepage Face
Line 126	28	12	

Points

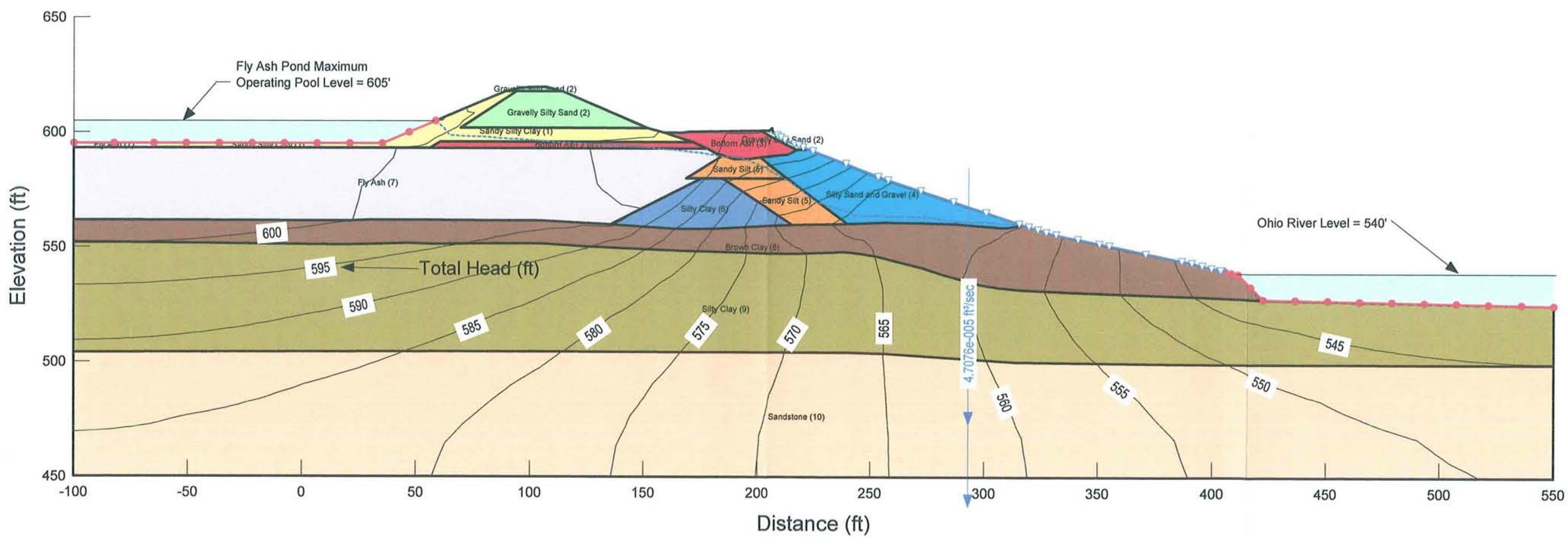
	X (ft)	Y (ft)
Point 1	-100	595.12092
Point 2	35.36015	595.10746
Point 3	35.37077	593.10938
Point 4	-100	593.10516
Point 5	60.72629	605.9827
Point 6	74.8905	612.04606
Point 7	89.08286	617.98267
Point 8	93.72016	617.98376
Point 9	69.42633	602.00461
Point 10	151.61692	602.00605
Point 11	158.87128	599.99208

Point 12	171.82425	595.91741
Point 13	60.47732	595.91216
Point 14	56.0411	593.12487
Point 15	95.74708	619.48275
Point 16	106.57718	619.95406
Point 17	114.07579	617.99114
Point 18	166.70528	600.0213
Point 19	169.58045	600.43082
Point 20	200.94364	600.90024
Point 21	217.30273	592.80917
Point 22	213.38189	590.83858
Point 23	200.88583	589.29528
Point 24	195.25394	588.59744
Point 25	189.42126	588.62008
Point 26	184.5	590.20374
Point 27	181.51772	591.16693
Point 28	177.65846	593.12697
Point 29	204.98541	600.97594
Point 30	206.35442	602.21331
Point 31	206.71422	599.99306
Point 32	214.00828	595.98847
Point 33	222.27612	592.82454
Point 34	168.66722	580.09858
Point 35	175.21974	580.09858
Point 36	184.51087	580.09817
Point 37	213.24737	580.09272
Point 38	255.42934	580.07172
Point 39	317.48058	559.92079
Point 40	315.59736	559.88781
Point 41	309.9739	558.80103
Point 42	307.4465	558.76312
Point 43	287.58173	560.34006
Point 44	273.69358	560.81173
Point 45	259.80542	560.94275
Point 46	255.45555	560.94275
Point 47	239.61428	560.44981

Point 48	215.41971	560.03735
Point 49	206.90911	559.67804
Point 50	185.33019	558.38907
Point 51	177.08328	558.01754
Point 52	173.62075	558.106
Point 53	169.80438	558.01754
Point 54	164.66112	558.14391
Point 55	135.13429	560.09691
Point 56	-100	561.74545
Point 57	20.16974	561.49271
Point 58	28.34588	561.72018
Point 59	50.65765	561.88173
Point 60	61.94724	561.81622
Point 61	89.85457	561.6852
Point 62	105.36228	561.59785
Point 63	-100	552.17166
Point 64	19.23461	550.94335
Point 65	32.24565	551.32246
Point 66	41.85988	551.67124
Point 67	47.10676	551.74706
Point 68	56.64516	551.4741
Point 69	78.08761	551.61058
Point 70	95.40534	551.48927
Point 71	105.51999	551.66113
Point 72	114.75208	551.07983
Point 73	124.43302	550.29735
Point 74	142.61209	549.56582
Point 75	165.69351	548.62684
Point 76	187.96697	548.08092
Point 77	205.85125	547.44765
Point 78	216.92246	547.535
Point 79	233.69307	548.10276
Point 80	236.99041	548.14643
Point 81	242.18755	547.92806
Point 82	246.77327	547.31663
Point 83	252.65171	546.21606

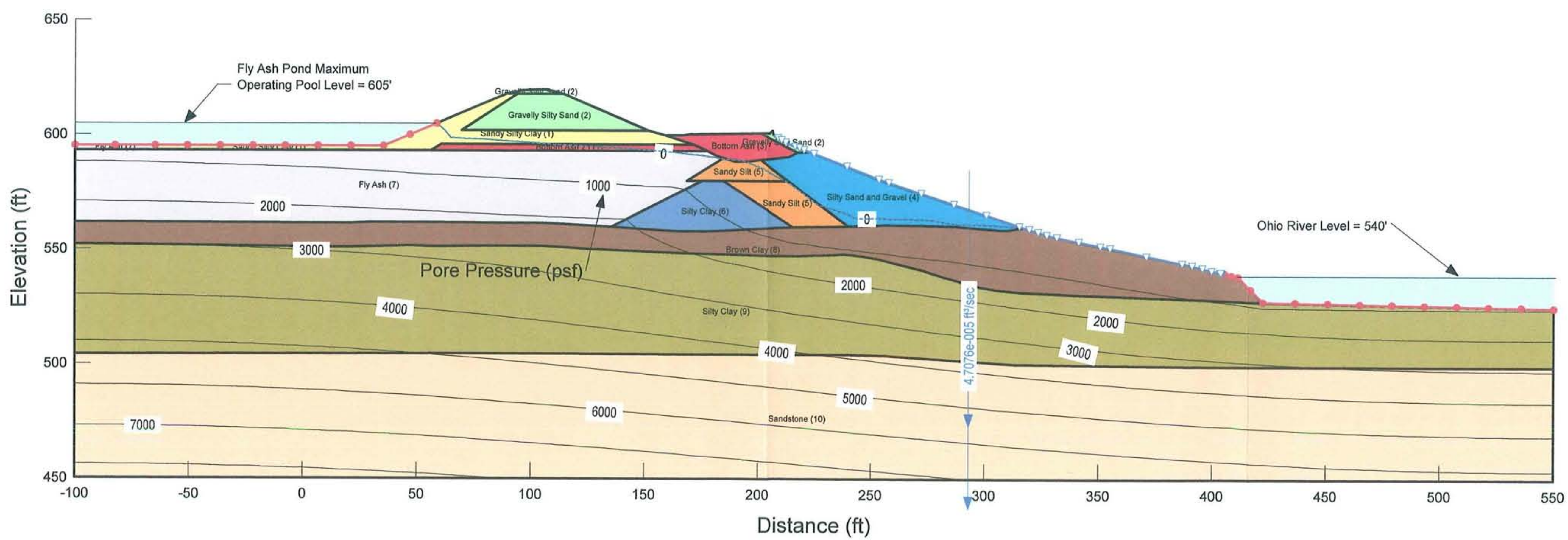
Point 84	273.24811	541.09055
Point 85	281.07788	538.66929
Point 86	297.9009	534.10978
Point 87	305.69923	532.66332
Point 88	316.39049	531.68853
Point 89	338.77924	530.77663
Point 90	389.87718	528.88993
Point 91	422.60496	527.57608
Point 92	411.3282	538.58079
Point 93	401.8504	540.81657
Point 94	388.80805	543.92059
Point 95	352.80366	551.31013
Point 96	329.44346	556.01129
Point 97	550	524.91002
Point 98	550	499.15439
Point 99	396.01919	499.3174
Point 100	313.20998	500.09985
Point 101	256.3846	503.93603
Point 102	240.95296	504.37072
Point 103	191.37067	504.40695
Point 104	86.37793	504.45549
Point 105	100	504.13087
Point 106	-100	449.97963
Point 107	550	450.03403
Point 108	-64.96913	595.11744
Point 109	-64.96913	593.10625
Point 110	58.47531	605
Point 111	405.33383	539.99484

Title: Sporn Fly Ash Pond
Comments: Section M-M Seepage Analysis
Created By: Roger W. Cecil, P.E.
File Name: SECTION M-M SEEPAGE.gsz
Date: 1/18/2010



SPP00003383

Title: Sporn Fly Ash Pond
Comments: Section M-M Seepage Analysis
Created By: Roger W. Cecil, P.E.
File Name: SECTION M-M SEEPAGE.gsz
Date: 1/18/2010



Steady-State Seepage

File Information

Title: Sporn Fly Ash Pond - Seismic Stability Analyses
Comments: Section L-L Seepage Analysis
Created By: Roger W. Cecil, P.E.
Revision Number: 55
Last Edited By: Roger Cecil
Date: 1/19/2010
Time: 5:59:32 AM
File Name: SECTION L-L SEEPAGE.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/19/2010
Last Solved Time: 6:02:06 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Mass(M) Units: lbs
Mass Flux Units: lbs/sec
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Steady-State Seepage

- Kind: SEEP/W
- Method: Steady-State
- Settings
  - Include Air Flow: No
- Control
  - Apply Runoff: Yes
- Convergence
  - Convergence Type: Gauss Point K
  - Convergence Settings
    - Maximum Number of Iterations: 500
    - Tolerance: 0.01
    - Maximum Change in K: 0.1
    - Rate of Change in K: 1.02

Minimum Change in K: 0.0001
Equation Solver: Parallel Direct
Potential Seepage Max # of Reviews: 10
Time
Starting Time: 0 sec
Duration: 0 sec
Ending Time: 0 sec

Materials

Sandy Silty Clay (1)
Model: Saturated / Unsaturated
Hydraulic
K-Function: Sandy Silty Clay
K-Ratio: 9
K-Direction: 90 °

Road Fill (2)
Model: Saturated / Unsaturated
Hydraulic
K-Function: Gravelly Silty Sand
K-Ratio: 9
K-Direction: 90 °

Gravelly Silty Sand (3)
Model: Saturated / Unsaturated
Hydraulic
K-Function: Gravelly Silty Sand
K-Ratio: 9
K-Direction: 90 °

Gravelly Silty Sand (4)
Model: Saturated / Unsaturated
Hydraulic
K-Function: Gravelly Silty Sand
K-Ratio: 9
K-Direction: 90 °

Bottom Ash (5)
Model: Saturated / Unsaturated
Hydraulic
K-Function: Bottom Ash
K-Ratio: 9
K-Direction: 90 °

Silty Sand & Gravel (6)

Model: Saturated / Unsaturated
Hydraulic
K-Function: Silty Sand with Gravel
K-Ratio: 9
K-Direction: 90 °

Silty Sandy Clay (7)

Model: Saturated / Unsaturated
Hydraulic
K-Function: Silty Sandy Clay
K-Ratio: 9
K-Direction: 90 °

Silty Clay (8)

Model: Saturated / Unsaturated
Hydraulic
K-Function: Silty Clay
K-Ratio: 9
K-Direction: 90 °

Fly Ash (9)

Model: Saturated / Unsaturated
Hydraulic
K-Function: Fly Ash
K-Ratio: 10
K-Direction: 90 °

Clay Foundation (10)

Model: Saturated / Unsaturated
Hydraulic
K-Function: Brown Foundation Clay
K-Ratio: 9
K-Direction: 90 °

Clay Foundation (11)

Model: Saturated / Unsaturated
Hydraulic
K-Function: Gray Foundation Clay
K-Ratio: 9
K-Direction: 90 °

Silty Clay Foundation (12)

Model: Saturated / Unsaturated
Hydraulic
K-Function: Gray Foundation Clay
K-Ratio: 9

K-Direction: 90 °

Boundary Conditions

Fly Ash Pond

Type: Head (H) 605

Potential Seepage Face

Review: true
Type: Unit Flux (q) 0

Ohio River

Type: Head (H) 540

Flux Sections

Flux Section 1

Coordinates
Coordinate: (310, 586) ft
Coordinate: (310, 486) ft

K Functions

Sandy Silty Clay

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 42 %
K-Saturation: 2e-007
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 2e-007)
Data Point: (0.1, 2e-007)
Data Point: (0.84851, 2e-007)
Data Point: (7.1998, 1.282561e-007)
Data Point: (61.091, 4.6544715e-008)
Data Point: (410.04, 5.5146341e-009)
Data Point: (4398.4, 7.9841463e-012)
Data Point: (37321, 4.6784553e-014)
Data Point: (316680, 7.4378049e-016)
Data Point: (964730, 6.1280488e-017)
Data Point: (2687000, 7.8504065e-018)
Estimation Properties
Hydraulic K Sat: 0 ft/sec

Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Fly Ash

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 42 %
K-Saturation: 2.2e-006
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 2.2e-006)
Data Point: (0.1, 2.2e-006)
Data Point: (0.84851, 2.2e-006)
Data Point: (7.1998, 1.7835427e-006)
Data Point: (61.091, 1.2705671e-006)
Data Point: (518.37, 2.2124756e-007)
Data Point: (4398.4, 5.3366768e-010)
Data Point: (25333, 5.5729756e-013)
Data Point: (37321, 2.0299695e-013)
Data Point: (316680, 4.4452744e-016)
Data Point: (2415100, 2.5504573e-018)
Data Point: (2687000, 1.9977073e-018)
Estimation Properties
Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Bottom Ash

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 42 %
K-Saturation: 9.5e-006
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 9.5e-006)
Data Point: (0.1, 9.5e-006)
Data Point: (0.84851, 9.5e-006)
Data Point: (7.1998, 8.4395035e-006)
Data Point: (61.091, 6.323766e-006)
Data Point: (518.37, 1.5704645e-008)
Data Point: (4398.4, 4.416422e-011)
Data Point: (25333, 2.5678972e-012)

Data Point: (37321, 1.4526241e-012)
Data Point: (316680, 4.5725993e-014)
Data Point: (2415100, 8.0258156e-016)
Data Point: (2687000, 6.4188333e-016)
Data Point: (4804900, 1.8231915e-016)

Estimation Properties

Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Gray Foundation Clay

Model: Data Point Function

Function: X Conductivity vs. Pore Water Pressure

Curve Fit to Data: 100 %
Segment Curvature: 40 %

K-Saturation: 3.6e-009

Data Points: Matric Suction (psf), X-Conductivity (ft/sec)

Data Point: (0.05, 3.6e-009)
Data Point: (0.1, 3.6e-009)
Data Point: (0.39536, 3.5907652e-009)
Data Point: (1.5631, 3.5683826e-009)
Data Point: (6.18, 3.5150087e-009)
Data Point: (24.433, 3.387913e-009)
Data Point: (96.6, 3.0914609e-009)
Data Point: (381.92, 2.4337565e-009)
Data Point: (1510, 1.2219183e-009)
Data Point: (5969.8, 1.569913e-010)
Data Point: (16286, 9.4554783e-012)
Data Point: (23603, 2.7879652e-012)
Data Point: (93315, 2.2589217e-014)
Data Point: (368930, 1.6295478e-016)
Data Point: (1458600, 1.160687e-018)
Data Point: (1585500, 8.5974261e-019)
Data Point: (3154800, 7.2333391e-020)
Data Point: (4724000, 1.6921565e-020)
Data Point: (5766900, 8.2558957e-021)
Data Point: (6293300, 6.0292174e-021)
Data Point: (7862500, 2.7064174e-021)
Data Point: (9431800, 1.4061443e-021)
Data Point: (11001000, 8.082313e-022)
Data Point: (12570000, 5.0022783e-022)
Data Point: (14139000, 3.276e-022)
Data Point: (15709000, 2.2432696e-022)
Data Point: (17278000, 1.5926087e-022)
Data Point: (18847000, 1.1648191e-022)

Data Point: (20416000, 8.7354783e-023)
Data Point: (21986000, 6.6922435e-023)
Data Point: (22800000, 5.8714435e-023)

Estimation Properties

Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Brown Foundation Clay

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 40 %
K-Saturation: 1.6e-008
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 1.6e-008)
Data Point: (0.1, 1.6e-008)
Data Point: (0.84851, 1.6e-008)
Data Point: (61.091, 9.0158049e-009)
Data Point: (518.37, 1.391122e-009)
Data Point: (4398.4, 3.163122e-011)
Data Point: (25333, 6.9640976e-013)
Data Point: (37321, 3.3350244e-013)
Data Point: (316680, 5.5125854e-015)
Data Point: (2415100, 7.6470244e-017)
Data Point: (2687000, 6.0554146e-017)
Data Point: (4804900, 1.6557073e-017)
Data Point: (7194700, 6.4148293e-018)

Estimation Properties

Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Silty Clay

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 40 %
K-Saturation: 1.2e-008
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 1.2e-008)
Data Point: (0.1, 1.2e-008)

Data Point: (0.84851, 1.2e-008)
Data Point: (61.091, 6.7618537e-009)
Data Point: (518.37, 1.0433415e-009)
Data Point: (4398.4, 2.3723415e-011)
Data Point: (25333, 5.2230732e-013)
Data Point: (37321, 2.5012683e-013)
Data Point: (316680, 4.134439e-015)
Data Point: (2415100, 5.7352683e-017)
Data Point: (2687000, 4.541561e-017)
Data Point: (4804900, 1.2417805e-017)
Data Point: (7194700, 4.811122e-018)

Estimation Properties

Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Silty Sandy Clay

Model: Data Point Function

Function: X-Conductivity vs. Pore Water Pressure

Curve Fit to Data: 100 %
Segment Curvature: 40 %

K-Saturation: 1.2e-008

Data Points: Matric Suction (psf), X-Conductivity (ft/sec)

Data Point: (0.05, 1.2e-008)
Data Point: (0.1, 1.2e-008)
Data Point: (0.84851, 1.2e-008)
Data Point: (61.091, 6.7618537e-009)
Data Point: (518.37, 1.0433415e-009)
Data Point: (4398.4, 2.3723415e-011)
Data Point: (25333, 5.2230732e-013)
Data Point: (37321, 2.5012683e-013)
Data Point: (316680, 4.134439e-015)
Data Point: (2415100, 5.7352683e-017)
Data Point: (2687000, 4.541561e-017)
Data Point: (4804900, 1.2417805e-017)
Data Point: (7194700, 4.811122e-018)

Estimation Properties

Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Gravelly Silty Sand

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 42 %
K-Saturation: 0.00021
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 0.00021)
Data Point: (0.1, 0.00021)
Data Point: (0.84851, 0.00021)
Data Point: (7.1998, 0.00021)
Data Point: (61.087, 0.00014519661)
Data Point: (518.37, 2.7604915e-007)
Data Point: (4398.4, 1.1747068e-010)
Data Point: (25333, 7.5777966e-013)
Data Point: (37321, 3.3240508e-013)
Data Point: (316680, 3.3684237e-015)
Data Point: (2415100, 2.8970508e-017)
Data Point: (2687000, 2.2525763e-017)
Estimation Properties
Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Silty Sand with Gravel

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 40 %
K-Saturation: 6.6e-005
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 6.6e-005)
Data Point: (0.1, 6.6e-005)
Data Point: (0.84851, 6.6e-005)
Data Point: (7.1998, 4.9767745e-005)
Data Point: (61.091, 2.0882213e-006)
Data Point: (518.37, 6.4129532e-009)
Data Point: (4398.4, 2.6239915e-011)
Data Point: (25333, 2.8829362e-013)
Data Point: (37321, 1.2569021e-013)
Data Point: (316680, 1.4333702e-015)
Estimation Properties
Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function

Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Regions

	Material	Points	Area (ft^2)
Region 1	Sandy Silty Clay (1)	105,2,3,106	198.64495
Region 2	Sandy Silty Clay (1)	2,5,6,7,8,9,10,11,12,99,13,14,15,16,17,18,19,3	1797.2287
Region 3	Road Fill (2)	11,20,21,22,12	50.839704
Region 4	Silty Sand & Gravel (6)	15,24,25,26,27,17,16	116.203
Region 5	Bottom Ash (5)	17,27,28,29,18	191.73337
Region 6	Silty Sand & Gravel (6)	19,18,29,30,31	391.82116
Region 7	Silty Sand & Gravel (6)	29,28,32,33,34,35,36,102,101,37,38,100,30	923.61928
Region 8	Silty Sandy Clay (7)	39,49,41,40	312.45828
Region 9	Silty Clay (8)	49,50,42,41	623.99905
Region 10	Fly Ash (9)	50,51,52,4,106,3,19,31,39,49	8353.7652
Regi	Clay	52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,	5937.015

on 11	Foundation (10)	74,75,51	1
Region 12	Clay Foundation (11)	51,50,42,43,44,45,46,47,48,38,37,76,77,78,79,80,81,82,83,84,85,86,87,88,89,69,70,71,72,73,74,75	4582.5269
Region 13	Silty Sand & Gravel (6)	103,90,91,92,104	107.81573
Region 14	Silty Clay Foundation (12)	53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,89,88,87,86,85,84,83,95,96,107,108,97,98	32386.101
Region 15	Gravelly Silty Sand (3)	12,22,23,99	270.1759
Region 16	Gravelly Silty Sand (4)	23,14,13,99	428.27559
Region 17	Silty Clay (8)	100,38,48,47,46,45,44,43,42,41	583.66388
Region 18	Silty Sandy Clay (7)	100,41,40,39,31,30	875.82886
Region 19	Bottom Ash (5)	103,104,92,93,101,102,36	285.90427
Region 20	Silty Sand & Gravel (6)	101,93,94,79,78,77,76,37	493.02893
Region 21	Fly Ash (9)	1,105,106,4	41.39401

Lines

	Start Point	End Point	Hydraulic Boundary
Line 1	2	3	
Line 2	2	5	Fly Ash Pond
Line 3	5	6	
Line 4	6	7	
Line 5	7	8	
Line 6	8	9	
Line 7	9	10	
Line 8	10	11	
Line 9	11	12	
Line 10	13	14	
Line 11	14	15	
Line 12	15	16	
Line 13	16	17	
Line 14	17	18	
Line 15	18	19	
Line 16	19	3	
Line 17	11	20	
Line 18	20	21	
Line 19	21	22	
Line 20	22	12	
Line 21	15	24	
Line 22	24	25	
Line 23	25	26	
Line 24	26	27	Potential Seepage Face
Line 25	27	17	
Line 26	27	28	Potential Seepage Face
Line 27	28	29	
Line 28	29	18	
Line 29	29	30	
Line 30	30	31	
Line 31	31	19	
Line 32	28	32	Potential Seepage Face
Line 33	32	33	Potential Seepage Face

Line 34	33	34	Potential Seepage Face
Line 35	34	35	Potential Seepage Face
Line 36	35	36	Potential Seepage Face
Line 37	37	38	
Line 38	31	39	
Line 39	39	40	
Line 40	40	41	
Line 41	41	42	
Line 42	42	43	
Line 43	43	44	
Line 44	44	45	
Line 45	45	46	
Line 46	46	47	
Line 47	47	48	
Line 48	48	38	
Line 49	39	49	
Line 50	49	41	
Line 51	49	50	
Line 52	50	42	
Line 53	50	51	
Line 54	51	52	
Line 55	52	4	
Line 56	52	53	
Line 57	53	54	
Line 58	54	55	
Line 59	55	56	
Line 60	56	57	
Line 61	57	58	
Line 62	58	59	
Line 63	59	60	
Line 64	60	61	
Line 65	61	62	
Line 66	62	63	
Line 67	63	64	
Line 68	64	65	
Line 69	65	66	

Line 70	66	67	
Line 71	67	68	
Line 72	68	69	
Line 73	69	70	
Line 74	70	71	
Line 75	71	72	
Line 76	72	73	
Line 77	73	74	
Line 78	74	75	
Line 79	75	51	
Line 80	37	76	
Line 81	76	77	
Line 82	77	78	
Line 83	78	79	
Line 84	79	80	
Line 85	80	81	Potential Seepage Face
Line 86	81	82	Potential Seepage Face
Line 87	82	83	Potential Seepage Face
Line 88	83	84	
Line 89	84	85	
Line 90	85	86	
Line 91	86	87	
Line 92	87	88	
Line 93	88	89	
Line 94	89	69	
Line 95	90	91	Potential Seepage Face
Line 96	91	92	Potential Seepage Face
Line 97	83	95	Potential Seepage Face
Line 98	95	96	Ohio River
Line 99	97	98	
Line 100	98	53	
Line 101	12	99	
Line 102	99	13	
Line 103	22	23	
Line 104	23	99	
Line 105	23	14	

Line 106	38	100	
Line 107	100	30	
Line 108	41	100	
Line 109	101	37	
Line 110	36	102	
Line 111	102	101	
Line 112	103	90	Potential Seepage Face
Line 113	92	104	
Line 114	104	103	
Line 115	92	93	Potential Seepage Face
Line 116	93	101	
Line 117	36	103	Potential Seepage Face
Line 118	93	94	Potential Seepage Face
Line 119	94	79	Potential Seepage Face
Line 120	105	2	Fly Ash Pond
Line 121	4	106	
Line 122	3	106	
Line 123	106	105	
Line 124	1	105	Fly Ash Pond
Line 125	4	1	
Line 126	96	107	Ohio River
Line 127	107	108	
Line 128	108	97	

Points

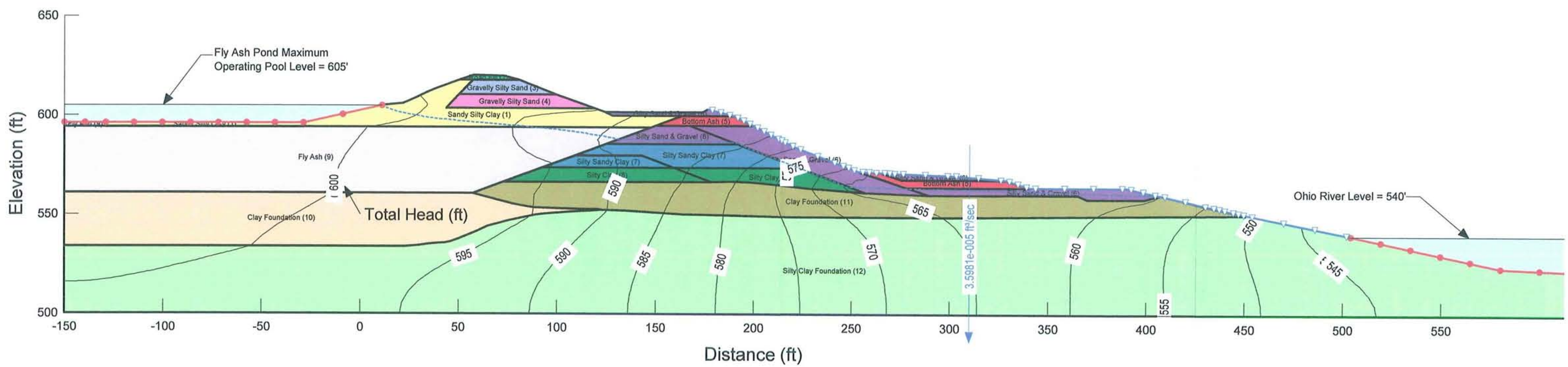
	X (ft)	Y (ft)
Point 1	-150	596.07556
Point 2	-28.73928	596.09012
Point 3	-28.7343	594.10387
Point 4	-150	594.10335
Point 5	10.87106	605.00492
Point 6	12.47008	605.36299
Point 7	21.58957	606.0128
Point 8	27.88941	608.93894
Point 9	34.84064	612.1236

Point 10	39.1222	614.02931
Point 11	50.19567	618.00197
Point 12	57.04232	618.00197
Point 13	43.46173	603.74724
Point 14	118.92142	603.75291
Point 15	123.93504	601.99213
Point 16	127.87795	600.00591
Point 17	163.14756	600.01118
Point 18	149.56535	595.01063
Point 19	147.06988	594.09744
Point 20	57.38569	620.4397
Point 21	72.81546	619.98477
Point 22	80.84007	617.99987
Point 23	99.3055	610.6283
Point 24	139.17652	601.67587
Point 25	173.72543	602.00845
Point 26	176.45339	603.29228
Point 27	189.71063	600.00886
Point 28	199.68996	595.00886
Point 29	167.47087	595.01
Point 30	191.72441	585.79626
Point 31	124.59213	585.79827
Point 32	210.5102	589.59755
Point 33	218.12189	585.75717
Point 34	221.75303	584.00508
Point 35	243.39222	575.85019
Point 36	253.50591	571.98819
Point 37	289.84961	560.28268
Point 38	256.97717	561.34945
Point 39	108.92713	580.01604
Point 40	142.96147	580.0084
Point 41	159.35433	573.84449
Point 42	178.27362	566.74311
Point 43	185.14195	566.8803
Point 44	197.25818	566.77308
Point 45	199.06388	566.49447

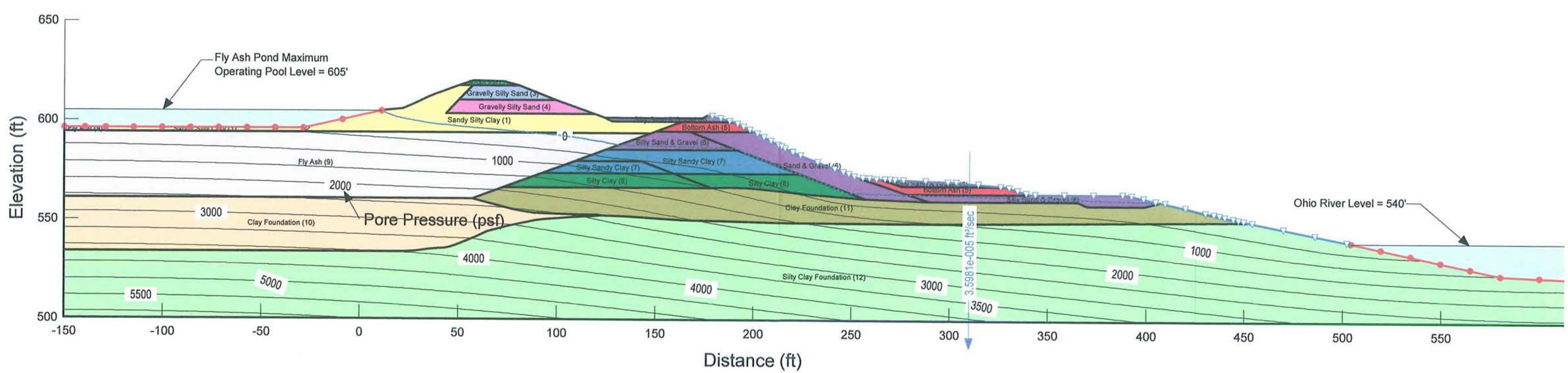
Point 46	214.43065	565.09473
Point 47	230.53524	563.39632
Point 48	234.91774	563.19918
Point 49	92.17246	573.83178
Point 50	72.44646	566.50502
Point 51	57.05752	560.85717
Point 52	-150	561.11382
Point 53	-150	533.82575
Point 54	21.33315	533.86583
Point 55	28.78186	534.53132
Point 56	34.71071	535.25795
Point 57	39.46011	535.53175
Point 58	42.85104	535.87926
Point 59	45.71543	536.46899
Point 60	49.77857	537.76077
Point 61	59.1159	541.81514
Point 62	64.62858	544.24532
Point 63	75.01429	546.95559
Point 64	83.26625	548.88905
Point 65	88.53588	549.98847
Point 66	93.23684	550.64559
Point 67	106.0002	551.53018
Point 68	116.47627	552.07357
Point 69	122.52939	552.65487
Point 70	120.68438	552.98343
Point 71	113.2235	552.91166
Point 72	98.93865	553.2756
Point 73	88.31144	553.78513
Point 74	81.74223	554.71319
Point 75	77.73883	555.51387
Point 76	364.93178	560.3689
Point 77	369.84787	558.28744
Point 78	398.62803	558.25568
Point 79	406.56907	560.14614
Point 80	407.16945	560.17165
Point 81	432.46006	554.51883

Point 82	442.14574	552.40143
Point 83	451.7179	550.43805
Point 84	378.61552	549.7332
Point 85	292.87496	549.02254
Point 86	215.96602	549.23217
Point 87	183.76122	549.91347
Point 88	163.4328	550.32461
Point 89	134.5598	552.09884
Point 90	274.22203	571.1344
Point 91	301.03752	569.99889
Point 92	328.15873	568.01175
Point 93	341.0609	563.99026
Point 94	390.16826	564.00289
Point 95	504	540
Point 96	580	523.86886
Point 97	580	500.03246
Point 98	150	499.99472
Point 99	49.98781	610.59727
Point 100	223.72901	573.80581
Point 101	278.12773	564.05804
Point 102	265.81244	568.02452
Point 103	264.70006	571.52684
Point 104	275.69963	568.00897
Point 105	129.04534	596.07808
Point 106	129.00866	594.10293
Point 107	620	522
Point 108	620	500

Title: Sporn Fly Ash Pond - Seismic Stability Analyses
Comments: Section L-L Seepage Analysis
Created By: Roger W. Cecil, P.E.
File Name: SECTION L-L SEEPAGE.gsz
Date: 1/19/2010



Title: Sporn Fly Ash Pond - Seismic Stability Analyses
Comments: Section L-L Seepage Analysis
Created By: Roger W. Cecil, P.E.
File Name: SECTION L-L SEEPAGE.gsz
Date: 1/19/2010



SPP00003365

Steady-State Seepage

File Information

Title: Sporn Fly Ash Pond
Comments: Section K-K Seepage Analysis
Created By: Roger W. Cecil, P.E.
Revision Number: 94
Last Edited By: Roger Cecil
Date: 1/19/2010
Time: 5:50:41 AM
File Name: SECTION K-K SEEPAGE.gsz
Directory: P:\Gateley\SPORN FLY ASH POND EASTERN DIKE STABILITY\
Last Solved Date: 1/19/2010
Last Solved Time: 5:51:56 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Mass(M) Units: lbs
Mass Flux Units: lbs/sec
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Steady-State Seepage

Description: Sporn Fly Ash Pond Section K-K Seepage Analysis
Kind: SEEP/W
Method: Steady-State
Settings
- Include Air Flow: No

Control
- Apply Runoff: Yes

Convergence
- Convergence Type: Gauss Point K
- Convergence Settings
  - Maximum Number of Iterations: 500
  - Tolerance: 0.01
  - Maximum Change in K: 0.1

Rate of Change in K: 1.02
Minimum Change in K: 0.0001
Equation Solver: Parallel Direct
Potential Seepage Max # of Reviews: 10
Time
Starting Time: 0 sec
Duration: 0 sec
Ending Time: 0 sec

Materials

Silty Clay (1)

Model: Saturated / Unsaturated
Hydraulic
K-Function: Sandy Silty Clay
K-Ratio: 9
K-Direction: 90 °

Gravelly Silty Sand (2)

Model: Saturated / Unsaturated
Hydraulic
K-Function: Gravelly Silty Sand
K-Ratio: 9
K-Direction: 90 °

Sand and Gravel (3)

Model: Saturated / Unsaturated
Hydraulic
K-Function: Sand and Gravel
K-Ratio: 9
K-Direction: 90 °

Bottom Ash (4)

Model: Saturated / Unsaturated
Hydraulic
K-Function: Bottom Ash
K-Ratio: 9
K-Direction: 90 °

Gravelly Silty Sand (5)

Model: Saturated / Unsaturated
Hydraulic
K-Function: Gravelly Silty Sand
K-Ratio: 9
K-Direction: 90 °

Silty Clay (6)
Model: Saturated / Unsaturated
Hydraulic
K-Function: Brown Silty Clay
K-Ratio: 9
K-Direction: 90 °

Bottom Ash 65 (7)
Model: Saturated / Unsaturated
Hydraulic
K-Function: Bottom Ash
K-Ratio: 9
K-Direction: 90 °

Fly Ash (8)
Model: Saturated Only
Hydraulic
K-Sat: 2.2e-006 ft/sec
Volumetric Water Content: 0 ft^3/ft^3
Mv: 0 /psf
K-Ratio: 10
K-Direction: 90 °

Sandy Silt (9)
Model: Saturated / Unsaturated
Hydraulic
K-Function: Sandy Silt
K-Ratio: 9
K-Direction: 90 °

Clay Foundation (10)
Model: Saturated / Unsaturated
Hydraulic
K-Function: Gray Foundation Clay
K-Ratio: 9
K-Direction: 90 °

Clay Foundation (11)
Model: Saturated / Unsaturated
Hydraulic
K-Function: Brown Foundation Clay
K-Ratio: 9
K-Direction: 90 °

Silty Clay Foundation (12)
Model: Saturated / Unsaturated
Hydraulic

K-Function: Gray Foundation Clay
K-Ratio: 9
K-Direction: 90 °

Original Dike (13)

Model: Saturated / Unsaturated
Hydraulic
K-Function: Brown Silty Clay
K-Ratio: 9
K-Direction: 90 °

Foundation Soil (14)

Model: Saturated / Unsaturated
Hydraulic
K-Function: Gray Foundation Clay
K-Ratio: 9
K-Direction: 90 °

Boundary Conditions

Fly Ash Pond

Type: Head (H) 605

Potential Seepage Face

Review: true
Type: Unit Flux (q) 0

Ohio River

Type: Head (H) 539.7

Flux Sections

Flux Section 1

Coordinates
Coordinate: (329.8, 580.6) ft
Coordinate: (328.6, 491.2) ft

K Functions

Sandy Silty Clay

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %

Segment Curvature: 42 %
K-Saturation: 4.92e-008
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 4.92e-008)
Data Point: (0.1, 4.92e-008)
Data Point: (0.84851, 4.92e-008)
Data Point: (7.1998, 3.1551e-008)
Data Point: (61.091, 1.145e-008)
Data Point: (410.04, 1.3566e-009)
Data Point: (4398.4, 1.9641e-012)
Data Point: (37321, 1.1509e-014)
Data Point: (316680, 1.8297e-016)
Data Point: (964730, 1.5075e-017)
Data Point: (2687000, 1.9312e-018)
Estimation Properties
Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Sandy Silt

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 42 %
K-Saturation: 1.3e-006
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 1.3e-006)
Data Point: (0.1, 1.3e-006)
Data Point: (0.84851, 1.3e-006)
Data Point: (7.1998, 1.2971847e-006)
Data Point: (61.087, 9.5007643e-007)
Data Point: (518.37, 5.7439299e-008)
Data Point: (4398.4, 4.9929936e-011)
Data Point: (25333, 6.0648726e-013)
Data Point: (37321, 2.1972484e-013)
Data Point: (316680, 1.6731911e-015)
Data Point: (2415100, 1.9197771e-017)
Data Point: (2687000, 1.5238153e-017)
Estimation Properties
Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Gravelly Silty Sand

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 42 %
K-Saturation: 1.77e-005
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 1.77e-005)
Data Point: (0.1, 1.77e-005)
Data Point: (0.84851, 1.77e-005)
Data Point: (7.1998, 1.77e-005)
Data Point: (61.087, 1.2238e-005)
Data Point: (518.37, 2.3267e-008)
Data Point: (4398.4, 9.9011e-012)
Data Point: (25333, 6.387e-014)
Data Point: (37321, 2.8017e-014)
Data Point: (316680, 2.8391e-016)
Data Point: (2415100, 2.4418e-018)
Data Point: (2687000, 1.8986e-018)
Estimation Properties
Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Sand and Gravel

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 100 %
K-Saturation: 0.00016
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 0.00016)
Data Point: (0.1, 0.00016)
Data Point: (0.84851, 0.00016)
Data Point: (7.1998, 0.00016)
Data Point: (61.087, 0.00011062599)
Data Point: (518.37, 2.1032316e-007)
Data Point: (4398.4, 8.9501469e-011)
Data Point: (25333, 5.7735593e-013)
Data Point: (37321, 2.5326102e-013)
Data Point: (316680, 2.5664181e-015)
Data Point: (2415100, 2.2072768e-017)
Data Point: (2687000, 1.7162486e-017)
Estimation Properties

Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Bottom Ash

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 42 %
K-Saturation: 9.5e-006
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 9.5e-006)
Data Point: (0.1, 9.5e-006)
Data Point: (0.84851, 9.5e-006)
Data Point: (7.1998, 8.4395035e-006)
Data Point: (61.091, 6.323766e-006)
Data Point: (518.37, 1.5704645e-008)
Data Point: (4398.4, 4.416422e-011)
Data Point: (25333, 2.5678972e-012)
Data Point: (37321, 1.4526241e-012)
Data Point: (316680, 4.5725993e-014)
Data Point: (2415100, 8.0258156e-016)
Data Point: (2687000, 6.4188333e-016)
Data Point: (4804900, 1.8231915e-016)
Estimation Properties
Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Gray Foundation Clay

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 40 %
K-Saturation: 3.6e-009
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 3.6e-009)
Data Point: (0.1, 3.6e-009)
Data Point: (0.39536, 3.5907652e-009)
Data Point: (1.5631, 3.5683826e-009)
Data Point: (6.18, 3.5150087e-009)
Data Point: (24.433, 3.387913e-009)

Data Point: (96.6, 3.0914609e-009)
Data Point: (381.92, 2.4337565e-009)
Data Point: (1510, 1.2219183e-009)
Data Point: (5969.8, 1.569913e-010)
Data Point: (16286, 9.4554783e-012)
Data Point: (23603, 2.7879652e-012)
Data Point: (93315, 2.2589217e-014)
Data Point: (368930, 1.6295478e-016)
Data Point: (1458600, 1.160687e-018)
Data Point: (1585500, 8.5974261e-019)
Data Point: (3154800, 7.2333391e-020)
Data Point: (4724000, 1.6921565e-020)
Data Point: (5766900, 8.2558957e-021)
Data Point: (6293300, 6.0292174e-021)
Data Point: (7862500, 2.7064174e-021)
Data Point: (9431800, 1.4061443e-021)
Data Point: (11001000, 8.082313e-022)
Data Point: (12570000, 5.0022783e-022)
Data Point: (14139000, 3.276e-022)
Data Point: (15709000, 2.2432696e-022)
Data Point: (17278000, 1.5926087e-022)
Data Point: (18847000, 1.1648191e-022)
Data Point: (20416000, 8.7354783e-023)
Data Point: (21986000, 6.6922435e-023)
Data Point: (22800000, 5.8714435e-023)

Estimation Properties
Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Brown Foundation Clay

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 40 %
K-Saturation: 1.6e-008
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 1.6e-008)
Data Point: (0.1, 1.6e-008)
Data Point: (0.84851, 1.6e-008)
Data Point: (61.091, 9.0158049e-009)
Data Point: (518.37, 1.391122e-009)
Data Point: (4398.4, 3.163122e-011)
Data Point: (25333, 6.9640976e-013)
Data Point: (37321, 3.3350244e-013)

Data Point: (316680, 5.5125854e-015)
Data Point: (2415100, 7.6470244e-017)
Data Point: (2687000, 6.0554146e-017)
Data Point: (4804900, 1.6557073e-017)
Data Point: (7194700, 6.4148293e-018)

Estimation Properties

Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Brown Silty Clay

Model: Data Point Function
Function: X-Conductivity vs. Pore-Water Pressure
Curve Fit to Data: 100 %
Segment Curvature: 40 %
K-Saturation: 1.2e-008
Data Points: Matric Suction (psf), X-Conductivity (ft/sec)
Data Point: (0.05, 1.2e-008)
Data Point: (0.1, 1.2e-008)
Data Point: (0.84851, 1.2e-008)
Data Point: (61.091, 6.7618537e-009)
Data Point: (518.37, 1.0433415e-009)
Data Point: (4398.4, 2.3723415e-011)
Data Point: (25333, 5.2230732e-013)
Data Point: (37321, 2.5012683e-013)
Data Point: (316680, 4.134439e-015)
Data Point: (2415100, 5.7352683e-017)
Data Point: (2687000, 4.541561e-017)
Data Point: (4804900, 1.2417805e-017)
Data Point: (7194700, 4.811122e-018)

Estimation Properties

Hydraulic K Sat: 0 ft/sec
Hyd. K-Function Estimation Method: Van Genuchten Function
Maximum: 1000
Minimum: 0.01
Num. Points: 20
Residual Water Content: 0 ft^3/ft^3

Regions

	Material	Points	Area (ft^2)
Region 1	Silty Clay (1)	65,2,25,3,64	203.89047

Region 2	Silty Clay (1)	2,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25	1176.8788
Region 3	Gravelly Silty Sand (2)	10,26,27,28,11	33.408658
Region 4	Sand and Gravel (3)	11,12,13,29,30,28	841.1626
Region 5	Sandy Silt (9)	3,31,22,23,24,25	425.72956
Region 6	Bottom Ash (4)	31,22,21,20,32,33,34	190.90717
Region 7	Silty Clay (6)	35,37,38,39,40,36	554.67017
Region 8	Bottom Ash 65 (7)	37,41,42,38	147.83552
Region 9	Original Dike (13)	42,38,39,40,43,44	841.25177
Region 10	Fly Ash (8)	4,45,62,44,42,41,37,35,34,31,3,64	11842.621
Region 11	Gravelly Silty Sand (5)	33,32,46,47,66,43,40,36,35,34	1406.9906
Region 12	Silty Clay Foundation (12)	52,55,56,57,58,53,63	11477.383
Region 13	Foundation Soil (14)	56,59,71,72,60,61,55	21838.358
Region 14	Clay Foundation (11)	45,62,63,52	3563.0574
Region 15	Clay Foundation (10)	62,44,43,66,51,70,50,54,53,63	2091.4421
Region 16	Fly Ash (8)	1,65,64,4	141.5511
Region 17	Bottom Ash (4)	47,67,68,69,70,51,66	102.11485
Region 18	Gravelly Silty Sand	67,48,49,69,68	161.58666

	(5)		
Regio n 19	Bottom Ash (4)	69,70,50	5.722693

Lines

	Start Point	End Point	Hydraulic Boundary
Line 1	2	25	
Line 2	25	3	
Line 3	2	5	Fly Ash Pond
Line 4	5	6	Fly Ash Pond
Line 5	6	7	
Line 6	7	8	
Line 7	8	9	
Line 8	9	10	
Line 9	10	11	
Line 10	11	12	
Line 11	12	13	
Line 12	13	14	
Line 13	14	15	
Line 14	15	16	
Line 15	16	17	
Line 16	17	18	
Line 17	18	19	
Line 18	19	20	Potential Seepage Face
Line 19	20	21	
Line 20	21	22	
Line 21	22	23	
Line 22	23	24	
Line 23	24	25	
Line 24	10	26	
Line 25	26	27	
Line 26	27	28	
Line 27	28	11	
Line 28	13	29	
Line 29	29	30	

Line 30	30	28	
Line 31	3	31	
Line 32	31	22	
Line 33	20	32	Potential Seepage Face
Line 34	32	33	
Line 35	33	34	
Line 36	34	31	
Line 37	34	35	
Line 38	35	36	
Line 39	35	37	
Line 40	37	38	
Line 41	38	39	
Line 42	39	40	
Line 43	40	36	
Line 44	37	41	
Line 45	41	42	
Line 46	42	38	
Line 47	40	43	
Line 48	43	44	
Line 49	44	42	
Line 50	4	45	
Line 51	32	46	Potential Seepage Face
Line 52	46	47	Potential Seepage Face
Line 53	52	55	
Line 54	55	56	
Line 55	56	57	Ohio River
Line 56	57	58	Potential Seepage Face
Line 57	58	53	Potential Seepage Face
Line 58	56	59	Ohio River
Line 59	60	61	
Line 60	61	55	
Line 61	45	62	
Line 62	62	44	
Line 63	52	63	
Line 64	63	53	
Line 65	62	63	

Line 66	52	45	
Line 67	50	54	Potential Seepage Face
Line 68	54	53	Potential Seepage Face
Line 69	3	64	
Line 70	64	4	
Line 71	65	2	Fly Ash Pond
Line 72	64	65	
Line 73	1	65	Fly Ash Pond
Line 74	4	1	
Line 75	51	66	
Line 76	66	43	
Line 77	47	66	
Line 78	50	70	
Line 79	70	51	
Line 80	47	67	Potential Seepage Face
Line 81	67	68	
Line 82	68	69	
Line 83	69	70	
Line 84	67	48	Potential Seepage Face
Line 85	48	49	Potential Seepage Face
Line 86	49	69	Potential Seepage Face
Line 87	50	69	Potential Seepage Face
Line 88	59	71	Ohio River
Line 89	71	72	
Line 90	72	60	

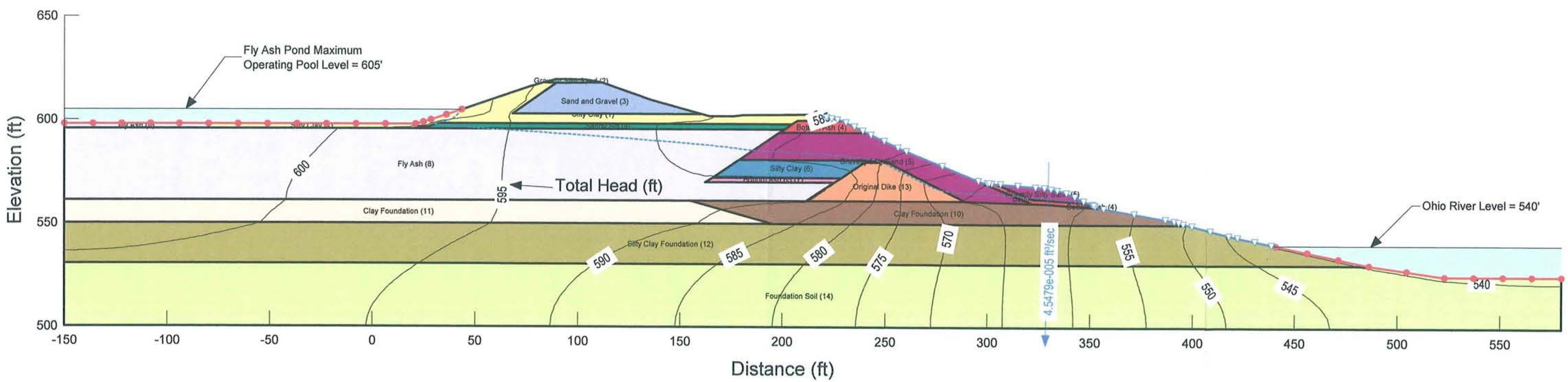
Points

	X (ft)	Y (ft)
Point 1	150	597.74003
Point 2	20.87006	597.74003
Point 3	20.88514	595.7195
Point 4	150	595.71741
Point 5	28.29932	599.9386
Point 6	43.4	605
Point 7	66.4449	612.83618

Point 8	71.00682	614.37347
Point 9	75.83799	615.92596
Point 10	83.12625	618.01207
Point 11	89.16676	618.0063
Point 12	67.99514	603.00606
Point 13	160.50996	603.01085
Point 14	164.36012	602.00265
Point 15	175.56909	602.00354
Point 16	179.88561	602.4977
Point 17	214.07092	602.96698
Point 18	216.26115	604.4504
Point 19	218.92113	601.99621
Point 20	228.49429	599.98195
Point 21	207.18559	599.99735
Point 22	204.40592	598.13958
Point 23	32.02668	598.14303
Point 24	26.54626	596.50886
Point 25	20.87931	596.50076
Point 26	89.27093	619.72571
Point 27	103.77188	619.42032
Point 28	111.47933	618.0121
Point 29	135.19671	609.9055
Point 30	123.47463	613.96956
Point 31	200.77083	595.72596
Point 32	240.76421	594.01059
Point 33	222.79049	594.01222
Point 34	198.17913	594.01083
Point 35	178.5748	580.99902
Point 36	248.77756	581.00098
Point 37	165.52362	572.33858
Point 38	228.39764	572.33563
Point 39	239.8063	579.91496
Point 40	250.94764	579.91496
Point 41	161.97373	569.98666
Point 42	224.86913	569.98596
Point 43	288.91143	560.96382

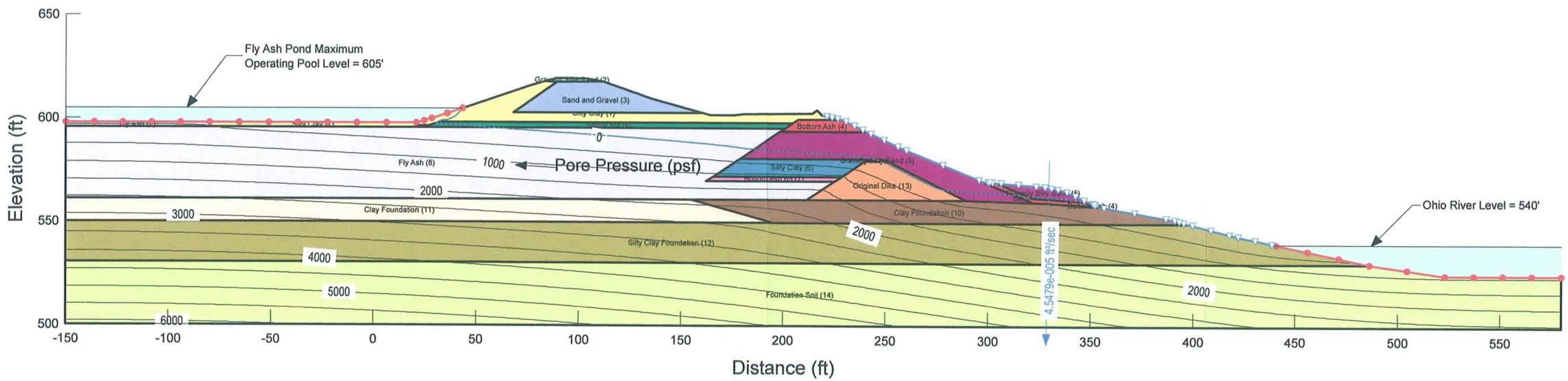
Point 44	211.29094	560.95827
Point 45	-150	560.99795
Point 46	257.89685	585.94071
Point 47	297.73567	569.9851
Point 48	325.50196	568.0018
Point 49	336.18826	565.99579
Point 50	354.42618	558.00394
Point 51	328.18785	559.80842
Point 52	-150	550.07288
Point 53	397.53591	549.83795
Point 54	388.85171	551.97178
Point 55	-150	530.60542
Point 56	486.17654	530.37993
Point 57	440.71606	539.69843
Point 58	420.04463	544.03139
Point 59	523	525
Point 60	523	500.03246
Point 61	-150	499.97967
Point 62	154.97895	560.96884
Point 63	194.99536	549.95765
Point 64	-80.00109	595.71827
Point 65	-80.00109	597.74003
Point 66	321.98827	559.99079
Point 67	304.18497	569.49578
Point 68	322.21879	562.20928
Point 69	349.0118	560.43036
Point 70	348.85409	558.38715
Point 71	580	525
Point 72	580	500

Title: Sporn Fly Ash Pond
Comments: Section K-K Seepage Analysis
Created By: Roger W. Cecil, P.E.
File Name: SECTION K-K SEEPAGE.gsz
Date: 1/19/2010



SPP00003344

Title: Sporn Fly Ash Pond
Comments: Section K-K Seepage Analysis
Created By: Roger W. Cecil, P.E.
File Name: SECTION K-K SEEPAGE.gsz
Date: 1/19/2010



SPP00003345

PHILIP SPORN FLY ASH POND
EASTERN DIKE ASSESSMENT
SEEPAGE ANALYSIS SUMMARY
GA FILE NO. 09-387

GENERAL

Geo/Environmental Associates, Inc. (GA) has prepared steady-state seepage analyses to support seismic (pseudo-static) slope stability analyses conducted on the upper dike of the Sporn Fly Ash Pond - Eastern Dike. Specifically, GA evaluated three critical sections (i.e., Section K-K, Section L-L, and Section M-M) through the Eastern Dike using the finite element analysis computer program, *SEEP/W*. *SEEP/W* is developed by GEO-SLOPE International, Ltd. of Calgary, Alberta, Canada.

Given material permeabilities and embankment geometry and using a value of total head at an inlet condition and review nodes on the downstream face (i.e., boundary conditions), the *SEEP/W* program adjusts the total head and the amount of flow at each of the nodal points until equilibrium is reached. Equilibrium conditions are then shown as a final free water (phreatic) surface. The approximated steady-state phreatic surface, potential total head contours, and potential pore pressures within the fill are included on the *SEEP/W* graphical output provided in this appendix.

ASSUMPTIONS AND MATERIAL PARAMETERS

Material parameters used in the seepage models were based on: (1) field testing, laboratory testing, and analysis data included in the "*Philip Sporn Electric Generating Plant Unit 5 Ash Facility – Engineering Report*," prepared/compiled by the Geotechnical Engineering Section of American Electric Power Service Corporation, dated July 1998; (2) field testing, laboratory testing, and analysis data included in the "*Philip Sporn Power Plant – Stability Analysis*," prepared/compiled by the Geotechnical Engineering Section of American Electric Power Service Corporation, dated March 2009; and (3) geotechnical subsurface exploration and laboratory testing conducted by GA in December 2009. For the analyses, we have conservatively assumed a horizontal permeability to vertical permeability (k_h:k_v) ratio of 9 for the dike and foundation materials and a k_h:k_v ratio of 10 for the hydraulically placed fly ash material. A summary of the material permeability parameters used for each of the critical sections is provided in Tables III-1, III-2, and III-3, respectively.

TABLE III-1 SUMMARY OF PERMEABILITY PARAMETERS FOR SECTION K-K SEEPAGE ANALYSES					
Soil Layer Number	**Material Type**	**Location**	**Horizontal Permeability k_h (ft/sec)**	**Vertical Permeability k_v (ft/sec)**	**Material Parameter Source**
1	Silty Clay	1972 Embankment Extension	4.4×10^{-7}	4.92×10^{-8}	From AEP Seepage Analysis for K-K in July 1998 Report
2	Gravelly Silty Sand	1972 Embankment Extension	1.6×10^{-4}	1.77×10^{-5}	From AEP Seepage Analysis for K-K in July 1998 Report
3	Sand & Gravel	1972 Embankment Extension	1.4×10^{-3}	1.6×10^{-4}	Using Hazen Formula on GSC for B-107 (11.6')
4	Bottom Ash (68)	1968 Embankment Extension	5.7×10^{-5}	9.5×10^{-6}	Using Hazen Formula on GSC for PZ-0901 (3.5')
5	Gravelly Silty Sand	1968 Embankment Extension	1.6×10^{-4}	1.77×10^{-5}	From AEP Seepage Analysis for K-K in July 1998 Report
6	Silty Clay	1965 Embankment Extension	1.1×10^{-7}	1.2×10^{-8}	From AEP Permeability Test on PZ-0902 (26.0')
7	Bottom Ash (65)	1965 Embankment Extension	8.6×10^{-5}	9.5×10^{-6}	Using Hazen Formula on GSC for PZ-0901 (3.5')
8	Fly Ash	Fly Ash Pond	2.2×10^{-5}	2.2×10^{-6}	From GA Permeability Test on GA-1A ST-4
9	Sandy Silt	1972 Embankment Extension	1.2×10^{-5}	1.3×10^{-6}	From AEP Seepage Analysis for K-K in July 1998 Report
10	Clay Foundation	Upper Foundation Soil	3.2×10^{-8}	3.6×10^{-9}	From AEP Permeability Test on PZ-0903 (46.0')
11	Clay Foundation	Upper Foundation Soil	1.4×10^{-7}	1.6×10^{-8}	From GA Permeability Test on GA-1C ST-2
12	Silty Clay Foundation	Mid-Level Foundation Soil	3.2×10^{-8}	3.6×10^{-9}	From AEP Permeability Test on PZ-0903 (46.0')
13	Silty Clay	Original Dike	1.1×10^{-7}	1.2×10^{-8}	From AEP Permeability Test on PZ-0902 (26.0')
14	Foundation Soil	Lower Foundation Soil	3.2×10^{-8}	3.6×10^{-9}	From AEP Permeability Test on PZ-0903 (46.0')

TABLE III-2 SUMMARY OF PERMEABILITY PARAMETERS FOR SECTION L-L SEEPAGE ANALYSES					
Soil Layer Number	**Material Type**	**Location**	**Horizontal Permeability k_h (ft/sec)**	**Vertical Permeability k_v (ft/sec)**	**Material Parameter Source**
1	Sandy Silty Clay	1972 Embankment Extension	$1.8x10^{-6}$	$2.0x10^{-7}$	From AEP Seepage Analysis for L-L in July 1998 Report
2	Road Fill	1972 Embankment Extension	$1.9x10^{-3}$	$2.1x10^{-4}$	Using Hazen Formula on GSC for B-109 (8.5')
3	Gravelly Silty Sand	1972 Embankment Extension	$1.9x10^{-3}$	$2.1x10^{-4}$	Using Hazen Formula on GSC for B-109 (8.5')
4	Gravelly Silty Sand	1972 Embankment Extension	$1.9x10^{-3}$	$2.1x10^{-4}$	Using Hazen Formula on GSC for B-109 (8.5')
5	Bottom Ash	1968 Embankment Extension	$8.6x10^{-5}$	$9.5x10^{-6}$	Using Hazen Formula on GSC for PZ-0901 (3.5')
6	Silty Sand & Gravel	1968 Embankment Extension	$5.9x10^{-4}$	$6.6x10^{-5}$	Using Hazen Formula on GSC for PZ-0902 (8.5')
7	Silty Sandy Clay	1965 Embankment Extension	$1.1x10^{-7}$	$1.2x10^{-8}$	From AEP Permeability Test on PZ-0902 (26.0')
8	Silty Clay	1965 Embankment Extension	$1.1x10^{-7}$	$1.2x10^{-8}$	From AEP Permeability Test on PZ-0902 (26.0')
9	Fly Ash	Fly Ash Pond	$2.2x10^{-5}$	$2.2x10^{-6}$	From GA Permeability Test on GA-1A ST-4
10	Clay Foundation	Upper Foundation Soil	$1.4x10^{-7}$	$1.6x10^{-8}$	From GA Permeability Test on GA-1C ST-2
11	Clay Foundation	Upper Foundation Soil	$3.2x10^{-8}$	$3.6x10^{-9}$	From AEP Permeability Test on PZ-0903 (46.0')
12	Silty Clay Foundation	Lower Foundation Soil	$3.2x10^{-8}$	$3.6x10^{-9}$	From AEP Permeability Test on PZ-0903 (46.0')

TABLE III-3 SUMMARY OF PERMEABILITY PARAMETERS FOR SECTION M-M SEEPAGE ANALYSES					
Soil Layer Number	**Material Type**	**Location**	**Horizontal Permeability k_h (ft/sec)**	**Vertical Permeability k_v (ft/sec)**	**Material Parameter Source**
1	Sandy Silty Clay	1972 Embankment Extension	$1.8x10^{-6}$	$2.0x10^{-7}$	From AEP Seepage Analysis for L-L in July 1998 Report
2	Gravelly Silty Sand	1972 Embankment Extension	$1.9x10^{-3}$	$2.1x10^{-4}$	Using Hazen Formula on GSC for B-109 (8.5')
3	Bottom Ash	1995 Embankment Modifications	$8.6x10^{-5}$	$9.5x10^{-6}$	Using Hazen Formula on GSC for PZ-0901 (3.5')
4	Silty Sand w/ Gravel	1968 Embankment Extension	$5.9x10^{-4}$	$6.6x10^{-5}$	Using Hazen Formula on GSC for PZ-0902 (8.5')
5	Sandy Silt	1965 Embankment Extension	$1.2x10^{-5}$	$1.3\ x10^{-6}$	From AEP Seepage Analysis for K-K in July 1998 Report
6	Silty Clay	Original Soil Dike	$1.1x10^{-7}$	$1.2x10^{-8}$	From AEP Permeability Test on PZ-0902 (26.0')
7	Fly Ash (1)	Fly Ash Pond	$2.2x10^{-5}$	$2.2x10^{-6}$	From GA Permeability Test on GA-1A ST-4
8	Brown Clay	Upper Foundation Soil	$1.4x10^{-7}$	$1.6x10^{-8}$	From GA Permeability Test on GA-1C ST-2
9	Silty Clay	Lower Foundation Soil	$1.1x10^{-7}$	$1.2x10^{-8}$	From AEP Permeability Test on PZ-0902 (26.0')
10	Sandstone	Foundation			
11	Bottom Ash 2	1972 Embankment Extension	$8.6x10^{-5}$	$9.5x10^{-6}$	Using Hazen Formula on GSC for PZ-0901 (3.5')

SEEPAGE ANALYSIS RESULTS

Results of the *SEEP/W* finite element analyses are provided in this appendix. Specifically, the following information is provided on the graphical output for each of the critical sections: (1) the approximated zero-pressure (phreatic) line; (2) total head, in feet; (3) pore pressure, in pounds per square feet; and (4) unit flux in cubic feet per second per foot width of embankment. After compilation, the *SEEP/W* data provided herein is imported into *SLOPE/W* for use in the slope stability analyses.

GEOTECHNICAL DATA COLLECTION REPORT

AEP SPORN FLY ASH AND BOTTOM ASH POND COMPLEX
NEW HAVEN, WEST VIRGINIA

HCN/TERRACON PROJECT NO. N2095019
March 3, 2009

Prepared For:

AMERICAN ELECTRIC POWER

Prepared by:

H.C. NUTTING
A Terracon Company
Charleston, West Virginia

H. C. NUTTING
A Terracon COMPANY
912 Morris Street
Charleston, West Virginia 25301
304-344-0821 Fax:304-342-4711

March 3, 2009

HCN/Terracon Project No. N2095019

Mr. Tim Howdyshell
American Electric Power
1 Riverside Plaza – 22nd Floor
Columbus, OH 43215

Re: Geotechnical Data Collection Report
AEP Sporn Fly Ash and Bottom Ash Pond Complex
New Haven, West Virginia

Dear Mr. Howdyshell:

H. C. Nutting Company (HCN), a Terracon company is pleased to present our geotechnical data collection report for the geotechnical services associated with the maintenance of the American Electric Power (AEP) Sporn Fly Ash and Bottom Ash Pond Complex in New Haven, West Virginia. This work was performed in general accordance with our proposal dated February 9, 2009 and AEP Letter of Authorization dated February 10, 2009.

SCOPE OF WORK

HCN's scope of work for this project included performing a total of five (5) test borings, installation of observation wells at all 5 boring locations, inspection of drilling activities, preparation of boring logs based on visual classification, and preparation of this report.

FIELD EXPLORATION

Test Borings

A total of five (5) Standard Penetration Test (SPT) borings were drilled for this project. The test borings were selected and staked in the field by AEP and HCN personnel and later surveyed in the field by AEP surveyor (to be provided).

The test borings were performed utilizing a drill rig mounted on an All-Terrain Vehicle. The field operations were performed between February 16, 2009 through February 23, 2009. Boreholes were advanced and stabilized using hollow-stem augers. The drilling activities were performed under the supervision of HCN personnel.

Sampling was accomplished using the Standard Penetration Test (ASTM D 1586) and Shelby tube (ASTM D 1587) methods. Split-spoon samples were obtained at 2.5 ft. intervals. Shelby tube samples were collected at within cohesive soils. The borings were completed at depths of 50 feet below the existing ground surface.

After completion of drilling activities, all of the five test borings were converted into observation wells. All wells were constructed from 1.92-inch OD (1.5-inch ID) threaded PVC with #10 slot screen and 5-foot solid PVC section at the top. The PVC casing was constructed to just below the existing ground surface and protected with a "Global HRB 141412-F H20" locking steel protective cover. The well pad was then constructed around the observation well with approximate dimensions of 3 feet by 3 feet and a minimum of 8 inch thickness.

Each well was developed using a surge block and evacuated until the discharge water stabilized. All development data and estimated purge volumes were recorded and are shown on the attached well development logs.

On the following table we have indicated the beginning and ending depths of the screening sections.

Observation Well Screen Depths

Boring	Screening Section	
	Beginning Depth (feet)	Ending Depth (feet)
PZ-09-01	6	50.3
PZ-09-02	5.5	35
PZ-09-03	6	50.4
PZ-09-04	5.5	49.8
PZ-09-05	5.2	50.2

The observation well logs are included with this report.

CLOSING

We appreciate the opportunity of working with you on this project. Please contact us concerning any questions that may arise during review of the report, or if you require additional information as you proceed into the final design and construction stage of this project.

Thank you for your consideration.

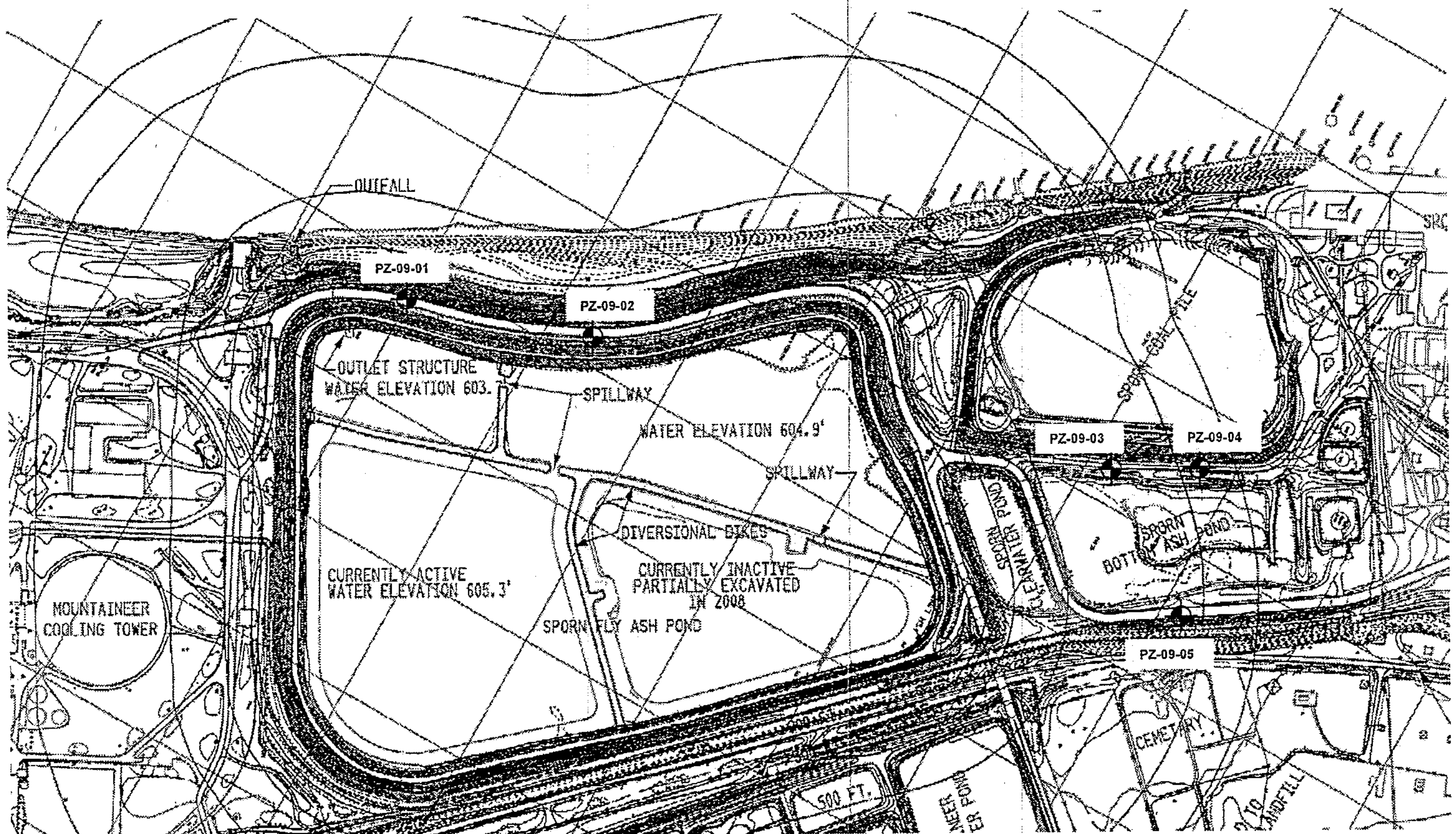
Respectfully submitted,
H. C. NUTTING COMPANY

Lewis E. Eplin
Staff Geologist

YOGESH S. REGE
REGISTERED
16606
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

Yogesh S. Rege, P.E.
Department Manager
Geotechnical Services

APPENDIX



Approximate Boring Location

Project Mngr:	YSR
Drawn By:	YSR
Checked By:	YSR
Approved By:	

Project No.	N2095019
Scale:	NTS
File No.	N2095019
Date:	2/23/2009

Terracon
Consulting Engineers and Scientists
Charleston, West Virginia

Boring Location Diagram

Sporn Fly Ash and Bottom Ash Pond Complex
New Haven, West Virginia
American Electric Power

FIG. No. 1

AEPSPP-000097

LOG OF BORING NO. PZ-09-01

CLIENT: **American Electric Power**

SITE: **Philip Sporn Power Plant, New Haven, West Virginia**

PROJECT: **Sporn Fly Ash and Bottom Ash Pond Complex**

Boring Location: 721043.509, 1735345.011

Approx. Surface Elev.: 600.817 ft

Depth, ft (top of layer)	Elev.	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	TYPE	RECOVERY, in.	SPT - N** BLOWS / ft.	TESTS: WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	
0.5	600.5	**ASPHALT**										
1	600	**FILL**, stabilized and compacted bottom ash		SM	1	SS	18	24				
		FILL, silty sand with bottom ash, trace gravel, gray, medium dense, dry to moist - Geogrid observed at 4'		SM	2	SS	18	17				
			5	SM	3	SS	18	16				
8.5	592.5	**FILL**, silty sand with bottom ash, gray to dark gray, medium dense, moist	10	SM	4	SS	18	14				
12	589	**FILL**, silty sand with gravel, light brown, medium dense, moist		SM	5	SS	18	12				
14	587	**FILL**, lean clay with sand, light brown, stiff, moist		CL	6	SS	12	16			9000*	
			15	CL	7	SS	12	10			4000*	
18.5	582.5	**FILL**, silty sand with gravel, dark brown, loose, moist	20	SM	8	SS	18	14				
21	580	**FILL**, bottom ash with coal fragments, black, medium dense, wet			9	SS	18	18				
23.5	577.5	**LEAN CLAY with SAND** light brown, stiff, moist		CL	10	SS	18	19			7000*	
			25	CL	11	ST	24					800 psi/24 sec
28.5	572.5	**SANDY LEAN CLAY**, brown to gray, stiff, moist		CL	12	SS	18	20			7000*	
			30	CL	13	SS	18	16			6500*	

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 21	WD ▼ 18.1	4 hr
WL	▼ 18	48 hr ▼	
WL			

Terracon

BORING STARTED	2-20-09
BORING COMPLETED	2-21-09
RIG	Track
FOREMAN	
LOGGED	LE
JOB #	N2095019

REVISED BORING LOGS SPORN BOTTOM ASH POND COMPLEX.GPJ TERRACON.GDT 3/3/09

LOG OF BORING NO. PZ-09-01

CLIENT
American Electric Power

SITE
Philip Sporn Power Plant
New Haven, West Virginia

PROJECT
Sporn Fly Ash and Bottom Ash Pond Complex

DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf
SANDY LEAN CLAY, brown to gray, stiff, moist		CL	14	SS	18	18			6500*
	35	CL	15	SS	18	10			4500*
	40	CL	16	SS	18	18			4000*
		CL	17	SS	18	14			3500*
	45	CL	18	SS	18	18			5000*
47 — 554		CL	19	SS	18	13			3000*
CLAYEY SAND, brown, dense, very moist, fine grained sand - with gravel at 49'		SC	20	SS	18	47			
50 — 551	50								
BORING COMPLETED									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 21	WD ▼ 18.1	4 hr
WL	▼ 18	48 hr	▽
WL			

Terracon

BORING STARTED	2-20-09
BORING COMPLETED	2-21-09
RIG Track	FOREMAN
LOGGED LE	JOB # N2095019

LOG OF BORING NO. PZ-09-02

CLIENT American Electric Power	
SITE Philip Sporn Power Plant, New Haven, West Virginia	PROJECT Sporn Fly Ash and Bottom Ash Pond Complex

Boring Location: 720306.293, 1735648.836

Approx. Surface Elev.: 601.345 ft

Depth (ft)	DESCRIPTION	Elev.	USCS SYMBOL	SAMPLES NUMBER	TYPE	RECOVERY, in.	SPT - N** BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	
0.5	**ASPHALT**	601									
2	**FILL**, stabilized and compacted bottom ash	599.5		1	SS	12	52				
7	**FILL**, silty sand with bottom ash and gravel, dark gray to brown, very dense, moist	594.5	SM	2	SS	18	65				
			SM	3	SS	18	51				
16	**FILL**, silty sand with gravel, light brown, dense, moist	585.5	SM	4	SS	18	36				
			SM	5	SS	18	47				
			SM	6	SS	18	45				
23.5	**FILL**, silty sand, light brown, very dense, dry to moist, fine grained	578	SM	7	SS	18	37			9000*	
			SM	8	ST	12					1000 psi/24 sec
			SM	9	SS	18	33			9000*	
26	**FILL**, silty sand, light brown, dense, moist, fine grained	575.5	SM	10	SS	18	38				
28.5	**FILL**, bottom ash with coal fragments, black, medium dense, wet	573		11	SS	18	21				
	LEAN CLAY, trace to with sand, gray to light brown, very stiff to stiff, moist - Trace organics (roots) at 28.5 - 29'		CL	12	SS	18	16			8000*	
			CL	13	ST	24					1200 psi/30 sec

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 26	WD	▼ 16 24 hr
WL	▼ 21.1	72 hr	▽
WL			

Terracon

BORING STARTED	2-19-09		
BORING COMPLETED	2-20-09		
RIG	Track	FOREMAN	
LOGGED	LE	JOB #	N2095019

REVISED BORING LOGS SPORN BOTTOM ASH POND COMPLEX.GPJ TERRACON.GDT 3/3/09

LOG OF BORING NO. PZ-09-02

CLIENT American Electric Power	
SITE Philip Sporn Power Plant, New Haven, West Virginia	PROJECT Sporn Fly Ash and Bottom Ash Pond Complex

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
	LEAN CLAY, trace to with sand, gray to light brown, very stiff to stiff, moist		CL	14	SS	18	34			8000*
		35								
			CL	15	SS	12	19			3000*
			CL	16	SS	18	17			8000*
		40								
			CL	17	SS	18	24			7000*
			CL	18	SS	18	23			4000*
		45								
			CL	19	SS	18	12			2500*
			CL	20	SS	18	13			3000*
	50 — 551.5	50								
	BORING COMPLETED									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 26	WD ▼ 16	24 hr
WL	▼ 21.1	72 hr ▽	
WL			

Terracon

BORING STARTED	2-19-09		
BORING COMPLETED	2-20-09		
RIG	Track	FOREMAN	
LOGGED	LE	JOB #	N2095019

REVISED BORING LOGS SPORN BOTTOM ASH POND COMPLEX.GPJ TERRACON.GDT 3/3/09

LOG OF BORING NO. PZ-09-03

CLIENT: American Electric Power	
SITE: Philip Sporn Power Plant, New Haven, West Virginia	PROJECT: Sporn Fly Ash and Bottom Ash Pond Complex

Boring Location: 718396.378, 1736131.654

Approx. Surface Elev.: 596.521 ft

GRAPHIC LOG	DESCRIPTION	Depth, ft	Elev., ft
	FILL, silty sand with gravel, yellowish brown to dark brown, medium dense to dense, moist, fine to coarse grained sand, rounded gravel	11	585.5
	FILL, silty sand with gravel, yellowish brown to dark brown, medium dense, moist, fine to coarse grained sand, rounded gravel	13.5	583
	FILL, sandy lean clay, light brown to gray, medium stiff, very moist, fine grained sand	18	578.5
	FILL, lean clay with sand, brown and gray mottled, very stiff, moist, fine grained sand	23.5	573
	FILL, coal and bottom ash, black, medium dense, wet, sand to gravel size particles	28.5	568
	FILL, coal and bottom ash, black to dark gray, loose, wet, fine sand to silt size particles with gravel size coal fragments	31	565.5

Continued Next Page

USCS SYMBOL	NUMBER	TYPE	RECOVERY, in.	SPT - N** BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	
SM	1	SS	14	30				
SM	2	SS	18	29				
SM	3	SS	18	45				
SM	4	SS	14	70				
SM	5	SS	18	22				
CL	6	SS	18	8				
CL	7	ST	21.5					800 psi/30 sec
CL	8	SS	18	20			9000*	
CL	9	SS	18	24			9000*	
SM	10	SS	10	15				
SM	11	SS	14	12				
SM	12	SS	18	4				
SM	13	SS	18	6				

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 23	WD ▼ 16.8	24 hr
WL	▼	▽	
WL			

Terracon

BORING STARTED	2-17-09		
BORING COMPLETED	2-18-09		
RIG	Track	FOREMAN	
LOGGED	LE	JOB #	N2095019

REVISED BORING LOGS SPORN BOTTOM ASH POND COMPLEX.GPJ TERRACON.GDT 3/3/09

LOG OF BORING NO. PZ-09-03

CLIENT: American Electric Power

SITE: Philip Sporn Power Plant, New Haven, West Virginia

PROJECT: Sporn Fly Ash and Bottom Ash Pond Complex

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf	
	FILL, coal and bottom ash, black to dark gray, loose to very loose, wet, fine sand to silt size particles		SM	14	SS	12	5				
		35	SM	15	SS	18	4				
			SM	16	SS	18	3				
		40	SM	17	SS	6	4				
43.5	553										
	SANDY LEAN CLAY, dark gray, stiff to very soft, moist to wet, fine grained sand		CL	18	SS	18	9			500*	
		45	CL	19	ST	22					800 psi/15 sec
			CL	20	SS	18	W.H.			500*	
50	546.5	50									
	BORING COMPLETED										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 23	WD ▼ 16.8	24 hr
WL	▼	▼	
WL			

Terracon

BORING STARTED			2-17-09
BORING COMPLETED			2-18-09
RIG	Track	FOREMAN	
LOGGED	LE	JOB #	N2095019

REVISED BORING LOGS SPORN BOTTOM ASH POND COMPLEX.GPJ TERRACON.GDT 3/3/09

LOG OF BORING NO. PZ-09-04

CLIENT
American Electric Power

SITE
Philip Sporn Power Plant
New Haven, West Virginia

PROJECT
Sporn Fly Ash and Bottom Ash Pond Complex

Boring Location: 718148.27, 1736259.447

Approx. Surface Elev.: 593.692 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf	
	FILL, silty sand with gravel, gray, medium dense, moist, medium to coarse grained sand		SM	1	SS	17	27				
	3.5 — 590										
	FILL, silty sand, trace gravel and clay, light brown, dense to medium dense, moist		SM	2	SS	18	43				
		5	SM	3	SS	18	28				
	8 — 585.5										
	FILL, lean clay, light brown		CL	4	ST	20					800 psi/34 sec
	11 — 582.5	10									
	FILL, well graded sand with gravel, light brown, medium dense, moist, coarse to fine grained sand, rounded gravel		SW	5	SS	18	21				
	▼		SW	6	SS	12	23				
		15	SW	7	SS	14	26				
	18.5 — 575										
	FILL, silty sand with gravel, trace clay, dark brown to gray, dense, very moist, coarse to fine grained sand, rounded gravel		SM	8	SS	18	30				
	21 — 572.5	20									
	FILL, well graded gravel with sand, brown, dense to medium dense, wet, rounded gravel ▽		GW	9	SS	18	35				
			GW	10	SS	18	16				
		25	GW	11	SS	18	10				
	27 — 566.5										
	FILL, bottom ash, gray to black, medium dense to very loose, wet, fine sand to silt size particles		SP	12	SS	18	9				
		30	SP	13	SS	18	6				

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 23	WD ▼ 14.5	24 hr
WL	▼ -	▽	
WL			

Terracon

BORING STARTED			2-18-09
BORING COMPLETED			2-19-09
RIG	Track	FOREMAN	
LOGGED	LE	JOB #	N2095019

REVISED BORING LOGS SPORN BOTTOM ASH POND COMPLEX.GPJ TERRACON.GDT 3/3/09

LOG OF BORING NO. PZ-09-04

CLIENT
American Electric Power

SITE **Philip Sporn Power Plant**
New Haven, West Virginia

PROJECT
Sporn Fly Ash and Bottom Ash Pond Complex

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf	
	FILL, bottom ash, gray to black, medium dense to very loose, wet, fine sand to silt size particles		SP	14	SS	18	9				
		35	SP	15	SS	18	11				
			SP	16	SS	18	WOT				
	41 ... 552.5	40									
	LEAN CLAY, dark gray, stiff, very moist to wet, high silt content		CL	17	SS	18	9				
			CL	18	ST						800 psi/15 sec
		45	CL	19	SS	18	9				
			CL	20	SS	18	10				
	50 ... 543.5	50									
	BORING COMPLETED										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	∇ 23	WD	▼ 14.5 24 hr
WL	▼		▼
WL			

Terracon

BORING STARTED			2-18-09
BORING COMPLETED			2-19-09
RIG	Track	FOREMAN	
LOGGED	LE	JOB #	N2095019

REVISED BORING LOGS SPORN BOTTOM ASH POND COMPLEX.GPJ TERRACON.GDT 3/3/09

LOG OF BORING NO. PZ-09-05

CLIENT American Electric Power	
SITE Philip Sporn Power Plant, New Haven, West Virginia	PROJECT Sporn Fly Ash and Bottom Ash Pond Complex

Boring Location: 717959.368, 1735750.984

Approx. Surface Elev.: 593.453 ft

Depth/Elev.	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	NUMBER	TYPE	RECOVERY, in.	SPT - N** BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
0.5 / 593	**ASPHALT**									
1.4 / 592	**FILL**, stabilized and compacted bottom ash		SM	1	SS	15	47			
2.5 / 591	**FILL**, silty sand with gravel, yellowish brown and gray, dense, dry to moist		SM	2	SS	18	25			
6.5 / 587	**FILL**, silty sand with bottom ash, trace gravel, dark brown to black, medium dense, moist	5	SM	3	SS	18	46			
9.5 / 584	**FILL**, silty sand with gravel, trace bottom ash and coal, yellowish brown, dense, moist, fine to coarse grained sand Trace clay at 8.5'		CL	4	SS	17	43			
11 / 582.5	**FILL**, silty sand with gravel, brown, dense, moist, fine to coarse grained sand	10								
26 / 567.5	**FILL**, silty sand with bottom ash and gravel, reddish brown to black, dense to medium dense, moist to wet, fine to coarse grained sand, cobbles present		SM	5	SS	17	50/5			
			SM	6	SS	2	50/2			
	▽	15	SM	7	SS	18	32			
	Clay seam at 17'		SM	8	SS	18	15			
	▼	20	SM	9	SS	18	22			
		25	SM	10	SS	18	12			
	FILL, silty sand with bottom ash, trace gravel, dark gray to black, loose to very loose, wet, fine grained sand, silt size particles		SM	11	SS	18	6			
	▼	30	SM	12	SS	18	8			
			SM	13	SS	18	3			

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 15	WD	▼ 20	AB
WL	▼ 29.8	20 hr	▼	
WL				

Terracon

BORING STARTED			2-16-09
BORING COMPLETED			2-16-09
RIG	Track	FOREMAN	
LOGGED	LE	JOB #	N2095019

LOG OF BORING NO. PZ-09-05

CLIENT	American Electric Power
SITE	Philip Sporn Power Plant New Haven, West Virginia
PROJECT	Sporn Fly Ash and Bottom Ash Pond Complex

DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf	
		SM	14	SS	18	2				
34.5 — 559										
LEAN CLAY with SAND, light brown and gray mottled to brown and gray mottled, soft to stiff, wet to very moist	35									
		CL	15	SS	18	14			2000*	
Sand content increase with depth		CL	16	ST	17.5					800 psi/10 sec
	40									
		CL	17	SS	6	6			500*	
		CL	18	SS	18	14				
45 — 548.5	45									
CLAYEY SAND, reddish brown and gray mottled, medium dense to loose, very moist to wet, fine grained sand		SC	19	SS	18	8				
		SC	20	SS	18	8				
50 — 543.5	50									
BORING COMPLETED										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 15	WD	▼ 20	AB
WL	▼ 29.8	20 hr	▽	
WL				

Terracon

BORING STARTED	2-16-09		
BORING COMPLETED	2-16-09		
RIG	Track	FOREMAN	
LOGGED	LE	JOB #	N2095019

REVISED BORING LOGS SPORN BOTTOM ASH POND COMPLEX.GPJ TERRACON.GDT 3/3/09

Well Development Log

HCN H. C. NUTTING
A Terracon COMPANY
790 Morrison Road • Columbus, OH 43230 • (614) 863-3113

JOB N2095019
SHEET NO. 1 OF 1
CALCULATED BY JCE DATE 2/21/09
CHECKED BY ________ DATE ________
SCALE NTS

American Electric Power

Sporn Plant

Date Well Installed: Feb. 21, 2009

PZ-09-01

Initial GW Elev. Prior to Well Development 18.1' B.G.S.

Grd. Surface/Top of Vault 0.0' B.G.S.

Well Vault – Top of Well Riser 1.06' B.G.S. (12 3/4")

*** Well Volume ***

- 1 1/2" ID Screen & Riser 0.09 gals/L.F.
- 32.2' x 0.09 = 2.9 gals.

Min. development volume
3 x 2.9 gals = 8.7 gals.

2/21/09

- 6[15] pm Initial H2O Rdg - Water @ 18.1' BGS
  Surge Well w/ 3' long by 1" Ø PVC Surge Block
- 6[20] Initiate Pumping - No Sediment Noted
- 6[20] - 6[35] pm Pump 15± gals Dark brown heavily silted H2O w/ fine sand
  - Well Depleted -
- * 6[35] - 6[45] pm Pump 10± gals Brown heavily silted H2O w/ fine sand while adding 20± gals potable H2O to top of well
- 6[45] - 6[50] pm Pump 5± gals Brown moderately to slightly silty H2O w/ some fine sand
  - 6[50] - 7[00] pm Allow well to recharge
- 7[00] - 7[10] pm Pump 10± gals. Brown moderately silty H2O w/ some fine sand
  - 7[10] - 7[35] pm Allow well to recharge
  - 7[35] pm H2O Rdg - Water @ 22.5' BGS
- 7[40] - 7[55] pm Pump 10± gals Brown moderately to slightly silty H2O w/ some to trace fine sand. Well nearly depleted.

Well Development Complete 8[00] pm

2/23/09

1[45] pm H2O @ 18.0' BGS.

- 20± gals potable H2O added to well during development.
- 50± gals H2O pumped from well during development.

H2O Rdg 2/25/09 11[30] am 18.0' BGS

Bottom of Well 50.3' B.G.S.

Well Development Log

H. C. NUTTING
A Terracon COMPANY
790 Morrison Road • Columbus, OH 43230 • (614) 863-3113

JOB N209501.9
SHEET NO. 1 OF 1
CALCULATED BY JCE DATE 2/21/09
CHECKED BY – DATE –
SCALE NTS

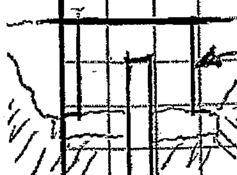
American Electric Power

Sporn Plant

Date Well Installed: Feb. 20, 2009

PZ-09-02

▼ Initial GW Elev. Prior to Well Development 16.0' B.G.S.



~~Grd. Surface / Top of Vault 0.0' B.G.S.~~
~~Top of Well Riser 0.44' B.G.S. (5¼")~~

2/21/09

- 4³⁵ pm Initial H2O Rdg 16.0' BGS
  Sediment noted in Bottom of Well
- Well surged w/ 3' long by 1" Ø PVC surge block
- 4⁴⁵ pm Initiate pumping
  4⁴⁵ - 5⁰⁰ pm Pumped 15± gals of Dark Brown heavily silted H2O w/ fine sand
  - Well depleted - Recharge for 5 mins.
- * 5⁰⁵ - 5¹⁵ pm Pumped 10± gals Brown heavily silted H2O w/ fine sand while adding 15± gals potable H2O to top of well
- 5¹⁵ - 5²⁵ pm Pump 10± Brown moderately silty then back to heavily silted H2O w/ fine sand - Well depleted.
- * 5²⁵ to 5³⁰ pm Pump 5± gals Br. heavily silted H2O while adding 5± gals potable H2O to top of well.
- * ▷ 5³⁰ to 5³⁵ pm Add 10± gals potable H2O to top of well.
- 5³⁵ - 5⁴⁵ pm Pump 10± gals Brown moderately to slightly silty H2O w/ some fine sand - Suspend Pumping

▼ 5⁴⁵ pm H2O @ 18.8' BGS
▼ 5⁵⁵ pm H2O @ 18.0' BGS
▼ 6⁰⁵ pm H2O @ 17.2' BGS
Development Complete

2/23/09
▼ 2³⁰ pm H2O @ 21.2' BGS

▼ H2O Rdg 2/25/09 12⁵⁰ pm 22.3' BGS

– Bottom of Well 34.7' B.G.S.

* Well Volume *
- 1½" ID Screen & Riser 0.09 gals/L.F.
- 18.7' x 0.09 = 1.7 gals.
  Min. development volume 3 x 1.7 gals = 5.1 gals.

30± gals H2O Added to well during development

50± Total gals H2O pumped from well during development.

Well Development Log

H. C. NUTTING
A Terracon COMPANY
790 Morrison Road • Columbus, OH 43230 • (614) 863-3113

JOB N2095019
SHEET NO. 1 OF 1
CALCULATED BY JCE DATE 2/19/09
CHECKED BY – DATE ~~2~~ 2/20/09
SCALE NTS

American Electric Power

Sporn Plant

Date Well Installed: Feb. 18, 2009

PZ-09-03

▼ Initial GW Elev. Prior to Well Development 16.8' B.G.S.

Grd. Surface / Top of Vault 0.0' B.G.S.
Well Vault – Top of Well Riser 1.14' B.G.S. (13 5/8")

* Well Volume *
• 1½" ID Screen & Riser
0.09 gals/L.F.
• 34.2' x 0.09 = 3.1 gals.
Min. development volume
3 x 3.1 = 9.3 gals.

2/19/09
• 9:00 Am Initial H2O Rdg - Water @ 16.8' BGS
Surge well w/ 3' long PVC 1" ϕ Surge Block
Sediment in well to 47.6' ± B.G.S.
• 11:00 Am initiate pumping set up
11:10 - 11:30 Am Pump 15± gals Gray heavily silted H2O w/ fine sand + Agitate well
11:45 - 12:00 pm Pump 15± gals Gray heavily silted H2O w/ fine sand
12:00 pm - 12:45 pm Pump 45± gals Gray heavily to moderately silty H2O w/ fine sand - Sand content diminishing
▼ H2O reading 2:00 pm after allowing well to settle 17.0' ± BGS
• 2:00 - 2:20 pm Pump 20± gals Gray heavily to moderately silty H2O w/ fine sand
▼ H2O Rdg 2:25 pm 16.9' ± BGS Suspend development

2/20/09
▼ H2O Rdg 5:30 pm 16.9' ± BGS Sediment in well to 48.0' ±
* Jetted well to suspend sediment w/ 5 to 10 gals potable H2O
• Resume pumping - All sediment in suspension
5:40 - 6:00 pm Pump 20± gals Heavily silted H2O w/ fine sand
6:00 - 6:30 pm Pump 30 gals Gray heavily then moderately silty H2O w/ fine sand - Sand content diminishing
6:30 - 6:45 pm Pump 15± gals Gray moderately to slightly silty H2O w/ some fine sand
▼ H2O level @ completion 6:50 pm 17.0' ± B.G.S.
~~5 to 10 gals H2O added to well during jetting~~ / 160± total gals H2O + pumped during development
– Bottom of Well 50.4' B.G.S.

Complete 6:50 pm 2/20/09

Well Development Log

H. C. NUTTING
A Terracon COMPANY
790 Morrison Road • Columbus, OH 43230 • (614) 863-3113

JOB N2095019
SHEET NO. 1 OF 1
CALCULATED BY JCE DATE 2/21/09
CHECKED BY – DATE –
SCALE NTS

American Electric Power

Sporn Plant

Date Well Installed: Feb. 19, 2009

PZ-09-04

▼ Initial GW Elev. Prior to Well Development 14.1' B.G.S.

Grd. Surface / Top of Vault 0.0' B.G.S.
Well Vault – Top of Well Riser 0.59' B.G.S. (7 1/8")

2/21/09

- 2:50 pm Initial H2O Rdg. Water @ 14.1 BGS
  Surge well w/ 3' long by 1" Ø PVC surge block
- 2:55 pm Initiate Pumping
- 2:55-3:05 pm Pumped 10 gals. Dark Gray very heavily silted H2O w/ fine sand
- 3:05-3:25 pm Pumped 25 ± gals Gray heavily silted H2O w/ fine sand
- 3:25 pm - 3:40 pm Pumped 20 ± gals Gray to Lt. gray moderately silty H2O w/ some fine sand
- 3:40-4:05 pm Pumped 25 ± gals Lt. gray moderately to slightly silty H2O w/ some fine sand
- 4:05 - 4:15 pm Pumped 10 ± gals Lt. gray slightly silty H2O w/ some fine sand

▼ H2O Rdg 4:25 pm Water @ 14.5' BGS

* Well Volume *

- 1 1/2" ID Screen & Riser
  0.09 gals / L.F.
- 35.7' x 0.09 = 3.2 gals.

Min. development volume
3 x 3.21 gals = 9.6 gals.

90 ± Total gals. H2O pumped from well during development

Development complete 4:25 pm

Bottom of Well 49.8' B.G.S.

Well Development Log

H. C. NUTTING
A Terracon COMPANY
790 Morrison Road • Columbus, OH 43230 • (614) 863-3113

JOB N2095019
SHEET NO. 1 OF 1
CALCULATED BY JCE DATE 2/20/09
CHECKED BY — DATE —
SCALE NTS

American Electric Power

Sporn Plant

Date Well Installed: Feb. 17, 2009

PZ-09-05

▼ Initial GW Elev. Prior to Well Development 15.7' B.G.S.

Grd. Surface/Top of Vault 0.0' B.G.S.

Well Vault – Top of Well Riser 0.2' B.G.S. (2 1/2")

*** Well Volume ***

- 1 1/2" ID Screen & Riser
  0.09 gals/L.F.
- 31.5' x 0.09 = 3.1 gals.
  Min. development volume
  3 x 3.1 = 9.3 gals.

2/20/09

- 2:30 pm Initial H2O Rdg - Water @ 15.7' BGS
  Surge well w/ 3' long PVC 1" Ø surge block
- 2:35 pm Initiate Pumping
  2:35 - 3:00 pm Pump 20 gals Brown/Grey heavily silted H2O w/ fine sand
- ▸ Sediment in well to 46.5' ± BGS

* Jetted well w/ 5 to 10 gallons potable H2O to suspend sediment

- Resume Pumping
  3:25 pm - 3:40 pm Pumped 15 ± gallons Brown/grey heavily silted H2O w/ fine sand
  3:40 pm - 4:00 pm Pumped 20 ± gallons Brown to Light brown moderately silty H2O w/ some fine sand
  4:00 pm - 4:20 pm Pumped 20 ± gallons Light brown moderately to slightly silty H2O w/ trace fine sand
  4:20 pm - 4:35 pm Pumped 15 ± gallons Light brown slightly silty H2O w/ trace fine sand

▼ H2O level immediately after pumping 15.9' B.G.S.

▸ 5 to 10 gallons H2O added to well during jetting.

90 ± gals. Total H2O Pumped from Well during development

2/20/09 4:40 pm Development Complete

Bottom of Well 50.2' B.G.S.

TERRACON PROJECT NO. N2095019

PROJECT SPORN FLY ASH AND BOTTOM ASH POND COMPLEX

SUMMARY ELEVATIONS
(FT. NGVD)

COORDINATES 721044.45 N/1735346.82 E (NAD 27)(NGVD29 WV N)

DATE INSTALLED 02/21/09

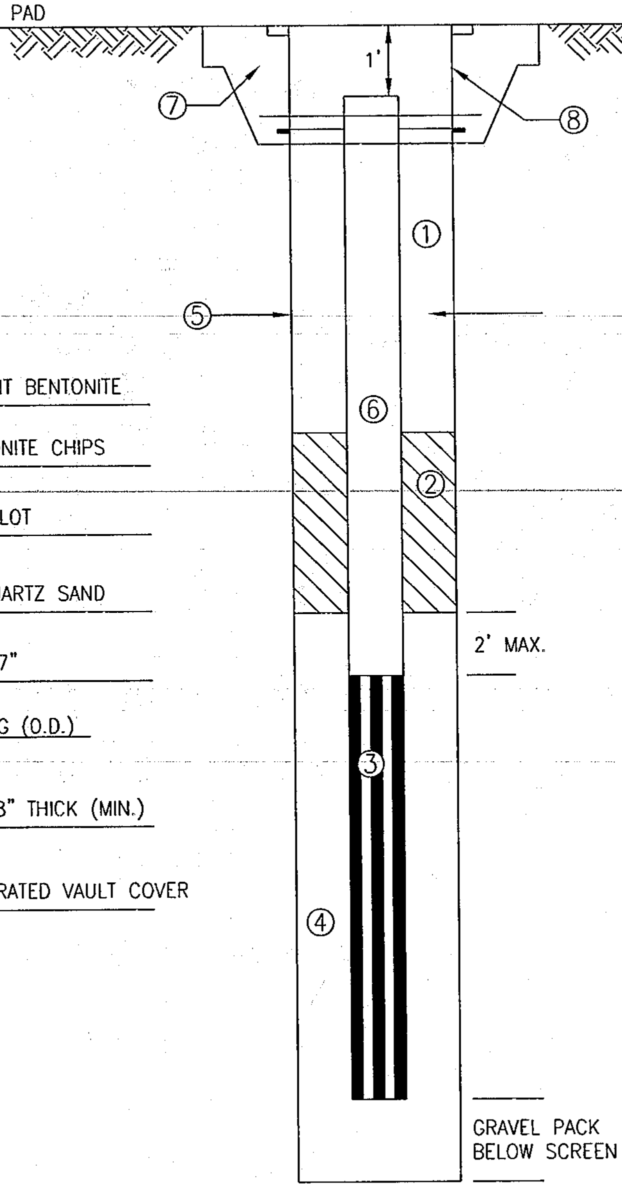
PIEZOMETER NO. PZ-09-01

REF. DATUM PT.: TOP OF PROTECTIVE VAULT/GROUND SURFACE

REF. DATUM PT. ________

GROUND SURFACE/TOP OF PAD

GRADE 0' (600.82')



DEPTH (ELEV.)

TOP OF BENTONITE SEAL 4.0' (596.82')

TOP OF GRAVEL PACK 5.0' (595.82')

TOP OF SCREEN 6.0' (594.82')

BOTTOM OF SCREEN 50.3' (550.52')

BOTTOM OF BLANK SEC. N/A

BOTTOM OF GRAVEL PACK 51.0' (549.82')

BOTTOM OF BOREHOLE 51.0' (549.82')

1 GROUT SEAL MATERIAL: CEMENT BENTONITE

2 BENTONITE SEAL MATERIAL: BENTONITE CHIPS

3 SCREEN SIZE: 0.010" SLOT

4 GRAVEL PACK MATERIAL: #5 QUARTZ SAND

5 BOREHOLE DIAMETER 6" MIN. 7"

6 1.92" DIA. PVC CASING (O.D.)

7 CONCRETE PAD DIMENSIONS: 3'x3'x8" THICK (MIN.)

8 PROTECTIVE STEEL H2 RATED VAULT COVER

NOTE: DEPTHS OF MATERIALS ARE TAKEN FROM TOP OF VAULT/GROUND SURFACE

SCALE: NTS

GEOTECHNICAL ENGINEERING SECTION CIVIL DESIGN STANDARD		REVISION 0		OBSERVATION WELL
APP'D.	DR.	C.K.	DATE	
AMERICAN ELECTRIC POWER SERVICE CORP.				CDS-04A / SH.

AMERICAN ELECTRIC POWER
SPORN FLY ASH AND BOTTOM ASH POND COMPLEX

GEOLOGIST/ENGINEER:

LEWIS EPLIN H.C. NUTTING CO.

AEPSPP-000113

PROJECT SPORN FLY ASH AND BOTTOM ASH POND COMPLEX

TERRACON PROJECT NO. N2095019

COORDINATES 720305.06 N/1735649.89 E (NAD 27)(NGVD29 WV N)

SUMMARY ELEVATIONS
(FT. NGVD)

DATE INSTALLED 02/20/09

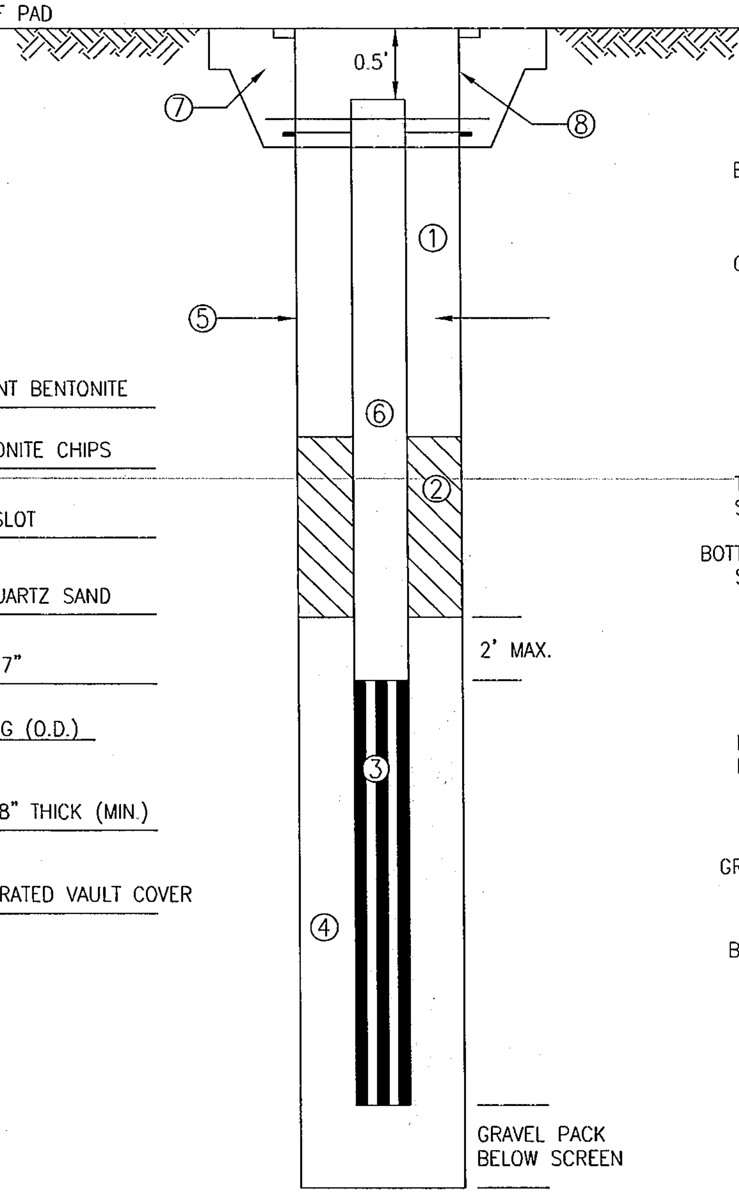
PIEZOMETER NO. PZ-09-02

REF. DATUM PT.:
TOP OF PROTECTIVE
VAULT/GROUND SURFACE

REF. DATUM PT. ________

GROUND SURFACE/TOP OF PAD

GRADE 0' (601.35')



DEPTH (ELEV.)

TOP OF BENTONITE SEAL 2.0' (599.35')

TOP OF GRAVEL PACK 3.5' (597.85')

TOP OF SCREEN 5.5' (595.85')

BOTTOM OF SCREEN 35.0' (566.35')

BOTTOM OF BLANK SEC. N/A

BOTTOM OF GRAVEL PACK 36.0' (565.35')

BOTTOM OF BOREHOLE 50.0' (551.35')

GROUTED 36.0' TO 50.0'

1 GROUT SEAL MATERIAL: CEMENT BENTONITE

2 BENTONITE SEAL MATERIAL: BENTONITE CHIPS

3 SCREEN SIZE: 0.010" SLOT

4 GRAVEL PACK MATERIAL: #5 QUARTZ SAND

5 BOREHOLE DIAMETER 6" MIN. 7"

6 1.92" DIA. PVC CASING (O.D.)

7 CONCRETE PAD DIMENSIONS: 3'x3'x8" THICK (MIN.)

8 PROTECTIVE STEEL H2 RATED VAULT COVER

NOTE: DEPTHS OF MATERIALS ARE TAKEN FROM TOP OF VAULT/GROUND SURFACE

SCALE: NTS

GEOTECHNICAL ENGINEERING SECTION CIVIL DESIGN STANDARD		REVISION 0		OBSERVATION WELL
APP'D.	DR.	C.K.	DATE	
AMERICAN ELECTRIC POWER SERVICE CORP.				CDS-04A / SH.

AMERICAN ELECTRIC POWER
SPORN FLY ASH AND BOTTOM ASH POND COMPLEX

GEOLOGIST/ENGINEER:
LEWIS EPLIN H.C. NUTTING CO.

TERRACON PROJECT NO. N2095019

PROJECT SPORN FLY ASH AND BOTTOM ASH POND COMPLEX

SUMMARY ELEVATIONS
(FT. NGVD)

COORDINATES 718399.12 N/1736131.92 E (NAD 27)(NGVD29 WV N)

DATE INSTALLED 02/18/09

PIEZOMETER NO. PZ-09-03

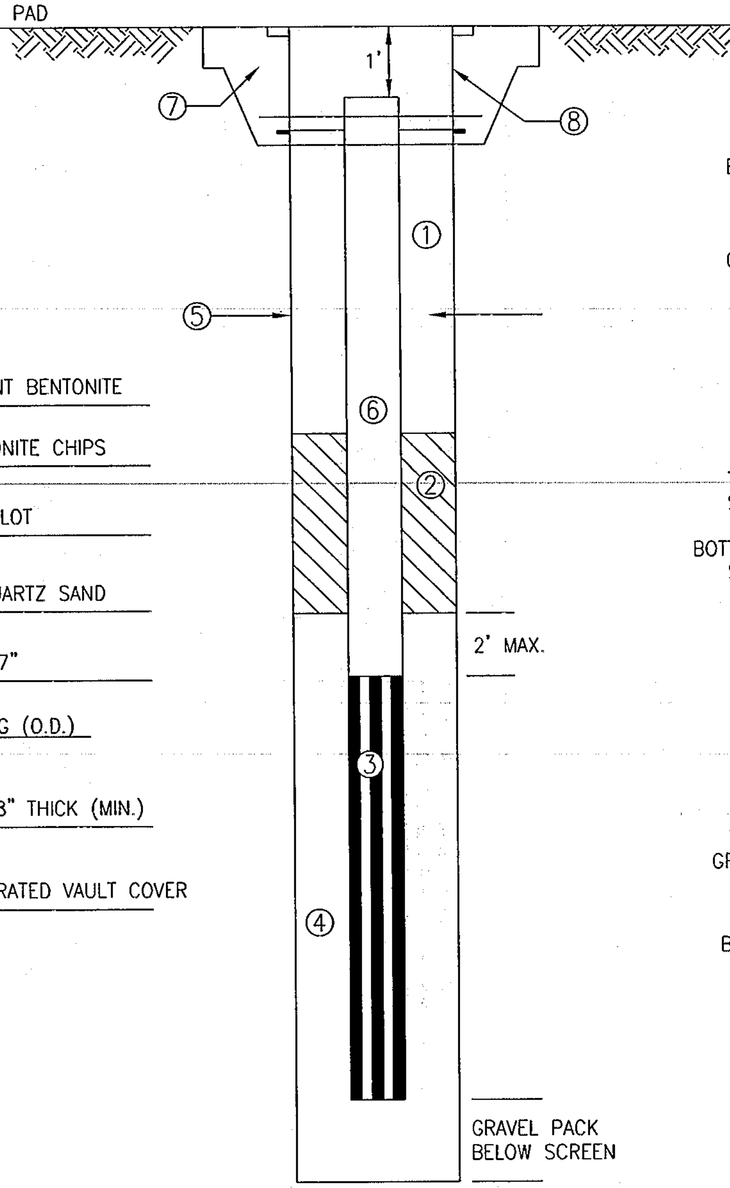
REF. DATUM PT.:
TOP OF PROTECTIVE
VAULT/GROUND SURFACE

REF. DATUM PT. ______

GROUND SURFACE/TOP OF PAD

GRADE 0' (596.52')

DEPTH (ELEV.)



TOP OF BENTONITE SEAL 4.0' (592.52')

TOP OF GRAVEL PACK 5.0' (591.52')

TOP OF SCREEN 6.0' (590.52')

BOTTOM OF SCREEN 50.4' (546.12')

BOTTOM OF BLANK SEC. N/A

BOTTOM OF GRAVEL PACK 51.0' (545.52')

BOTTOM OF BOREHOLE 51.0' (545.52')

1 GROUT SEAL MATERIAL: CEMENT BENTONITE

2 BENTONITE SEAL MATERIAL: BENTONITE CHIPS

3 SCREEN SIZE: 0.010" SLOT

4 GRAVEL PACK MATERIAL: #5 QUARTZ SAND

5 BOREHOLE DIAMETER 6" MIN. 7"

6 1.92" DIA. PVC CASING (O.D.)

7 CONCRETE PAD DIMENSIONS: 3'x3'x8" THICK (MIN.)

8 PROTECTIVE STEEL H2 RATED VAULT COVER

NOTE: DEPTHS OF MATERIALS ARE TAKEN FROM TOP OF VAULT/GROUND SURFACE

SCALE: NTS

GEOTECHNICAL ENGINEERING SECTION CIVIL DESIGN STANDARD		REVISION 0		OBSERVATION WELL
APP'D.	DR.	C.K.	DATE	
AMERICAN ELECTRIC POWER SERVICE CORP.				CDS-04A / SH.

AMERICAN ELECTRIC POWER
SPORN FLY ASH AND BOTTOM ASH POND COMPLEX

GEOLOGIST/ENGINEER:

LEWIS EPLIN H.C. NUTTING CO.

TERRACON PROJECT NO. N2095019

PROJECT SPORN FLY ASH AND BOTTOM ASH POND COMPLEX

SUMMARY ELEVATIONS
(FT. NGVD)

COORDINATES 718150.72 N/1736258.64 E (NAD 27)(NGVD29 WV N)

DATE INSTALLED 02/19/09

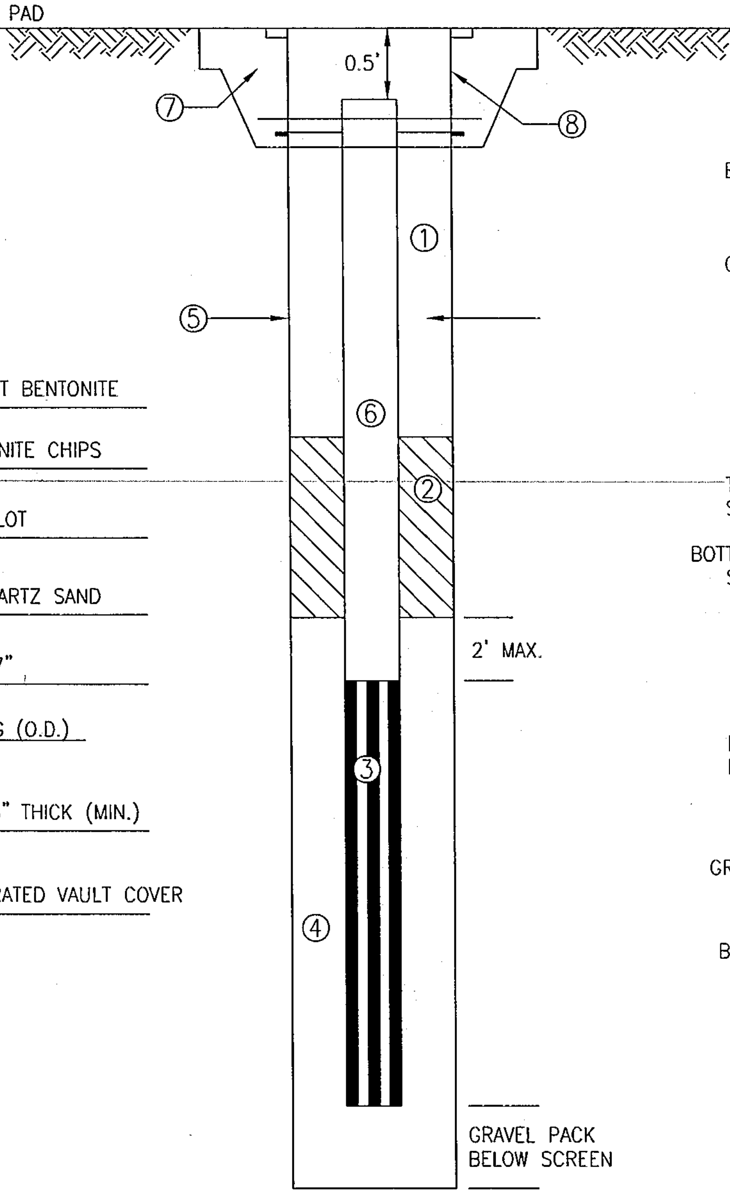
PIEZOMETER NO. PZ-09-04

REF. DATUM PT.:
TOP OF PROTECTIVE
VAULT/GROUND SURFACE

REF. DATUM PT. ________

GROUND SURFACE/TOP OF PAD

GRADE 0' (593.69')



DEPTH (ELEV.)

TOP OF BENTONITE SEAL 3.5' (590.19')

TOP OF GRAVEL PACK 4.5' (589.19')

TOP OF SCREEN 5.5' (588.19')

BOTTOM OF SCREEN 49.8' (543.89')

BOTTOM OF BLANK SEC. N/A

BOTTOM OF GRAVEL PACK 51.0' (542.69')

BOTTOM OF BOREHOLE 51.0' (542.69')

1 GROUT SEAL MATERIAL: CEMENT BENTONITE

2 BENTONITE SEAL MATERIAL: BENTONITE CHIPS

3 SCREEN SIZE: 0.010" SLOT

4 GRAVEL PACK MATERIAL: #5 QUARTZ SAND

5 BOREHOLE DIAMETER 6" MIN. 7"

6 1.92" DIA. PVC CASING (O.D.)

7 CONCRETE PAD DIMENSIONS: 3'x3'x8" THICK (MIN.)

8 PROTECTIVE STEEL H2 RATED VAULT COVER

NOTE: DEPTHS OF MATERIALS ARE TAKEN FROM TOP OF VAULT/GROUND SURFACE

SCALE: NTS

GEOTECHNICAL ENGINEERING SECTION CIVIL DESIGN STANDARD		REVISION 0		OBSERVATION WELL
APP'D.	DR.	C.K.	DATE	
AMERICAN ELECTRIC POWER SERVICE CORP.				CDS-04A / SH.

AMERICAN ELECTRIC POWER
SPORN FLY ASH AND BOTTOM ASH POND COMPLEX

GEOLOGIST/ENGINEER:
LEWIS EPLIN H.C. NUTTING CO.

TERRACON PROJECT NO. N2095019

PROJECT SPORN FLY ASH AND BOTTOM ASH POND COMPLEX

SUMMARY ELEVATIONS
(FT. NGVD)

COORDINATES 717961.56 N/1735749.39 E (NAD 27)(NGVD29 WV N)

DATE INSTALLED 02/17/09

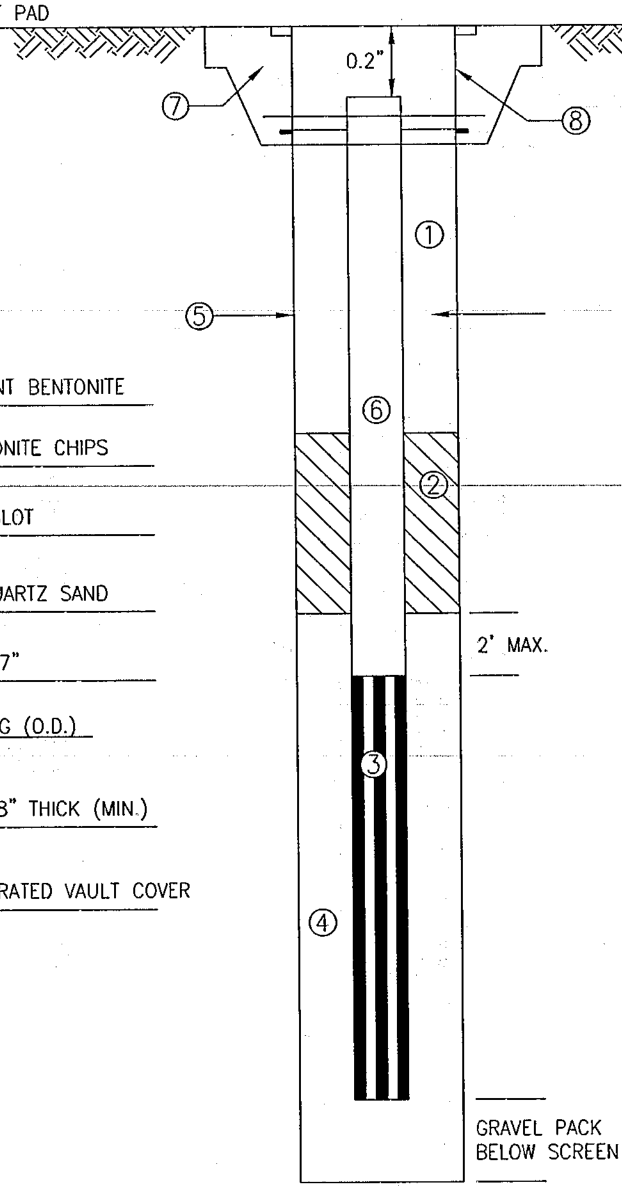
PIEZOMETER NO. PZ-09-05

REF. DATUM PT.: TOP OF PROTECTIVE VAULT/GROUND SURFACE

REF. DATUM PT.

GROUND SURFACE/TOP OF PAD

GRADE 0' (593.45')



DEPTH (ELEV.)

TOP OF BENTONITE SEAL 3.2' (590.25')

TOP OF GRAVEL PACK 4.2' (589.25')

TOP OF SCREEN 5.2' (588.25')

BOTTOM OF SCREEN 50.2' (543.25')

BOTTOM OF BLANK SEC. N/A

BOTTOM OF GRAVEL PACK 51.0' (542.45')

BOTTOM OF BOREHOLE 51.0' (542.45')

1 GROUT SEAL MATERIAL: CEMENT BENTONITE

2 BENTONITE SEAL MATERIAL: BENTONITE CHIPS

3 SCREEN SIZE: 0.010" SLOT

4 GRAVEL PACK MATERIAL: #5 QUARTZ SAND

5 BOREHOLE DIAMETER 6" MIN. 7"

6 1.92" DIA. PVC CASING (O.D.)

7 CONCRETE PAD DIMENSIONS: 3'x3'x8" THICK (MIN.)

8 PROTECTIVE STEEL H2 RATED VAULT COVER

NOTE: DEPTHS OF MATERIALS ARE TAKEN FROM TOP OF VAULT/GROUND SURFACE

SCALE: NTS

GEOTECHNICAL ENGINEERING SECTION CIVIL DESIGN STANDARD		REVISION 0	OBSERVATION WELL
APP'D.	DR.	C.K. / DATE	
AMERICAN ELECTRIC POWER SERVICE CORP.			CDS-04A / SH.

AMERICAN ELECTRIC POWER
SPORN FLY ASH AND BOTTOM ASH POND COMPLEX

GEOLOGIST/ENGINEER:
LEWIS EPLIN H.C. NUTTING CO.

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1-$^3/8$" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube - 2" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling		
DCI:	Dry Cave in	BCR:	Before Casing Removal		
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0 - 1	Very Soft
500 – 1,000	2 - 4	Soft
1,000 – 2,000	4 - 8	Medium Stiff
2,000 – 4,000	8 - 15	Stiff
4,000 – 8,000	15 - 30	Very Stiff
8,000+	> 30	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Relative Density
0 – 3	Very Loose
4 – 9	Loose
10 – 29	Medium Dense
30 – 49	Dense
> 50	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifiers	> 12

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	> 30

Terracon

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]					Soil Classification: Group Symbol	Soil Classification: Group Name[B]
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]		GW	Well-graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]		GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH		GM	Silty gravel[F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]		SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]		SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH		SM	Silty sand[G,H,I]
			Fines Classify as CL or CH		SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	$PI > 7$ and plots on or above "A" line[J]		CL	Lean clay[K,L,M]
			$PI < 4$ or plots below "A" line[J]		ML	Silt[K,L,M]
		organic	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay[K,L,M,N]
						Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line		CH	Fat clay[K,L,M]
			PI plots below "A" line		MH	Elastic Silt[K,L,M]
		organic	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay[K,L,M,P]
						Organic silt[K,L,M,Q]
Highly organic soils		Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains $\geq$ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains $\geq$ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains $\geq$ 30% plus No. 200 predominantly sand, add "sandy" to group name.

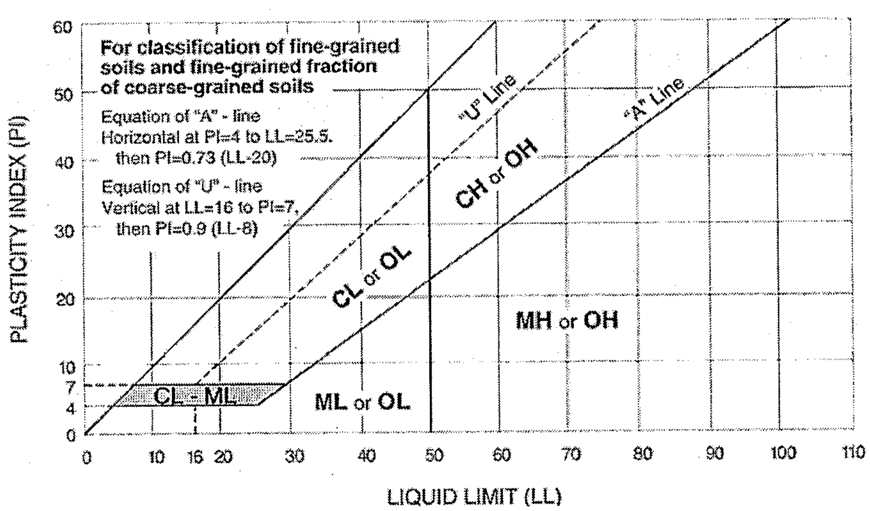
[M] If soil contains $\geq$ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] $PI \geq 4$ and plots on or above "A" line.

[O] $PI < 4$ or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



Terracon

Form 111—6/98

Well anc

ID Number	12/9/08	1/13/09	1/13/09	2/9/09	2/9/09	3/16/09	3/16/09	4/23/09	4/23/09	5/12/09	5/12/09
1	550.20	4.20	554.00	4.60	553.60	7.00	551.20	5.50	552.70	5.45	552.75
2	547.10	9.70	549.80	12.20	547.30	12.38	547.12	13.00	546.50	12.40	547.10
3	547.26	9.76	550.84	12.70	547.90	13.40	547.20	13.44	547.16	12.90	547.70
4	551.12	9.20	553.10	11.40	550.90	13.00	549.30	11.90	550.40	12.40	549.90
5	555.94	5.00	557.10	5.78	556.32	6.14	555.96	6.24	555.86	6.15	555.95
6	558.45	4.36	558.94	4.78	558.52	5.04	558.26	4.66	558.64	4.70	558.60
7	548.10	12.42	552.68	16.56	548.54	17.40	547.70	17.16	547.94	16.90	548.20
8	547.45	13.98	549.22	16.80	546.40	15.96	547.24	16.42	546.78	15.75	547.45
9	546.18	13.88	547.62	16.78	544.72	16.02	545.48	17.62	543.88	16.70	544.80
10	545.70	12.54	547.36	15.50	544.40	14.70	545.20	16.60	543.30	15.75	544.15
11	545.74	13.40	548.10	16.80	544.70	16.20	545.30	17.44	544.06	17.02	544.48
96-101	600.20	18.70	600.30	18.74	600.26	18.42	600.58	19.20	599.80	17.90	601.10
96-104	617.40	2.64	616.06	3.84	614.86	5.58	613.12	6.44	612.26	6.80	611.90
96-108	557.84	44.30	559.10	45.28	558.12	45.30	558.10	45.52	557.88	45.40	558.00
96-110	587.35	21.20	581.10	43.80	558.50	26.70	575.60	26.70	575.60	26.68	575.62
93101	587.90	15.20	587.90	14.60	588.50	15.18	587.92	15.20	587.90	15.20	587.90
93103	587.32	13.16	589.44	15.20	587.40	15.18	587.42	15.02	587.58	14.68	587.92
93104	588.86	14.74	588.86	14.72	588.88	14.70	588.90	14.72	588.88	14.74	588.86
PZ-09-01								17.14	582.71	16.45	583.40
PZ-09-02								24.42	577.03	25.25	576.20
PZ-09-03								20.33	575.18	21.60	573.91
PZ-09-04								20.56	572.75	21.80	571.51
PZ-09-05											

ID Number	6/10/09	6/10/09	7/30/09	7/30/09	8/18/09	8/18/09	9/11/09	9/11/09	10/19/09	10/19/09	11/12/09	11/12/09	12/8/09	12/8/09
1	6.42	551.78	12.30	545.90	12.10	546.10	16.30	541.90	9.80	548.40	10.90	547.30	11.30	546.90
2	13.68	545.82	15.30	544.20	15.50	544.00	16.40	543.10	13.60	545.90	15.30	544.20	15.80	543.70
3	14.70	545.90	16.70	543.90	16.30	544.30	17.60	543.00	14.60	546.00	16.10	544.50	16.10	544.50
4	14.30	548.00	16.50	545.80	17.50	544.80	19.20	543.10	13.30	549.00	15.60	546.70	17.10	545.20
5	6.40	555.70	7.80	554.30	7.50	554.60	8.80	553.30	16.10	546.00	7.70	554.40	8.70	553.40
6	4.64	558.66	5.10	558.20	5.00	558.30	5.50	557.80	4.50	558.80	5.10	558.20	5.70	557.60
7	18.76	546.34	20.70	544.40	22.00	543.10	23.50	541.60	18.90	546.20	21.40	543.70	22.00	543.10
8	17.78	545.42	20.60	542.60	21.00	542.20	22.00	541.20	18.00	545.20	20.60	542.60	21.10	542.10
9	18.20	543.30	19.00	542.50	19.70	541.80	20.70	540.80	17.50	544.00	20.10	541.40	20.40	541.10
10	17.30	542.60	18.10	541.80	18.40	541.50	19.30	540.60	16.20	543.70	19.00	540.90	19.40	540.50
11	18.70	542.80	19.90	541.60	20.15	541.35	21.10	540.40	17.40	544.10	20.60	540.90	20.90	540.60
96-101	16.84	602.16	17.80	601.20	19.00	600.00	18.00	601.00	18.50	600.50	18.60	600.40	19.00	600.00
96-104	7.12	611.58	7.20	611.50	7.20	611.50	7.10	611.60	7.20	611.50	7.20	611.50	7.40	611.30
96-108	45.90	557.50	46.50	556.90	46.90	556.50	47.00	556.40	47.20	556.20	47.30	556.10	47.30	556.10
96-110	26.42	575.88	26.70	575.60	26.50	575.80	27.50	574.80	28.20	574.10	28.10	574.20	28.20	574.10
93101	15.18	587.92	15.20	587.90	15.22	587.88	15.20	587.90	15.20	587.90	15.20	587.90	15.20	587.90
93103	14.16	588.44	15.30	587.30	15.24	587.36	15.30	587.30	15.20	587.40	15.30	587.30	15.30	587.30
93104	14.80	588.80	14.70	588.90	14.76	588.84	14.70	588.90	14.80	588.80	14.80	588.80	14.80	588.80
PZ-09-01	12.90	586.95	15.00	584.85	15.30	584.55	17.40	582.45	13.30	586.55	15.00	584.85	17.50	582.35
PZ-09-02	24.82	576.63	25.50	575.95	25.60	575.85	25.70	575.75	25.30	576.15	25.60	575.85	25.10	576.35
PZ-09-03	18.70	576.81	23.10	572.41	22.20	573.31	23.50	572.01	22.80	572.71	23.10	572.41	21.90	573.61
PZ-09-04	18.19	575.12	24.40	568.91	19.40	573.91	23.10	570.21	21.00	572.31	21.50	571.81	16.00	577.31
PZ-09-05	17.71	575.51	22.60	570.62	19.64	573.58	22.50	570.72	21.10	572.12	21.80	571.42	18.40	574.82

Geo/Environmental Associates, Inc.

Boring No. GA-1D

PROJECT: AEP Philip Sporn	PROJECT NO: 09-387
Start Date: 12-16-09	Drilling Contractor: Horn and Associates
Finish Date: 12-17-09	Driller: Tom Leininger
Logged By: Seth Frank	Helper: Robert, George, Jared
Location: FAP – East Dike section K-K	Drill Type: Diedrich D120 Truck Mounted
Ground Elevation: 619.21' NGVD29	AEP Contacts: Mark King and Ginger MacKnight
Notes: woven fabric approx 0.5' bgs	Thickness of Soil:
NAD27 Coordinates Provided by AEP	Depth Drilled In Rock:
N 719729.38 E 1736015.38	Total Depth of Boring: 59.0'

DEPTH (FEET)		SAMPLE NOS., & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
FROM	TO			
9.0	10.5	S-1 / 0.3'	Sand, gravel, brown, very dense, damp	50 / 0.4'
19.0	20.5	S-2 / 1.4'	Sand, clay, brown streaked black, medium dense, damp-moist	21-14-12
29.0	30.5	ST-1 / 1.17'	Fly Ash, grey, wet	
32.5		Vane Shear	10 lb-ft / 60° 10 lb-ft / 360°	
39.0	41.5	ST-2 / 2.48'	Fly Ash, grey, wet	
42.5		Vane Shear	30 lb-ft / 60° 20 lb-ft / 360°	
50.5'		Vane Shear	30 lb-ft / 60° 20 lb-ft / 360°	
59.0	61.5	ST-3 / 2.36'	Fly Ash, clay, grey-black	

Geo/Environmental Associates, Inc.

Project Name/ Job Number: 09-387

Boring Log No.: GA-1D

DEPTH (FEET)		SAMPLE NO., SAMPLE INTERVAL & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
FROM	TO			
			Set Piezometer at approximately 60' bgs	
0	0.5		Flush Mount Piezometer Cover	
0.5	23.0		Grout	
23.0	25.0		Bentonite	
25.0	60.0		Prepak Screen Backfilled With Sand	
60.0	61.5		Bentonite mix	
			Water Elevation December 17, 2009: 25.2' bgs	
			Water Elevation January 8, 2010: 25.6' bgs	

Geo/Environmental Associates, Inc.

Boring No. GA-1A

Page 1 Of 2

PROJECT: AEP Philip Sporn	PROJECT NO: 09-387
Start Date: 12-10-09	Drilling Contractor: Horn and Associates
Finish Date: 12-10-09	Driller: Tom Leininger
Logged By: Seth Frank	Helper: Robert, George
Location: FAP – East Dike section K-K	Drill Type: Diedrich D120 Truck Mounted
Ground Elevation: 619.13' NGVD29	AEP Contacts: Mark King and Ginger MacKnight
Notes: woven fabric approx 0.5' bgs	Thickness of Soil:
NAD27 Coordinates Provided by AEP	Depth Drilled In Rock:
N 719696.84 E 1736037.33	Total Depth of Boring: 69.0'

DEPTH (FEET) FROM	TO	SAMPLE NOS., & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
2.0	2.5	S-1 / 0.4'	Sand, gravel, brown, very dense, damp	50 / 0.5'
4.0	5.5	S-2 / 0.5'	Sand, gravel, brown, very dense, damp	35-50 / 0.1'
6.5	8.0	S-3 / 0.4'	Sand, gravel, brown, very dense, damp	50 / 0.5'
9.0	10.5	S-4 / 0.4'	Sand, gravel, brown, very dense, damp	33-37-31
14.0	15.0	S-5 / 1.4'	Sand, gravel, brown, very dense, damp	35-36-29
14.0	14.5	S-6 / 0.4'	Sand, gravel, brown, very dense, damp	50 / 0.5'
16.5	18.0	S-7 / 1.5'	Sand, clay, brown, medium dense, damp	17-17-13
19.0	20.5	S-8 / 1.5'	Sand, clay, brown, medium dense, damp	20-12-11
20.5	22.0	S-9 / 1.3'	Sand, clay, brown, medium dense, damp	11-14-15
22.0	23.5	S-10 / 1.5'	0 -1.1' Sand, clay, brown / 1.1-1.5' Bottom Ash, sand, black, dense, damp	23-26-20
23.5	25.0	S-11 / 1.5'	Sand, bottom ash streaks, clay, brown streaked black, dense, damp	17-20-17
25.0	26.5	S-12 / 1.5'	Bottom Ash, fly ash, grey-black, dense, moist (approximate start of fly ash)	17-16-16

Geo/Environmental Associates, Inc.

Project Name/ Job Number: 09-387

Boring Log No.: GA-1A

DEPTH (FEET)		SAMPLE NO., SAMPLE INTERVAL & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
FROM	TO			
26.5	27.2	ST-1 / 0.7'	Fly Ash, bottom ash, grey-black, wet	W/L ≈ 27' bgs
28.5	31.0	ST-2 / 2.66'	Fly Ash, grey, wet	
31.0	32.5	S-13 / 1.5'	Fly Ash, grey, loose, wet	3-2-3
32.5	35.0	ST-3 / 2.50'	Fly Ash, grey, wet	
35.0	36.5	S-14 / 1.5'	Fly Ash, grey, loose wet	3-3-3
36.5	39.0	ST-4 / 2.60'	Fly Ash, grey, wet	
39.0	40.5	S-15 / 1.5'	Fly Ash, grey, loose, wet	2-3-2
40.5	43.0	ST-5 / 2.55'	Fly Ash, grey, wet	
43.0	44.5	S-16 / 1.5'	Fly Ash, grey, loose, wet	1-3-3
44.5	47.0	ST-6 / 2.55'	Fly Ash, grey, wet	
47.0	48.5	S-17 / 1.5'	Fly Ash, grey, loose, wet	5-4-4
48.5	51.0	ST-7 / 2.41'	Fly Ash, grey, wet	
51.0	52.5	S-18 / 1.5'	Fly Ash, grey, loose, wet	7-2-4
52.5	55.0	ST-8 / 2.55'	Fly Ash, grey, wet	
55.0	56.5	S-19 / 1.5'	Fly Ash, grey, loose, wet	1-3-4
56.5	59.0	ST-9 / 2.37'	Fly Ash, grey, wet	
59.0	60.5	S-20 / 1.5'	0-1.0' Fly Ash, clay, grey 1.0-1.5' Clay, silt, brown, stiff, wet (approximate end of fly ash)	3-4-8
60.5	63.0	ST-10 / 2.49'	Clay, silt, brown	
69.0	70.5	S-21 / 1.5'	Silt, clay, brown, very stiff, moist-wet	6-8-8
			Set Inclinometer at ≈ 69' bgs. Back fill with grout mix: approx 1 unit pcc, 1 unit bentonite, 6.25 units water by weight.	

Geo/Environmental Associates, Inc.

Boring No. GA-1B

Page 1 Of 1

PROJECT: AEP Philip Sporn | **PROJECT NO: 09-387**

Start Date: 12-11-09	Drilling Contractor: Horn and Associates
Finish Date: 12-14-09	Driller: Tom Leininger
Logged By: Seth Frank	Helper: Robert, George, Jared
Location: FAP – East Dike section K-K	Drill Type: Diedrich D120 Truck Mounted
Ground Elevation: 619.04' NGVD29	AEP Contacts: Mark King and Ginger MacKnight
Notes: woven fabric approx 0.5' bgs	Thickness of Soil:
NAD27 Coordinates Provided by AEP	Depth Drilled In Rock:
N 719704.38 E 1736031.96	Total Depth of Boring: 69.0'

DEPTH (FEET)		SAMPLE NOS., & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
FROM	TO			
9.0	10.5	S-1 / 0.4'	Sand, gravel, brown, very dense, damp	32-37-35
19.0	20.5	S-2 / 0.5'	Sand, clay, brown – mottled black, medium dense, damp	12-7-9
29.0	30.5	S-3 / 0.4'	Fly Ash, grey, loose, wet	5-4-5
39.0	40.5	S-4 / 0.4'	Fly Ash, grey, very loose, wet	0-1-0
49.0	50.5	S-5 / 1.4'	Fly Ash, grey, loose, wet	2-3-5
59.0	60.5	S-6 / 0.4'	0-1.0 Fly Ash, grey, very loose, wet 1.0-1.5 Clay, silty, brown, soft, damp-moist	0-0-3
69.0	70.5	S-7 / 1.5'	Clay, silty, brown, very stiff, damp-moist	9-10-10
			Set Inclinometer at ≈ 69' bgs. Back fill with grout mix: approx 1 unit pcc, 1 unit bentonite, 6.25 units water by weight.	

Geo/Environmental Associates, Inc.

Boring No. GA-1C

Page 1 Of 1

PROJECT: AEP Philip Sporn	**PROJECT NO: 09-387**
Start Date: 12-16-09	Drilling Contractor: Horn and Associates
Finish Date: 12-16-09	Driller: Tom Leininger
Logged By: Seth Frank	Helper: Robert, George, Jared
Location: FAP – East Dike section K-K	Drill Type: Diedrich D120 Truck Mounted
Ground Elevation: 619.03' NGVD29	AEP Contacts: Mark King and Ginger MacKnight
Notes: woven fabric approx 0.5' bgs	Thickness of Soil:
NAD27 Coordinates Provided by AEP	Depth Drilled In Rock:
N 719712.67 E 1736026.24	Total Depth of Boring: 79.0'

DEPTH (FEET)		SAMPLE NOS., & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
FROM	TO			
9.0	10.5	S-1 / 1.4'	Sand, gravel, brown, very dense, damp	29-30-31
19.0	20.5	S-2 / 1.5'	Sand, clay, brown streaked black, medium dense, damp-moist	9-11-7
29.0	30.5	S-3 / 1.5'	Fly Ash, grey-black, medium dense, wet	9-8-7
35.0		Vain Shear	30 lb-ft / 60° 10 lb-ft / 360°	
39.0	41.5	ST-1 / 0.98'	Fly Ash, grey, wet	
42.5		Vane Shear	100 lb-ft / 90° 60 lb-ft / 360°	
50.0'		Vane Shear	40 lb-ft / 60° 20 lb-ft / 360°	
59.0	60.5	S-4 / 1.5'	Fly Ash, clay, organic material, silty, dark brown – black, soft, moist-wet	1-1-3
69.0	71.5	ST-2 / 2.58'	Clay, silty, sandy, brown, moist-wet	
79.0	80.5	S-5 / 1.5'	Clay, silty, brown, stiff, wet	5-8-7 1.75 tsf
			Set Inclinometer at ≈ 79' bgs. Back fill with grout mix: approx 1 unit pcc, 1 unit bentonite, 6.25 units water by weight.	

Geo/Environmental Associates, Inc.

Boring No. GA-1D

Page 1 Of 1

PROJECT: AEP Philip Sporn	PROJECT NO: 09-387
Start Date: 12-16-09	Drilling Contractor: Horn and Associates
Finish Date: 12-17-09	Driller: Tom Leininger
Logged By: Seth Frank	Helper: Robert, George, Jared
Location: FAP – East Dike section K-K	Drill Type: Diedrich D120 Truck Mounted
Ground Elevation: 619.21' NGVD29	AEP Contacts: Mark King and Ginger MacKnight
Notes: woven fabric approx 0.5' bgs	Thickness of Soil:
NAD27 Coordinates Provided by AEP	Depth Drilled In Rock:
N 719729.38 E 1736015.38	Total Depth of Boring: 59.0'

DEPTH (FEET) FROM	TO	SAMPLE NOS., & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
9.0	10.5	S-1 / 0.3'	Sand, gravel, brown, very dense, damp	50 / 0.4'
19.0	20.5	S-2 / 1.4'	Sand, clay, brown streaked black, medium dense, damp-moist	21-14-12
29.0	30.5	ST-1 / 1.17'	Fly Ash, grey, wet	
32.5		Vane Shear	10 lb-ft / 60° 10 lb-ft / 360°	
39.0	41.5	ST-2 / 2.48'	Fly Ash, grey, wet	
42.5		Vane Shear	30 lb-ft / 60° 20 lb-ft / 360°	
50.5'		Vane Shear	30 lb-ft / 60° 20 lb-ft / 360°	
59.0	61.5	ST-3 / 2.36'	Fly Ash, clay, grey-black	
			Set Piezometer at approximately 59.5' bgs	
0	0.5		Flush Mount Piezometer Cover	
0.5	23.0		Grout	
23.0	25.0		Bentonite	
25.0	60.0		Prepak Screen Backfilled With Sand	
60.0	61.5		Bentonite mix	

Geo/Environmental Associates, Inc.

Boring No. GA-2

PROJECT: AEP Philip Sporn	**PROJECT NO: 09-387**
Start Date: 12-17-09	Drilling Contractor: Horn and Associates
Finish Date: 12-18-09	Driller: Tom Leininger
Logged By: Seth Frank	Helper: Robert, George, Jared
Location: FAP – East Dike section M-M	Drill Type: Diedrich D120 Truck Mounted
Ground Elevation: 619.76' NGVD29	AEP Contacts: Mark King and Ginger MacKnight
Notes: woven fabric approx 0.5' bgs	Thickness of Soil:
NAD27 Coordinates Provided by AEP	Depth Drilled In Rock:
N 721075.13 E 1735262.04	Total Depth of Boring: 69.0'

DEPTH (FEET)		SAMPLE NOS., & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
FROM	TO			
4.0	5.5	S-1 / 0.3'	Sand, gravel, brown, very dense, damp	50 / 0.5'
9.0	10.5	S-2 / 0.5'	Sand, gravel, brown, very dense, damp-moist	35-50 / 0.3'
14.0	15.5	S-3 / 0.6'	Sand, gravel, clay, brown, very dense, damp-moist	29-50 / 0.3'
19.0	20.5	S-4 / 1.4'	Sand, brown, dense, damp	27-22-18
24.0	25.5	S-5 / 1.5'	Sand, bottom ash, black, dense, damp	22-18-14
29.0	30.5	S-6 / 1.5'	Fly Ash, grey, loose, moist-wet	2-4-5
34.0	35.5	S-7 / 1.5'	Fly Ash, grey, very loose, wet	2-1-2
39.0	41.5	ST-1 / 1.10'	Fly Ash, grey, wet	
44.0	45.5	S-8 / 1.5'	Fly Ash, grey, very loose, wet	1-0-2
49.0	50.5	S-9 / 1.5'	Fly Ash, grey, very loose, wet	1-0-0
54.0	55.5	S-10 / 1.5'	Fly Ash, grey, very loose, wet	0-0-0
59.0	61.5	ST-2 / 2.50'	Fly Ash at top of sample – Transition to Silt, clay, sand, brown, moist	

Geo/Environmental Associates, Inc.

Project Name/ Job Number: 09-387

Boring Log No.: GA-2

Page 2 **of** 2

DEPTH (FEET)		SAMPLE NO., SAMPLE INTERVAL & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
FROM	TO			
64.0	65.5	S-11 / 1.5'	Sand, clay, brown, medium dense, moist	6-9-8
69.0	70.5	ST-3 / 1.70'	Sand, clay, brown, some gravel at bottom of tube	
			Backfill hole with grout mix	

Geo/Environmental Associates, Inc.

Boring No. GA-3

Page 1 Of 2

PROJECT: AEP Philip Sporn

PROJECT NO: 09-387

Start Date: 12-17-09

Finish Date: 12-17-09

Logged By: Seth Frank

Location: FAP – East Dike section L-L

Ground Elevation: 619.83' NGVD29

Drilling Contractor: Horn and Associates

Driller: Tom Leininger

Helper: Robert, George, Jared

Drill Type: Diedrich D120 Truck Mounted

AEP Contacts: Mark King and Ginger MacKnight

Notes: woven fabric approx 0.5' bgs

NAD27 Coordinates Provided by AEP

N 720258.79 E 1735560.40

Thickness of Soil:

Depth Drilled In Rock:

Total Depth of Boring: 79.0'

DEPTH (FEET)		SAMPLE NOS., & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
FROM	TO			
4.0	5.5	S-1 / 0.4'	Sand, gravel, dark brown, very dense, damp	50 / 0.5'
9.0	10.5	S-2 / 1.1'	Sand, gravel, brown, dense, moist	37-31-17
14.0	15.5	S-3 / 1.4'	Sand, clay, brown, dense, damp	23-24-12
19.0	20.5	S-4 / 1.5'	Clay, sand, silt, brown, very stiff, moist-wet	14-13-12 2.5 tsf
24.0	25.5	S-5 / 1.5'	Clay, sand, silt, brown, hard, wet	22-18-14 2.25 tsf
29.0	30.5	ST-1 / 1.51'	Fly Ash, grey	
34.0	35.5	S-6 / 1.5'	Fly Ash, grey, medium dense, wet	6-7-8
39.0	41.5	S-7 / 1.5'	Fly Ash, grey, very loose, wet	3-0-1
44.0	45.5	S-8 / 1.5'	Fly Ash, grey, loose, wet	0-2-3
49.0	51.5	ST-2 / 2.34'	Fly Ash, grey	
54.0	55.5	S-9 / 1.5'	Fly Ash, grey, loose, wet	5-5-5
59.0	60.5	S-10 / 1.5'	0.0-0.1' Ash, clay, grey 0.1-1.5' Clay, silty, sandy, brown, very stiff, moist-wet	7-10-14

Geo/Environmental Associates, Inc.

Project Name/ Job Number: 09-387

Boring Log No.: GA-3

DEPTH (FEET)		SAMPLE NO., SAMPLE INTERVAL & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
FROM	TO			
64.0	65.5	S-11 / 1.5'	Clay, silt, sand, brown, very stiff, moist	8-9-13
69.0	70.5	S-12 / 1.5'	Clay, silt, red-brown, very stiff, moist	8-9-9
74.0	75.5	S-13 / 1.5'	Clay, sand, silt, brown, soft, moist-wet	0-2-2
79.0	81.5	ST-3 / 2.27'	Clay, sand, silt, brown	
			Backfill hole with grout mix	

SUMMARY OF LABOR. TORY TEST RESULTS

						ATTERBERG LIMITS				Project: Philip Sporn Plant Project Number: 09-387 Date: January 18, 2010
Boring	Sample No.	Sample Type*	Depth (ft)	Natural Moisture (%)	Dry Density (pcf)	Liquid Limit (%)	Plasticity Index (%)	USCS	Other Test **	Soil Description
GA-1A	ST-1	ST	26.5-27.2	26.8	80.6	--	--	SM	S	Ash mix, clay, sandy, dark brown & light brown
GA-1A	ST-2	ST	28.5-31.0	53.3	61.3	46	np	ML	S	Fly Ash, gray
GA-1A	ST-3	ST	32.5-35.0	58.5	61.0	--	--	ML	S	Fly Ash, dark gray, dark brown
GA-1A	ST-4	ST	36.5-39.0	33.0	--	--	--	ML	S	Fly Ash, dark gray
GA-1A	ST-5	ST	40.5-43.0	46.6	69.3	37	np	ML	S	Fly Ash, dark gray, dark brown
GA-1A	ST-6	ST	44.5-47.0	44.6	71.9	44	np	ML	S,T	Fly Ash, dark gray
GA-1A	ST-7	ST	48.5-51.0	37.2	--	--	--	ML	S	Fly Ash, dark gray
GA-1A	ST-8	ST	52.5-55.0	53.3	65.7	44	np	ML	S	Fly Ash, gray
GA-1A	ST-9	ST	56.5-59.0	51.5	66.5	45	np	ML	S	Fly Ash, dark gray
GA-1A	ST-10	ST	60.5-63.0	53.7	63.5	44	np	ML	S	Fly Ash, dark gray, dark brown
GA-1C	ST-2	ST	69.0-71.5	28.2	95.1	35	16	CL	S,T	Clay, silty, brown
GA-2	ST-2	ST	59.0-61.5	20.3	--	20	4	CL/ML	S	Clay, silty, brown
GA-2	ST-3	ST	69.0-71.5	20.8	--	23	6	CL/ML	S	Clay, silty, light brown
GA-3	ST-3	ST	79.0-81.5	24.4	--	32	12	CL	S	Clay, silty, light brown

*ST-SHELBY TUBE SAMPLE, SS-SPLIT SPOON SAMPLE, B-BAG SAMPLE, J-JAR SAMPLE

**TEST RESULTS REPORTED ON OTHER SHEETS:

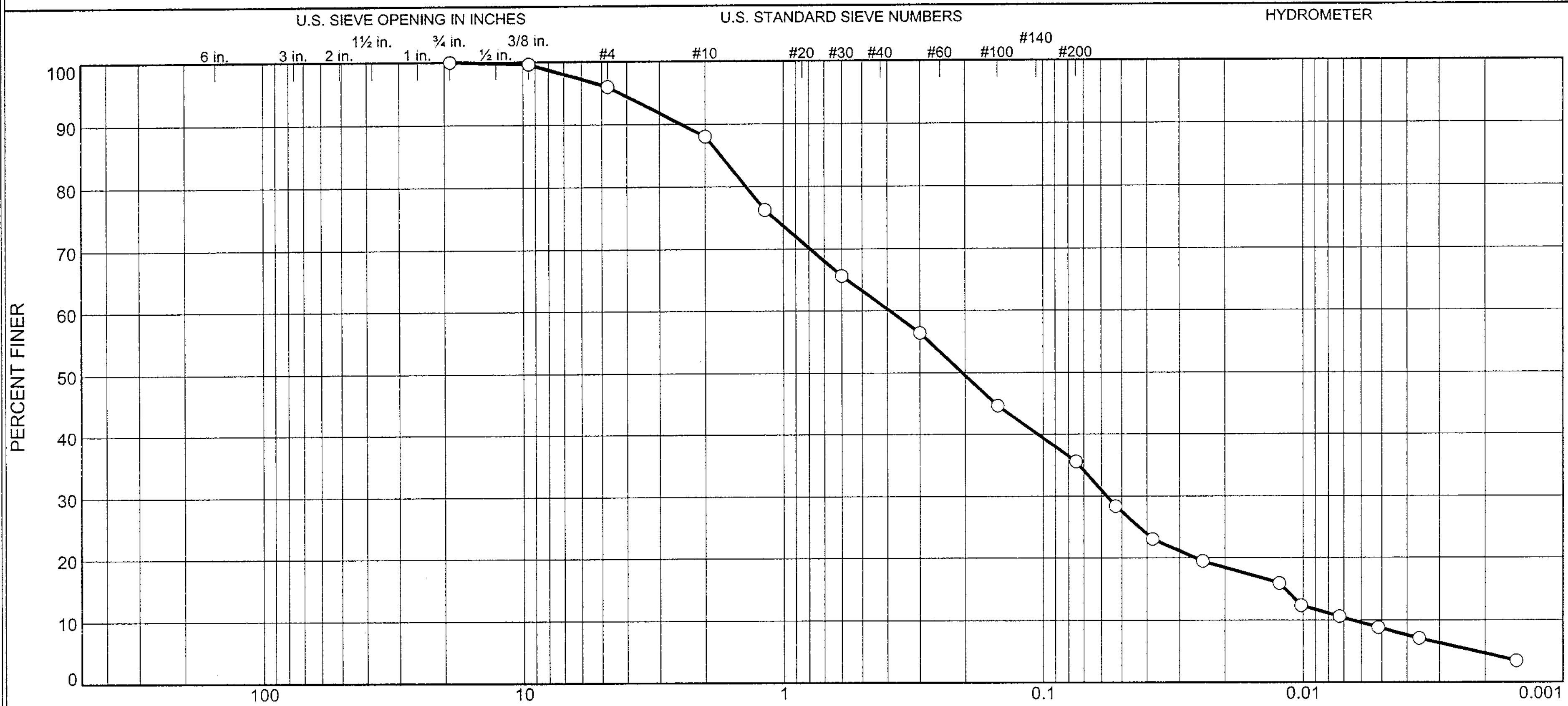
T-TRIAXIAL
S-SIEVE OR GRAIN SIZE ANALYSIS
U-UNCONFINED COMPRESSION

P-PROCTOR TEST
K-PERMEABILITY
C-CONSOLIDATION

Geo/Environmental
Associates

DATA CHECKED BY ________

Particle Size Distribution Report



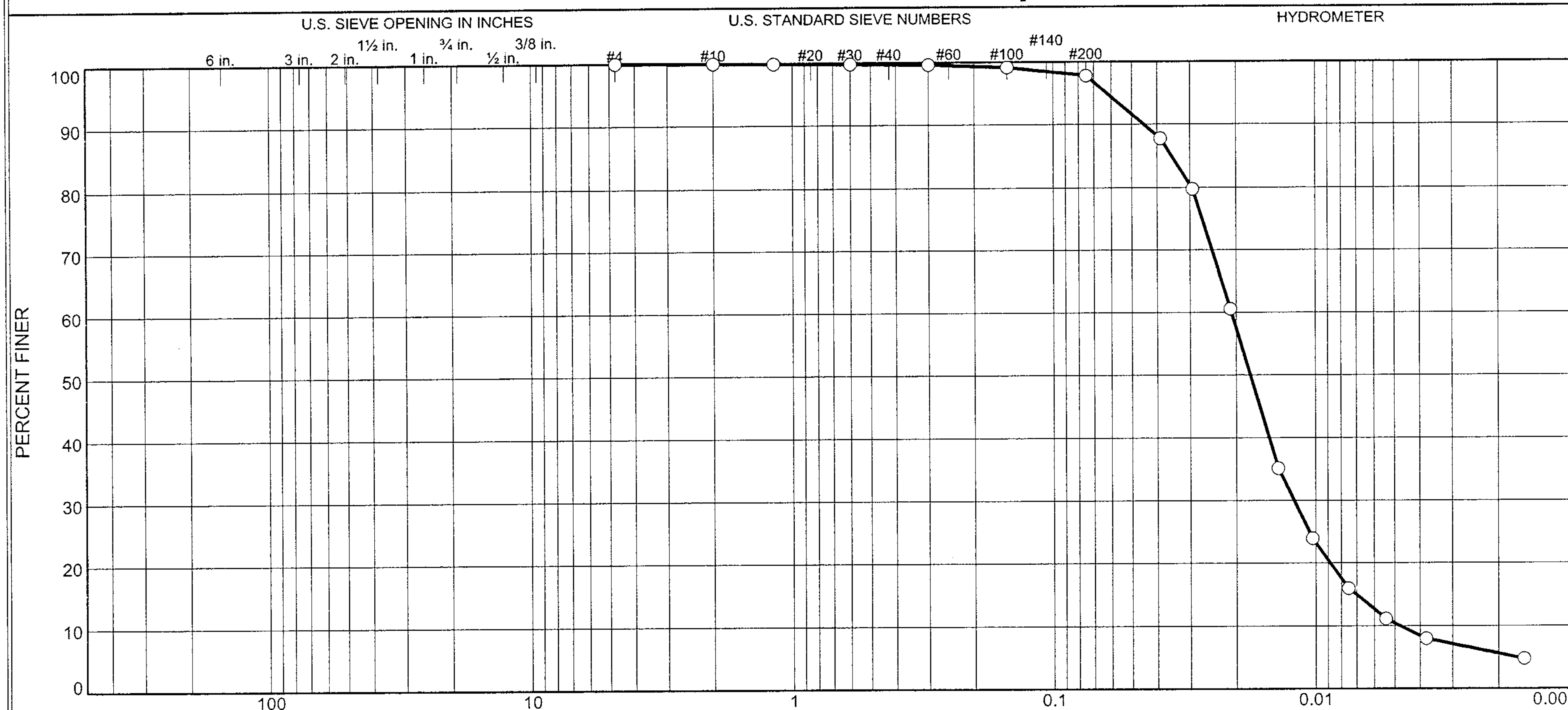
% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○ 0.0	0.0	4.0	8.0	27.0	25.5	26.9	8.6

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		GA-1A ST1	26.5'-27.2'		SM	Ash mix, clay, sandy, dark brown & light brown	26.8	nv	np

Client American Electric Power
Project Philip Sporn Plant
Project No. 09-387 Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	0.2	1.9	87.4	10.4

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		GA-1A ST2	28.5'-31.0'		ML	Fly Ash, gray	53.3	46	np

Client American Electric Power

Project Philip Sporn Plant

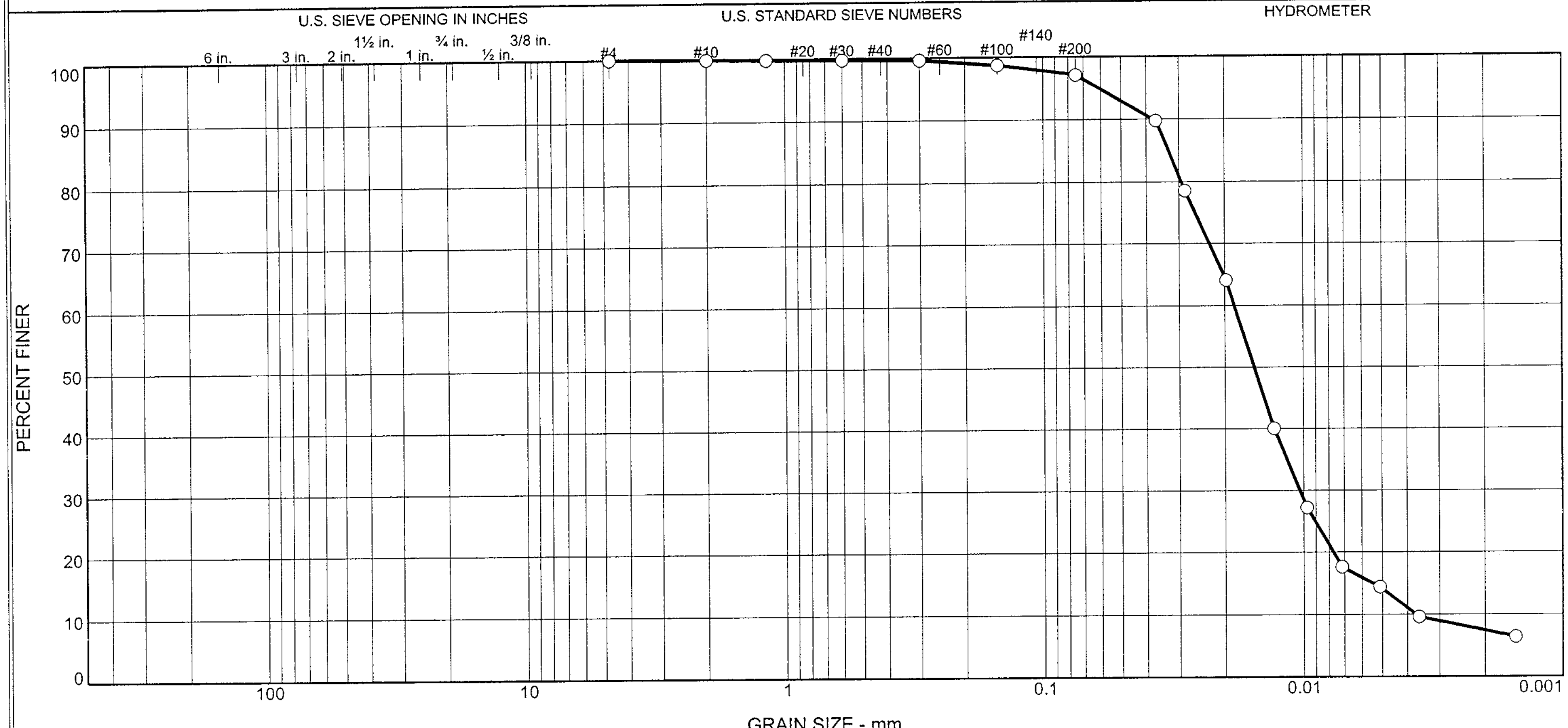
Project No. 09-387

Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

SPP00003301

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	0.2	2.6	83.1	14.0

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		GA-1A ST3	32.5'-35.0'		ML	Fly Ash, dark gray, dark brown	58.5	nv	np

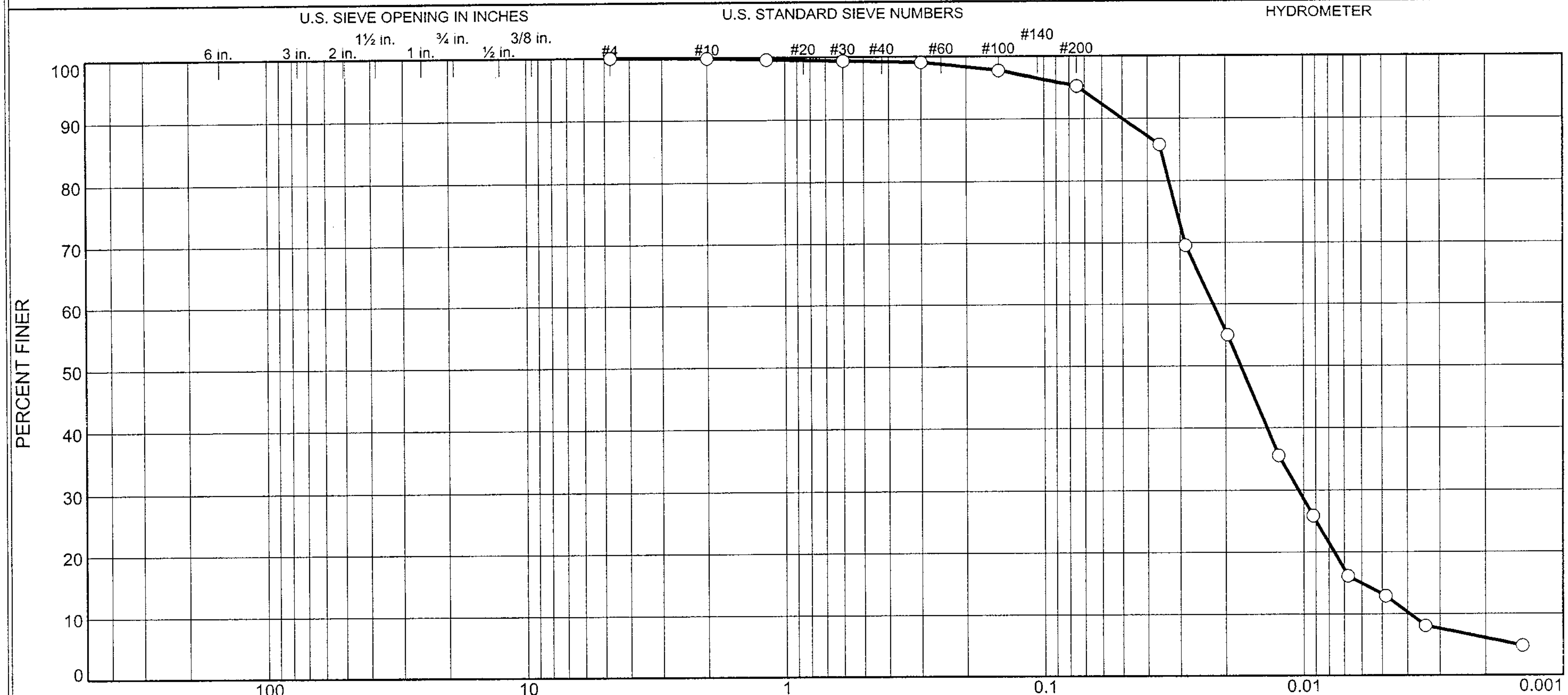
Client American Electric Power

Project Philip Sporn Plant

Project No. 09-387 Figure

Geo/Environmental Associates, Inc. Knoxville, Tennessee

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	0.7	4.0	82.0	13.2

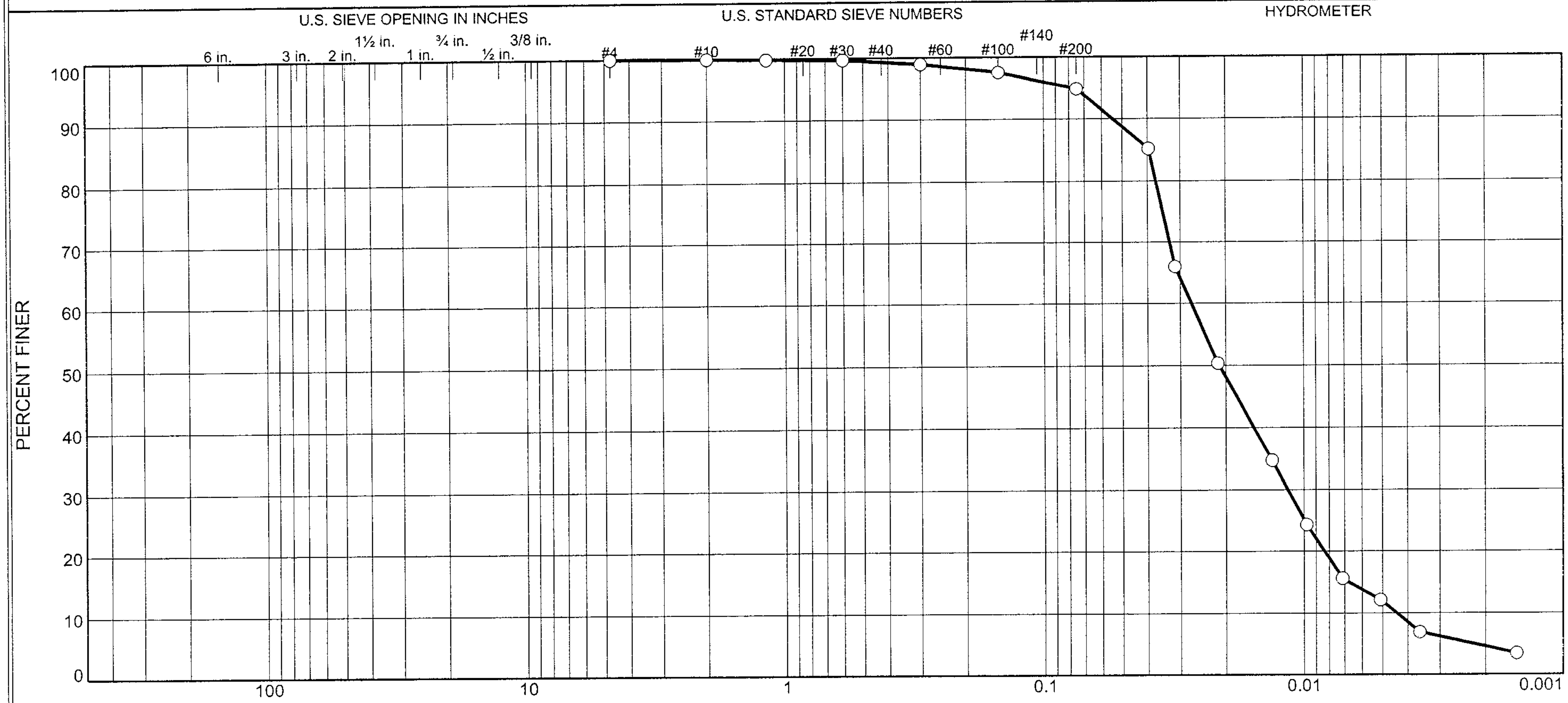
	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		GA-1A ST4	36.5'-39.0'		ML	Fly Ash, dark gray	33.0	nv	np

Client American Electric Power
Project Philip Sporn Plant
Project No. 09-387 Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

SPP00003303

Particle Size Distribution Report



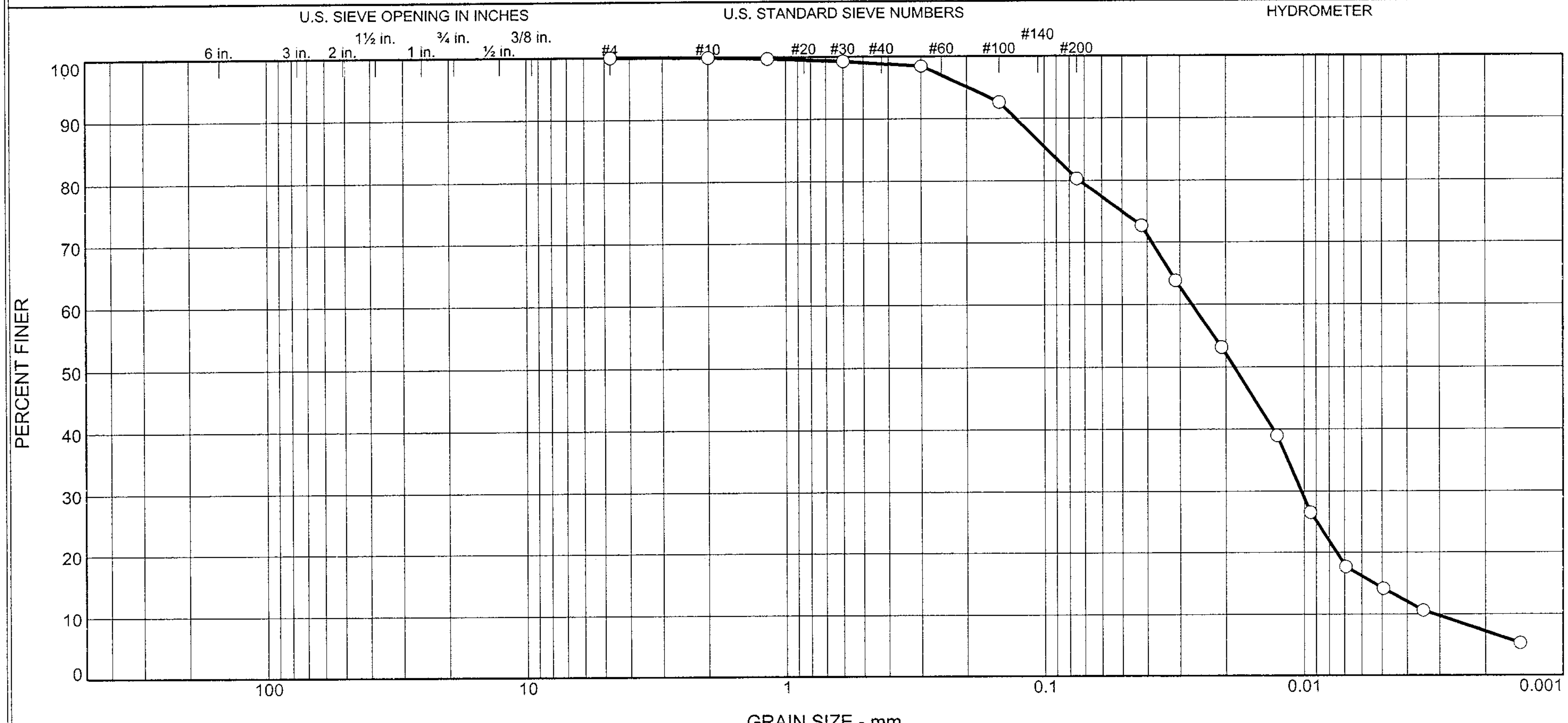
	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	0.6	4.5	83.0	11.8

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		GA-1A ST5	40.5'-43.0'		ML	Fly Ash, dark gray, dark brown	46.6	37	np

Client American Electric Power
Project Philip Sporn Plant
Project No. 09-387 Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	1.1	18.5	66.1	14.2

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		GA-1A ST6	44.5'-47.0'	12/18/09	ML	Fly Ash, dark gray	44.6	44	np

Client American Electric Power
Project Philip Sporn Plant
Project No. 09-387 Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084-90/EPA 9100 Method 2.8

PROJECT NAME : Philip Sporn Plant

PROJECT NUMBER : 09-387

CLIENT : AEP

DATE : December 18, 2009

SAMPLE LOCATION AND CONDITIONS

Sample Id.: GA-1A ST-6 - 20 psi

Depth of Tested Sample : 44.5' - 47.0'

Remolded: No

Sample Type : Shelby Tube

Sample Description : Fly Ash, dark gray - 20 psi triaxial specimen

INITIAL SPECIMEN PROPERTIES

Length (in.): 5.55

Diameter (in.): 2.83

Area (ft^2): 0.0437

Volume (ft^3): 0.0202

Weight (lbs): 2.10

Moisture (%): 44.6

Wet Density (PCF): 104.0

Dry Density (PCF): 71.9

Chamber Pressure (psi): 10

Influent Pressure (psi): 8

Back Pressure (psi): 5

Change in Pore Pressure (psi): 2.0

Change in Chamber Pressure (psi): 2.0

"B" Factor: 1.0

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

L = Length of Sample, along path of flow, (cm)

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

A = Cross-sectional area of specimen, (cm^2)

t = Interval of time, over which the flow Q occurs, (sec)

h = Difference in hydraulic head across specimen, (cm)

$$k = \frac{QL}{Ath} \text{ cm/sec}$$

$$k = \frac{(600.0)(14.10)}{(40.58)(14{,}506)(211.01)}$$

$$k = \frac{8{,}460.00}{124{,}211{,}770.81}$$

$$k = 6.81 \times 10^{-5} \text{ cm/sec}$$

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084-90/EPA 9100 Method 2.8

'ROJECT NAME : Philip Sporn Plant

PROJECT NUMBER : 09-387

CLIENT : AEP

DATE : December 18, 2009

SAMPLE LOCATION AND CONDITIONS

Sample Id.: GA-1A ST-6 - 40 psi

Depth of Tested Sample : 44.5' - 47.0'

Remolded: No

Sample Type : Shelby Tube

Sample Description : Fly Ash, dark gray - 40 psi triaxial specimen

INITIAL SPECIMEN PROPERTIES

Length (in.): 5.58

Volume (ft^3): 0.0206

Wet Density (PCF): 103.8

Diameter (in.): 2.85

Weight (lbs): 2.14

Dry Density (PCF): 71.5

Area (ft^2): 0.0443

Moisture (%): 45.2

Chamber Pressure (psi): 10

Change in Pore Pressure (psi): 2.0

Influent Pressure (psi): 8

Change in Chamber Pressure (psi): 2.0

Back Pressure (psi): 5

"B" Factor: 1.0

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

$$k = \frac{QL}{Ath} \text{ cm/sec}$$

L = Length of Sample, along path of flow, (cm)

$$k = \frac{(600.0)(14.17)}{(41.16)(8{,}599)(211.01)}$$

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

A = Cross-sectional area of specimen, (cm^2)

$$k = \frac{8{,}502.00}{74{,}683{,}790.59}$$

t = Interval of time, over which the flow Q occurs, (sec)

h = Difference in hydraulic head across specimen, (cm)

$$k = 1.14 \times 10^{-4} \text{ cm/sec}$$

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084-90/EPA 9100 Method 2.8

PROJECT NAME : Philip Sporn Plant

PROJECT NUMBER : 09-387

CLIENT : AEP

DATE : December 18, 2009

SAMPLE LOCATION AND CONDITIONS

Sample Id.: GA-1A ST-6 - 60 psi

Depth of Tested Sample : 44.5' - 47.0'

Remolded: No

Sample Type : Shelby Tube

Sample Description : Fly Ash, dark gray - 60 psi triaxial specimen

INITIAL SPECIMEN PROPERTIES

Length (in.): 5.44

Volume (ft^3): 0.0202

Wet Density (PCF): 104.0

Diameter (in.): 2.86

Weight (lbs): 2.10

Dry Density (PCF): 73.5

Area (ft^2): 0.0446

Moisture (%): 41.6

Chamber Pressure (psi): 10

Change in Pore Pressure (psi): 2.0

Influent Pressure (psi): 8

Change in Chamber Pressure (psi): 2.0

Back Pressure (psi): 5

"B" Factor: 1.0

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

$$k = \frac{QL}{Ath} \text{ cm/sec}$$

L = Length of Sample, along path of flow, (cm)

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

$$k = \frac{(600.0)(13.82)}{(41.45)(9{,}531)(211.01)}$$

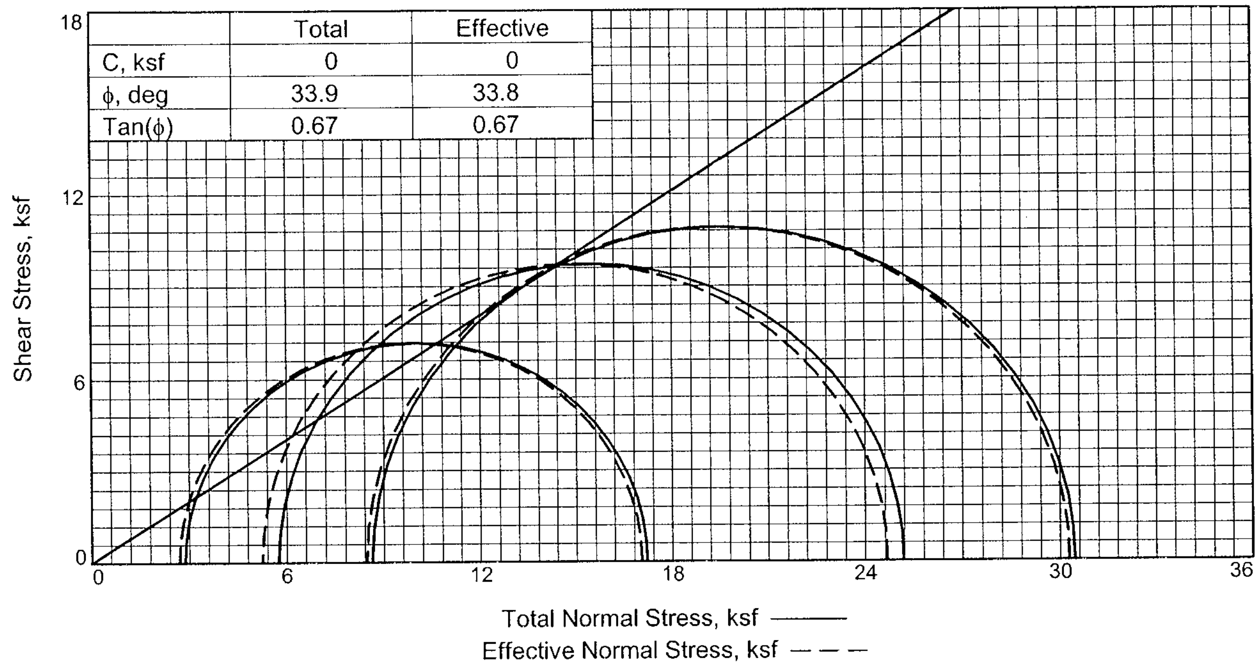
A = Cross-sectional area of specimen, (cm^2)

$$k = \frac{8{,}292.00}{83{,}361{,}600.05}$$

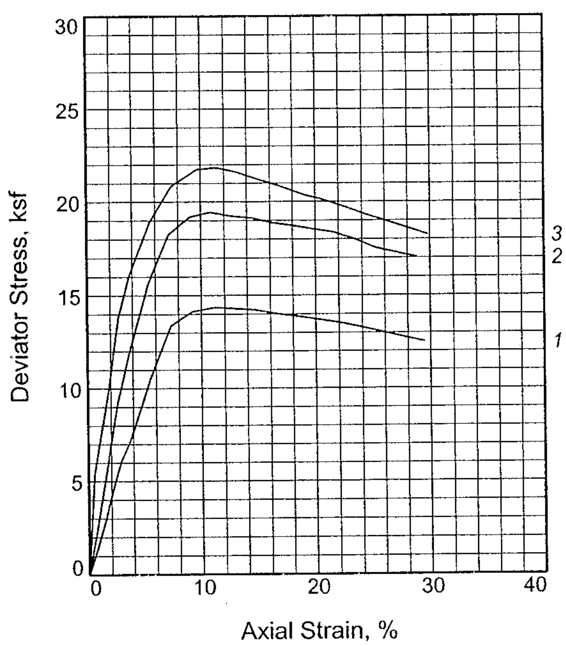
t = Interval of time, over which the flow Q occurs, (sec)

h = Difference in hydraulic head across specimen, (cm)

$$k = 9.95 \times 10^{-5} \text{ cm/sec}$$



	Total	Effective
C, ksf	0	0
ϕ, deg	33.9	33.8
Tan(ϕ)	0.67	0.67



Sample No.		1	2	3
Initial	Water Content, %	44.6	45.2	41.6
	Dry Density, pcf	71.9	71.5	73.5
	Saturation, %	97.7	98.0	94.8
	Void Ratio	1.1095	1.1210	1.0651
	Diameter, in.	2.83	2.85	2.86
	Height, in.	5.55	5.58	5.44
At Test	Water Content, %	40.1	44.4	40.7
	Dry Density, pcf	76.8	73.0	76.3
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.9746	1.0779	0.9883
	Diameter, in.	2.77	2.83	2.82
	Height, in.	5.43	5.54	5.37
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, psi		30.00	30.00	30.00
Cell Pressure, psi		50.00	70.00	90.00
Fail. Stress, ksf		14.3	19.4	21.8
Total Pore Pr., ksf		4.5	4.8	4.5
Ult. Stress, ksf				
Total Pore Pr., ksf				
$\bar{\sigma}_1$ Failure, ksf		17.0	24.7	30.3
$\bar{\sigma}_3$ Failure, ksf		2.7	5.3	8.5

Type of Test:
CU with Pore Pressures

Sample Type: Shelby Tube

Description: Fly Ash, dark gray

LL= 44

Specific Gravity= 2.43

Remarks:

Figure 1

Client: American Electric Power

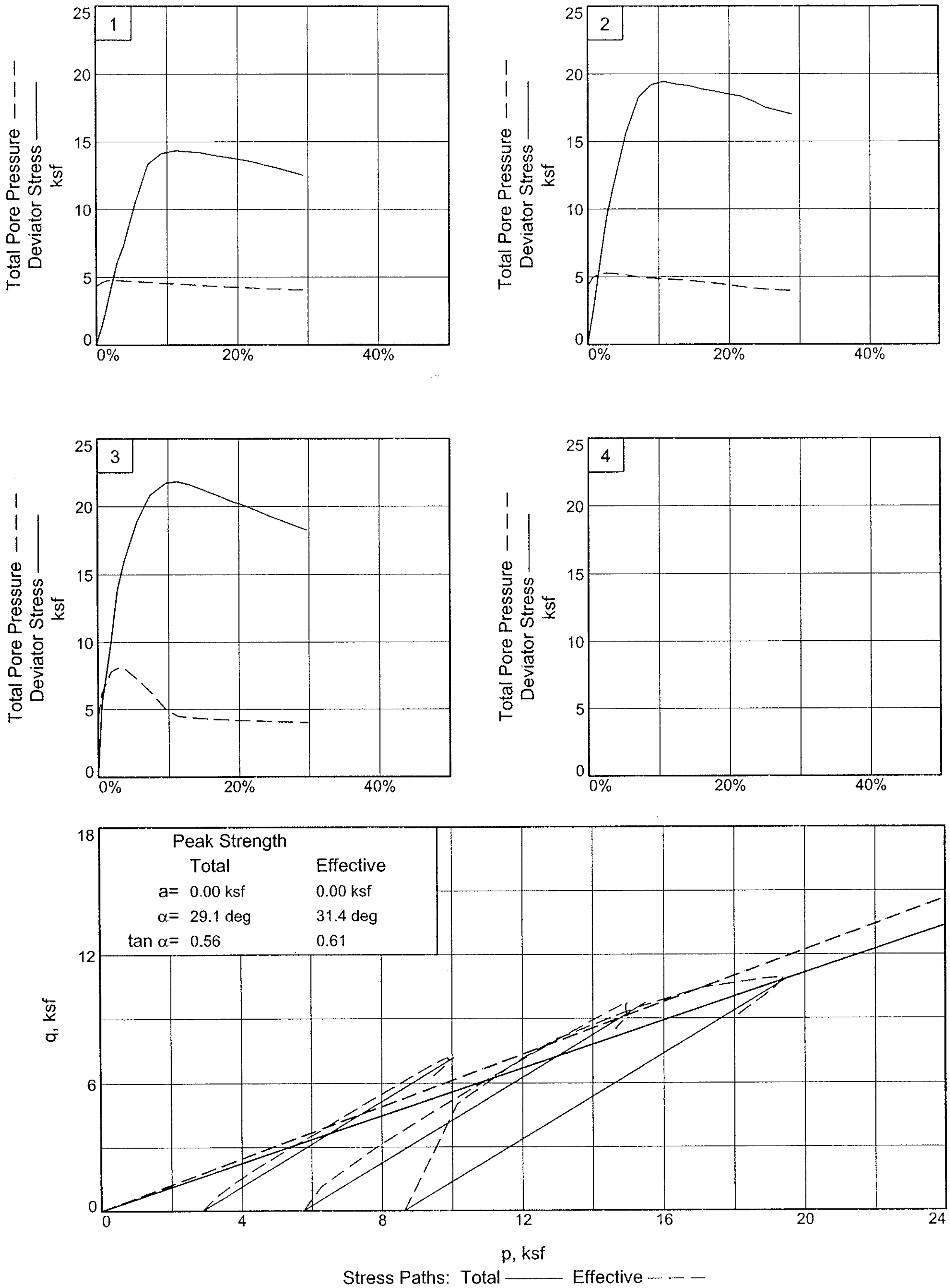
Project: Philip Sporn Plant

Sample Number: GA-1A ST6 **Depth:** 44.5'-47.0'

Proj. No.: 09-387 **Date Sampled:** 12/18/09

TRIAXIAL SHEAR TEST REPORT

Geo/Environmental Associates, Inc.



Client: American Electric Power

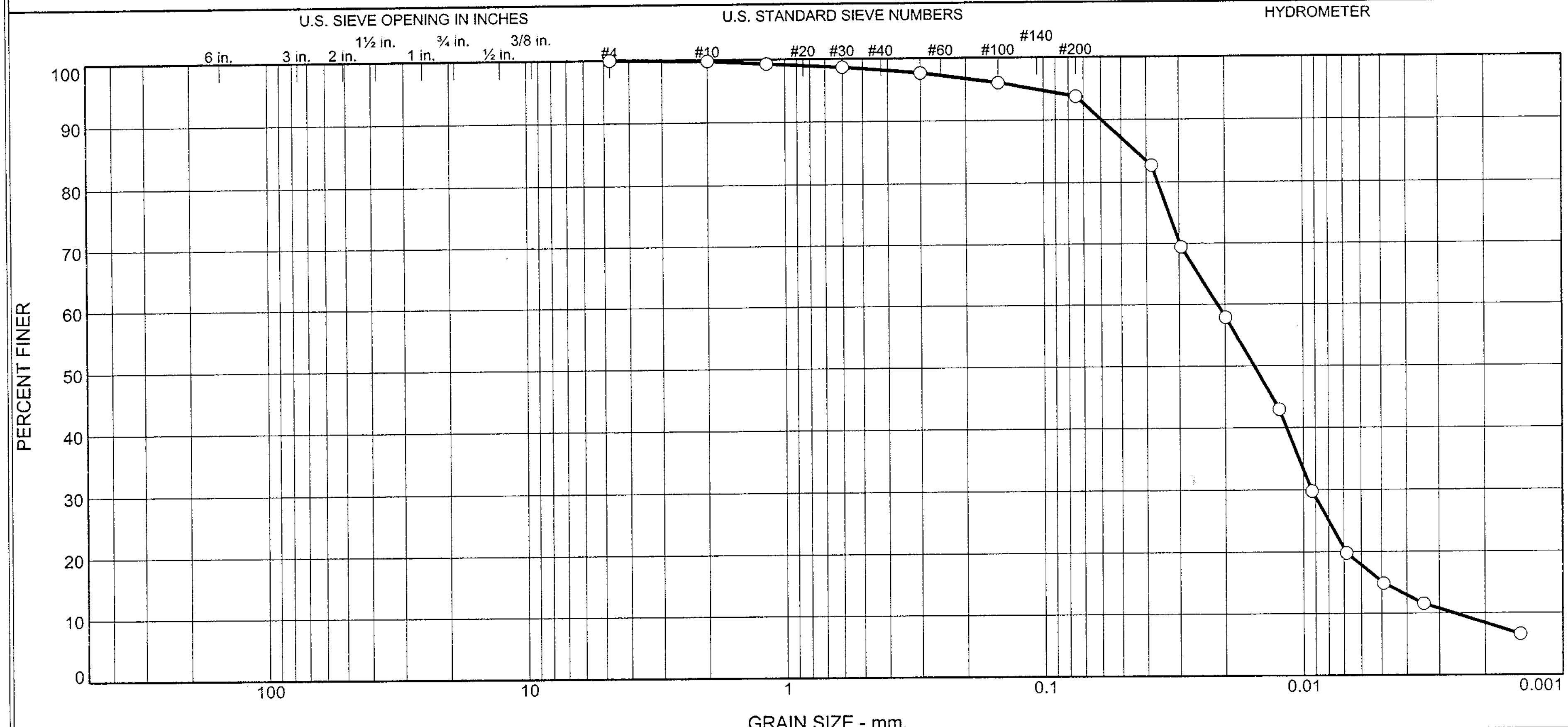
Project: Philip Sporn Plant

Depth: 44.5'-47.0' **Sample Number:** GA-1A ST6

Project No.: 09-387 **Figure** 2

Geo/Environmental Associates, Inc.

Particle Size Distribution Report



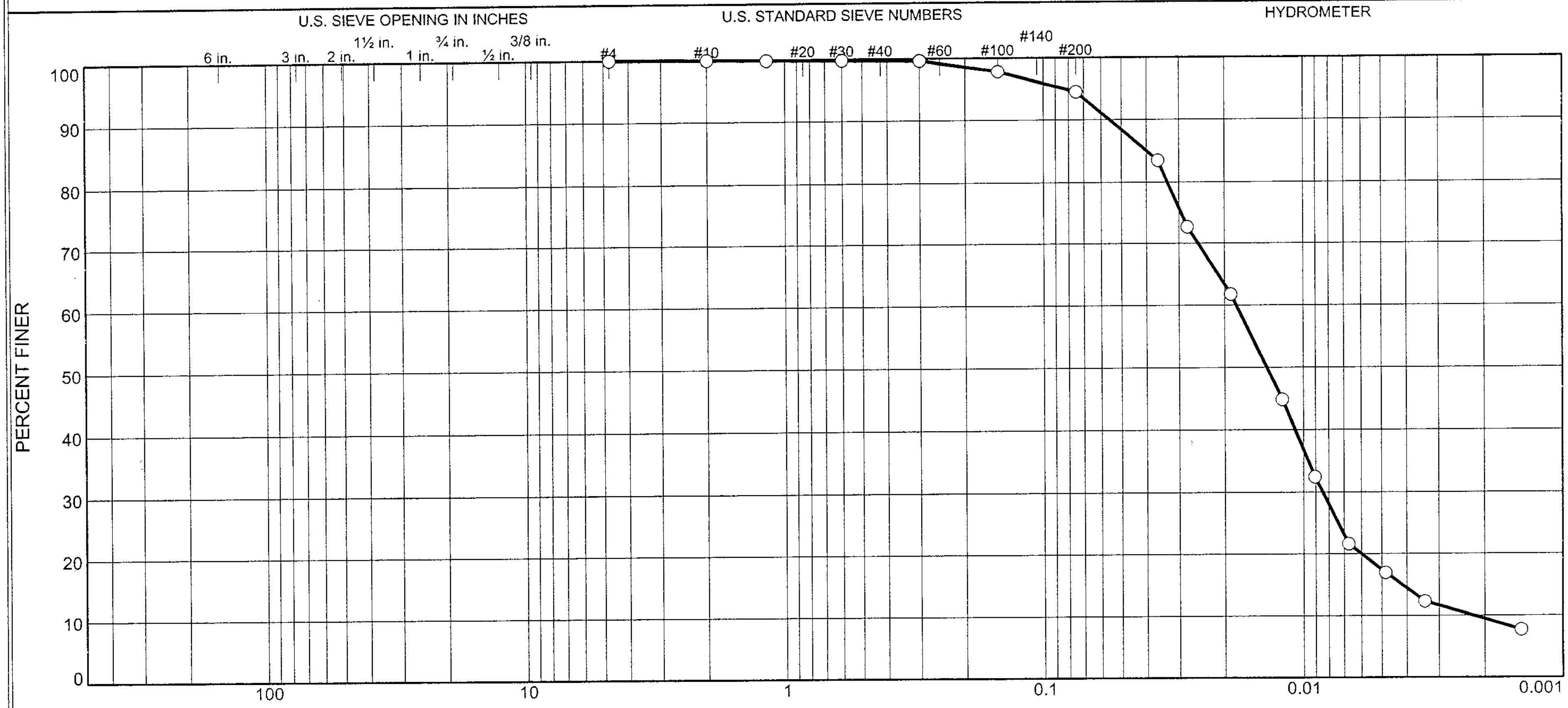
	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.2	1.7	4.4	78.6	15.1

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		GA-1A ST7	48.5'-51.0'		ML	Fly Ash, dark gray	37.2	nv	np

Client American Electric Power
Project Philip Sporn Plant
Project No. 09-387
Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.3	5.2	77.1	17.4

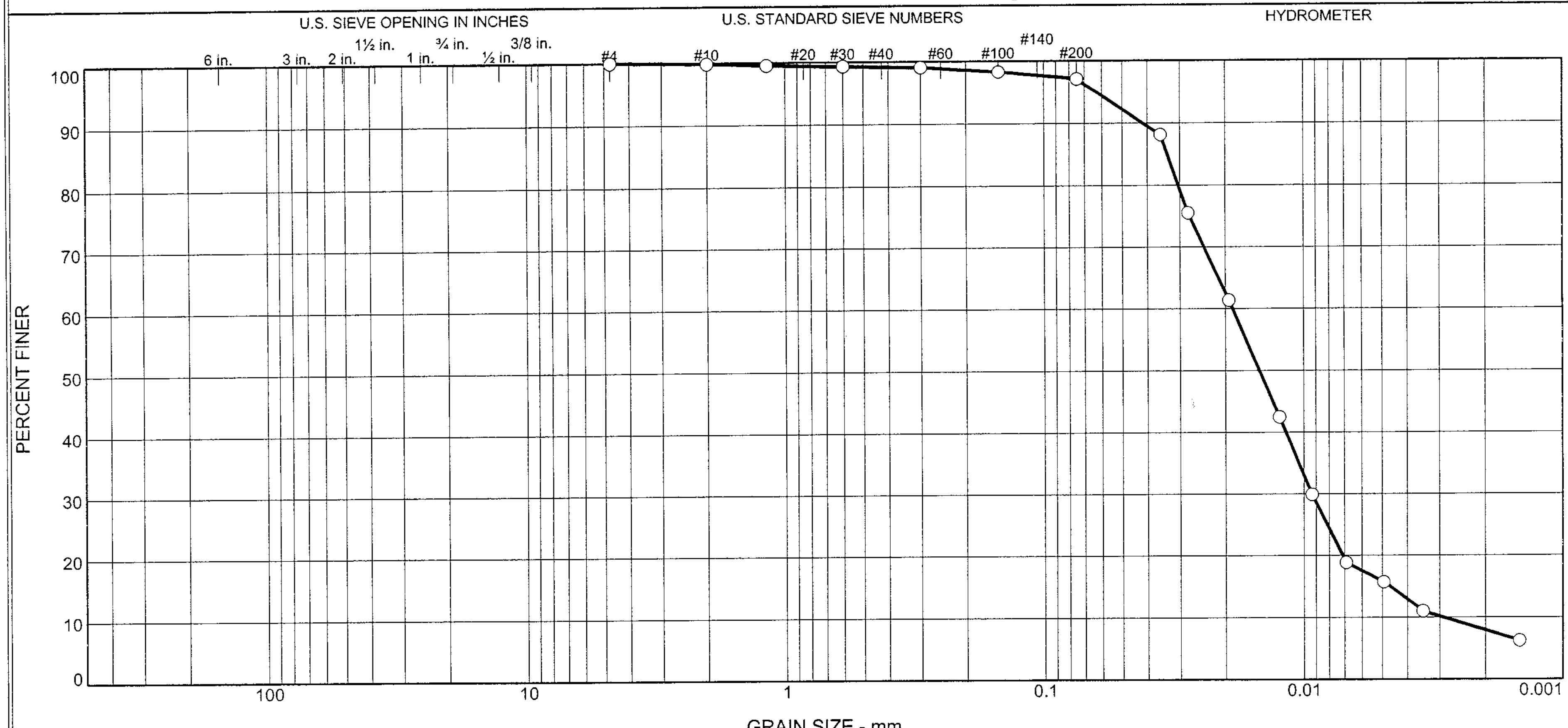
	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		GA-1A ST8	52.5'-55.0'		ML	Fly Ash, gray	53.3	44	np

Client American Electric Power
Project Philip Sporn Plant

Project No. 09-387 Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.2	0.6	2.1	81.3	15.8

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		GA-1A ST9	56.5'-59.0'		ML	Fly Ash, dark gray	51.5	45	np

Client American Electric Power

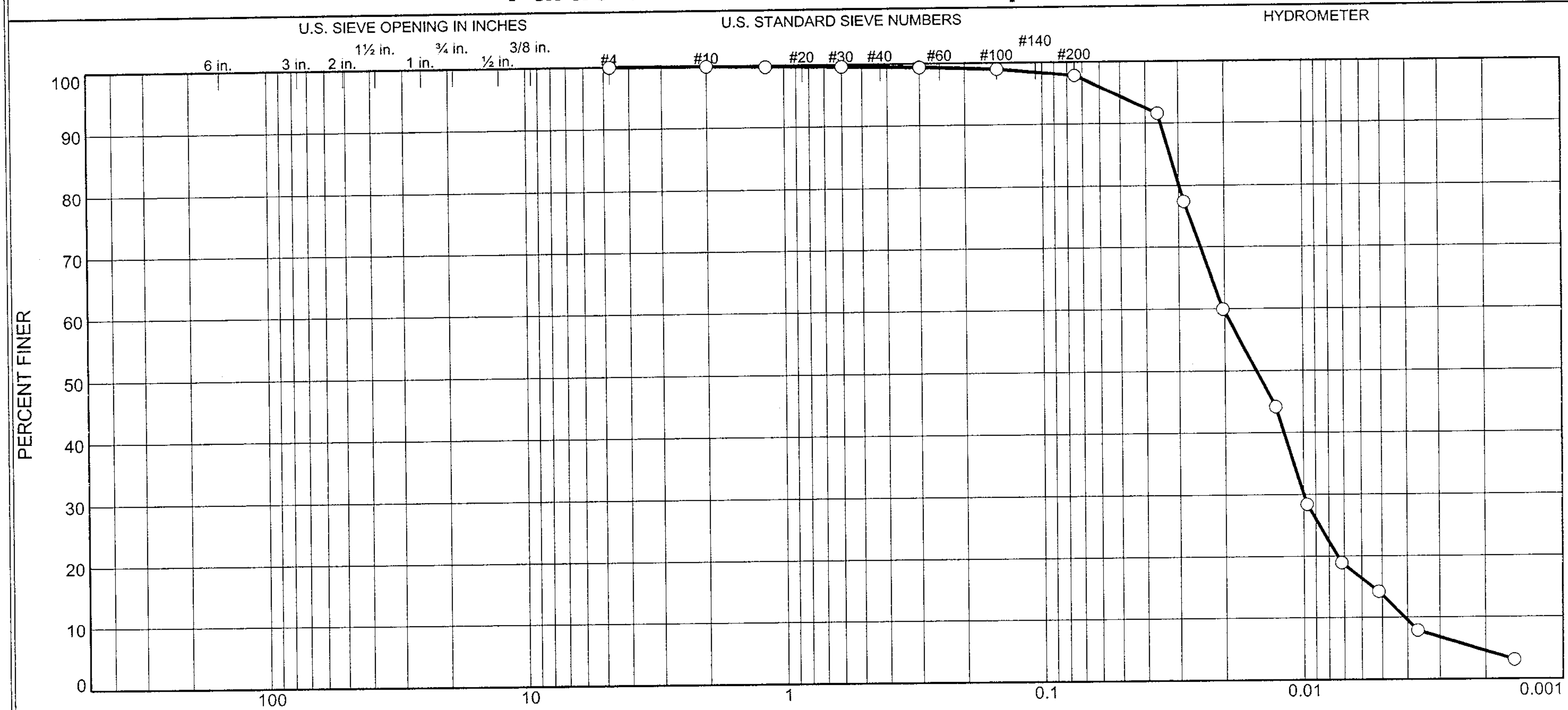
Project Philip Sporn Plant

Project No. 09-387

Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	0.4	1.7	84.2	13.6

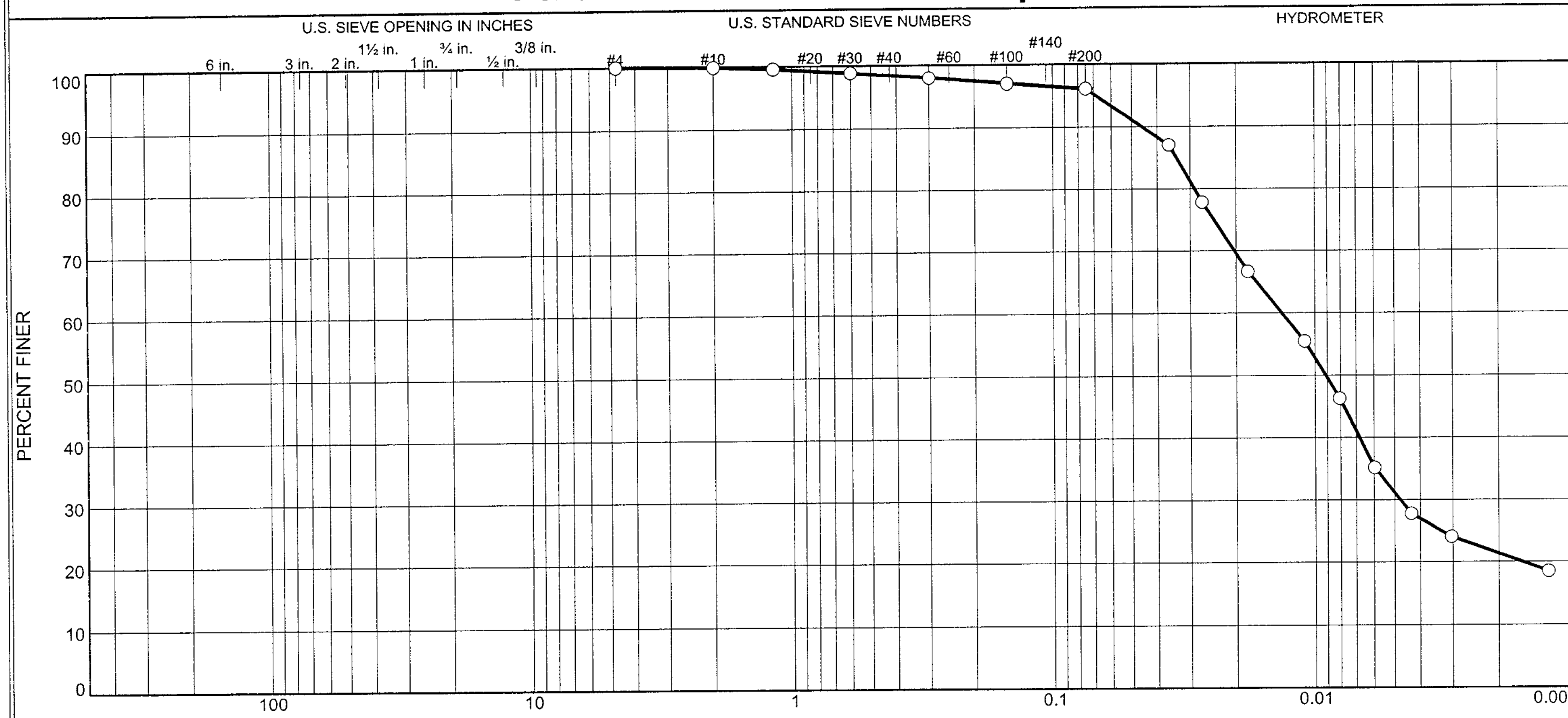
	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		GA1A ST10	60.5'-63.0'		ML	Fly Ash, dark gray, dark brown	53.7	44	np

Client American Electric Power
Project Philip Sporn Plant
Project No. 09-387
Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

SPP00003314

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	1.5	2.3	65.0	31.1

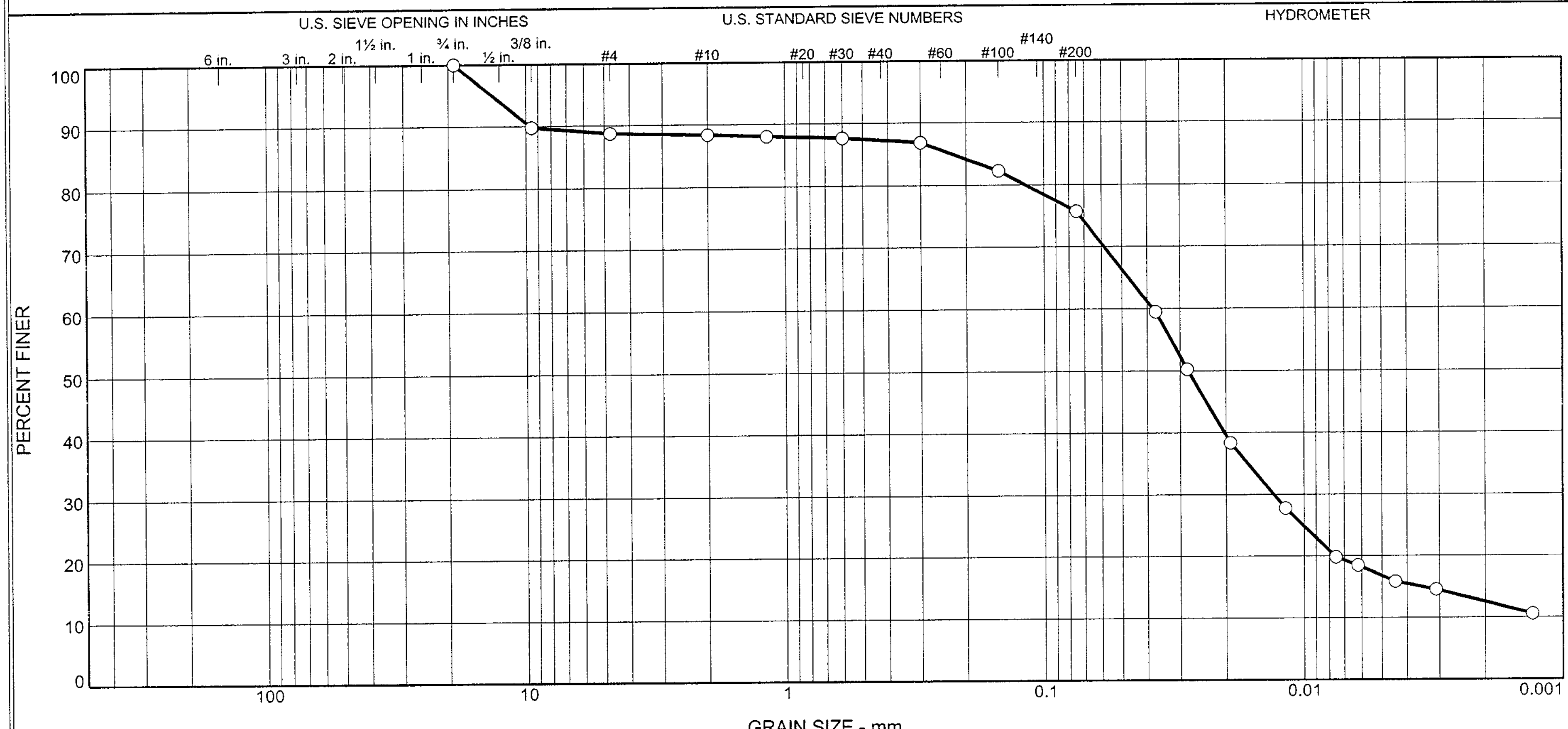
	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		GA-1C ST2	69.0'-71.5'		CL	Clay, silty, brown	27.2	35	19

Client American Electric Power
Project Philip Sporn Plant

Project No. 09-387 Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	11.3	0.4	1.1	11.5	58.9	16.8

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		GA-2 ST2	59.0'-61.5'		CL-ML	Clay, silty, brown	20.3	20	16

Client American Electric Power
Project Philip Sporn Plant
Project No. 09-387 Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084-90/EPA 9100 Method 2.8

'ROJECT NAME : Philip Sporn Plant

PROJECT NUMBER : 09-387

CLIENT : AEP

DATE : December 29, 2009

SAMPLE LOCATION AND CONDITIONS

Sample Id.: GA-1C ST-2 - 20 psi

Depth of Tested Sample : 69.0' - 71.5'

Remolded: No

Sample Type : Shelby Tube

Sample Description : Clay, silty brown - 20 psi triaxial specimen

INITIAL SPECIMEN PROPERTIES

Length (in.): 5.15

Volume (ft^3): 0.0190

Wet Density (PCF): 122.7

Diameter (in.): 2.85

Weight (lbs): 2.33

Dry Density (PCF): 96.3

Area (ft^2): 0.0443

Moisture (%): 27.4

Chamber Pressure (psi): 10

Change in Pore Pressure (psi): 2.0

Influent Pressure (psi): 8

Change in Chamber Pressure (psi): 2.0

Back Pressure (psi): 5

"B" Factor: 1.0

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

$$k = \frac{QL}{Ath} \text{ cm/sec}$$

L = Length of Sample, along path of flow, (cm)

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

$$k = \frac{(16.8)(13.08)}{(41.16)(63,300)(211.01)}$$

A = Cross-sectional area of specimen, (cm^2)

$$k = \frac{219.74}{549,771,362.28}$$

t = Interval of time, over which the flow Q occurs, (sec)

h = Difference in hydraulic head across specimen, (cm)

$$k = 4.00 \times 10^{-7} \text{ cm/sec}$$

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084-90/EPA 9100 Method 2.8

'ROJECT NAME : Philip Sporn Plant

PROJECT NUMBER : 09-387

CLIENT : AEP

DATE : December 29, 2009

SAMPLE LOCATION AND CONDITIONS

Sample Id.: GA-1C ST-2 - 40 psi

Depth of Tested Sample : 69.0' - 71.5'

Remolded: No

Sample Type : Shelby Tube

Sample Description : Clay, silty brown - 40 psi triaxial specimen

INITIAL SPECIMEN PROPERTIES

Length (in.): 5.97

Volume (ft^3): 0.0224

Wet Density (PCF): 121.7

Diameter (in.): 2.87

Weight (lbs): 2.72

Dry Density (PCF): 94.9

Area (ft^2): 0.0449

Moisture (%): 28.2

Chamber Pressure (psi): 10

Change in Pore Pressure (psi): 2.0

Influent Pressure (psi): 8

Change in Chamber Pressure (psi): 2.0

Back Pressure (psi): 5

"B" Factor: 1.0

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

L = Length of Sample, along path of flow, (cm)

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

A = Cross-sectional area of specimen, (cm^2)

t = Interval of time, over which the flow Q occurs, (sec)

h = Difference in hydraulic head across specimen, (cm)

$$k = \frac{QL}{Ath} \text{ cm/sec}$$

$$k = \frac{(16.8)(15.16)}{(41.74)(63,300)(211.01)}$$

$$k = \frac{254.69}{557,518,383.42}$$

$$k = 4.57 \times 10^{-7} \text{ cm/sec}$$

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084-90/EPA 9100 Method 2.8

PROJECT NAME	: Philip Sporn Plant	**PROJECT NUMBER**	: 09-387
CLIENT	: AEP	**DATE**	: December 29, 2009

SAMPLE LOCATION AND CONDITIONS

Sample Id.:	GA-1C ST-2 - 60 psi	**Depth of Tested Sample :**	69.0' - 71.5'
Remolded:	No	**Sample Type :**	Shelby Tube

Sample Description : Clay, silty brown - 60 psi triaxial specimen

INITIAL SPECIMEN PROPERTIES

Length (in.):	5.88	**Volume (ft^3):**	0.0220	**Wet Density (PCF):**	121.9
Diameter (in.):	2.87	**Weight (lbs):**	2.68	**Dry Density (PCF):**	95.1
Area (ft^2):	0.0449	**Moisture (%):**	28.2		

Chamber Pressure (psi):	10	**Change in Pore Pressure (psi):**	2.0
Influent Pressure (psi):	8	**Change in Chamber Pressure (psi):**	2.0
Back Pressure (psi):	5	**"B" Factor:**	1.0

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

$$k = \frac{QL}{Ath} \text{ cm/sec}$$

L = Length of Sample, along path of flow, (cm)

$$k = \frac{(23.0)(14.94)}{(41.74)(69,600)(211.01)}$$

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

A = Cross-sectional area of specimen, (cm^2)

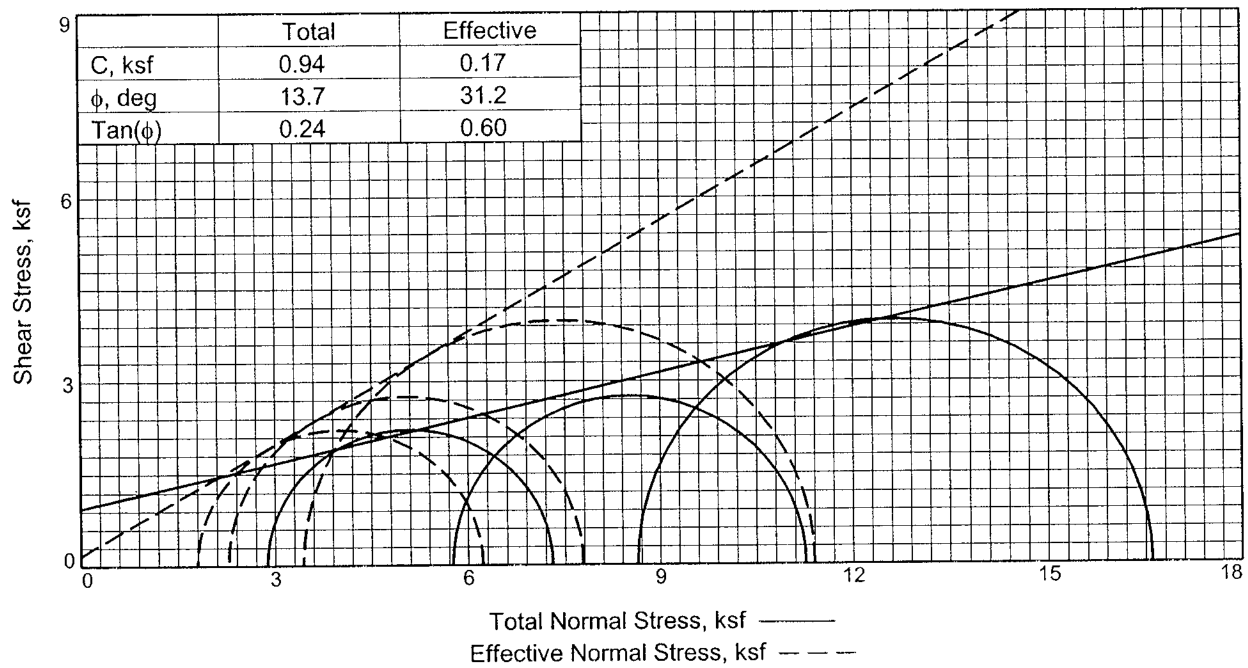
$$k = \frac{343.62}{613,005,995.04}$$

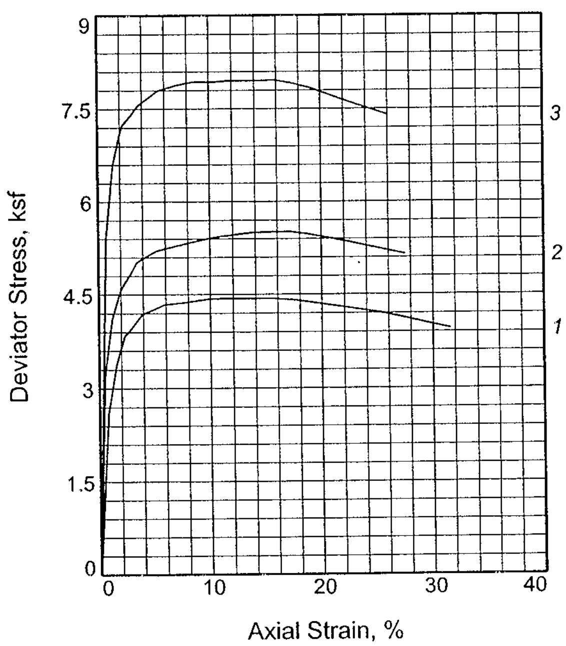
t = Interval of time, over which the flow Q occurs, (sec)

h = Difference in hydraulic head across specimen, (cm)

$$k = 5.61 \times 10^{-7} \text{ cm/sec}$$

	Total	Effective
C, ksf	0.94	0.17
ϕ, deg	13.7	31.2
Tan(ϕ)	0.24	0.60





Sample No.		1	2	3
Initial	Water Content, %	27.4	28.2	28.2
	Dry Density, pcf	96.3	94.9	95.1
	Saturation, %	98.1	97.8	98.1
	Void Ratio	0.7572	0.7825	0.7782
	Diameter, in.	2.85	2.87	2.87
	Height, in.	5.15	5.97	5.88
At Test	Water Content, %	25.1	24.1	25.2
	Dry Density, pcf	100.6	102.3	100.6
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.6812	0.6539	0.6823
	Diameter, in.	2.81	2.80	2.82
	Height, in.	5.08	5.82	5.77
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, psi		30.00	30.00	30.00
Cell Pressure, psi		50.00	70.00	90.00
Fail. Stress, ksf		4.4	5.5	8.0
Total Pore Pr., ksf		5.4	7.8	9.5
Ult. Stress, ksf				
Total Pore Pr., ksf				
$\bar{\sigma}_1$ Failure, ksf		6.2	7.8	11.4
$\bar{\sigma}_3$ Failure, ksf		1.8	2.3	3.4

Type of Test:
CU with Pore Pressures
Sample Type: Shelby Tube
Description: Clay, silty, brown

LL= 35 **PL=** 19 **PI=** 16
Specific Gravity= 2.71
Remarks:

Figure 1

Client: American Electric Power

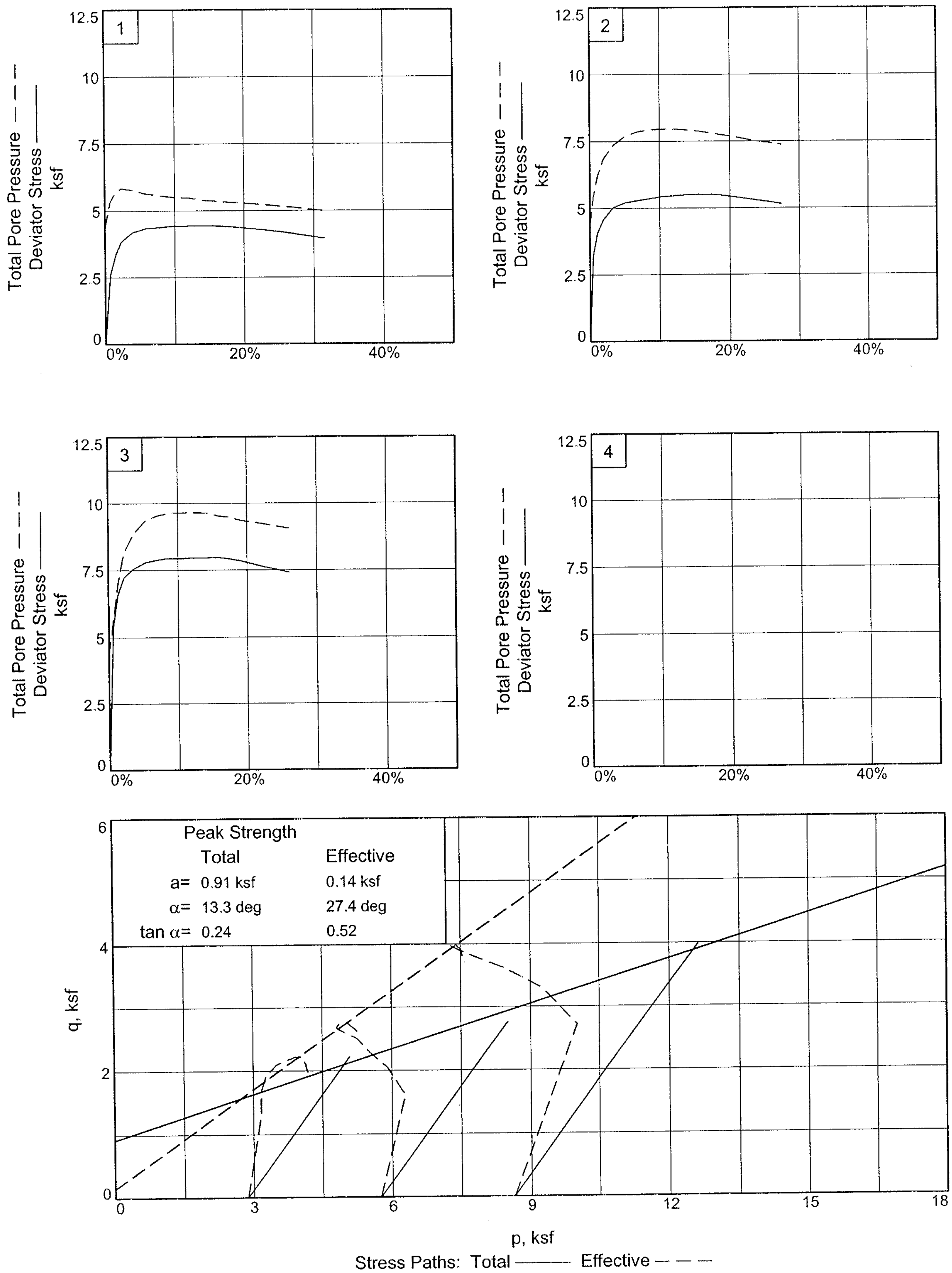
Project: Philip Sporn Plant

Sample Number: GA-1C ST2 **Depth:** 69.0'-71.5'

Proj. No.: 09-387 **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT

Geo/Environmental Associates, Inc.



Client: American Electric Power

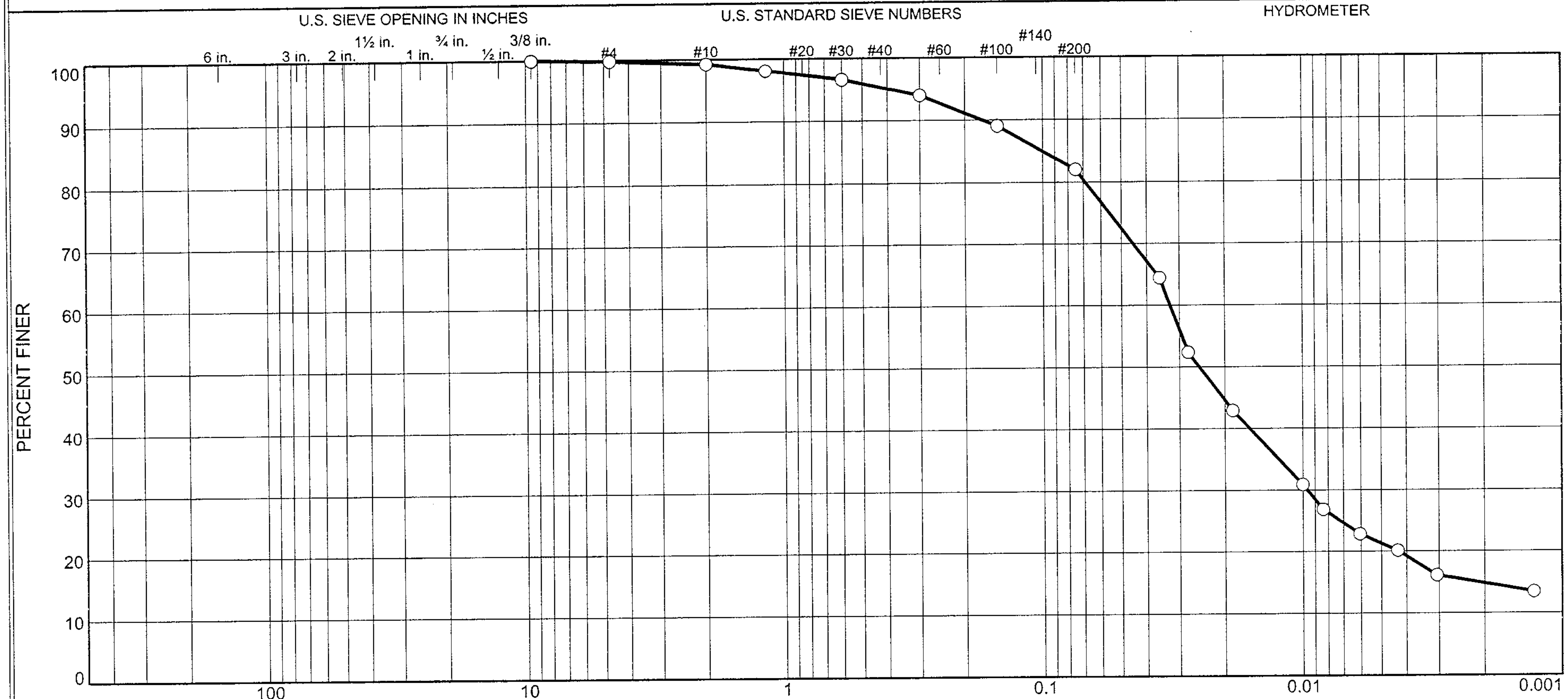
Project: Philip Sporn Plant

Depth: 69.0'-71.5' **Sample Number:** GA-1C ST2

Project No.: 09-387 **Figure** 2

Geo/Environmental Associates, Inc.

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.2	0.6	3.9	13.3	60.7	21.3

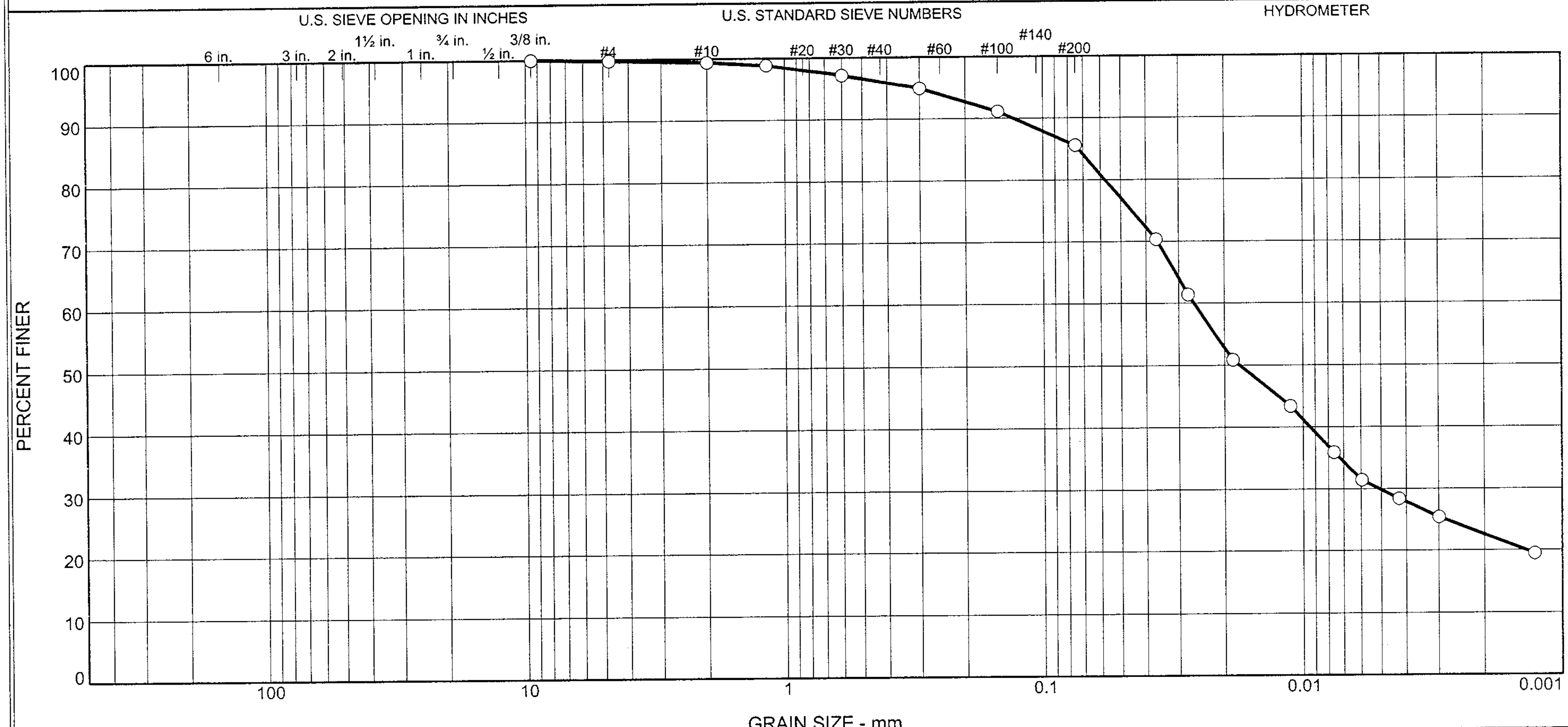
	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		GA-2 ST3	69.0'-71.5'		CL-ML	Clay, silty, light brown	20.8	23	17

Client American Electric Power
Project Philip Sporn Plant
Project No. 09-387 Figure

Geo/Environmental Associates, Inc. Knoxville, Tennessee

SPP00003322

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.2	0.4	3.4	10.5	55.7	29.8

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		GA-3 ST3	79.0'-81.5'		CL	Clay, silty, light brown	24.4	32	20

Client American Electric Power
Project Philip Sporn Plant
Project No. 09-387
Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

H. C. NUTTING COMPANY
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS
SINCE 1921

CORPORATE CENTER
4120 AIRPORT ROAD
CINCINNATI, OHIO 45226
(513) 321-5816
FAX (513) 321-0294

Order No. 90979.030

December 19, 1996

Mr. J.P. Amaya
American Electric Power Corporation
1 Riverside Plaza
Columbus, OH 45315

Re: **Laboratory Tests**
Project: **Sporn Plt-Bott. Ash Pond**
Certification-C-9117
LOA-002-96

Dear Mr. Amaya:

Submitted herewith is our report covering the results of seventeen (17) consolidated undrained triaxial tests with pore pressure measurements, seven (7) mechanical sieve and hydrometer and (7) Atterberg Limits. Tests were performed per your request by letter dated November 22, 1996. All samples were obtained and shipped to our laboratory from the referenced project by your representative. Cost for these tests were as outlined per Contract No. C-9117.

Should any discussion be required concerning this report, please feel free contact the undersigned. The H.C. Nutting Company **thanks** American Electric Power for allowing them this opportunity to be of service.

Respectfully submitted,

H.C. NUTTING COMPANY

Robert L. House

Robert L. House,
Vice President/Lab. Director

H.C. Nutting Company
4120 Airport Road
Cincinnati, Ohio 45226

12/19/69smo

American Electric Power
Sporn Plt-Bott. Ash Pond Certification LOA-002-96
New Haven, WV
HCN W.O. #90979.030

TABLE I

CLASSIFICATION TEST DATA

Lab No.	Boring No.	Sample No.	Depth (Ft.)	Mechanical Analysis				Atterberg Limits			U.S.C.S Classifi-cation
				% Gravel	% Sand	% Silt	% Clay	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	
8563	96-101	ST-10	---	0	18	58	24	27	20	7	CL-ML
8564	96-104	ST-9	31.7-33.7	16	46	26	12	NP	NP	NP	SM
8565	96-106	ST-15	61.5-63.5	0	7	58	35	38	24	14	CL
8566	96-107	ST-16	66.6-68.6	0	16	52	32	43	26	17	CL
8567	96-108	ST-10	41.6-43.6	0	7	52	42	44	30	14	ML
8568	96-109	ST-8	26.7-28.7	0	54	43	3	NP	NP	NP	SM
8569	96-110	ST-18	58.6-60.6	0	19	50	31	39	27	12	ML

H.C. NUTTING COMPANY

Robert L. House

Robert L. House,
Vice President/Lab. Director

H.C. Nutting Company
4120 Airport Road
Cincinnati, Ohio 45226

12/19/96smo

American Electric Power
Sporn Plt-Bott. Ash Pond Certification LOA-002-96
New Haven, WV
HCN W.O. # 90979.030

TABLE II
TABULATION OF UNDISTURBED TEST DATA

Boring No.	Sample No.	Depth (Ft.)	Triaxial Compressive Strength (TSF)	Confining Pressure P.S.I.	Failure Strain (%)	Dry Density (Lbs./Cu. Ft.)	Water Content (%)	Lab No.
96-101	ST-10	---	4.31	14	13.4	106.5	18.5	8563
			5.69	28	15.9	113.5	16.8	"
			9.15	56	21.8	114.3	15.4	"
96-104	ST-9	31.7-33.7	3.67	14	23.4	119.4	8.2	8564
			3.22	28	24.6	113.3	9.2	"
			---	56	---	---	9.9	"
96-106	ST-15	61.5-63.5	2.17	21	17.5	97.1	26.5	8565
			3.69	42	15.8	98.1	26.5	"
			3.64	84	20.4	99.1	26.5	"
96-107	ST-16	66.6-68.6	2.18	21	15.7	98.3	26.0	8566
			3.40	42	11.7	97.2	27.4	"
			5.83	84	12.1	96.5	28.4	"

H.C. NUTTING COMPAN

Robert L. House

Robert L. House,
Vice President/Lab. Director

H.C. Nutting Company
4120 Airport Road
Cincinnati, Ohio 45226

12/19/96smo

American Electric Power
Sporn Plt-Bott. Ash Pond Certification LOA-002-96
New Haven, WV
HCN W.O. # 90979.030

TABLE II
TABULATION OF UNDISTURBED TEST DATA

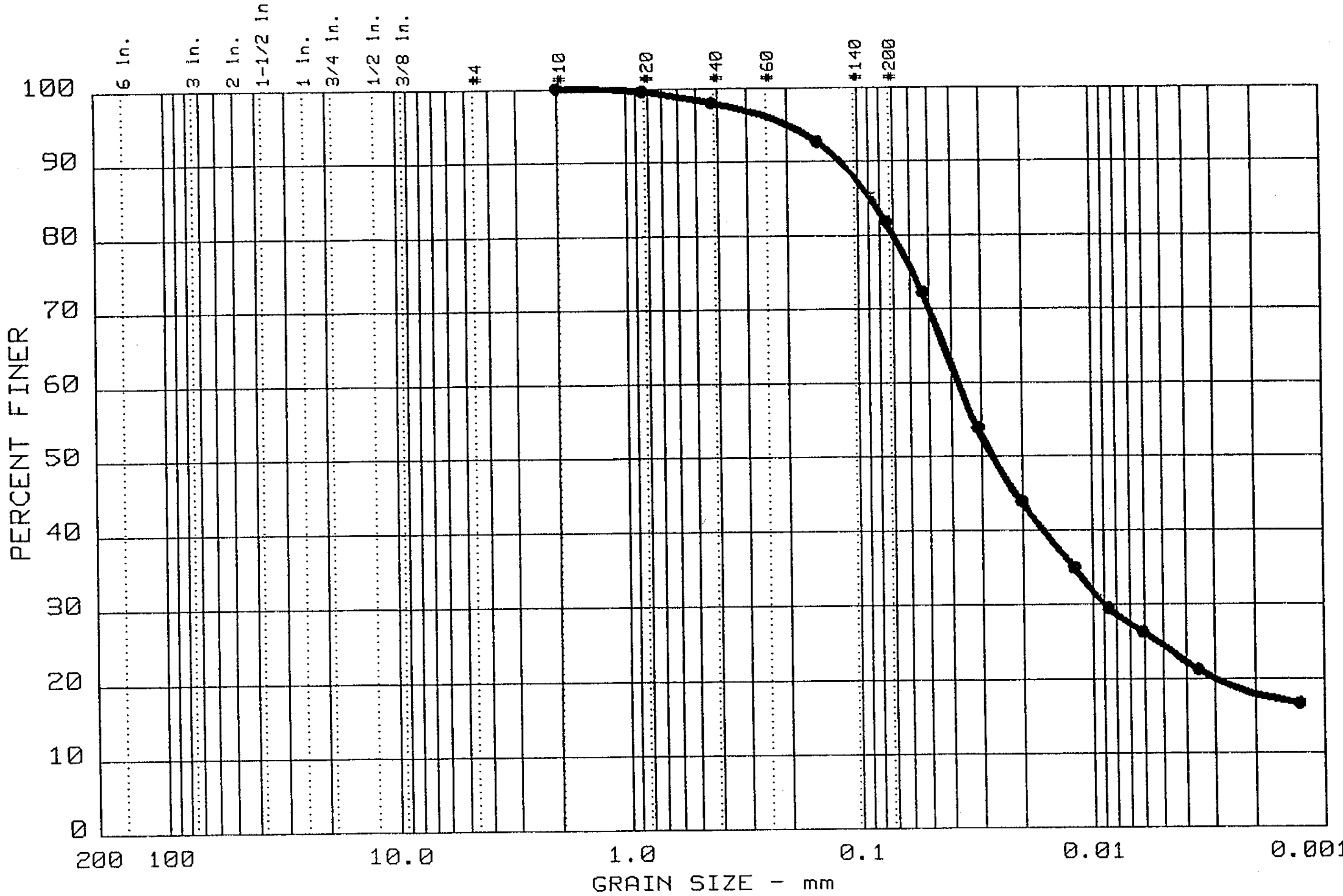
Boring No.	Sample No.	Depth (Ft.)	Triaxial Compressive Strength (TSF)	Confining Pressure P.S.I.	Failure Strain (%)	Dry Density (Lbs./Cu. Ft.)	Water Content (%)	Lab No.
96-108	ST-10	41.6-43.6	1.77	14	7.4	88.1	34.6	8567
			2.25	28	12.8	85.1	38.4	"
			3.82	56	15.8	84.7	36.9	"
96-109	ST-8	26.7-28.7	UNIT WT.	---	---	74.3	4.1	8568
96-110	ST-18	58.6-60.6	2.55	21	6.3	94.3	28.9	8569
			2.70	42	9.3	93.9	28.8	"
			5.22	84	5.7	94.5	27.5	"

H.C. NUTTING COMPAN

Robert L. House

Robert L. House,
Vice President/Lab. Director

GRAIN SIZE DISTRIBUTION TEST REPORT



	% +75 mm	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	18.3	57.3	24.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	27	7	0.09	0.04	0.03	0.009				

MATERIAL DESCRIPTION	USCS	AASHTO
● SILTY CLAY WITH SAND	CL-ML	

Project No.: 90979.030
Project: Sporn Plt-Bott.Ash Pond Certification LOI-002-96*
● Location: Boring:96-101 Sample:ST-10

*New Haven, WV

Date: 12/13/95

Remarks:

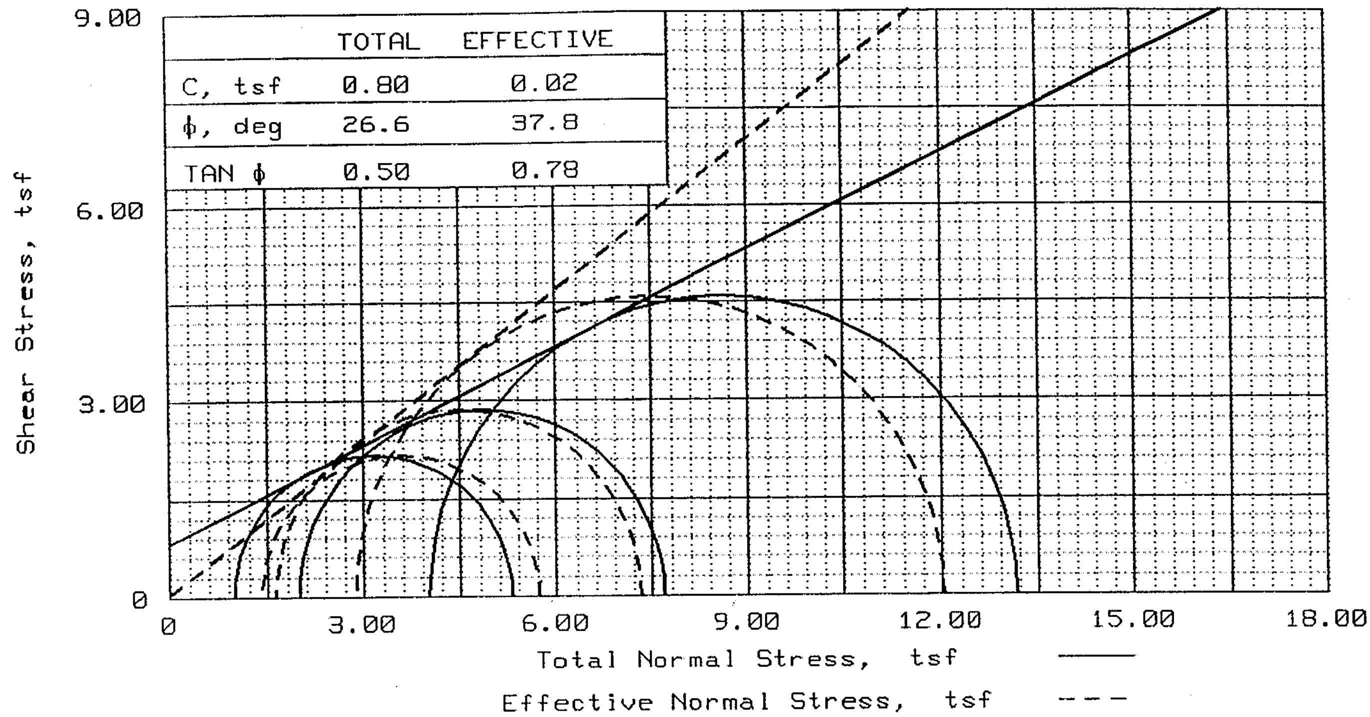
Client: American Electric Power

Lab No. 8563

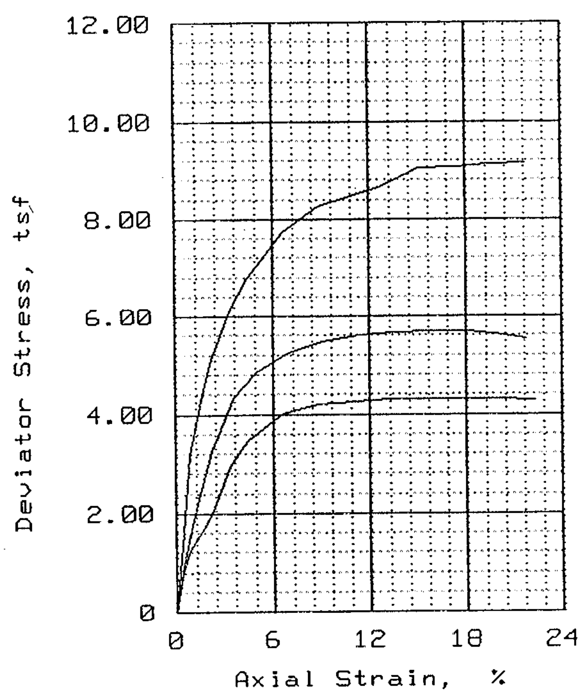
GRAIN SIZE DISTRIBUTION TEST REPORT
H. C. NUTTING COMPANY

Figure No. ______

AEPSPP-000640



	TOTAL	EFFECTIVE
C, tsf	0.80	0.02
ϕ, deg	26.6	37.8
TAN ϕ	0.50	0.78



	SAMPLE NO.	1	2	3
INITIAL	WATER CONTENT, %	18.5	16.8	15.4
	DRY DENSITY, pcf	106.5	113.5	114.3
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.594	0.496	0.485
	DIAMETER, in	2.84	2.85	2.85
	HEIGHT, in	4.54	4.52	4.62
AT TEST	WATER CONTENT, %	22.5	18.2	16.3
	DIAMETER, in	2.81	2.82	2.78
	HEIGHT, in	4.49	4.47	4.50
	Strain rate, %/min	0.001	0.001	0.001
	BACK PRESSURE, tsf	2.88	2.88	2.88
	CELL PRESSURE, tsf	3.89	4.90	6.91
	FAILURE STRESS, tsf	4.31	5.69	9.15
	PORE PRESSURE, tsf	2.46	3.25	4.02
	ULTIMATE STRESS, tsf			
	PORE PRESSURE, tsf			
	$\bar{\sigma}_1$ FAILURE, tsf	5.74	7.34	12.04
	$\bar{\sigma}_3$ FAILURE, tsf	1.43	1.65	2.89

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE:
DESCRIPTION: BR & GR SILTY CLAY WITH SAND
LL= 27 PL= 20 PI= 7.0
SPECIFIC GRAVITY=
REMARKS: Lab No. 8563

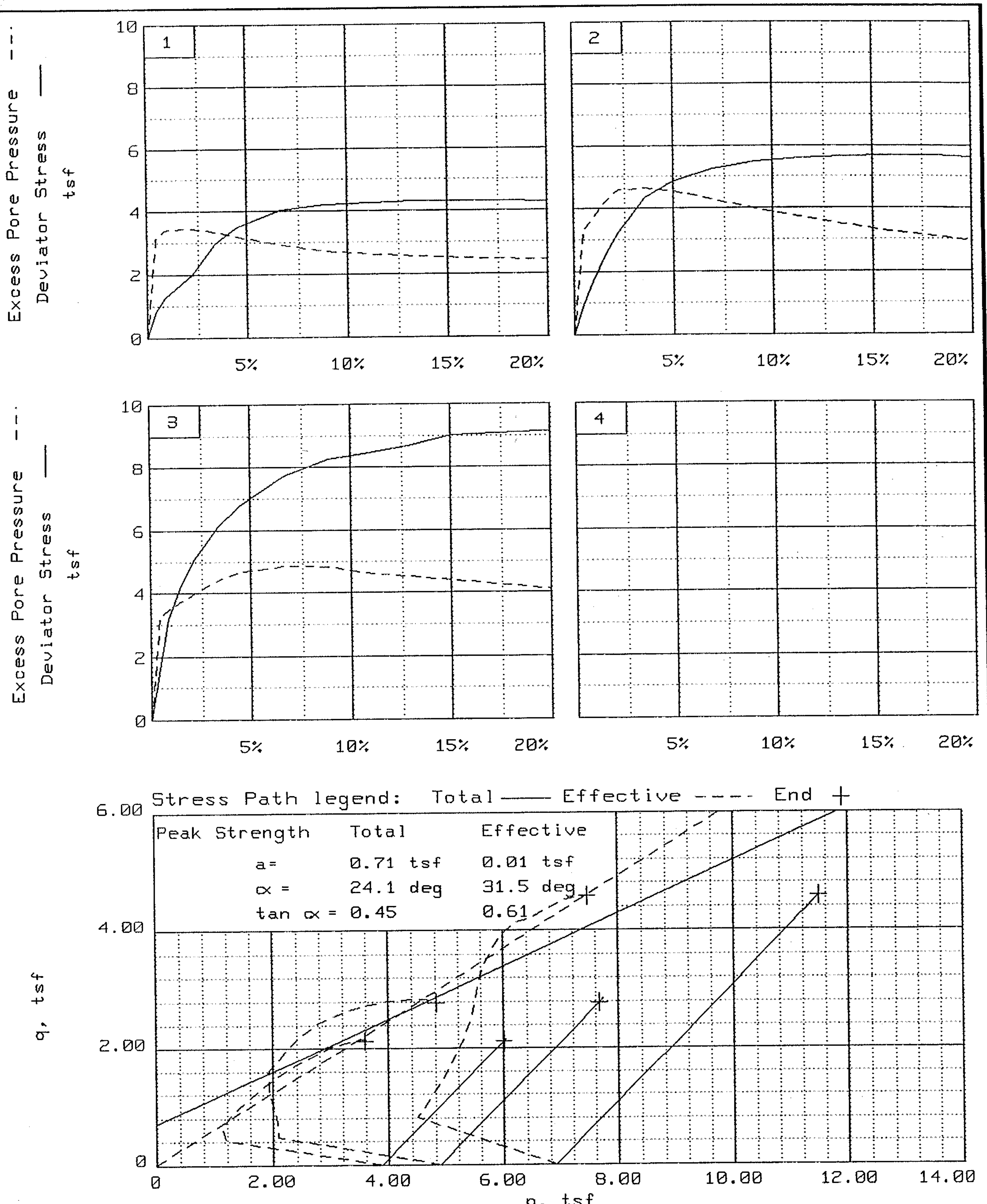
FIG. NO.

CLIENT: American Electric Power

PROJECT: Sporn Plt-Bott.Ash Pond
Certification LOA-002-96, New Haven, WV
SAMPLE LOCATION: Boring:96-101
Sample:ST-10
PROJ. NO.: 90979.030 DATE: 12/13/96

TRIAXIAL SHEAR TEST REPORT

H. C. NUTTING COMPANY



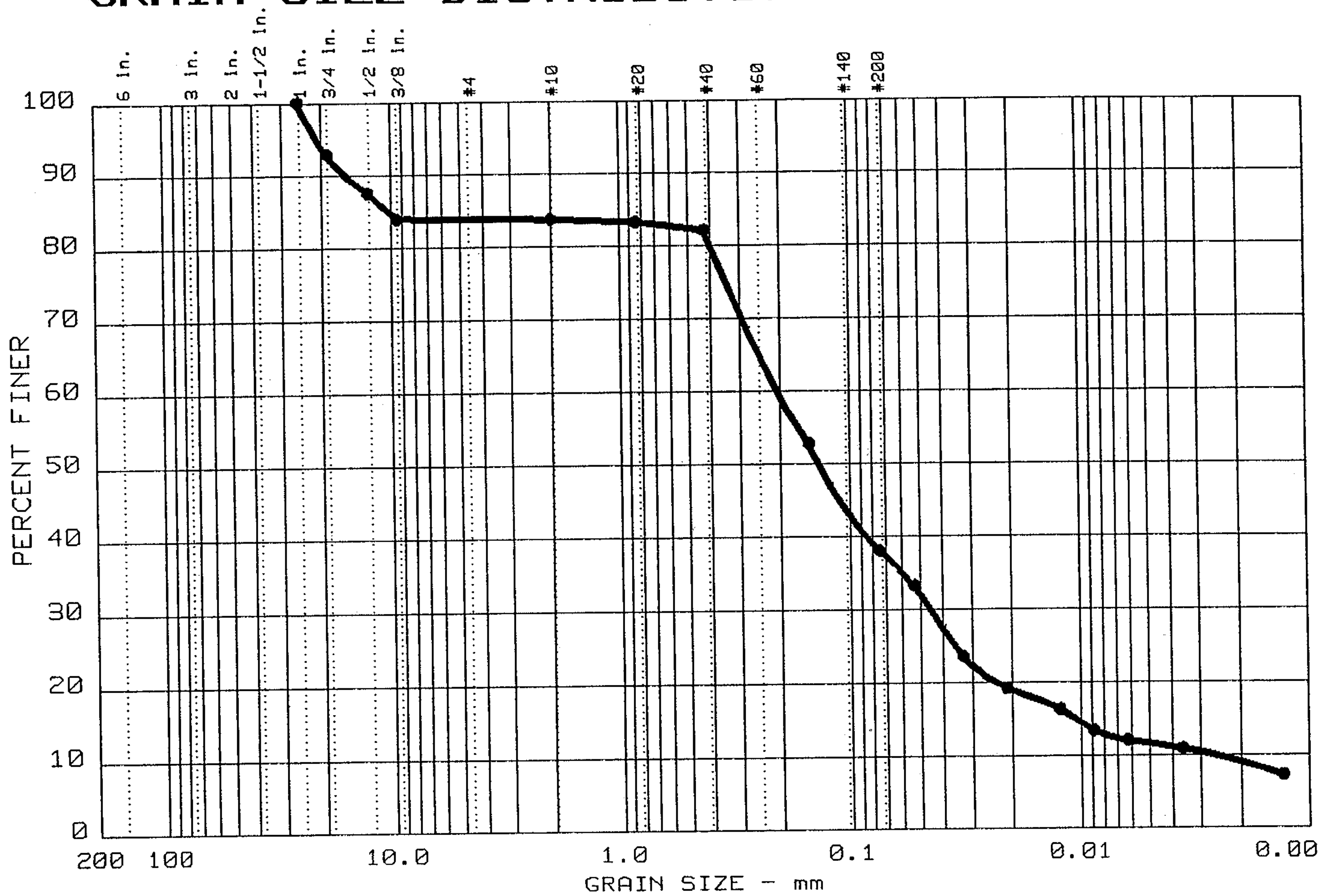
Client: American Electric Power

Project: Sporn Plt-Bott.Ash Pond Certification LOA-002-96, New Haven, WV

Location: Boring:96-101 Sample:ST-10

File: 8563 Project No.: 90979.030 Page 2/2 Fig. No. ____

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	16.2	45.7	26.4	11.7

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	10.35	0.20	0.14	0.045	0.0106	0.0025	3.92	80.6

MATERIAL DESCRIPTION	USCS	AASHTO
● SILTY SAND WITH GRAVEL	SM	

Project No.: 90979.030
Project: Sporn Plt-Bott. Ash Pond Certification LOA-002-96*
● Location: Boring:96-104 Depth:31.7-33.7' *
*New Haven, WV

Date: 12/13/95

GRAIN SIZE DISTRIBUTION TEST REPORT
H. C. NUTTING COMPANY

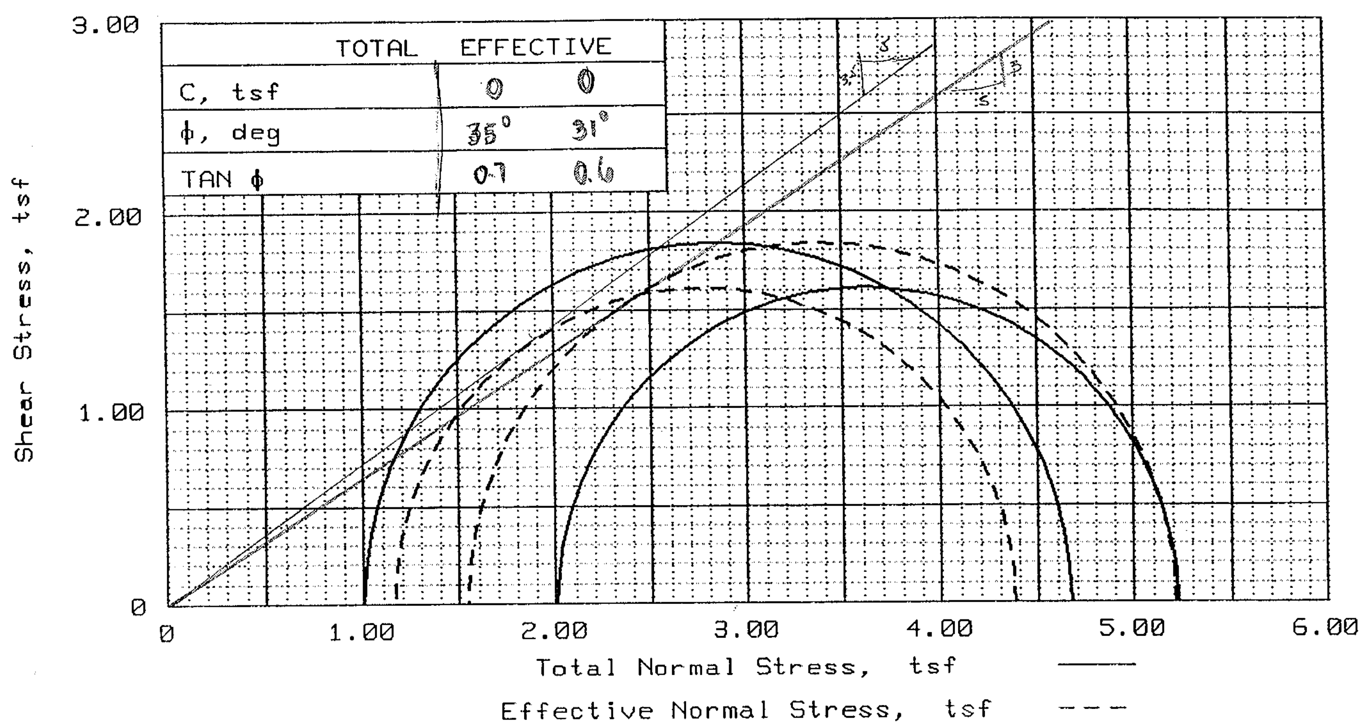
Remarks:

Client: American Electric Power

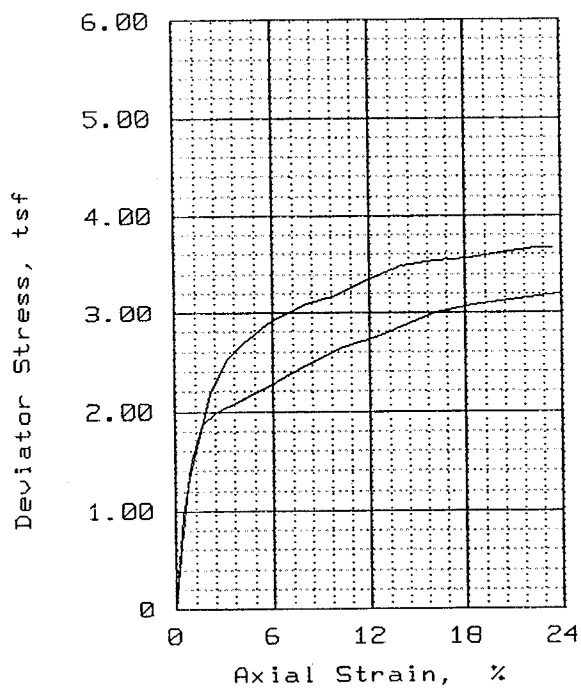
* Sample:ST-9

Lab No. 8564

Figure No. _______



	TOTAL	EFFECTIVE
C, tsf	0	0
ϕ, deg	35°	31°
TAN ϕ	0.7	0.6



	SAMPLE NO.	1	2
INITIAL	WATER CONTENT, %	8.2	9.2
	DRY DENSITY, pcf	119.4	113.3
	SATURATION, %	100.0	100.0
	VOID RATIO	0.401	0.477
	DIAMETER, in	2.85	2.81
	HEIGHT, in	4.91	4.40
AT TEST	WATER CONTENT, %	13.5	14.2
	DIAMETER, in	2.77	2.75
	HEIGHT, in	4.78	4.31
	Strain rate, %/min	0.001	0.001
	BACK PRESSURE, tsf	2.88	2.88
	CELL PRESSURE, tsf	3.89	4.90
	FAILURE STRESS, tsf	3.67	3.22
	PORE PRESSURE, tsf	2.34	3.72
	ULTIMATE STRESS, tsf		
	PORE PRESSURE, tsf		
	$\bar{\sigma}_1$ FAILURE, tsf	5.22	4.39
	$\bar{\sigma}_3$ FAILURE, tsf	1.55	1.17

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE:
DESCRIPTION: BR SILTY SAND WITH GRAVEL
LL= NP PL= NP PI= NP
SPECIFIC GRAVITY=
REMARKS: Lab No. 8564

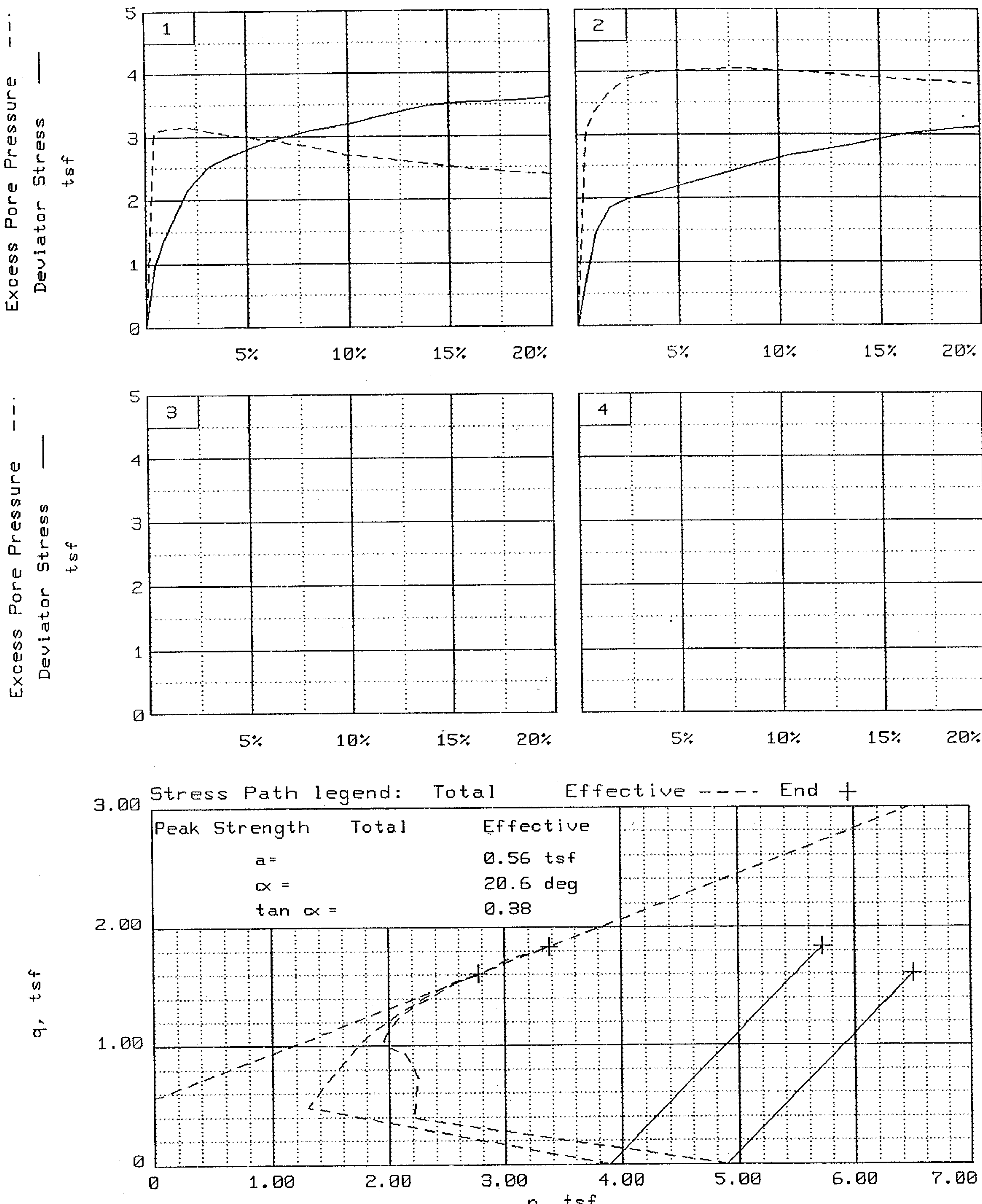
CLIENT: American Electric Power

PROJECT: Sporn Plt-Bott.Ash Pond
Certification LOA-002-96, New Haven, WV
SAMPLE LOCATION: Boring:96-104
Depth:31.7-33.7' Sample:ST-9
PROJ. NO.: 90979.030 DATE: 12/13/96

TRIAXIAL SHEAR TEST REPORT

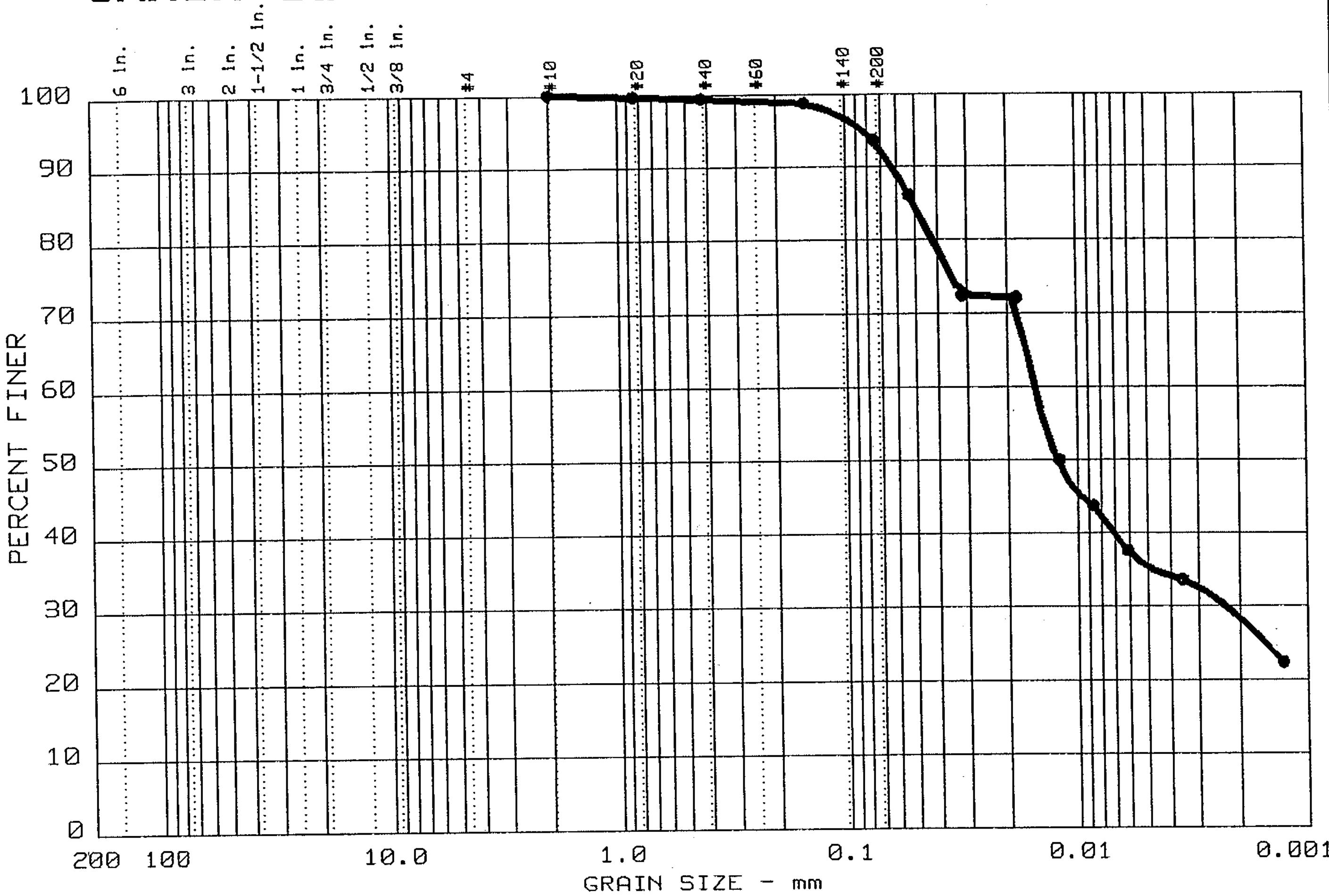
H. C. NUTTING COMPANY

FIG. NO.



Client: American Electric Power
Project: Sporn Plt-Bott.Ash Pond Certification LOA-002-96, New Haven, WV
Location: Boring:96-104 Depth:31.7-33.7' Sample:ST-9
File: 8564 Project No.: 90979.030 Page 2/2 Fig. No. ____

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75 mm	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	6.5	58.2	35.3

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	38	14	0.05	0.02	0.01	0.002				

MATERIAL DESCRIPTION	USCS	AASHTO
● LEAN CLAY	CL	

Project No.: 90979.030
Project: Sporn Plt-Bott.Ash Pond Certification LOA-002-96*
● Location: Boring:96-106 Depth:61.5-63.5' *
*New Haven, WV

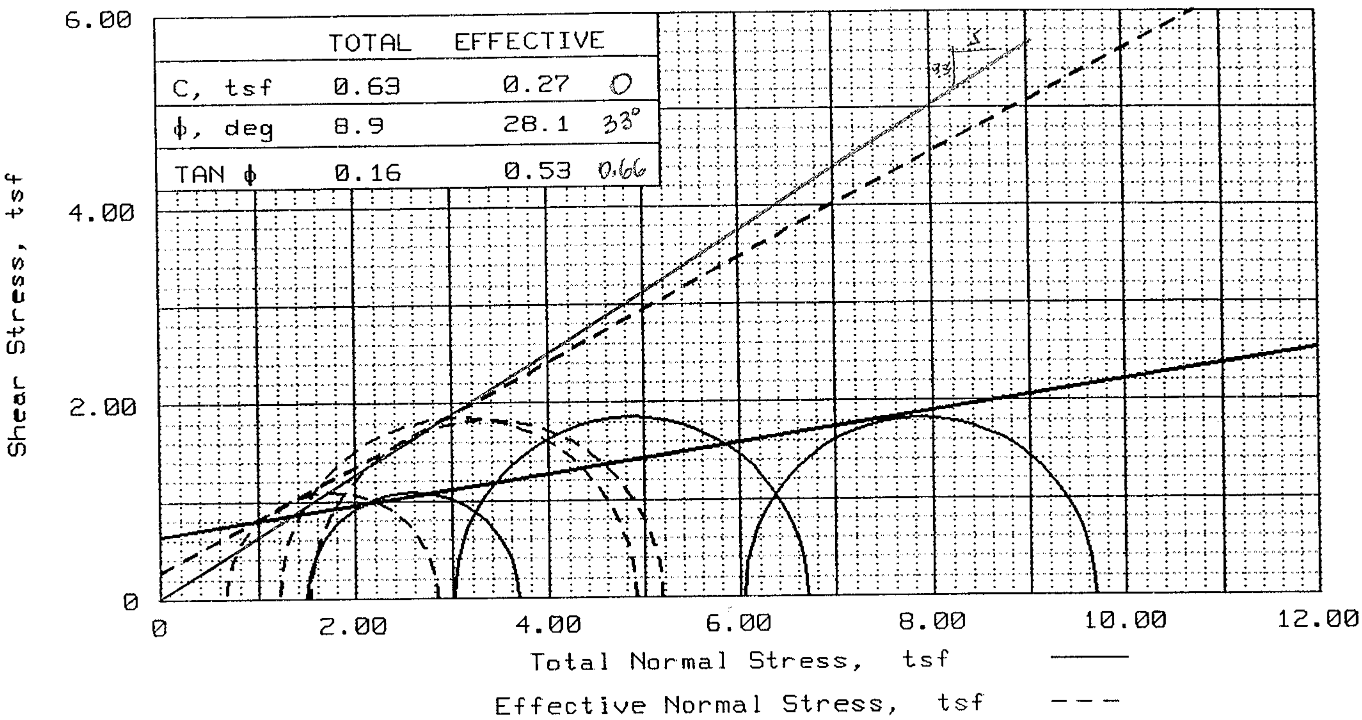
Date: 12/13/95

Remarks:
Client: American Electric Power

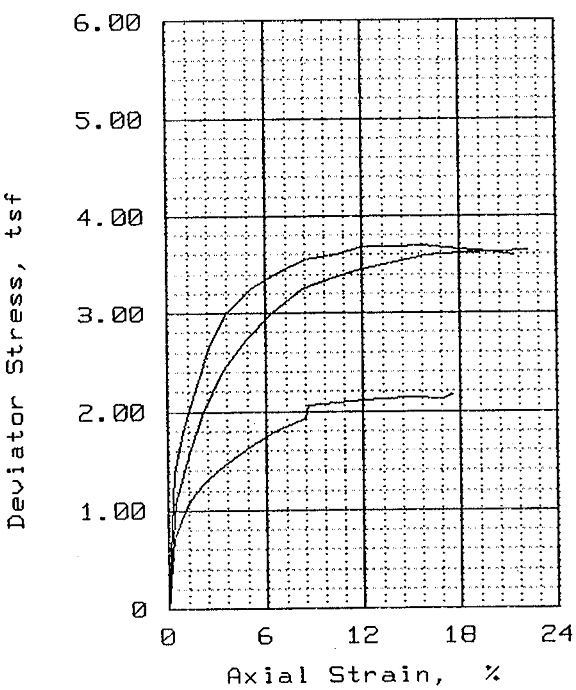
* Sample:ST-15
Lab No. 8565

GRAIN SIZE DISTRIBUTION TEST REPORT
H. C. NUTTING COMPANY

Figure No. ______



	TOTAL	EFFECTIVE
C, tsf	0.63	0.27 O
ϕ, deg	8.9	28.1 33°
TAN ϕ	0.16	0.53 0.66



	SAMPLE NO.	1	2	3
INITIAL	WATER CONTENT, %	26.5	26.5	26.5
	DRY DENSITY, pcf	97.1	98.1	99.1
	SATURATION, %	96.4	98.7	100.0
	VOID RATIO	0.749	0.730	0.713
	DIAMETER, in	2.78	2.83	2.84
	HEIGHT, in	5.25	5.37	5.16
AT TEST	WATER CONTENT, %	26.7	24.7	25.0
	DIAMETER, in	2.73	2.77	2.77
	HEIGHT, in	5.16	5.26	5.04
	Strain rate, %/min	0.001	0.001	0.001
	BACK PRESSURE, tsf	2.88	2.88	2.88
	CELL PRESSURE, tsf	4.39	5.90	8.93
	FAILURE STRESS, tsf	2.17	3.69	3.64
	PORE PRESSURE, tsf	3.72	4.67	7.38
	ULTIMATE STRESS, tsf			
	PORE PRESSURE, tsf			
	$\bar{\sigma}_1$ FAILURE, tsf	2.85	4.92	5.19
	$\bar{\sigma}_3$ FAILURE, tsf	0.68	1.23	1.55

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE:
DESCRIPTION: Br LEAN CLAY

LL= 38 PL= 24 PI= 14.0
SPECIFIC GRAVITY=
REMARKS: Lab No. 8565

FIG. NO.

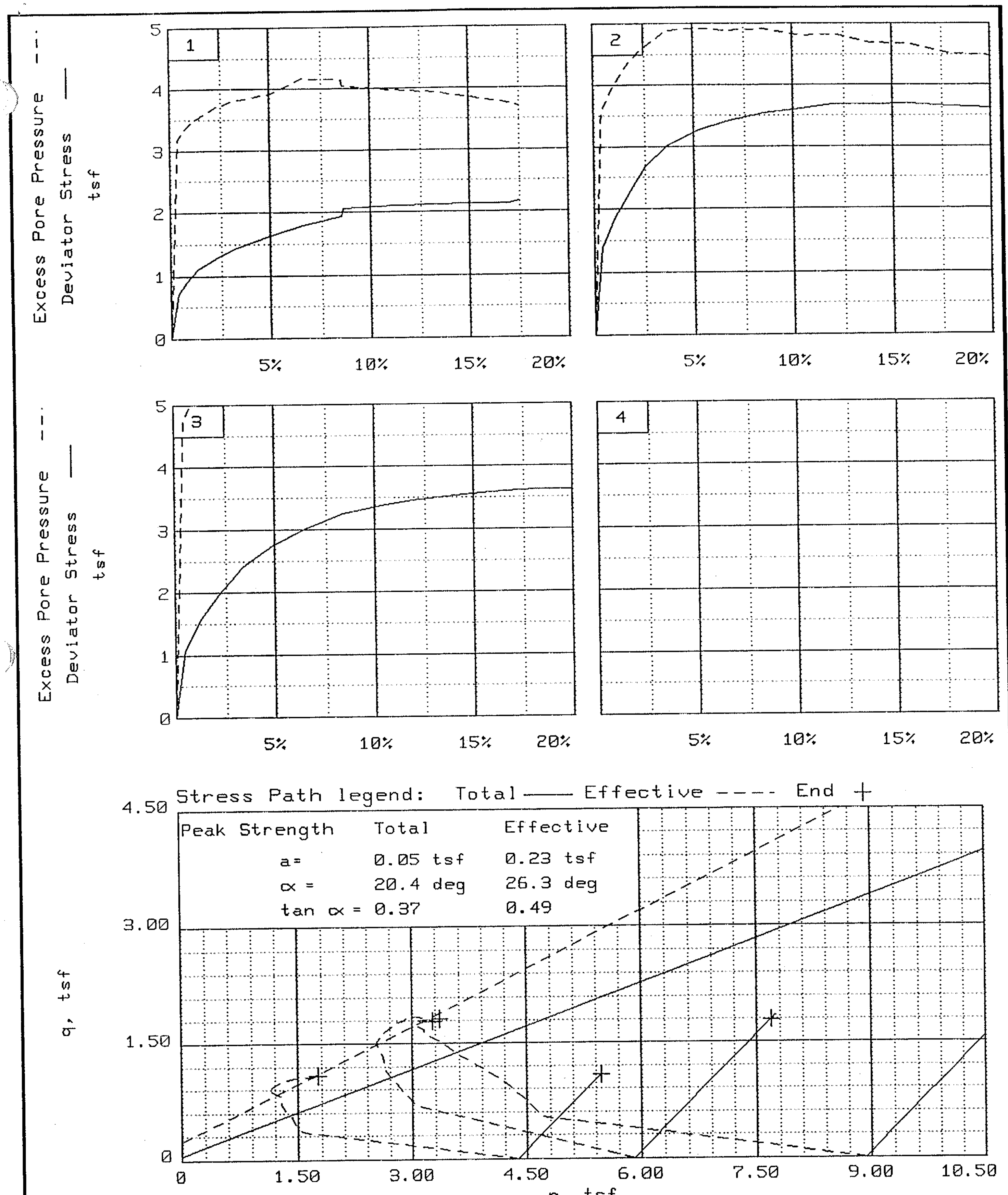
CLIENT: American Electric Power

PROJECT: Sporn Plt-Bott.Ash Pond
Certification LOA-002-96, New Haven, WV
SAMPLE LOCATION: Boring:96-106
Depth:61.5-63.5' Sample:ST-15

PROJ. NO.: 90979.030 DATE: 12/13/96

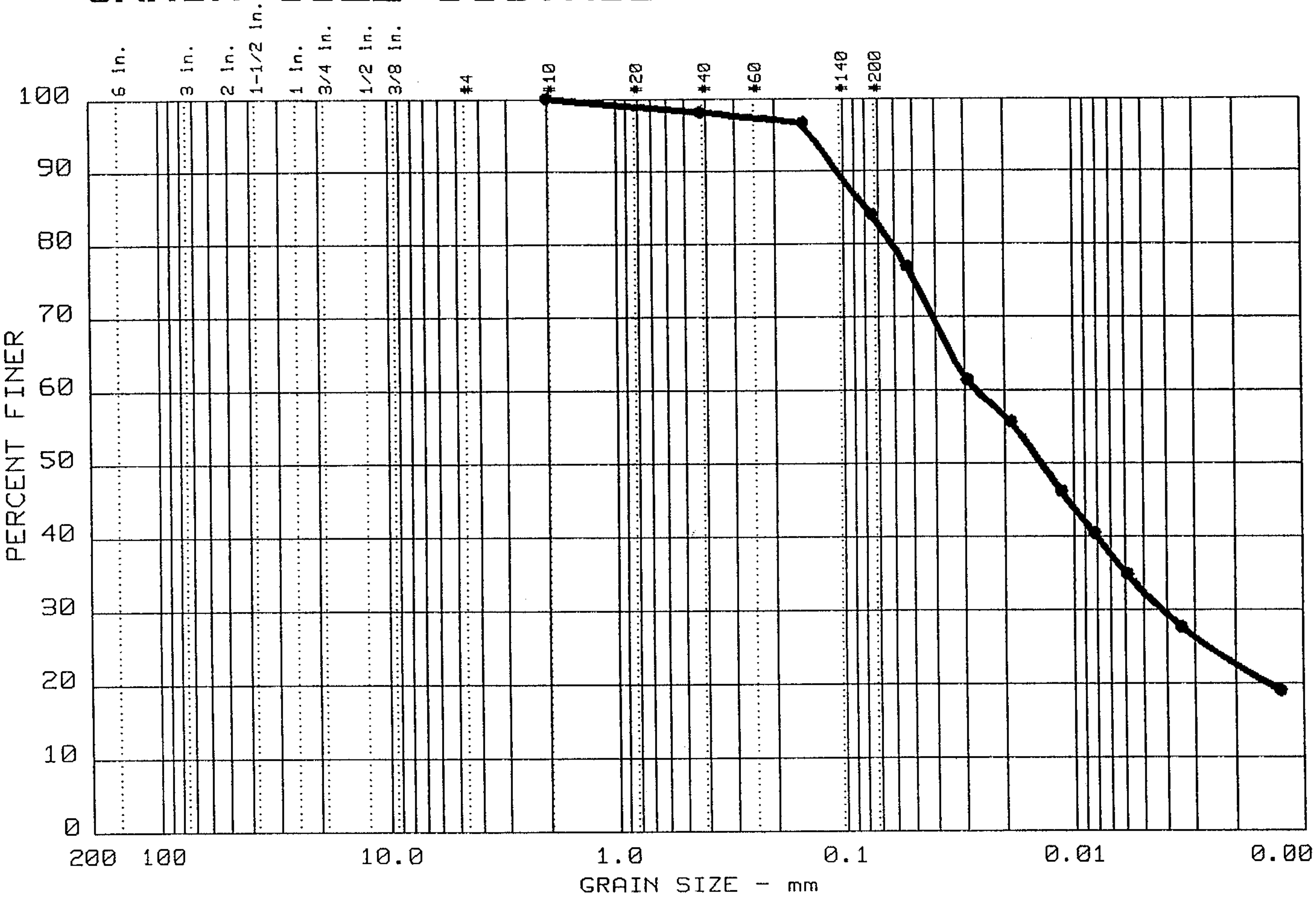
TRIAXIAL SHEAR TEST REPORT

H. C. NUTTING COMPANY



Client: American Electric Power
Project: Sporn Plt-Bott.Ash Pond Certification LOA-002-96, New Haven, WV
Location: Boring:96-106 Depth:61.5-63.5' Sample:ST-15
File: 8565 Project No.: 90979.030 Page 2/2 Fig. No. ____

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	16.1	51.5	32.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	43	17	0.08	0.03	0.01	0.004				

MATERIAL DESCRIPTION	USCS	AASHTO
● CLAY WITH SAND	CL	

Project No.: 90979.030
Project: Sporn Plt-~~Bott~~ Fly.Ash Pond Certification LOA-002-96*
● Location: Boring:96-107 Depth:66.6-68.6' *
*New Haven, WV

Date: 12/13/95

Remarks:

Client: American Electric Power

* Sample:ST-16

Lab No. 8566

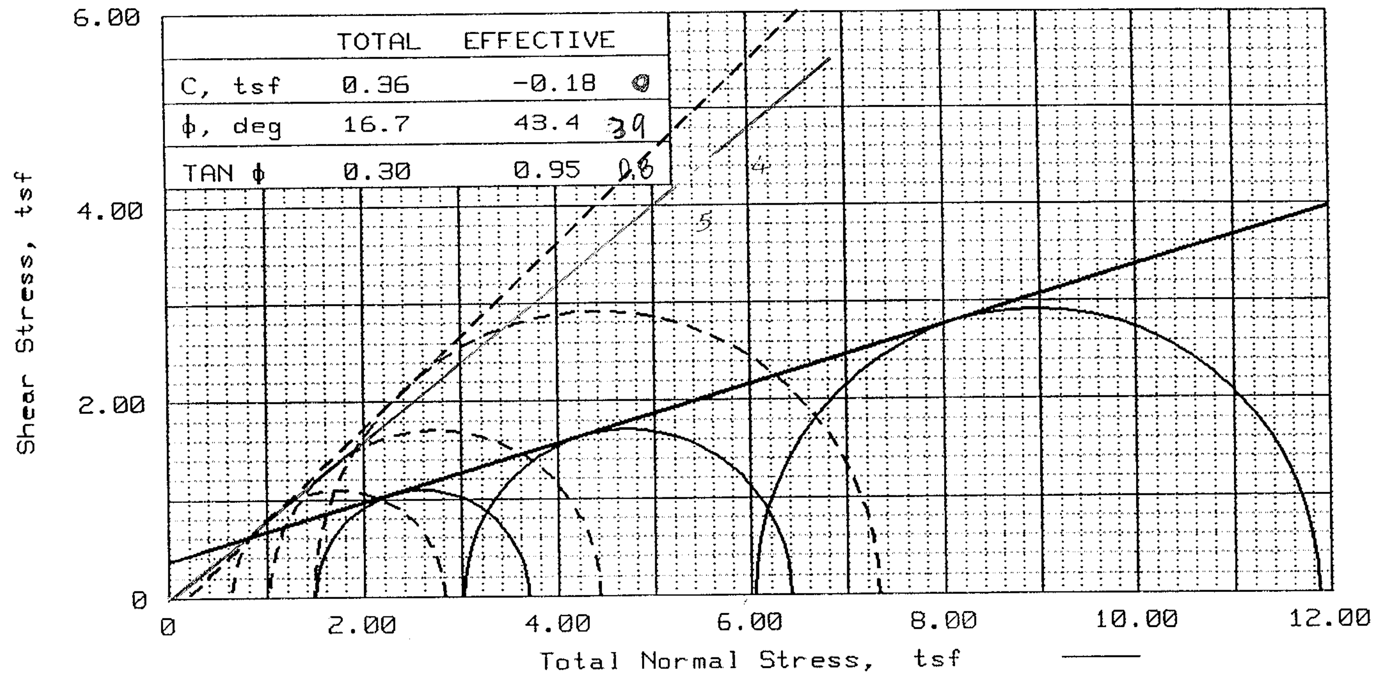
GRAIN SIZE DISTRIBUTION TEST REPORT

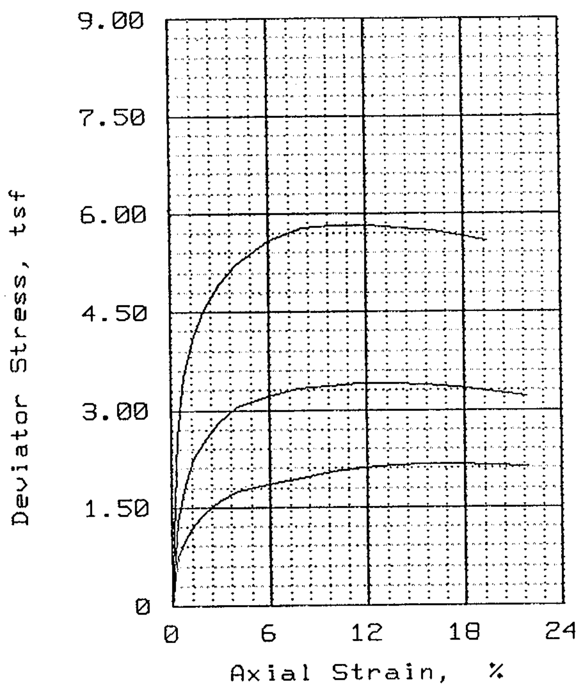
H. C. NUTTING COMPANY

Figure No. ______

AEPSPP-000649

	TOTAL	EFFECTIVE
C, tsf	0.36	-0.18
ϕ, deg	16.7	43.4 39
TAN ϕ	0.30	0.95 0.8





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	26.0	27.4	28.4
	DRY DENSITY, pcf	98.3	97.2	96.5
	SATURATION, %	95.8	98.4	100.0
	VOID RATIO	0.747	0.767	0.778
	DIAMETER, in	2.83	2.85	2.84
	HEIGHT, in	5.20	5.21	5.16
AT TEST	WATER CONTENT, %	26.6	25.6	23.6
	DIAMETER, in	2.78	2.81	2.73
	HEIGHT, in	5.11	5.13	4.96
Strain rate, %/min		0.001	0.001	0.001
BACK PRESSURE, tsf		2.88	2.88	2.88
CELL PRESSURE, tsf		4.39	5.90	8.93
FAILURE STRESS, tsf		2.18	3.40	5.83
PORE PRESSURE, tsf		3.74	4.87	7.43
ULTIMATE STRESS, tsf				
PORE PRESSURE, tsf				
$\bar{\sigma}_1$ FAILURE, tsf		2.82	4.43	7.33
$\bar{\sigma}_3$ FAILURE, tsf		0.65	1.04	1.5

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE:
DESCRIPTION: Br CLAY WITH SAND

LL= 43 PL= 17 PI= 26.0
SPECIFIC GRAVITY=
REMARKS: Lab No. 8566

FIG. NO.

CLIENT: American Electric Power

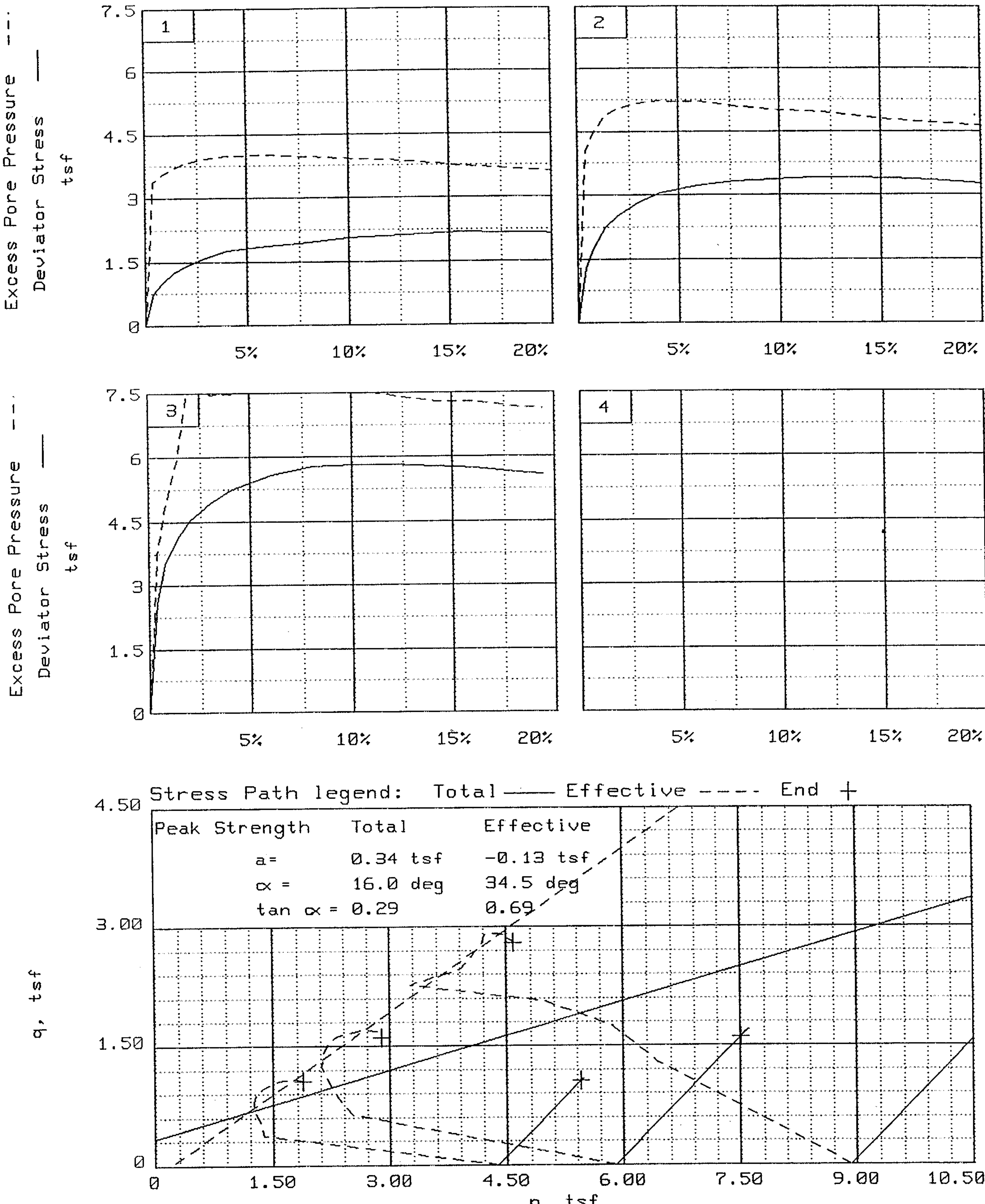
PROJECT: Sporn Plt-~~Bot~~ Fly t.Ash Pond
Certification LOA-002-96, New Haven, WV
SAMPLE LOCATION: Boring:96-107
Depth:66.6-68.6' Sample:ST-16

PROJ. NO.: 90979.030 DATE: 12/13/96

TRIAXIAL SHEAR TEST REPORT

H. C. NUTTING COMPANY

AEPSPP-000650



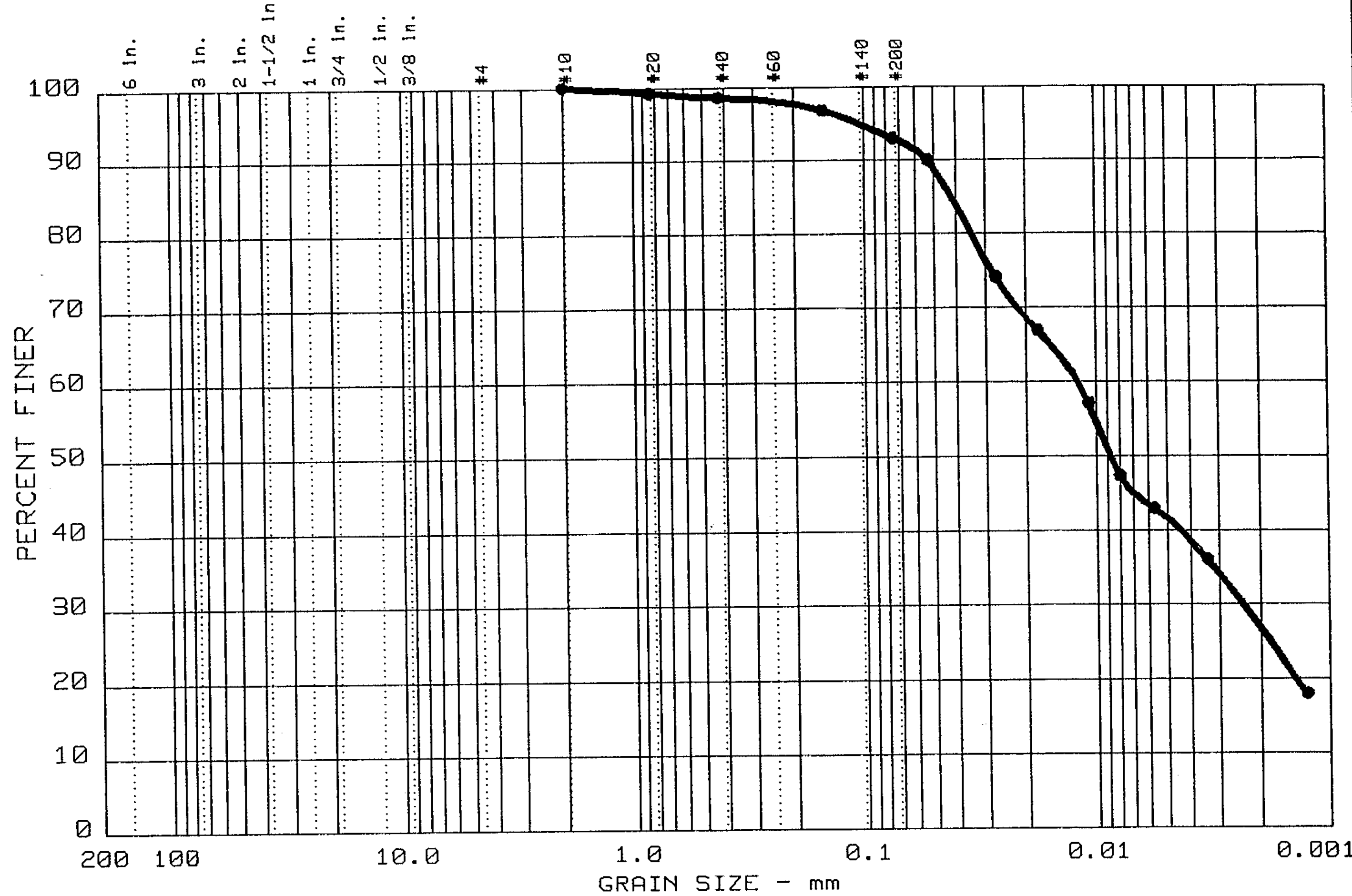
Client: American Electric Power

Project: Sporn Plt-Bott.Ash Pont Certification LOA-002-96, New Haven, WV

Location: Boring:96-107 Depth:66.6-68.6' Sample:ST-16

File: 8566 Project No.: 90979.030 Page 2/2 Fig. No. ____

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75 mm	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	7.2	51.3	41.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	44	14	0.04	0.01	0.01	0.002				

MATERIAL DESCRIPTION	USCS	AASHTO
● SILT	ML	

Project No.: 90979.030

Project: Sporn Plt-~~Bot~~ fly.Ash Pond Certification LOA-002-96*

● Location: Boring:96-108 Depth:41.6-43.6' *

* New Haven, WV

Date: 12/16/95

GRAIN SIZE DISTRIBUTION TEST REPORT

H. C. NUTTING COMPANY

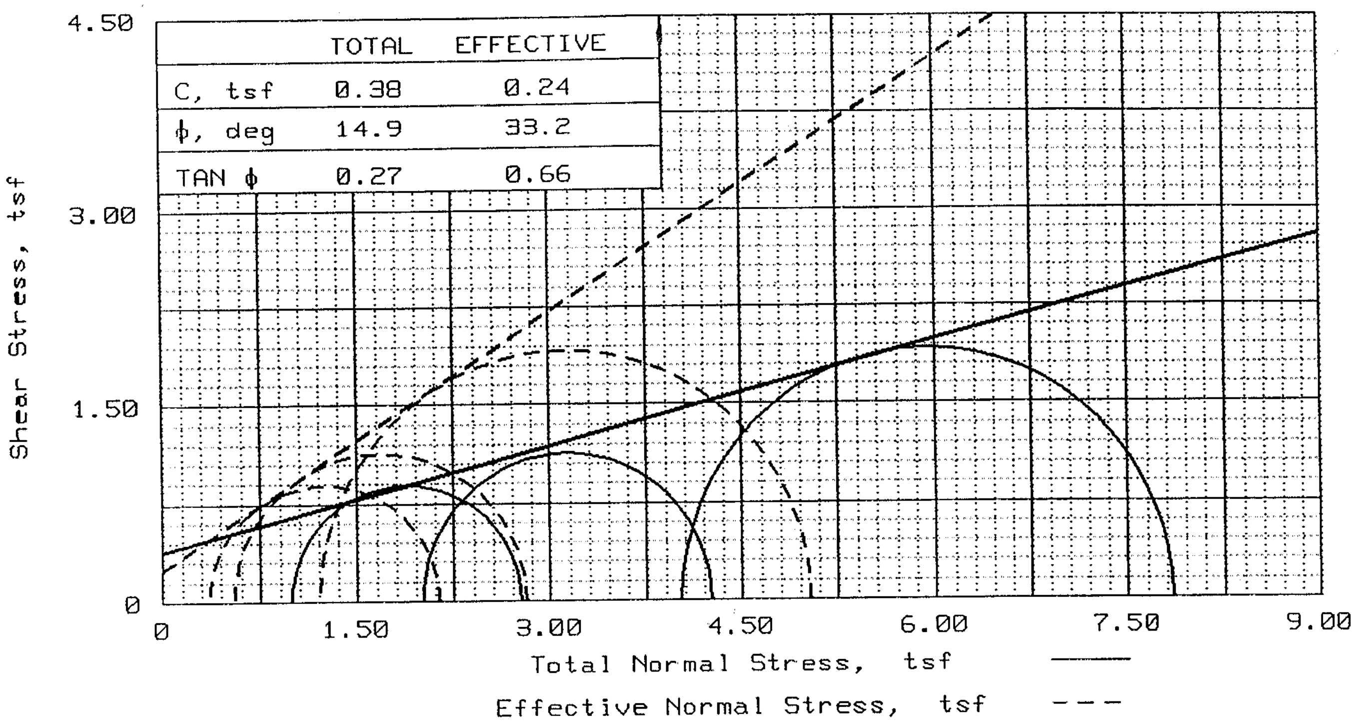
Remarks:

Client: American Electric Power

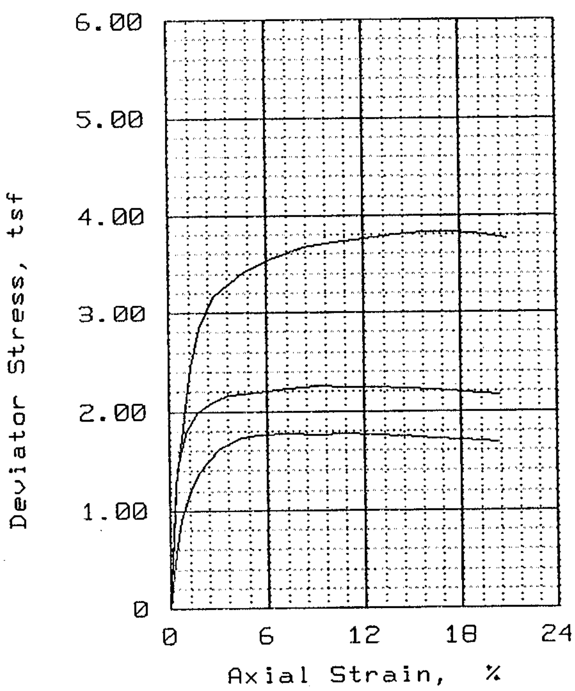
* Sample:ST-10

Lab No. 8567

Figure No. ______



	TOTAL	EFFECTIVE
C, tsf	0.38	0.24
ϕ, deg	14.9	33.2
TAN ϕ	0.27	0.66



SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	34.6	38.4	36.9
	DRY DENSITY, pcf	88.1	85.1	84.7
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.913	0.980	0.990
	DIAMETER, in	2.83	2.84	2.84
	HEIGHT, in	5.56	5.56	5.56
AT TEST	WATER CONTENT, %	34.5	33.9	32.9
	DIAMETER, in	2.81	2.80	2.75
	HEIGHT, in	5.52	5.49	5.38
Strain rate, %/min		0.001	0.001	0.001
BACK PRESSURE, tsf		2.88	2.88	2.88
CELL PRESSURE, tsf		3.89	4.90	6.91
FAILURE STRESS, tsf		1.77	2.25	3.82
PORE PRESSURE, tsf		3.51	4.33	5.70
ULTIMATE STRESS, tsf				
PORE PRESSURE, tsf				
$\bar{\sigma}_1$ FAILURE, tsf		2.14	2.81	5.04
$\bar{\sigma}_3$ FAILURE, tsf		0.37	0.56	1.22

TYPE OF TEST:
CU with pore pressures

SAMPLE TYPE:

DESCRIPTION: ~~SILT~~ Clay

LL= 44 PL= 14 PI= 30.0

SPECIFIC GRAVITY= 0

REMARKS: Lab No. 8567

FIG. NO.

CLIENT: American Electric Power

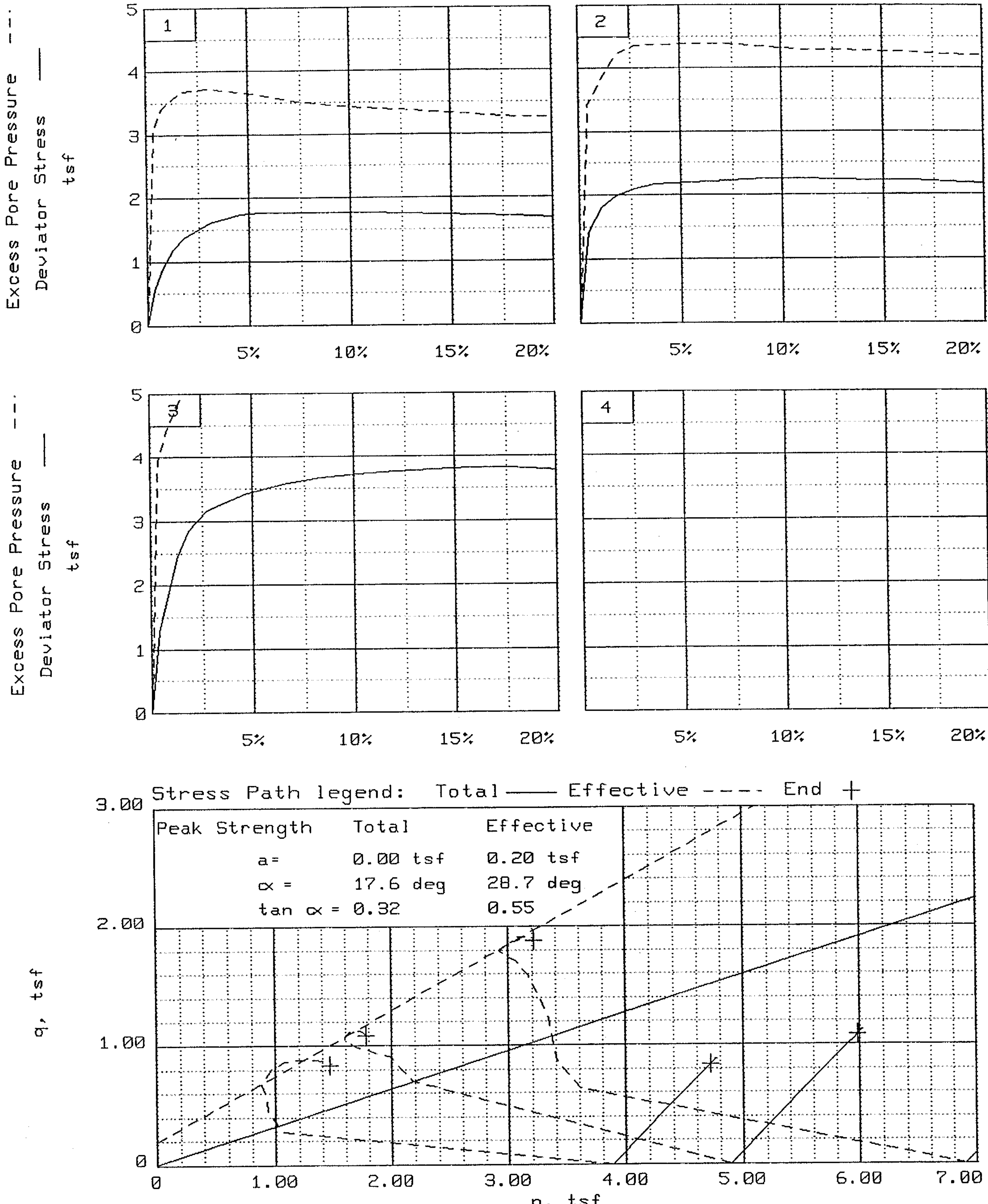
PROJECT: Sporn Plt-~~Bott.~~ fly. Ash Pond
Certification LOA-002-96

SAMPLE LOCATION: Boring:96-108
Depth:41.6-43.6' Sample:ST-10

PROJ. NO.: 90979.030 DATE: 12/16/96

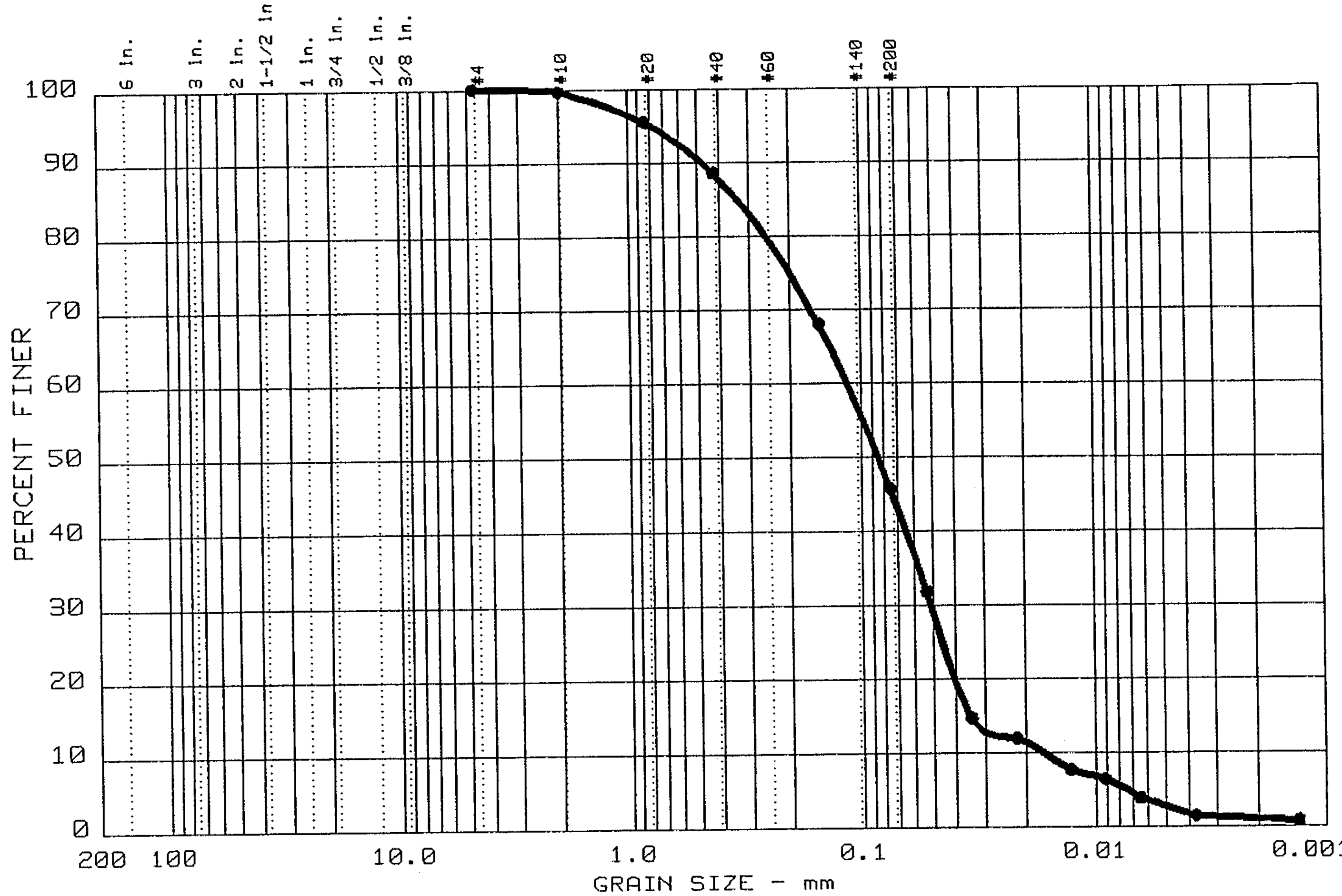
TRIAXIAL SHEAR TEST REPORT

H. C. NUTTING COMPANY



Client: American Electric Power
Project: Sporn Plt-Bott. Ash Pond Certification LOA-002-96
Location: Boring:96-108 Depth:41.6-43.6' Sample:ST-10
File: 8567 Project No.: 90979.030 Page 2/2 Fig. No. ____

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	54.3	43.0	2.7

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	0.33	0.11	0.08	0.051	0.0347	0.0168	1.34	6.8

MATERIAL DESCRIPTION	USCS	AASHTO
● SILTY SAND (Fly Ash)	SM	

Project No.: 90979.030
Project: Sporn Plt-~~Bott~~ Fly Ash Pond Certification LOA-002-96*
● Location: Boring:96-109 Depth:26.7-28.7' *
* New Haven, WV

Date: 12/16/95

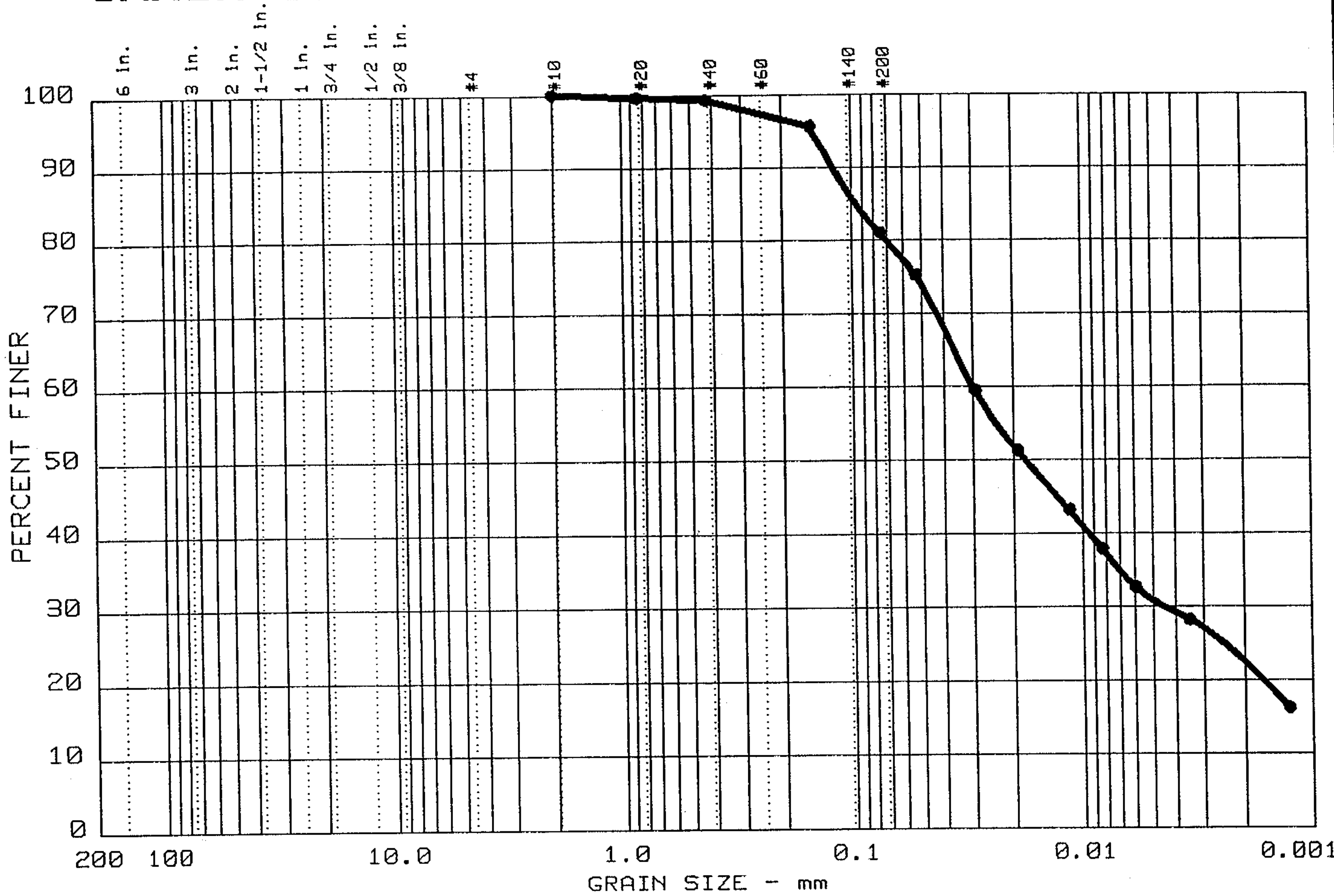
Remarks:
Client: American Electric Power

* Sample:ST-8
Lab No. 8568

GRAIN SIZE DISTRIBUTION TEST REPORT
H. C. NUTTING COMPANY

Figure No. ______

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75 mm	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	0.0	19.0	50.3	30.7

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	39	12	0.10	0.03	0.02	0.005				

MATERIAL DESCRIPTION	USCS	AASHTO
● SILT WITH SAND	ML	

Project No.: 90979.030

Project: Sporn Plt-~~Bott~~ Fly.Ash Pond Certification LOA-002-96*

● Location: Boring:96-110 Depth:58.6-60.6' *

* New Haven, WV

Date: 12/16/95

GRAIN SIZE DISTRIBUTION TEST REPORT

H. C. NUTTING COMPANY

Remarks:

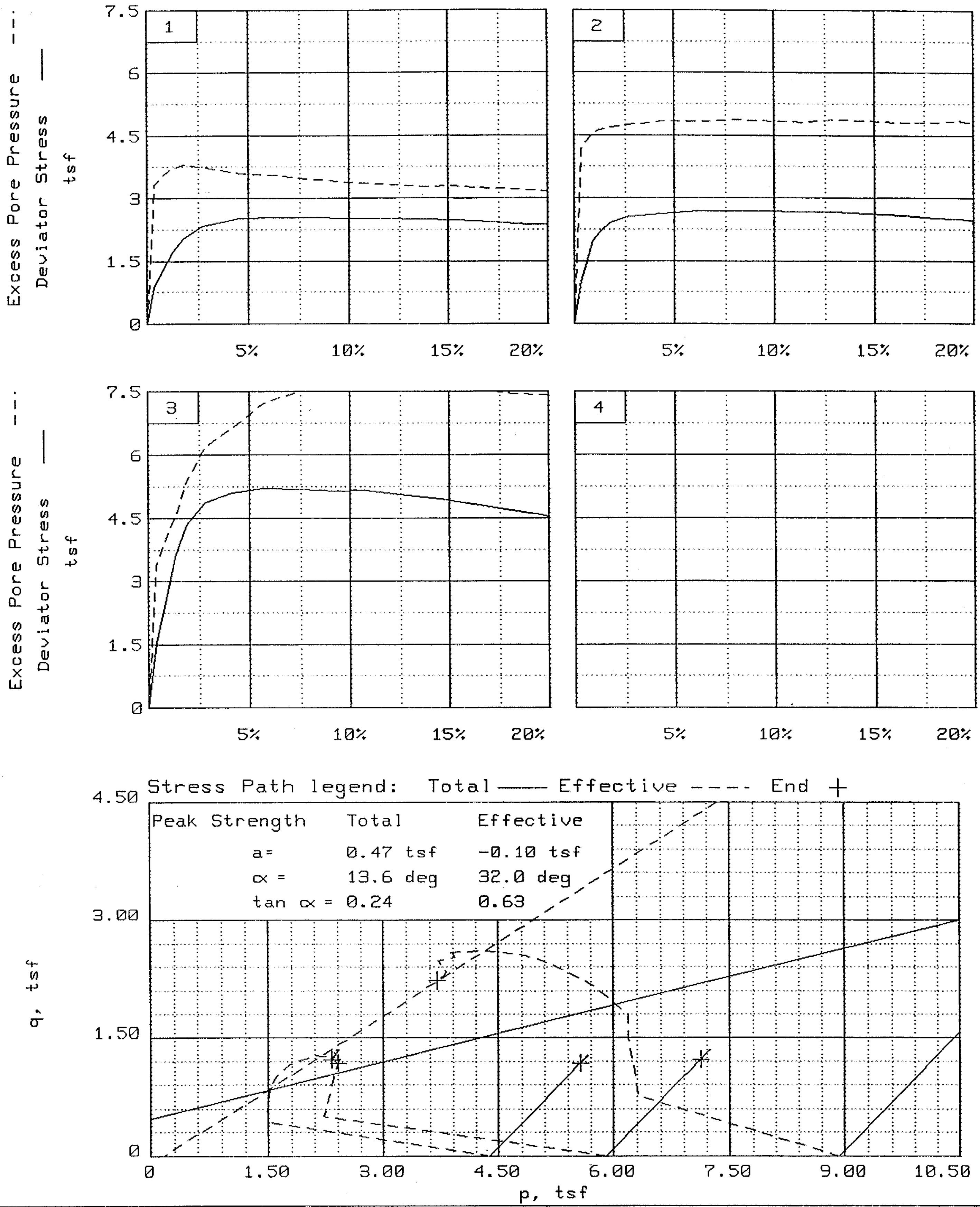
Client: American Electric Power

* Sample:ST-18

Lab No. 8569

Figure No. ______

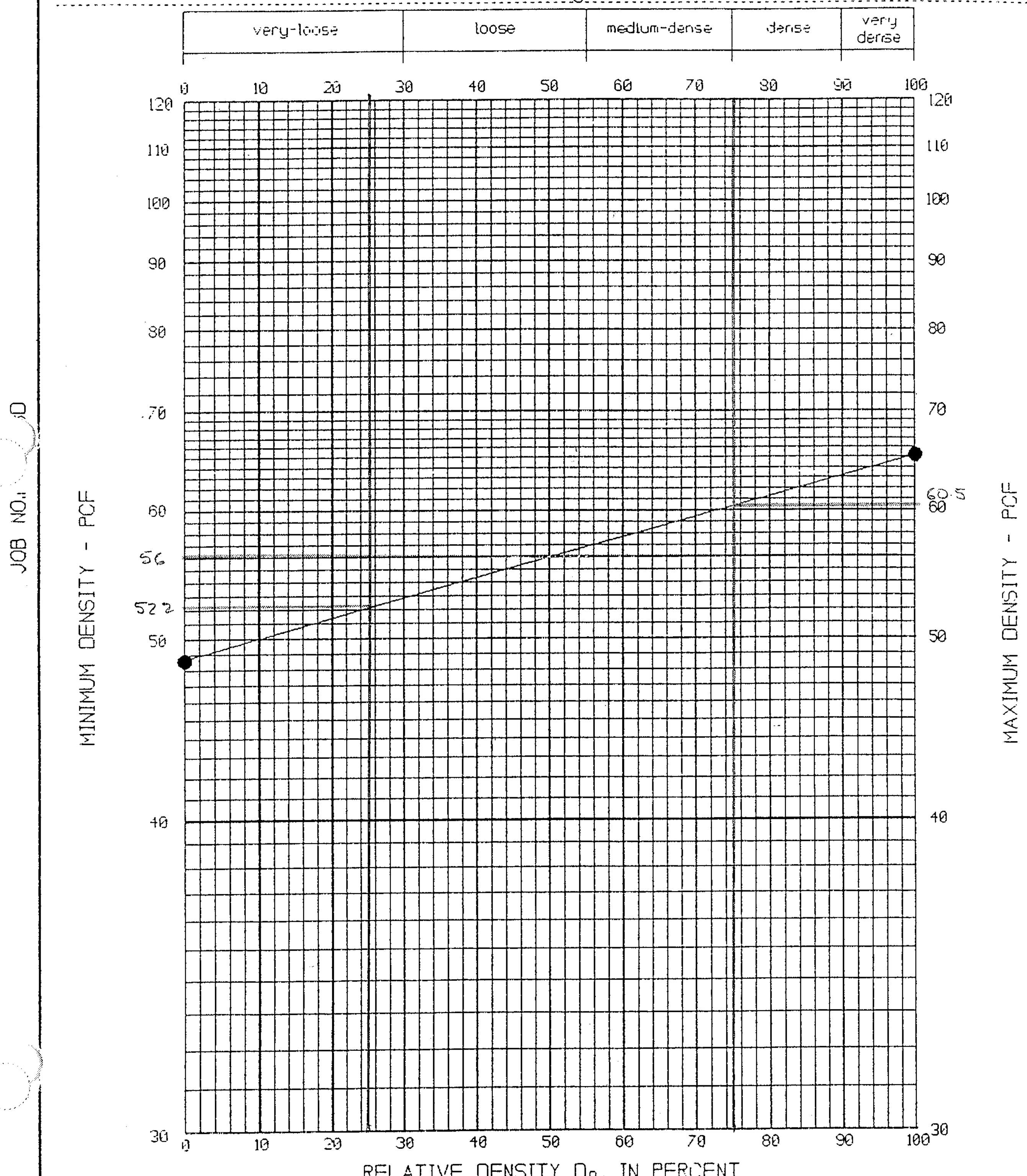
AEPSPP-000656



Client: American Electric Power
Project: Sporn Plt-Bott. Ash Pond Certification LOA-002-96, New Haven, WV
Location: Boring:96-110 Depth:58.6-60.6' Sample:St-18
File: 8569 Project No.: 09079.030 Page 2/2 Fig. No. ____

RELATIVE DENSITY - MAX/MIN METHOD

Project : Sporn Fly Ash Pond Dike Remediation
Location : New Haven, West Virginia
Sample : Bucket
Material : Bottom Ash : Dark-gray and gray fine to coarse sand, little fine to coarse gravel, trace silt.



AEPSPP-000658

SUMMARY OF MATERIAL PROPERTIES

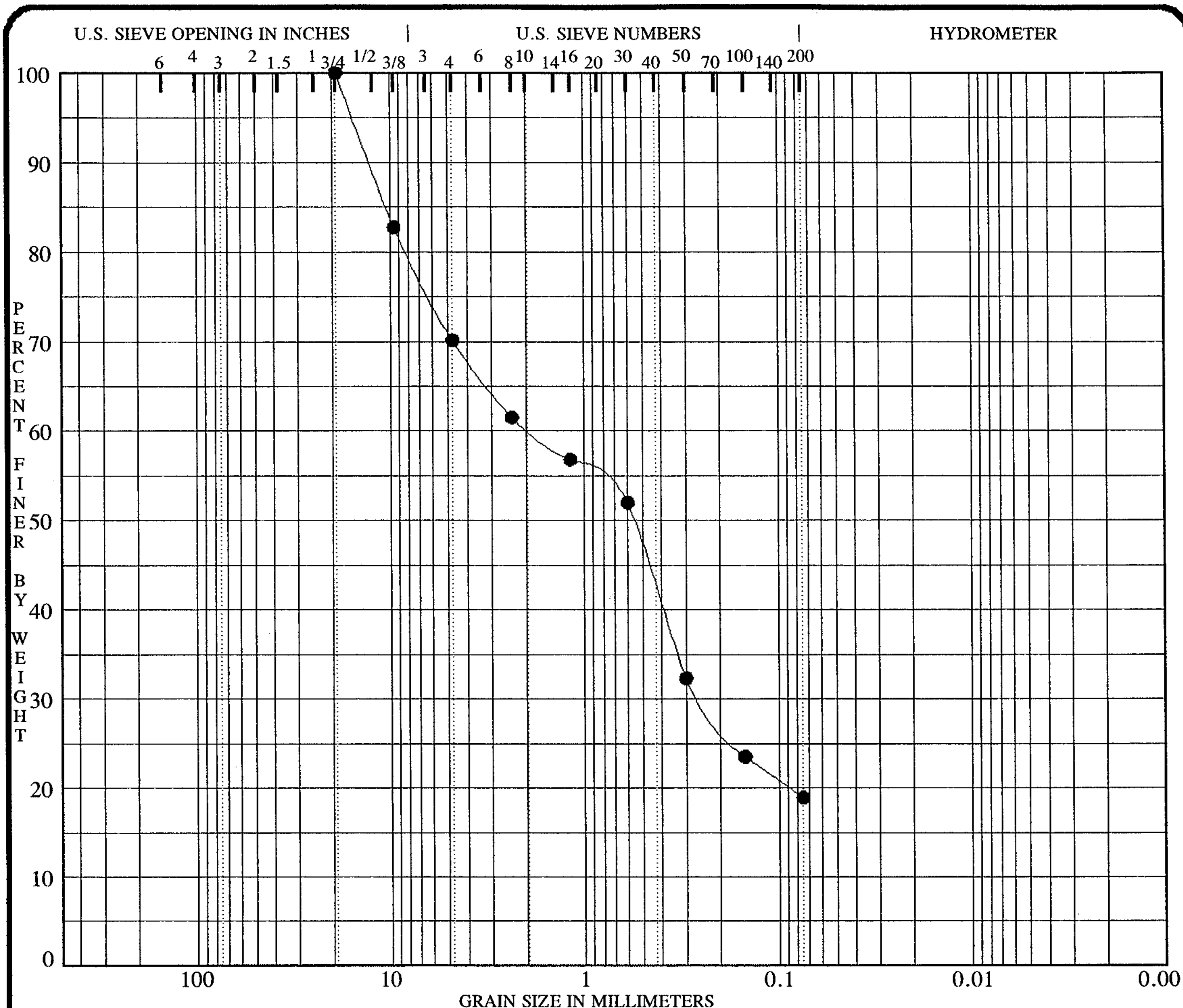
PROJECT: SPORN PLANT - FLY ASH POND DIKES
NUMBER:

Borehole or Excav No.	Depth ft.	ASTM Description	ASTM Classif-ication	Soil Type	Maximum Dry Density pcf	Optimum Moisture %	Liquid Limit %	Plastic Limit %	Gravel %	Sand %	<#200 Sieve %	<.002 mm %	Specific Gravity	Prmblty cm/sec	Natural Moisture %
96-101	5.0	SILTY SAND with GRAVEL	SM				NP	NP	29.9	51.2	18.9				6.5
96-101	8.5	SILTY SAND with GRAVEL	SM				NP	NP	17.6	44.1	38.3				10.0
96-101	16.5	SILTY SAND with GRAVEL	SM				NP	NP	24.7	57.3	18.0				4.2
96-101	21.5	POORLY GRADED SAND with SILT and GRAVEL	SP-SM				NP	NP	43.2	49.1	7.7				2.6
96-101	26.5	POORLY GRADED SAND with SILT and GRAVEL	SP-SM				NP	NP	35.5	52.3	12.2				6.8
96-101	31.5	[redacted] Silty clay w/sand	(CL-ML)	SEE TRIAXIAL TEST [illegible]			NP	NP	0.4	48.7	50.9				10.8
96-101	36.5	LEAN CLAY	CL				26.6	16.3	0.0	10.7	89.3				17.0
96-102	8.5	SILTY SAND with GRAVEL	SM				NP	NP	31.3	49.7	19.0				6.5
96-102	16.7	POORLY GRADED GRAVEL with SILT and SAND	GP-GM				NP	NP	50.2	42.9	6.9				2.8
96-102	26.7	SANDY SILT	ML				NP	NP	1.7	37.1	61.2				11.8
96-102	31.7	LEAN CLAY with SAND	CL				27.7	18.4	0.0	24.2	75.8				18.4
96-102	36.7	SANDY LEAN CLAY	CL				23.8	16.2	0.0	47.3	52.7				15.6
96-102	41.7	POORLY GRADED SAND with SILT and GRAVEL	SP-SM				NP	NP	38.3	52.5	9.2				5.3
96-103	21.6	POORLY GRADED SAND with SILT and GRAVEL	SP-SM				NP	NP	40.0	51.0	9.0				4.7
96-103	31.6	LEAN CLAY with SAND	CL				28.6	18.8	0.0	26.6	73.4				14.5
96-103	41.6	SILTY SAND	SM				NP	NP	0.0	53.7	46.3				11.4
96-104	3.0	POORLY GRADED SAND with SILT and GRAVEL	SP-SM				NP	NP	41.5	53.6	4.9				1.1
96-104	8.5	POORLY GRADED SAND with SILT and GRAVEL	SP-SM				NP	NP	30.8	57.5	11.7				1.0
96-104	11.7	POORLY GRADED SAND with SILT and GRAVEL	SP-SM				NP	NP	41.7	48.5	9.8				1.2
96-104	16.7	SILTY SAND with GRAVEL	SM				NP	NP	19.4	64.7	15.9				4.0
96-104	21.7	SILTY SAND with GRAVEL	SM				NP	NP	34.4	47.5	18.1				2.9
96-104	36.7	LEAN CLAY with SAND	CL				27.2	19.0	0.0	22.8	77.2				18.9
96-104	41.7	SANDY SILT	ML				NP	NP	0.0	35.3	64.7				8.1
96-105	3.0	POORLY GRADED SAND with SILT and GRAVEL	SP-SM				NP	NP	40.2	53.9	5.9				1.6
96-105	16.5	POORLY GRADED SAND with SILT and GRAVEL	SP-SM				NP	NP	42.7	48.8	8.5				3.1
96-105	21.5	SILTY SAND with GRAVEL	SM				NP	NP	19.0	61.9	19.1				6.7
96-105	26.5	LEAN CLAY with SAND	CL				27.4	17.7	0.0	26.6	73.4				13.3
96-105	36.5	LEAN CLAY	CL				28.8	18.7	0.0	4.4	95.6				22.1
96-105	41.5	SILTY SAND	SM				NP	NP	0.0	51.2	48.8				11.9
96-106	11.5	SILTY SAND with GRAVEL	SM				NP	NP	19.1	59.8	21.1				5.5
96-106	21.5	SANDY LEAN CLAY	CL				26.1	17.5	0.0	33.4	66.6				11.1
96-106	31.5	SILT	ML				NP	NP	0.0	11.1	88.9		2.29		42.6

SUMMARY OF MATERIAL PROPERTIES

PROJECT: SPORN PLANT - FLY ASH POND DIKES
NUMBER:

Borehole or Excav No.	Depth ft.	ASTM Description	ASTM Classification	Soil Type	Maximum Dry Density pcf	Optimum Moisture %	Liquid Limit %	Plastic Limit %	Gravel %	Sand %	<#200 Sieve %	<.002 mm %	Specific Gravity	Prmblty cm/sec	Natural Moisture %
96-106	51.5	SILT with SAND	ML				NP	NP	0.0	15.2	84.8		2.42		35.7
96-106	56.5	LEAN CLAY	CL				43.6	25.6	0.0	2.6	97.4				31.9
96-107	11.6	POORLY GRADED SAND with SILT and GRAVEL	SP-SM				NP	NP	34.7	54.9	10.4				3.9
96-107	16.6	SANDY LEAN CLAY	CL				25.2	18.1	0.0	31.9	68.1				14.0
96-107	21.6	SANDY SILT	ML				NP	NP	0.0	35.4	64.6				11.4
96-107	36.6	SILT with SAND	ML				NP	NP	0.0	21.9	78.1		2.38		37.6
96-107	56.6	SILT	ML				NP	NP	0.0	11.3	88.7		2.31		36.2
96-107	71.6	LEAN CLAY	CL				41.3	21.1	0.0	11.4	88.6				25.2
96-108	3.0	SILTY SAND with GRAVEL	SM				NP	NP	14.8	50.6	34.6				9.1
96-108	8.5	SILTY SAND	SM				NP	NP	13.7	49.9	36.4				6.2
96-108	11.6	SILTY SAND with GRAVEL	SM				NP	NP	34.4	50.4	15.2				3.0
96-108	16.6	SILTY SAND with GRAVEL	SM				NP	NP	16.9	55.3	27.8				1.9
96-108	21.6	SANDY SILTY CLAY	CL-ML				23.3	16.5	0.0	40.5	59.5				12.2
96-108	26.6	SILTY SAND	SM				NP	NP	10.4	72.7	16.9				20.6
96-108	41.6	LEAN CLAY	CL				38.7	20.3	0.0	9.5	90.5				23.2
96-108	56.6	LEAN CLAY with SAND	CL				34.9	20.1	0.0	25.3	74.7				25.1
96-109	8.5	POORLY GRADED SAND with SILT and GRAVEL	SP-SM				NP	NP	34.7	55.9	9.4				0.4
96-109	11.7	SILTY SAND	SM				NP	NP	4.9	72.1	23.0				4.3
96-109	16.7	SANDY SILTY CLAY	CL-ML				22.9	17.1	0.0	40.9	59.1				9.0
96-109	36.7	SILT	ML				NP	NP	0.0	8.9	91.1		2.34		38.1
96-109	56.7	SILT	ML				NP	NP	0.0	0.9	99.1		2.29		34.3
96-109	71.7	LEAN CLAY	CL				40.3	21.8	0.0	6.8	93.2				23.7
96-110	5.0	SILTY SAND	SM				NP	NP	8.8	59.5	31.7				6.8
96-110	8.5	POORLY GRADED GRAVEL with SILT and SAND	GP-GM				NP	NP	53.3	38.0	8.7				0.1
96-110	16.6	LEAN CLAY with SAND	CL				25.5	17.6	0.0	29.1	70.9				11.5
96-110	21.6	SANDY SILTY CLAY	CL-ML				24.0	17.0	0.0	41.1	58.9				12.5
96-110	31.6	LEAN CLAY with SAND	CL				30.7	18.4	0.0	18.0	82.0				14.7
96-110	46.6	LEAN CLAY	CL				36.2	21.3	0.0	12.3	87.7				25.1
96-110	56.6	LEAN CLAY	CL				37.5	20.3	0.0	13.1	86.9				24.4
96-110	66.6	LEAN CLAY with SAND	CL				38.7	21.7	0.0	16.2	83.8				25.6



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-101	5.0		6.5	NP	NP	NP		
			SILTY SAND with GRAVEL SM						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-101	5.0	19.000	1.892	0.250		29.9	51.2	18.9	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

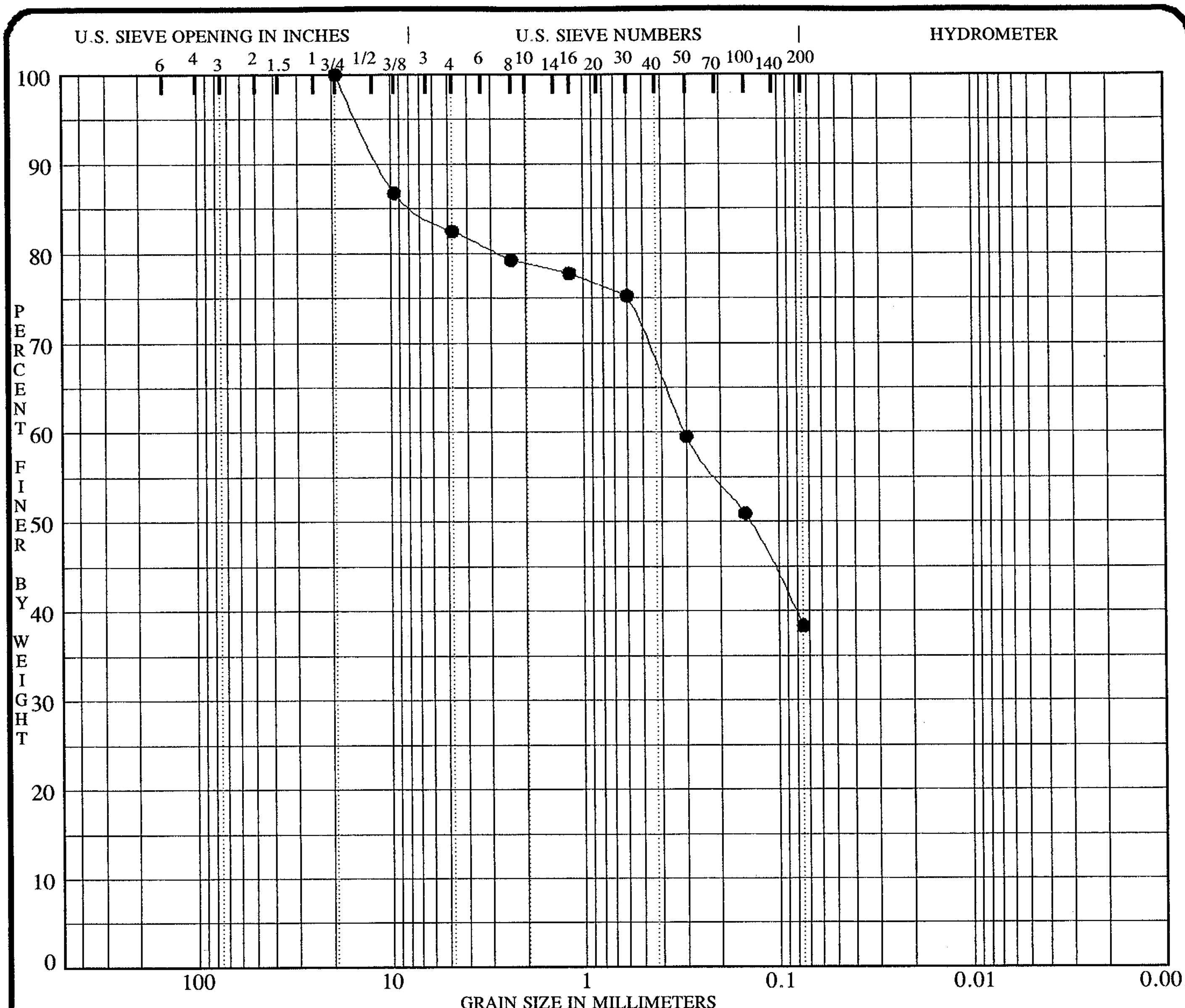
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	**96-101**	**8.5**		**10.0**	**NP**	**NP**	**NP**		
			SILTY SAND with GRAVEL SM						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	**96-101**	**8.5**	**19.000**	**0.307**			**17.6**	**44.1**	**38.3**	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

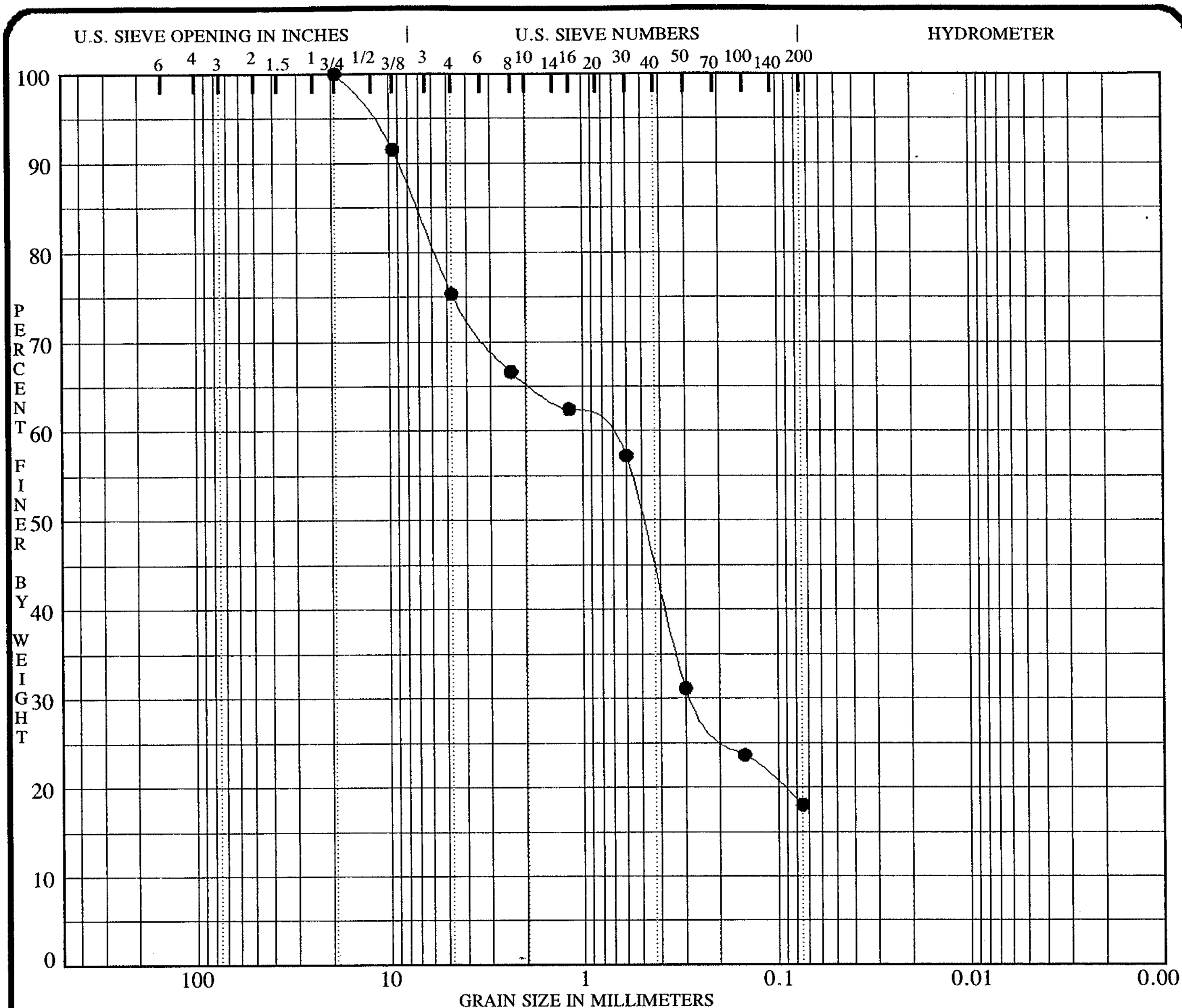
JOB NO.
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.
Groveport, Ohio

AEP

AEPSPP-000662



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-101	16.5		4.2	NP	NP	NP		
			SILTY SAND with GRAVEL SM						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-101	16.5	19.000	0.864	0.271		24.7	57.3	18.0	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

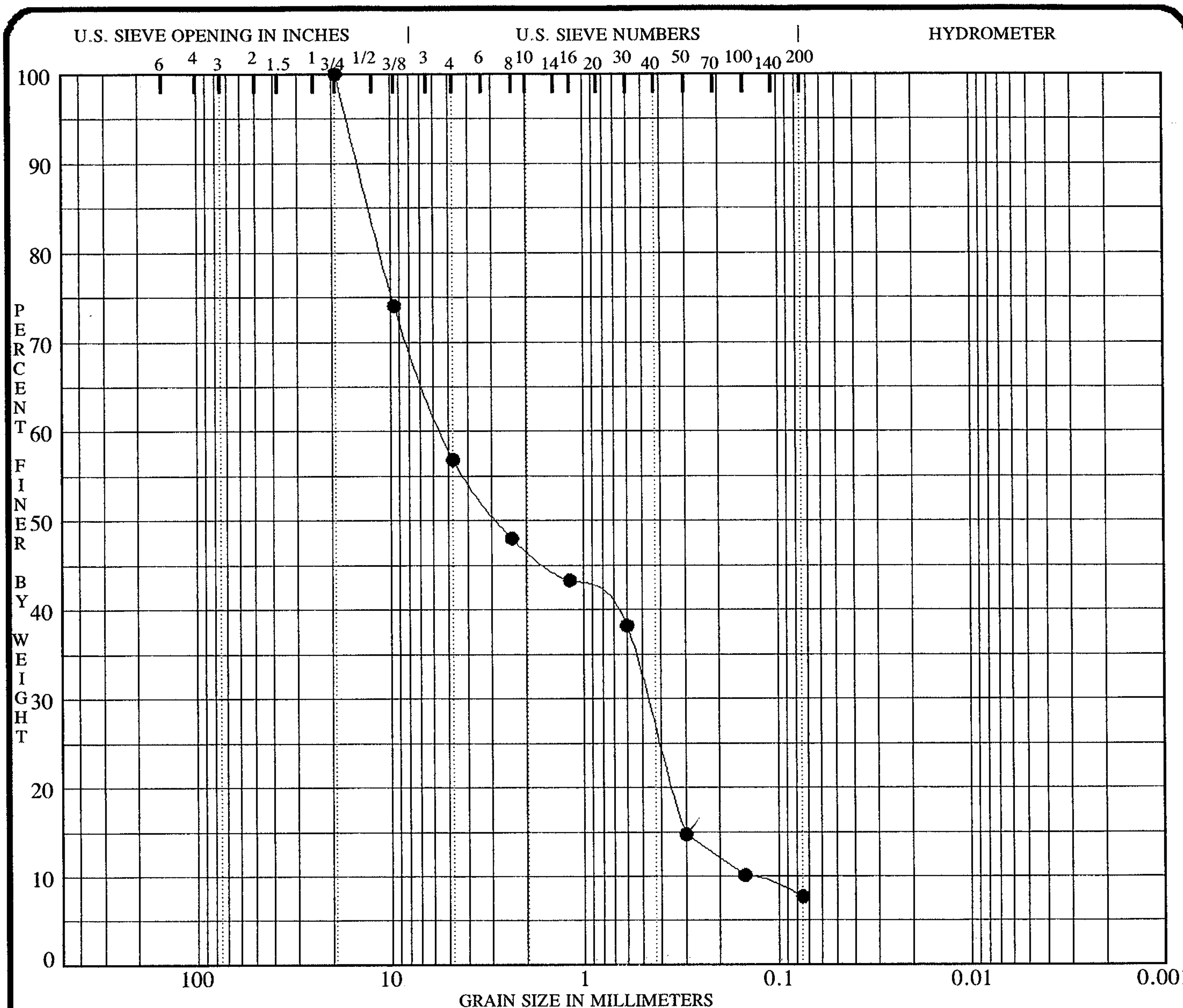
JOB NO.
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.
Groveport, Ohio

AEP

AEPSPP-000663



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.
●	96-101	21.5		2.6	NP	NP	NP	
			POORLY GRADED SAND with SILT and GRAVEL SP-SM					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
●	96-101	21.5	19.000	5.404	0.471	0.146	43.2	49.1	7.7	

PROJECT SPORN PLANT - FLY ASH POND DIKES

JOB NO.

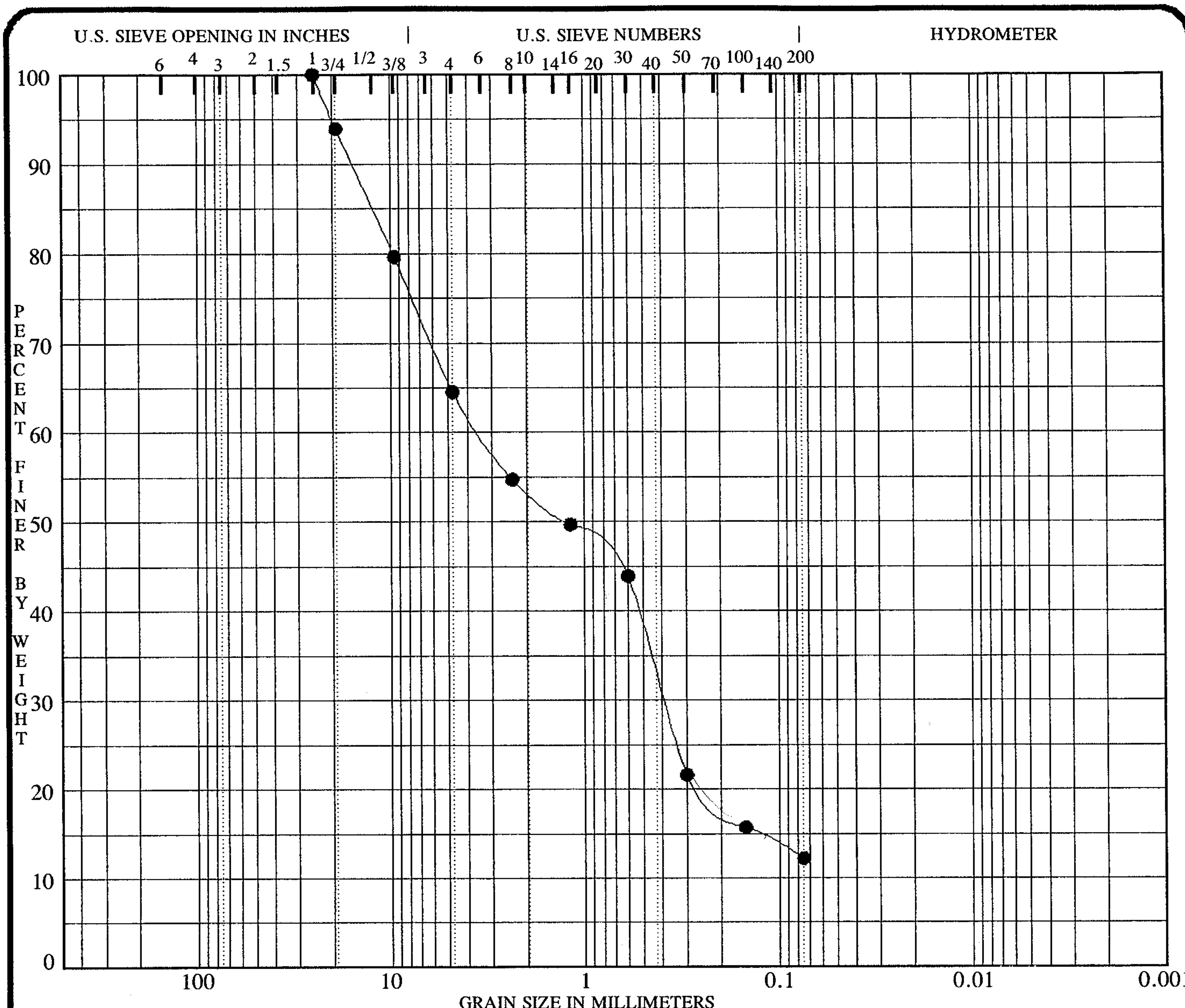
DATE 05/21/97

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEPSPP-000664



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.
●	96-101	26.5		6.8	NP	NP	NP	
			POORLY GRADED SAND with SILT and GRAVEL SP-SM					

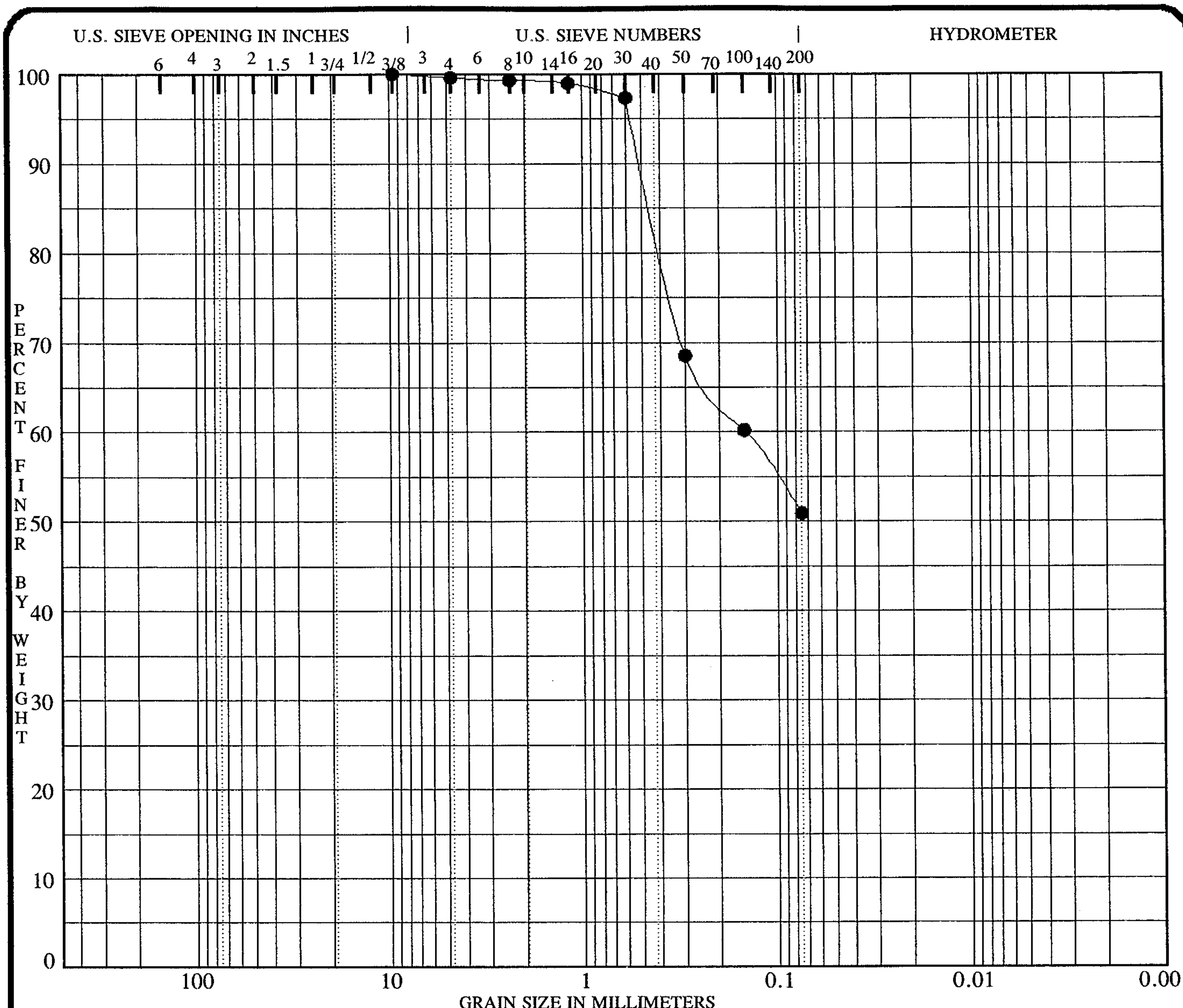
	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-101	26.5	25.000	3.445	0.390		35.5	52.3	12.2	

PROJECT SPORN PLANT - FLY ASH POND DIKES
JOB NO.
DATE 05/21/97

GRADATION CURVES

American Electric Power Service Corp.
Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-101	31.5		10.8	NP	NP	NP		
			SANDY SILT ML						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
●	96-101	31.5	9.500	0.148			0.4	48.7	50.9	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

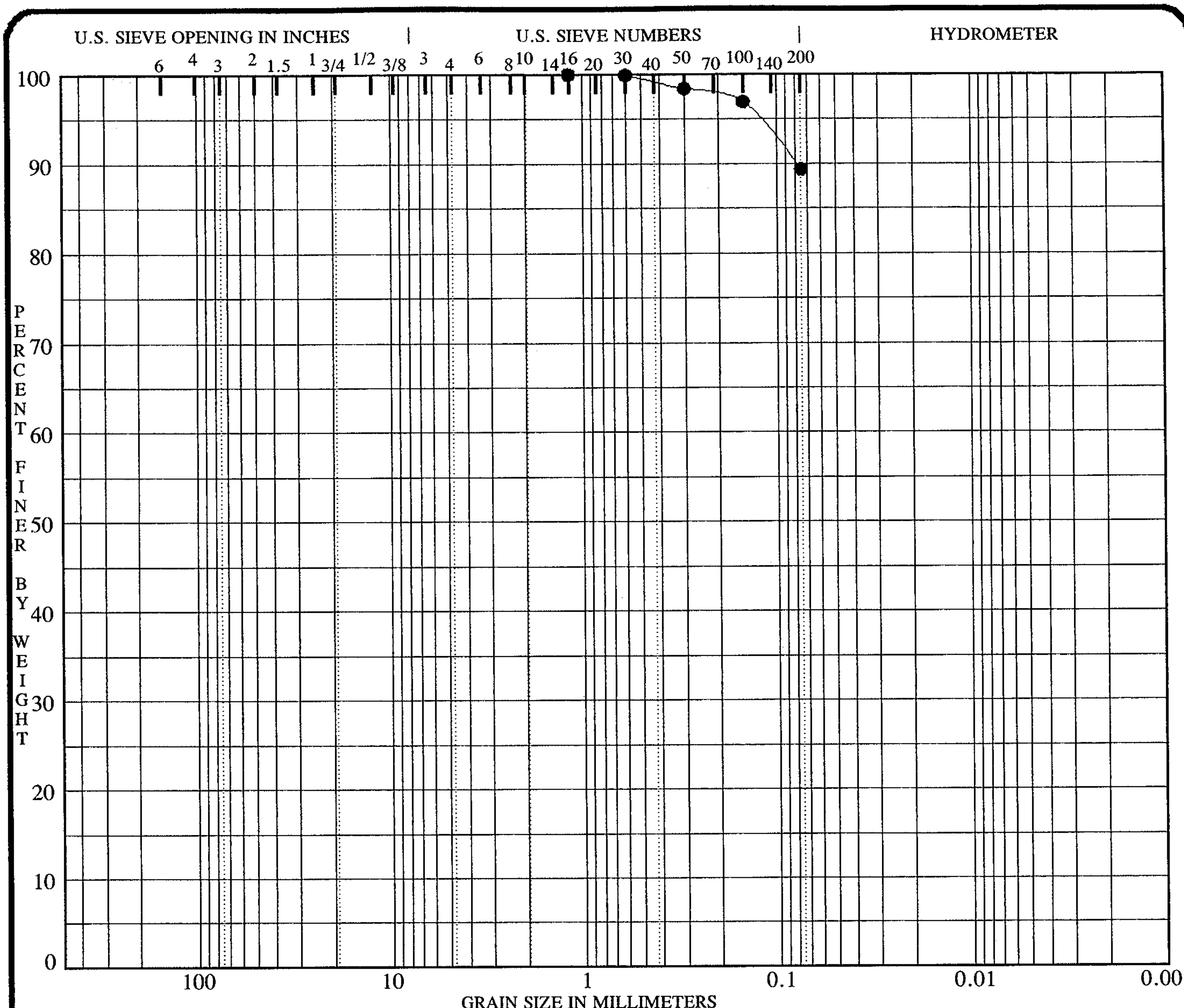
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-101	36.5		17.0	26.6	16.3	10.3		
			LEAN CLAY CL						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-101	36.5	1.180				0.0	10.7	89.3	

PROJECT SPORN PLANT - FLY ASH POND DIKES

JOB NO.

DATE 05/21/97

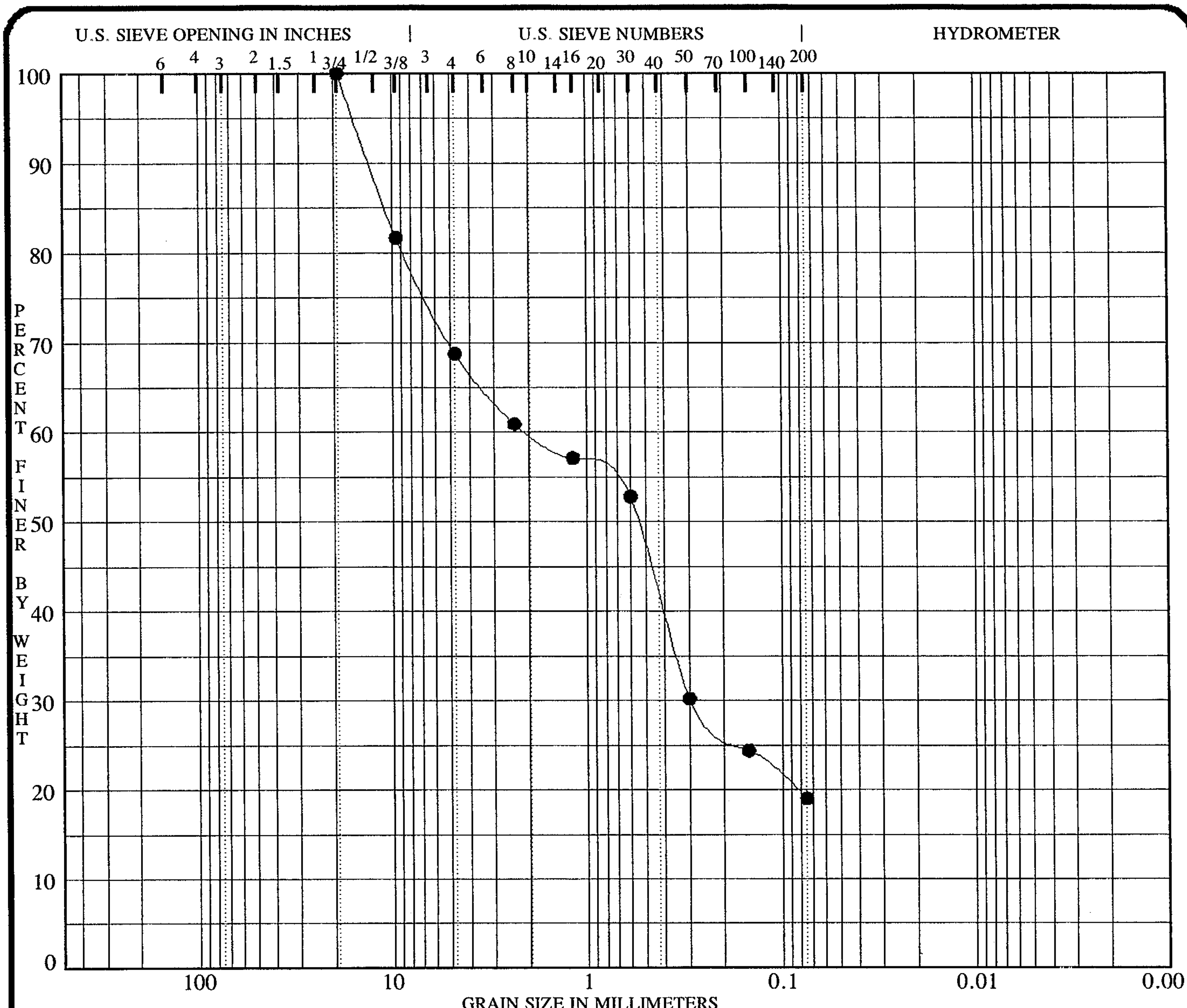
GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP

AEPSPP-000667



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-102	8.5		6.5	NP	NP	NP		
			SILTY SAND with GRAVEL SM						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-102	8.5	19.000	2.003	0.293		31.3	49.7	19.0	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

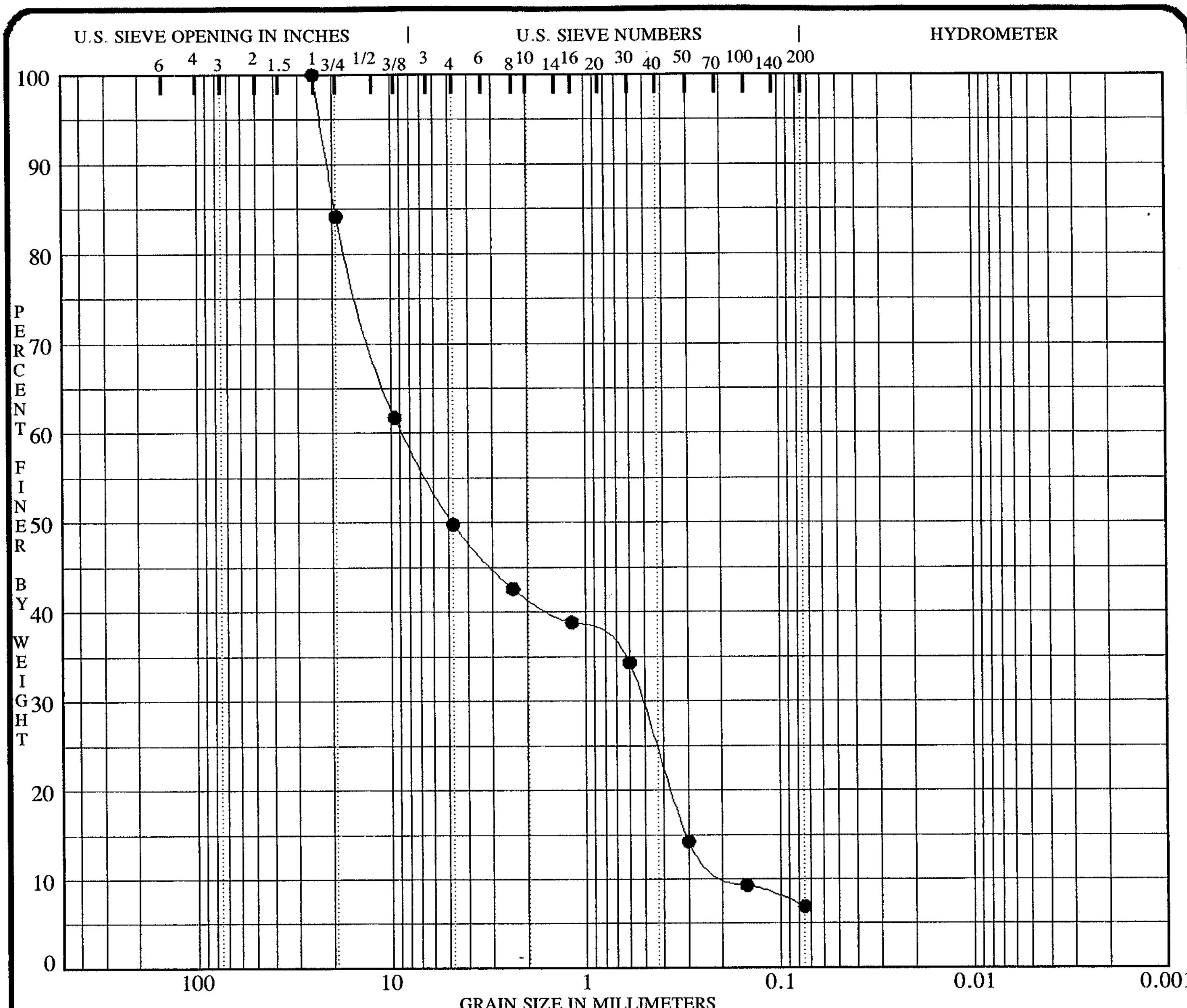
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEPSPP-000668



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-102	16.7		2.8	NP	NP	NP		
			POORLY GRADED GRAVEL with SILT and SAND GP-GM						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-102	16.7	25.000	8.604	0.517	0.166	50.2	42.9	6.9	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

DATE **05/21/97**

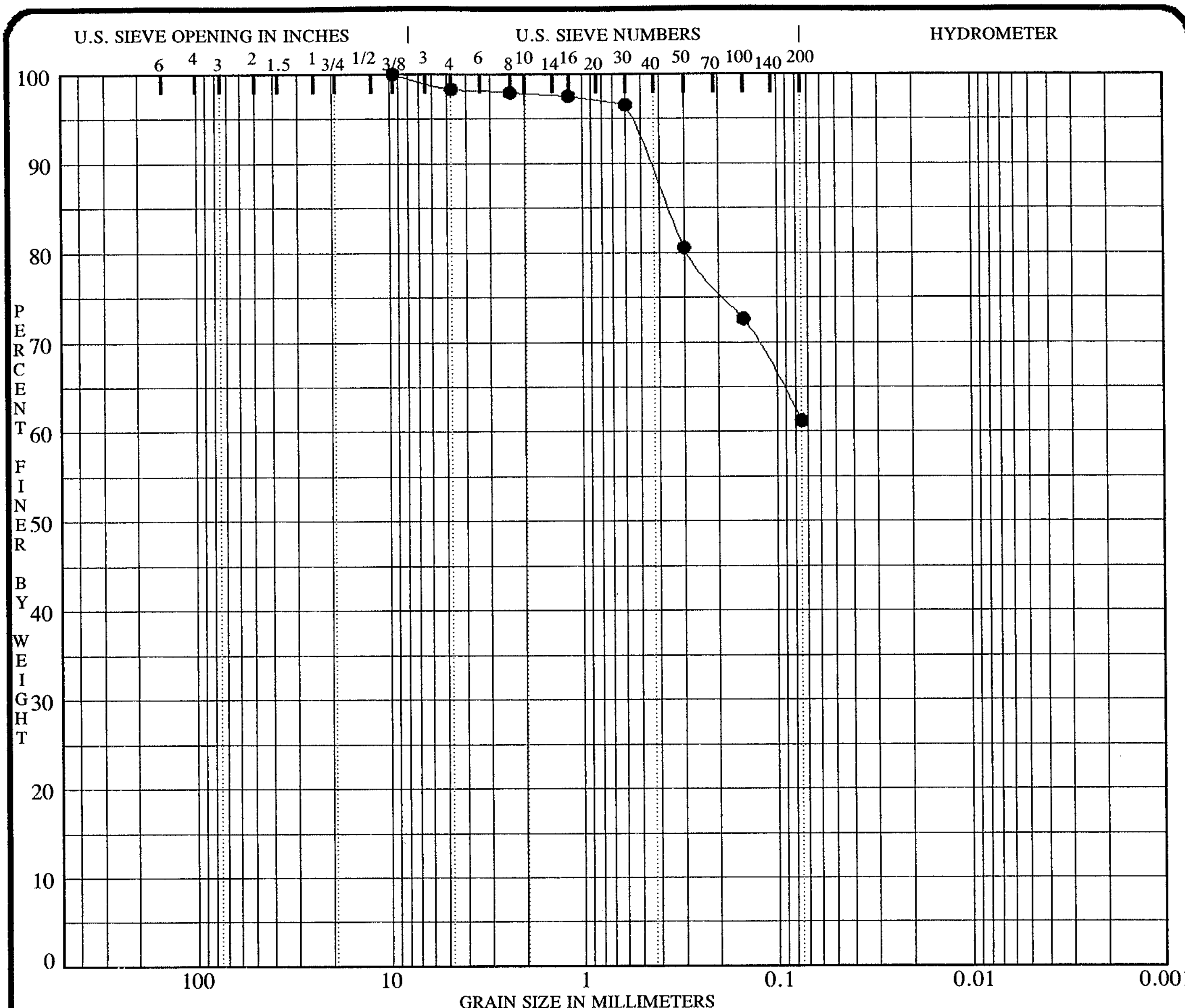
GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP

AEPSPP-000669



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
● 96-102	26.7		**11.8**	**NP**	**NP**	**NP**		
		SANDY SILT ML						

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● **96-102**	**26.7**	**9.500**				**1.7**	**37.1**	**61.2**	

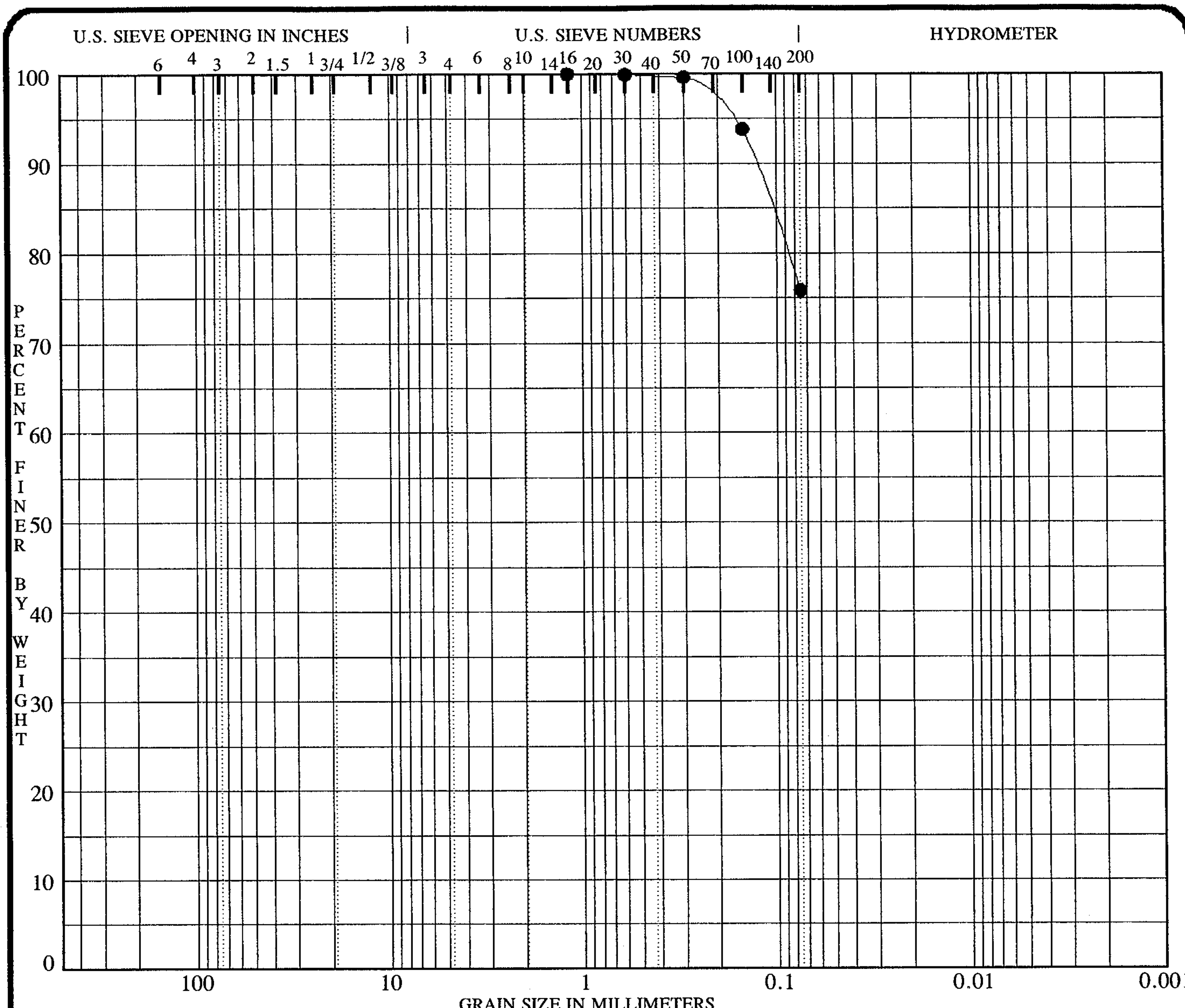
PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.
Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-102	31.7		18.4	27.7	18.4	9.3		
			LEAN CLAY with SAND CL						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
●	96-102	31.7	1.180				0.0	24.2	75.8	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

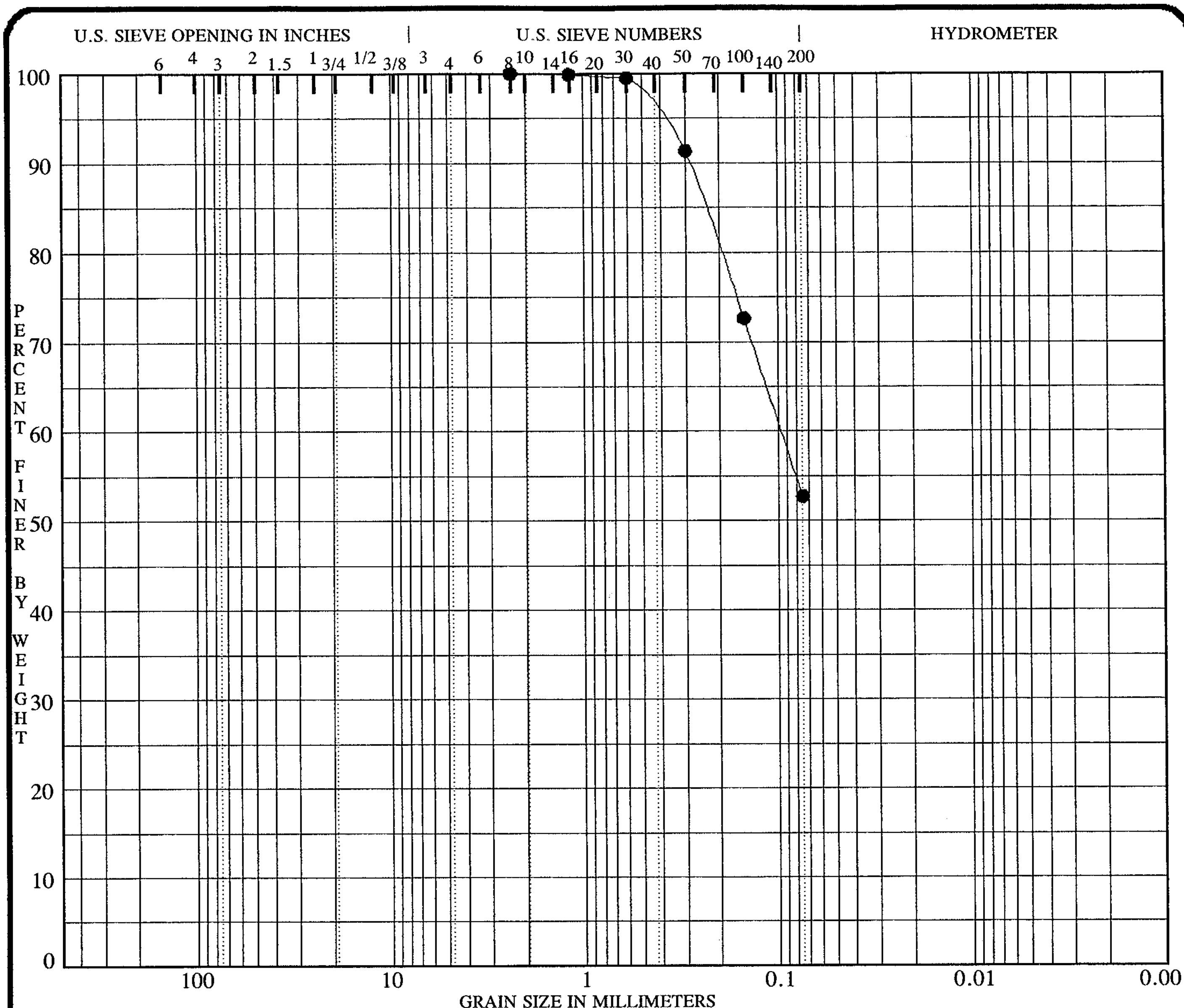
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-102	36.7		15.6	23.8	16.2	7.6		
			SANDY LEAN CLAY CL						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
●	96-102	36.7	2.360	0.097			0.0	47.3	52.7	

PROJECT SPORN PLANT - FLY ASH POND DIKES

JOB NO.

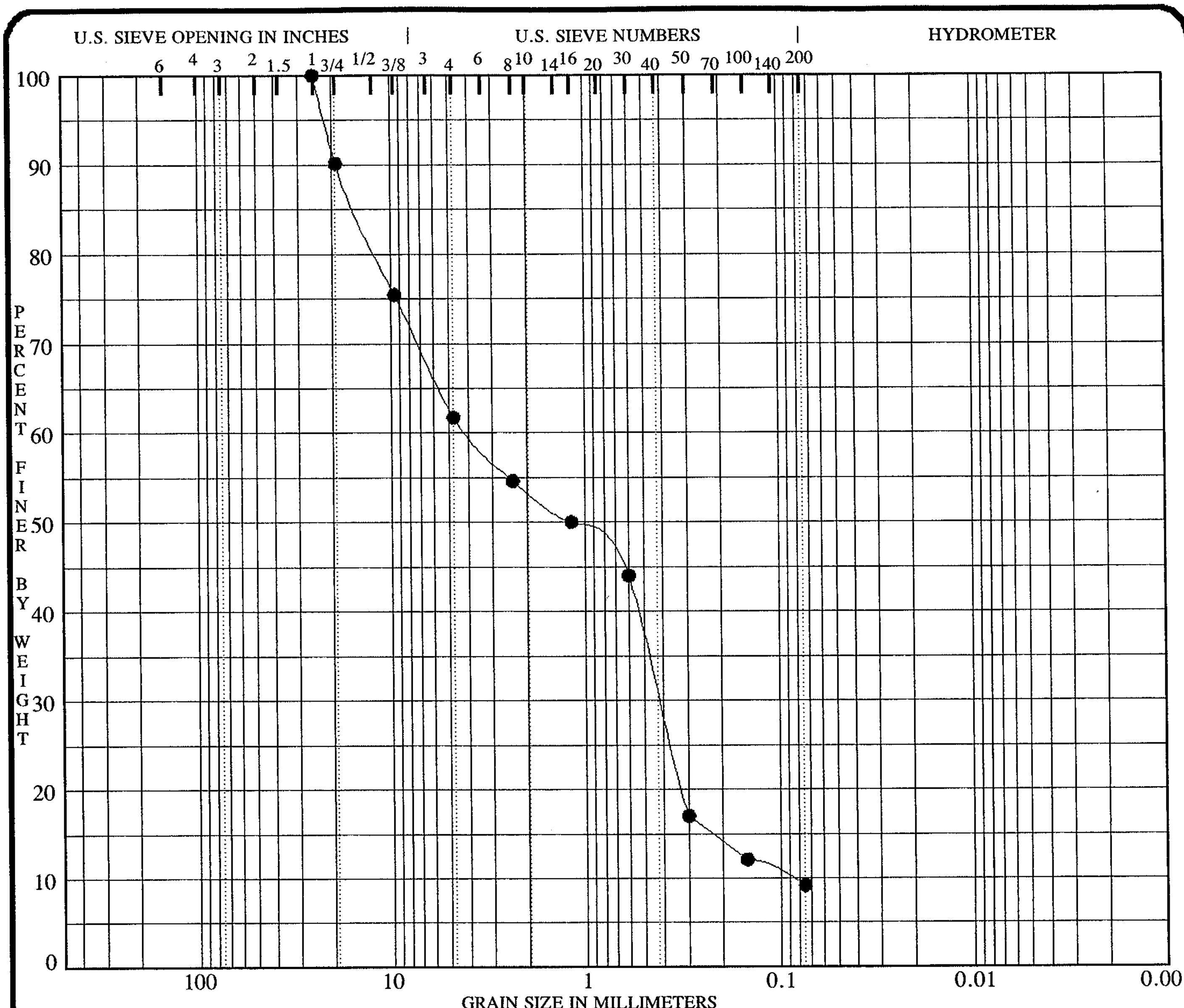
DATE 05/21/97

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEPSPP-000672



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.
●	96-102	41.7		5.3	NP	NP	NP	
	POORLY GRADED SAND with SILT and GRAVEL SP-SM							

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
●	96-102	41.7	25.000	4.018	0.419	0.091	38.3	52.5	9.2	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

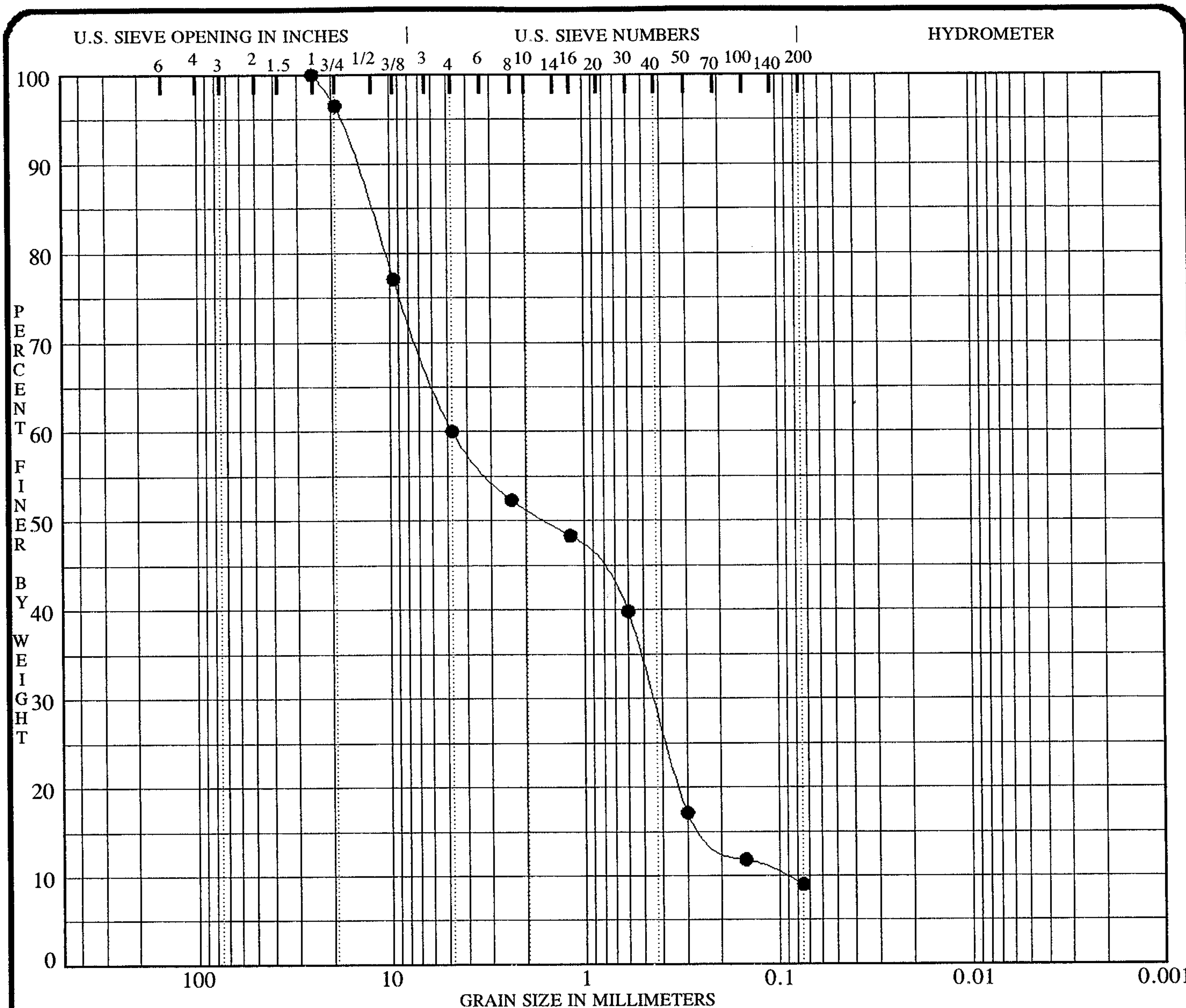
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.
●	96-103	21.6	POORLY GRADED SAND with SILT and GRAVEL SP-SM	4.7	NP	NP	NP	

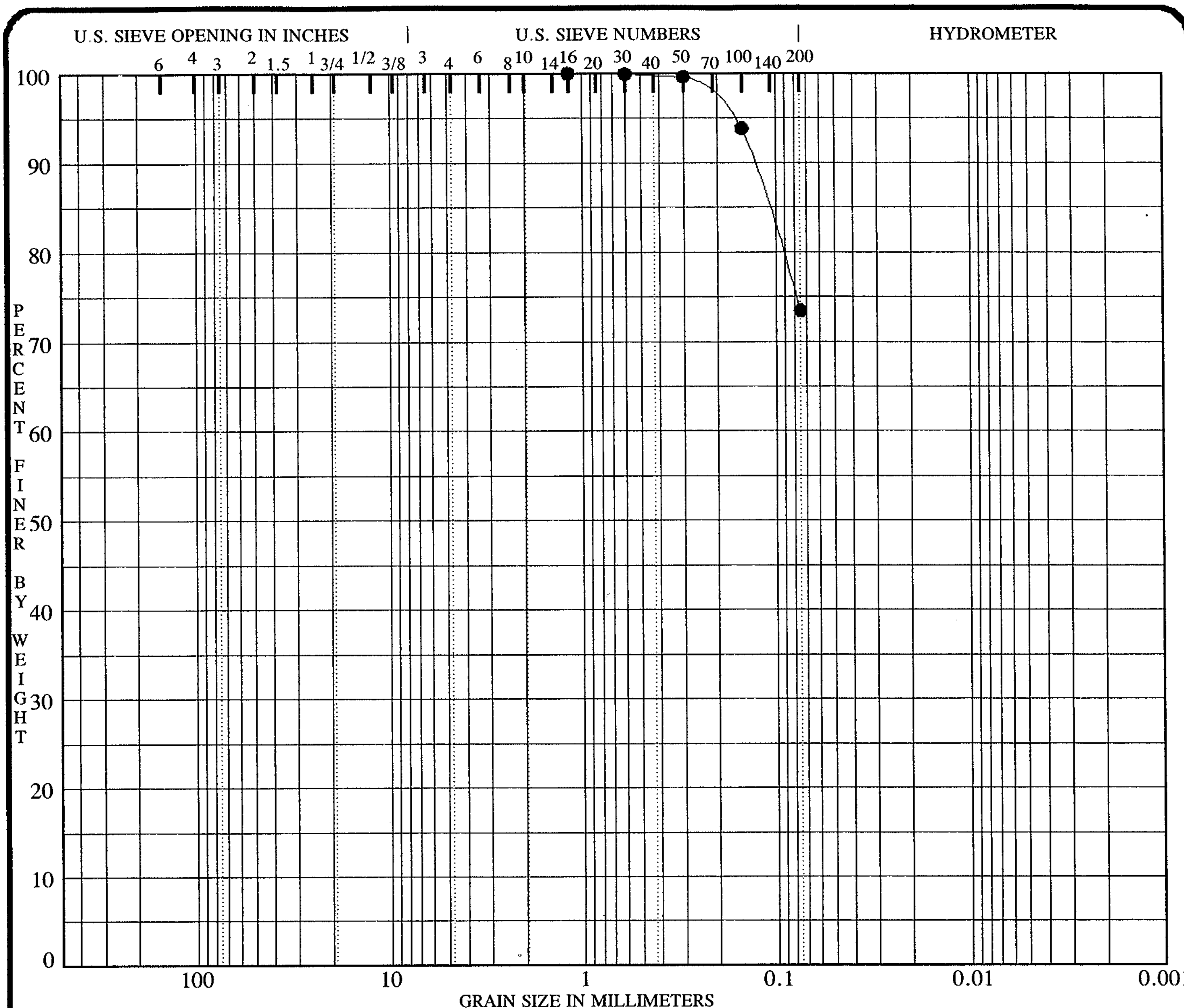
	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-103	21.6	25.000	4.750	0.445	0.096	40.0	51.0	9.0	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.
Groveport, Ohio



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-103	31.6		14.5	28.6	18.8	9.8		
			LEAN CLAY with SAND CL						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-103	31.6	1.180				0.0	26.6	73.4	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

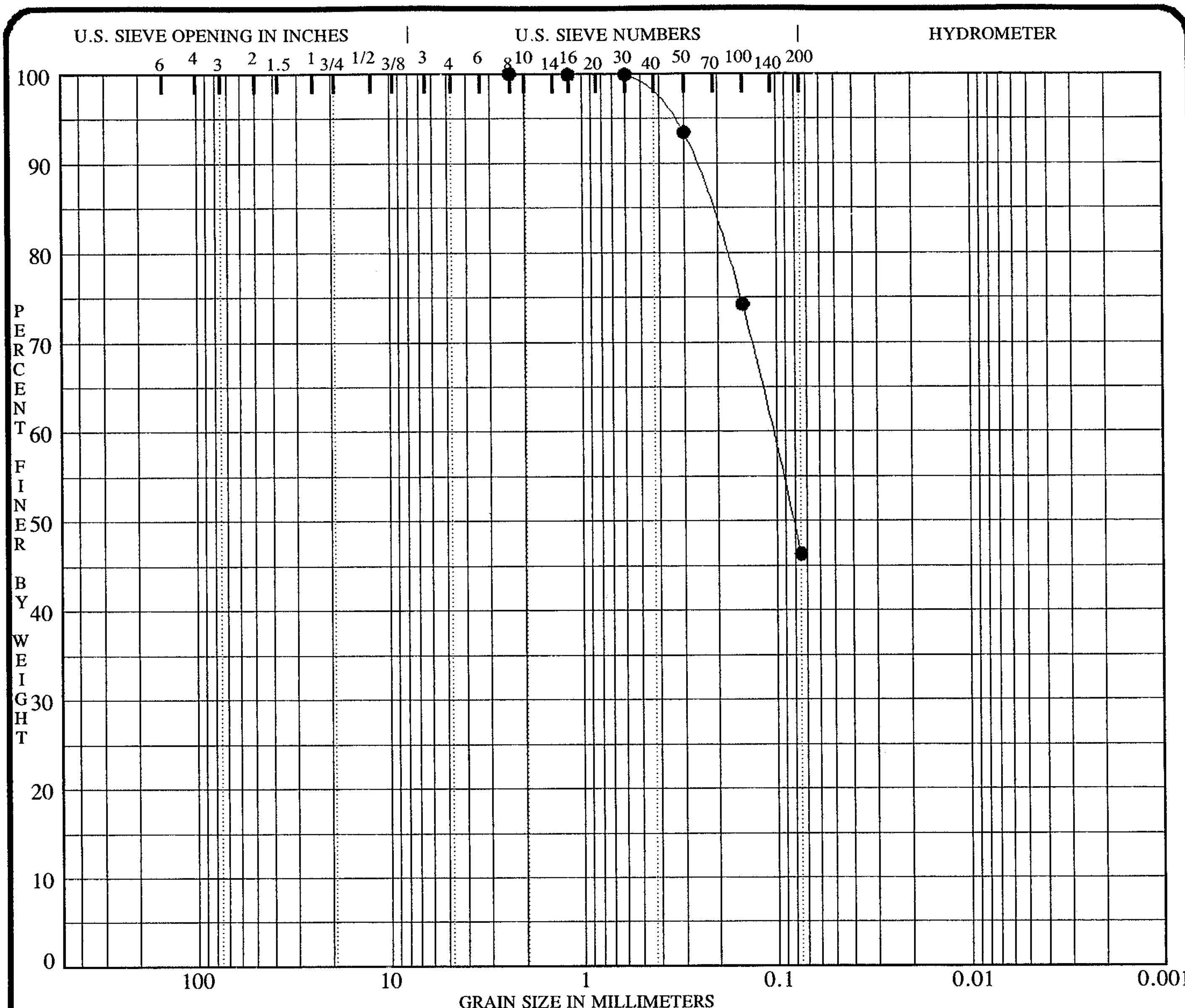
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.
●	96-103	41.6		11.4	NP	NP	NP	
			SILTY SAND SM					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-103	41.6	2.360	0.105			0.0	53.7	46.3	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

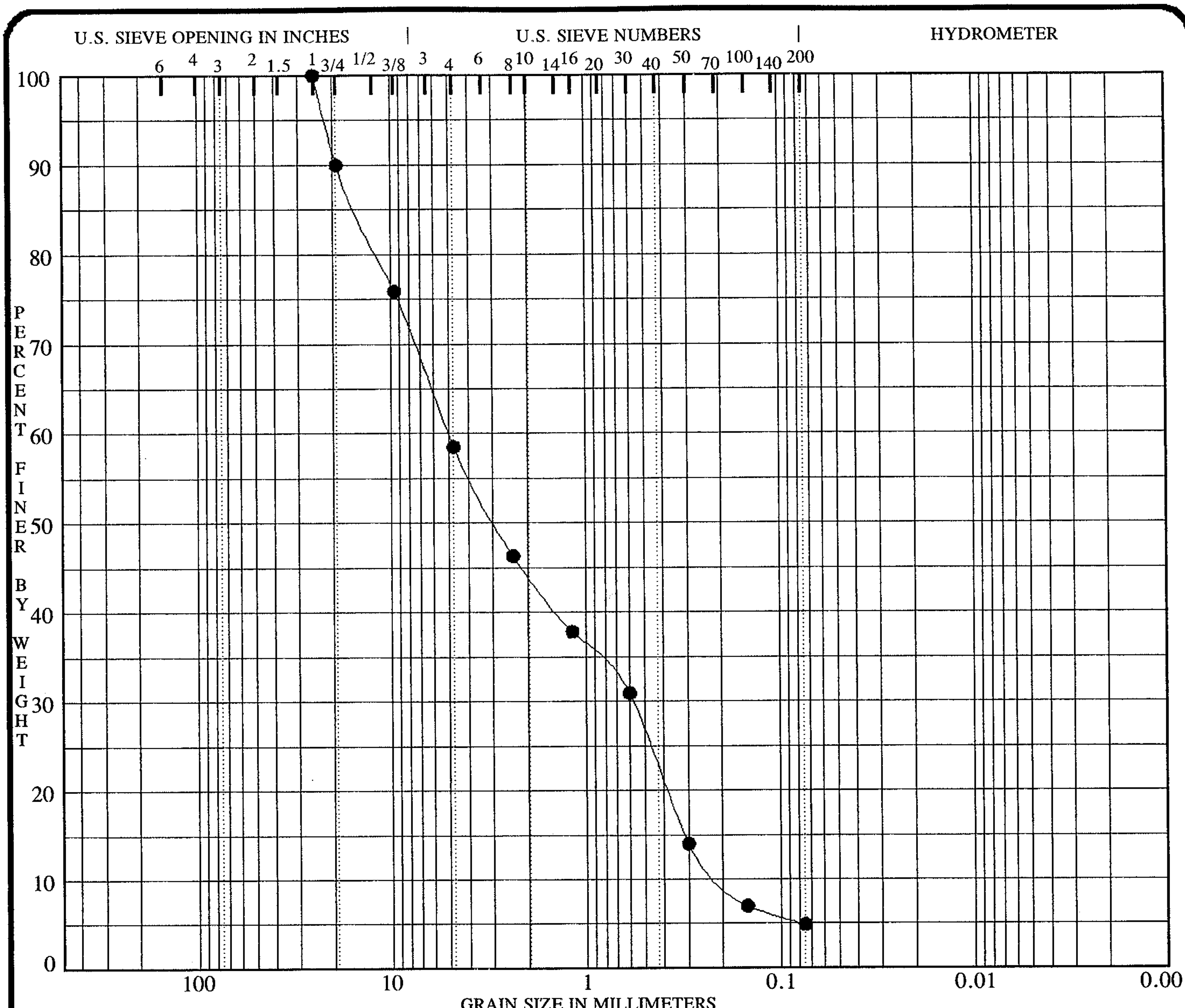
JOB NO.

DATE **05/22/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	MC%	LL	PL	PI	Sp.Gr.	
●	**96-104**	**3.0**		**1.1**	**NP**	**NP**	**NP**		
			POORLY GRADED SAND with SILT and GRAVEL SP-SM						

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	**96-104**	**3.0**	**25.000**	**5.044**	**0.578**	**0.202**	**41.5**	**53.6**	**4.9**	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

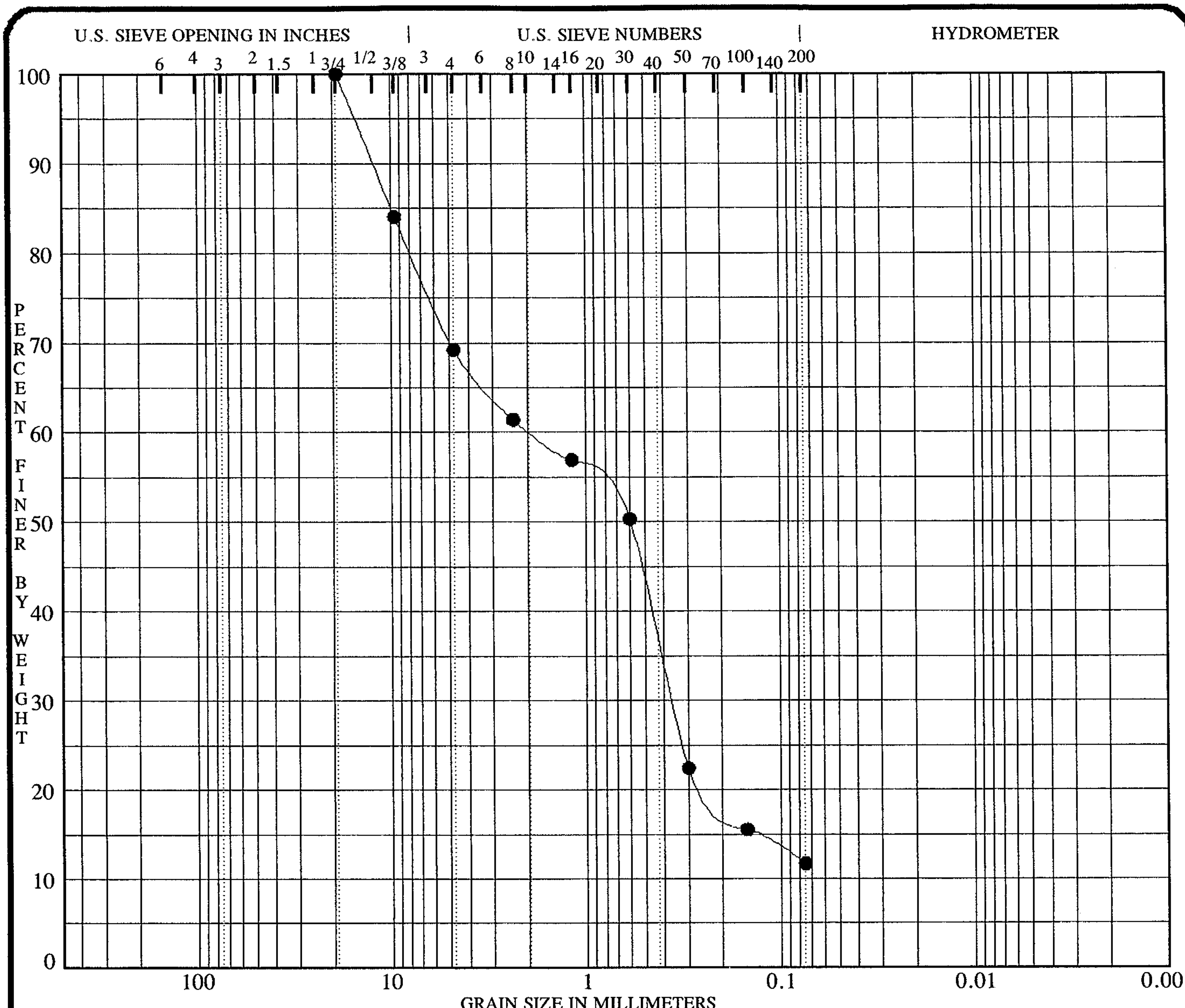
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-104	8.5		1.0	NP	NP	NP		
			POORLY GRADED SAND with SILT and GRAVEL SP-SM						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	**96-104**	**8.5**	**19.000**	**1.902**	**0.362**		**30.8**	**57.5**	**11.7**	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

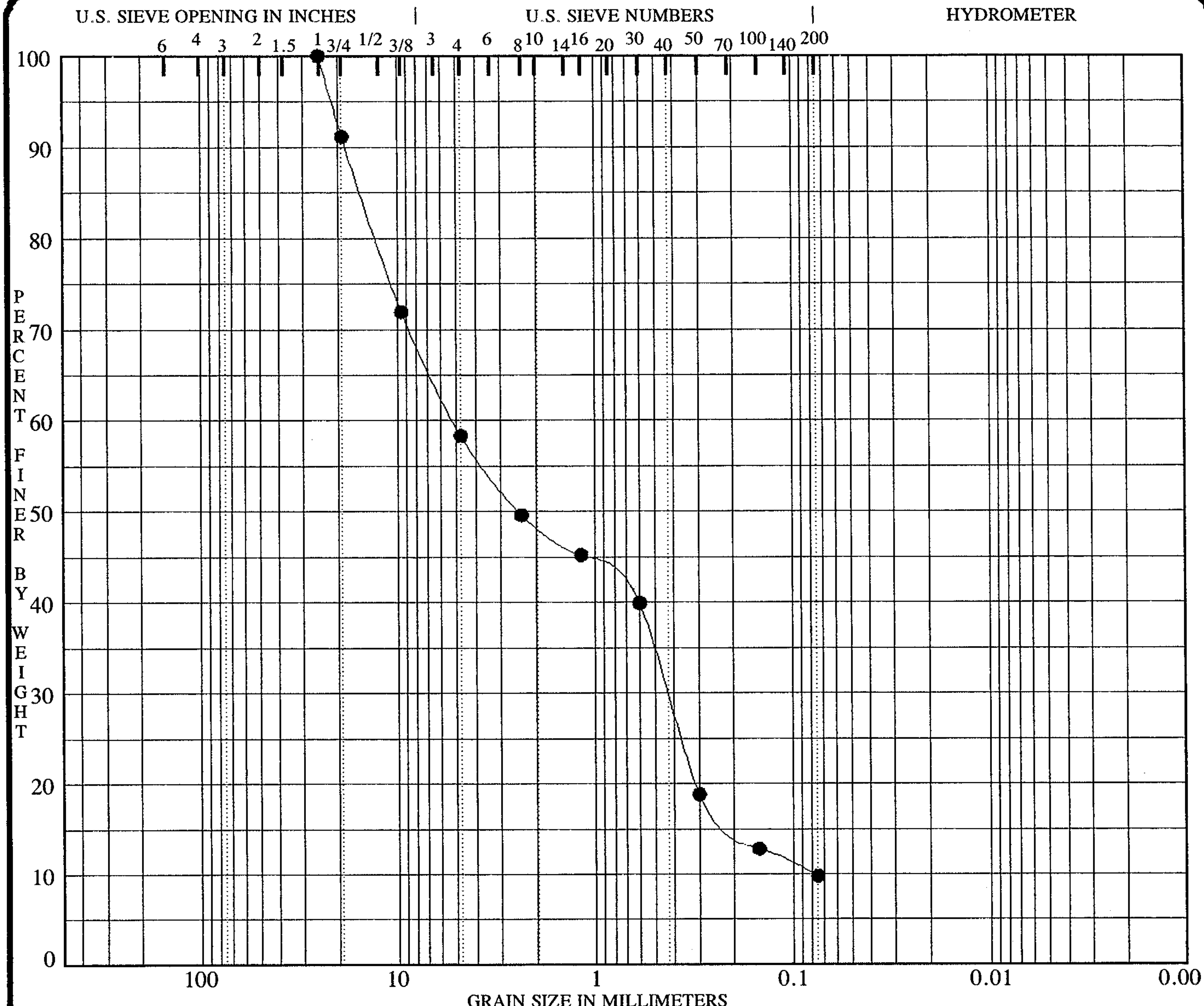
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEPSPP-000678



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	**96-104**	**11.7**		**1.2**	**NP**	**NP**	**NP**		
			POORLY GRADED SAND with SILT and GRAVEL SP-SM						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
●	**96-104**	**11.7**	**25.000**	**5.180**	**0.433**	**0.079**	**41.7**	**48.5**	**9.8**	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

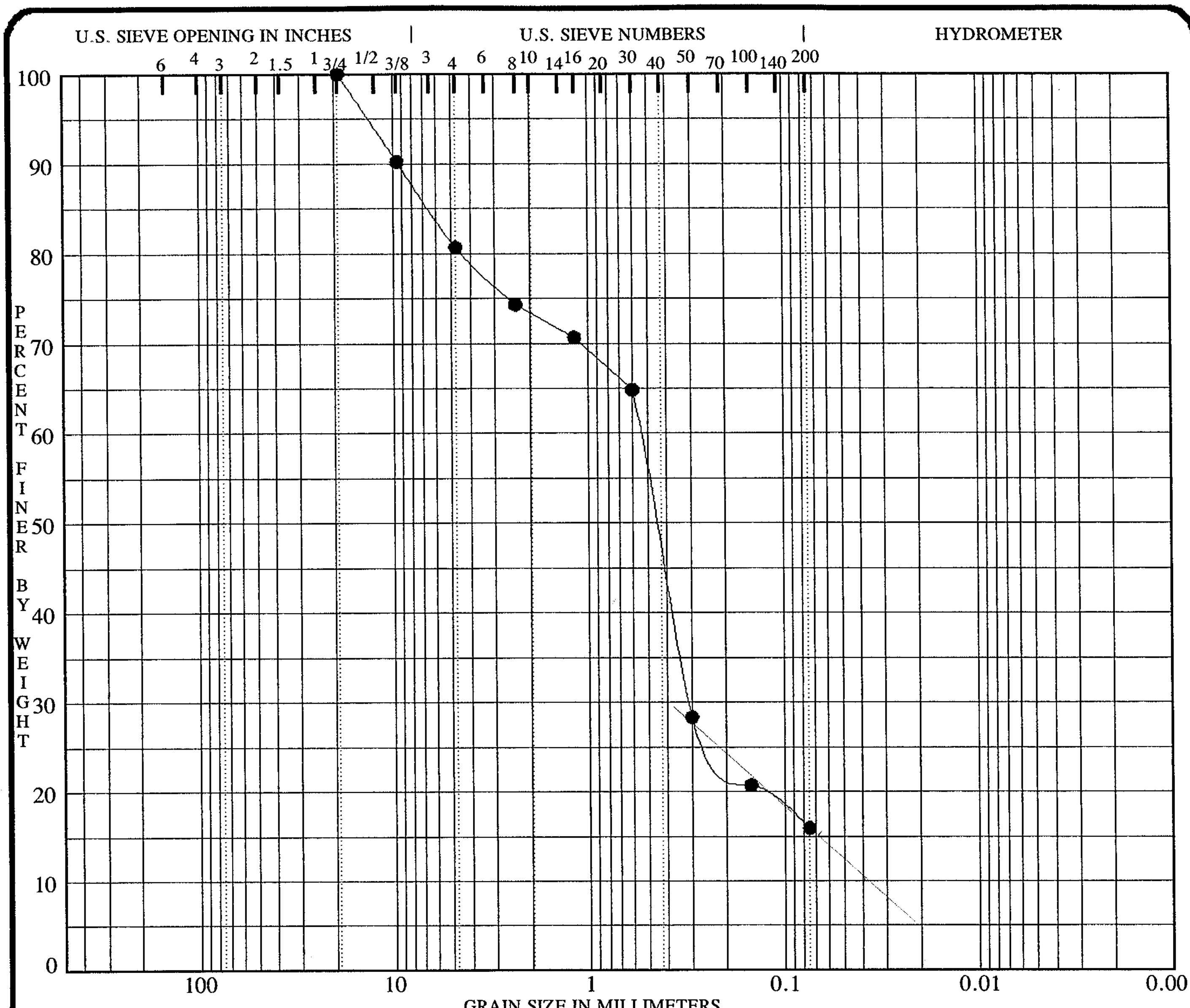
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-104	16.7		4.0	NP	NP	NP		
			SILTY SAND with GRAVEL SM						

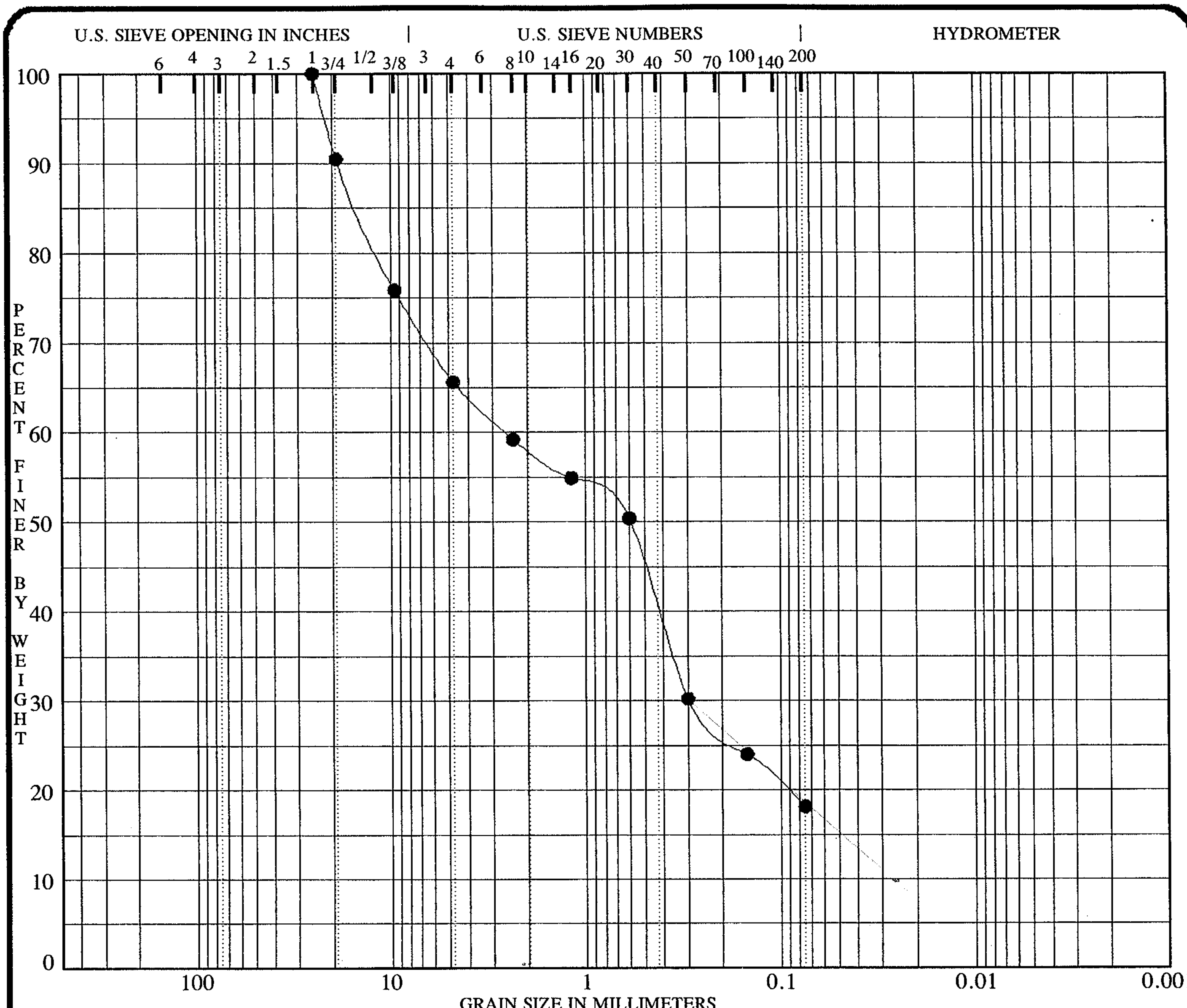
Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-104	16.7	19.000	0.548	0.310		19.4	64.7	15.9	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.
DATE **05/21/97**

GRADATION CURVES
American Electric Power Service Corp.
Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
● 96-104	21.7		2.9	NP	NP	NP		
		SILTY SAND with GRAVEL SM						

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
● 96-104	21.7	25.000	2.576	0.293		34.4	47.5	18.1	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

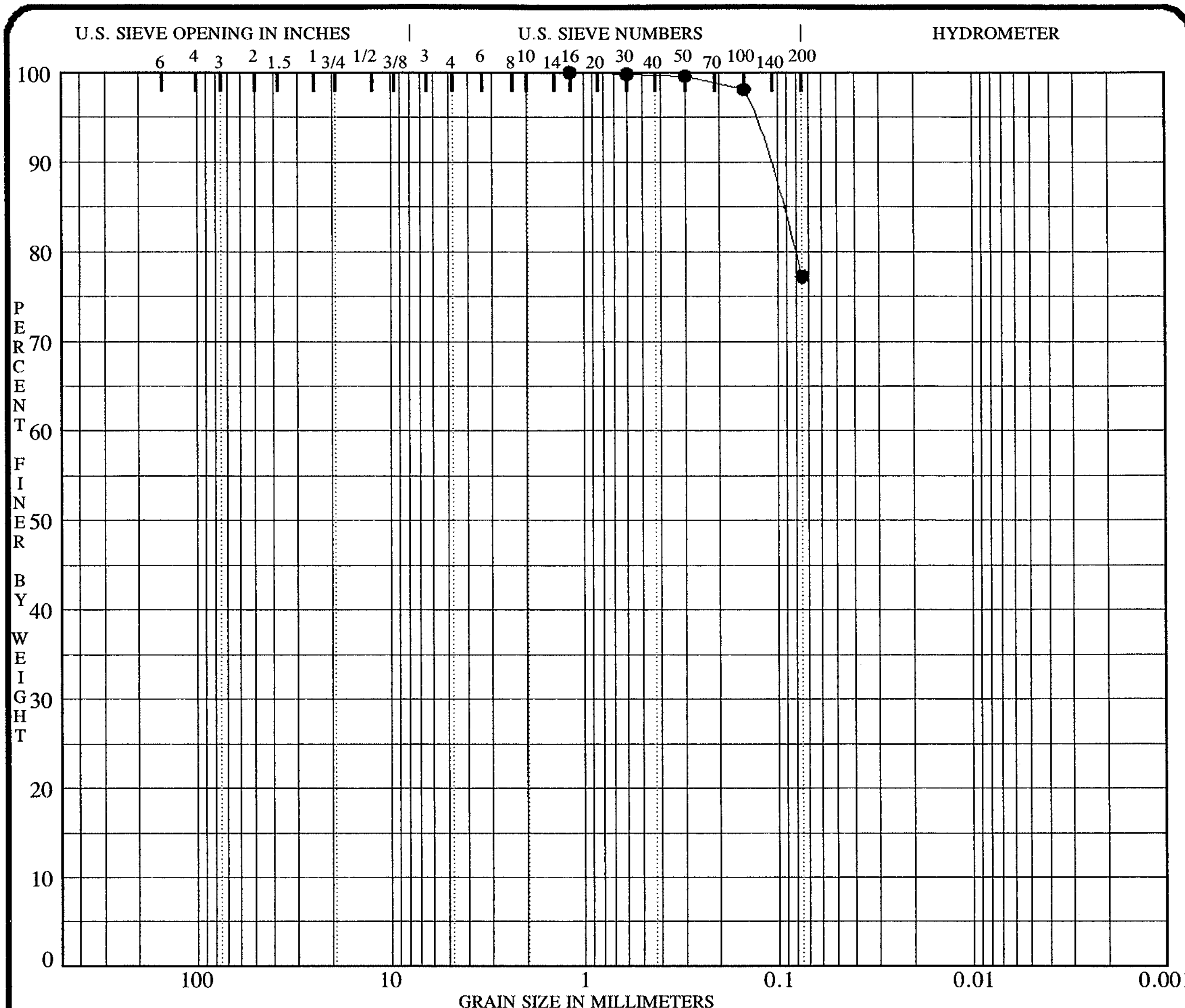
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-104	36.7		18.9	27.2	19.0	8.2		
			LEAN CLAY with SAND CL						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
●	96-104	36.7	1.180				0.0	22.8	77.2	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

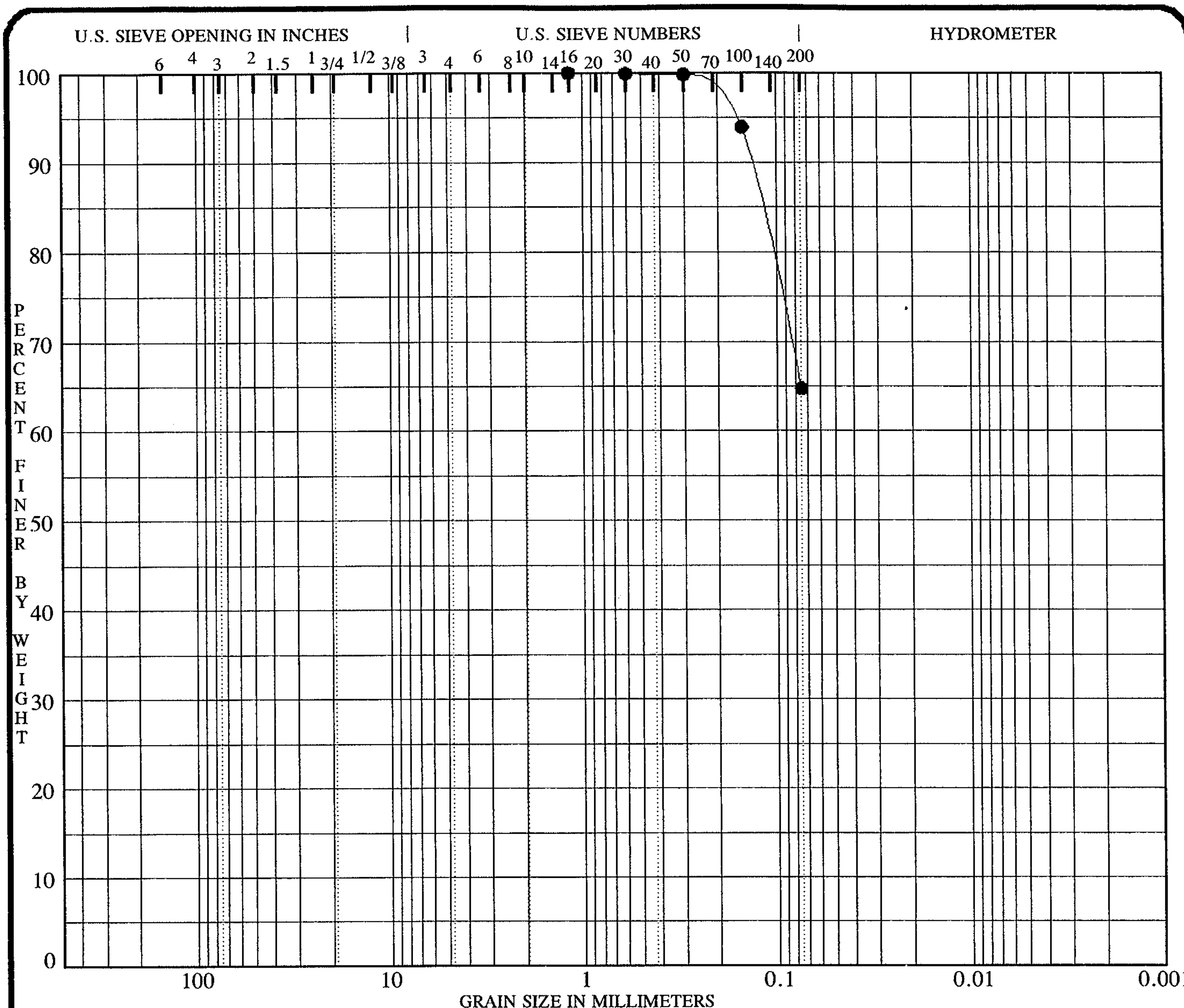
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEPSPP-000682



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	**96-104**	**41.7**		**8.1**	**NP**	**NP**	**NP**		
			SANDY SILT ML						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	**96-104**	**41.7**	**1.180**				**0.0**	**35.3**	**64.7**	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

DATE **05/21/97**

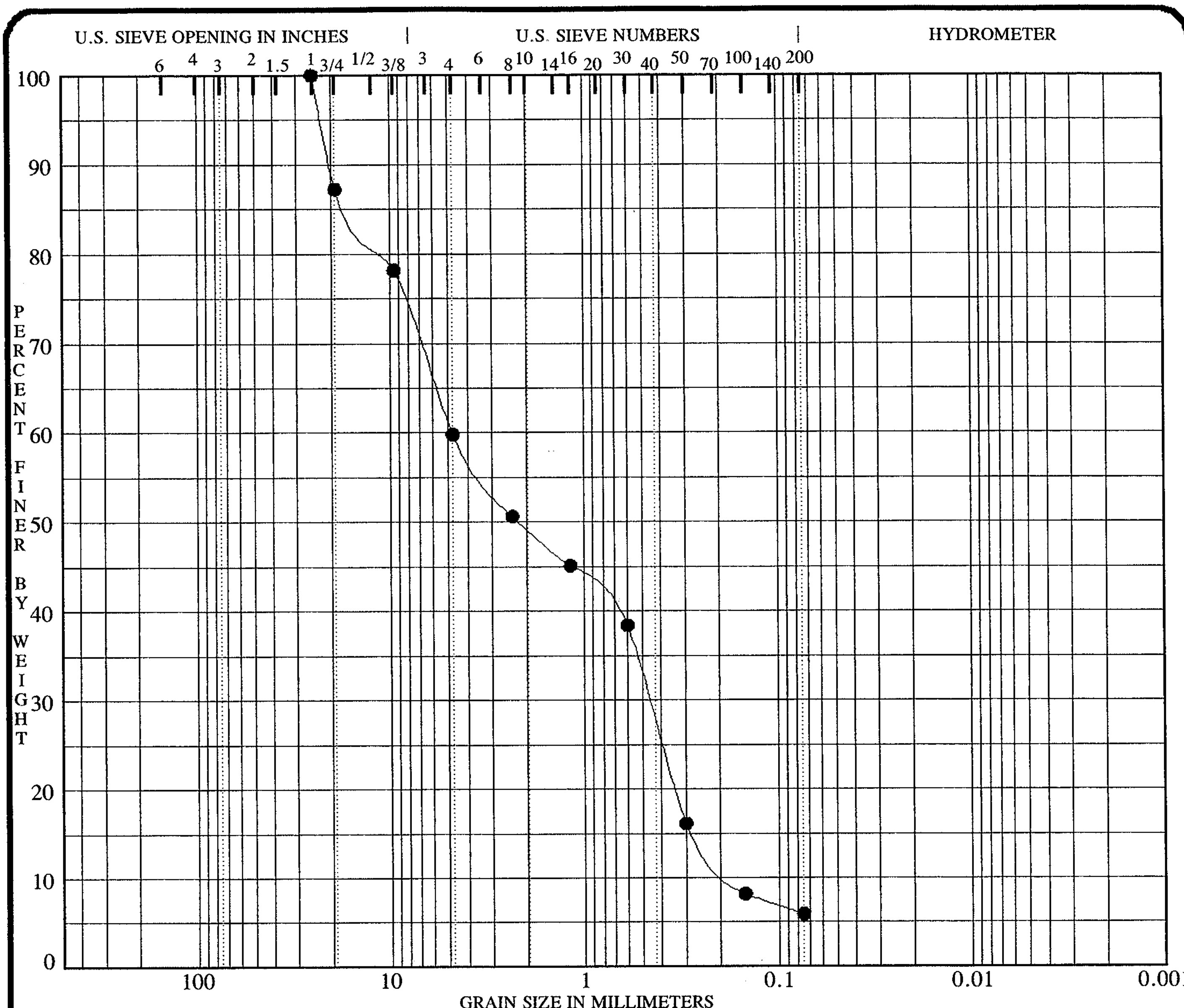
GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP

AEPSPP-000683



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-105	3.0		1.6	NP	NP	NP		
			POORLY GRADED SAND with SILT and GRAVEL SP-SM						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-105	3.0	25.000	4.786	0.462	0.176	40.2	53.9	5.9	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

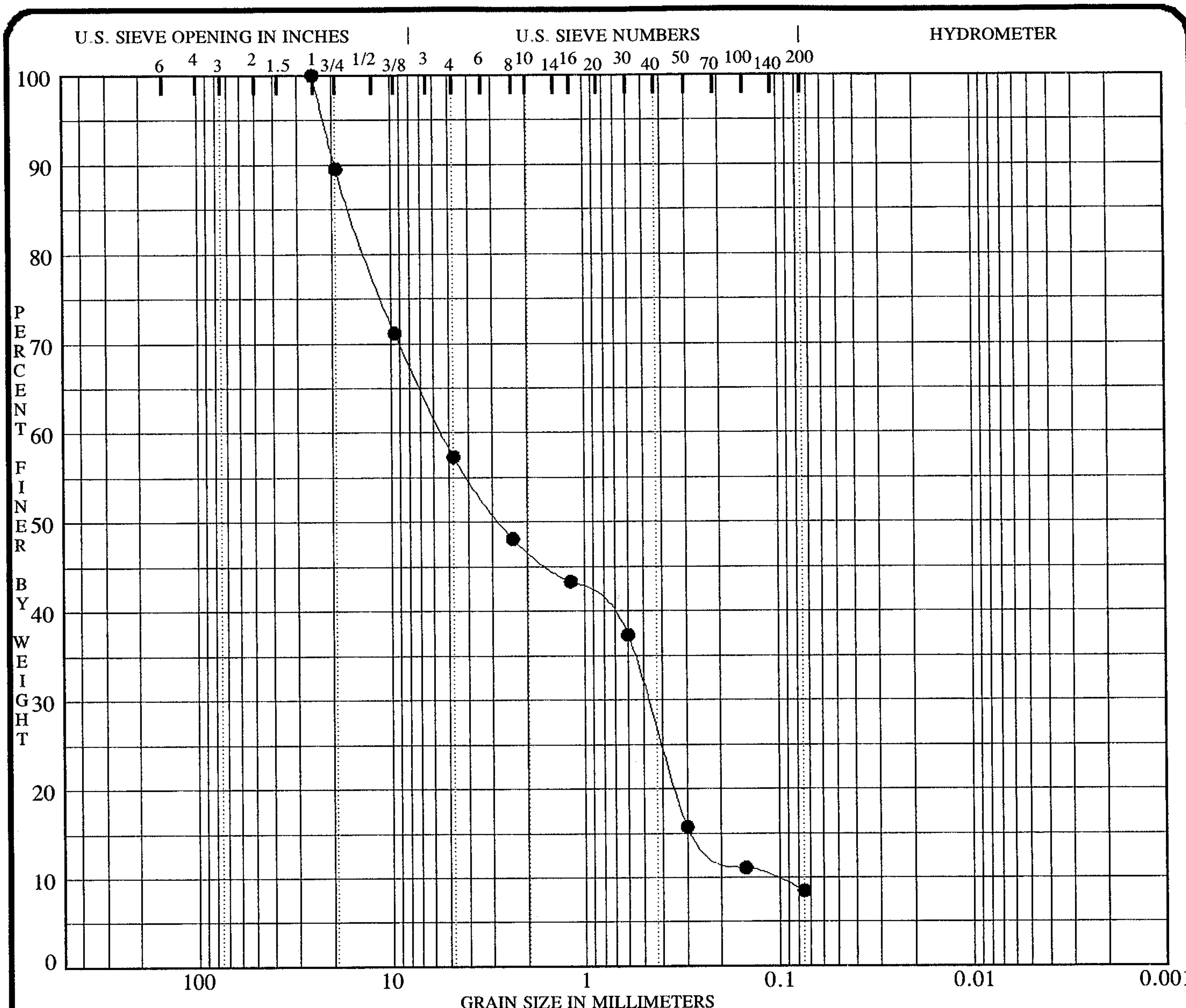
JOB NO.

DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-105	16.5		3.1	NP	NP	NP		
			POORLY GRADED SAND with SILT and GRAVEL SP-SM						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
●	96-105	16.5	25.000	5.440	0.475	0.112	42.7	48.8	8.5	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

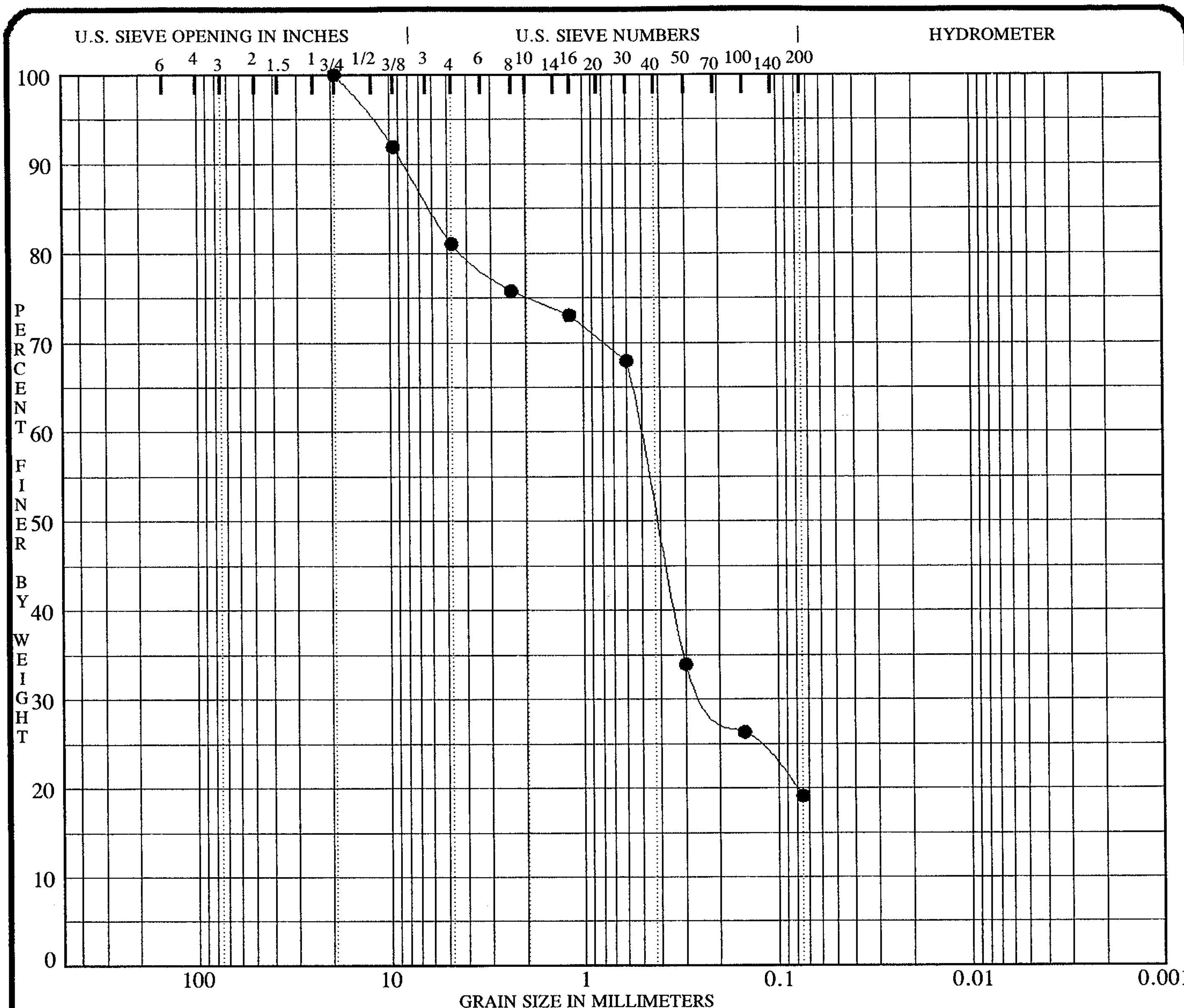
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEPSPP-000685



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-105	21.5		6.7	NP	NP	NP		
			SILTY SAND with GRAVEL SM						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-105	21.5	19.000	0.511	0.210		19.0	61.9	19.1	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

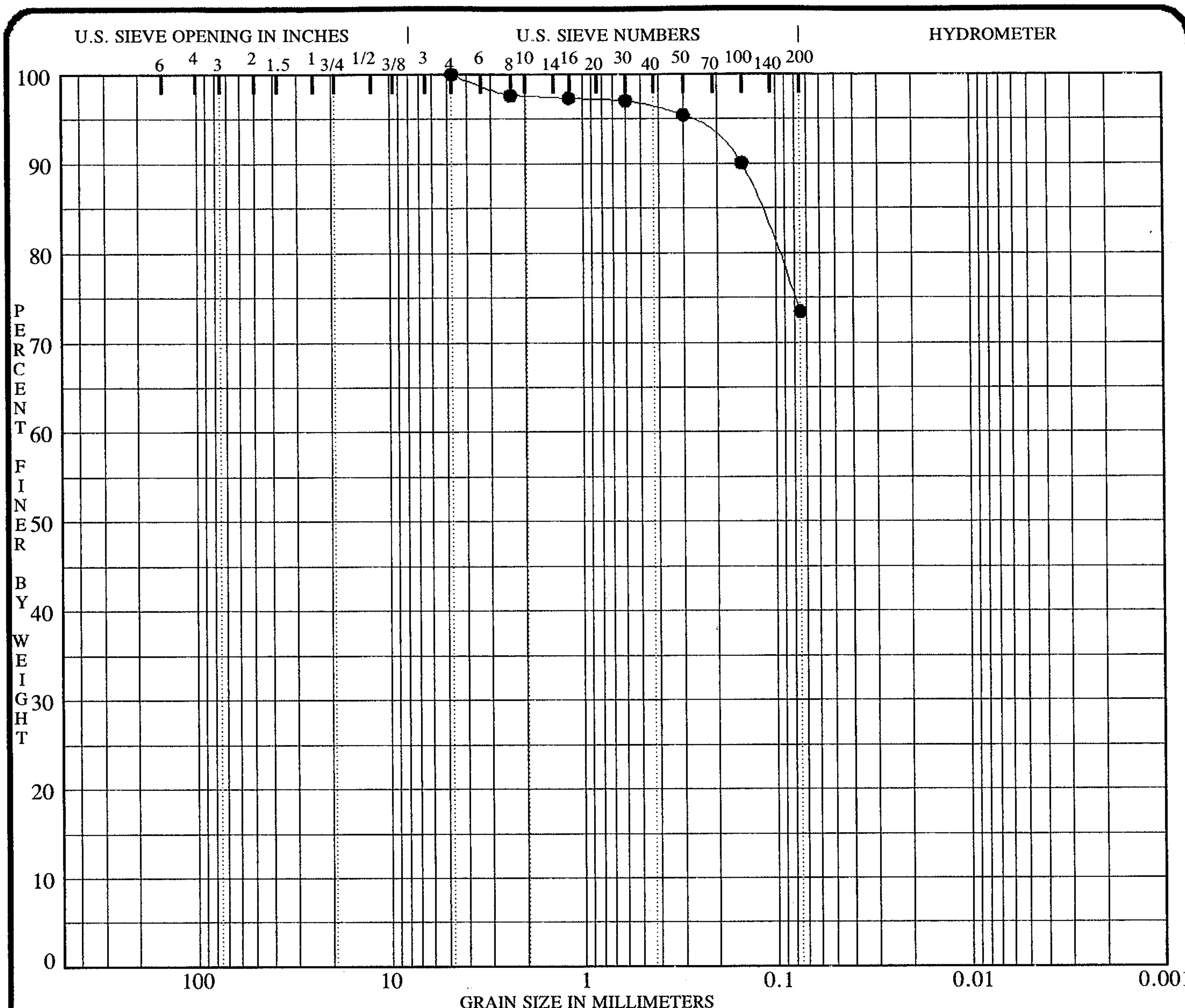
DATE 05/21/97

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.
●	96-105	26.5		13.3	27.4	17.7	9.8	
			LEAN CLAY with SAND CL					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-105	26.5	4.750				0.0	26.6	73.4	

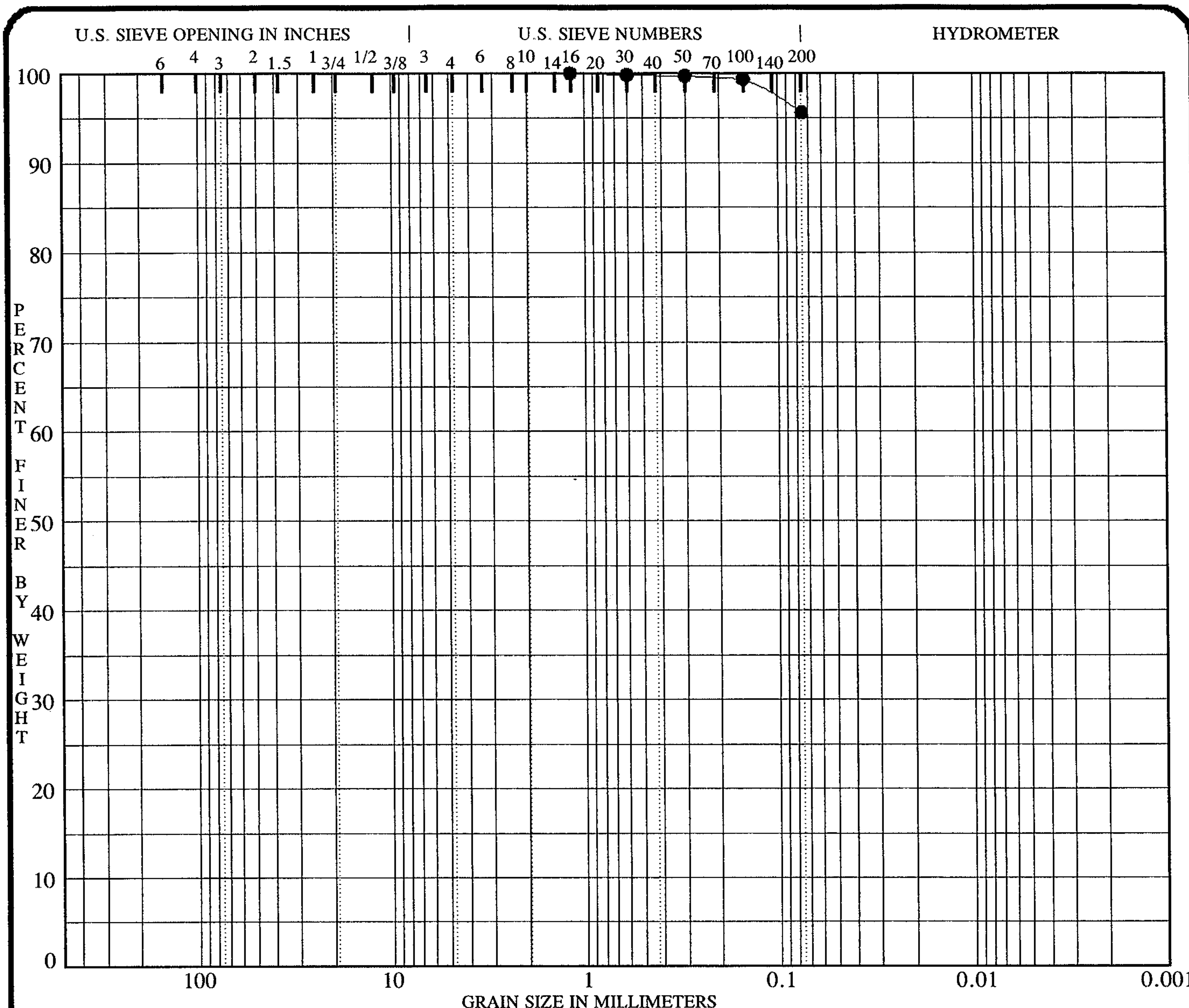
PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.
Groveport, Ohio

AEPSPP-000687



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-105	36.5		22.1	28.8	18.7	10.1		
			LEAN CLAY CL						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-105	36.5	1.180				0.0	4.4	95.6	

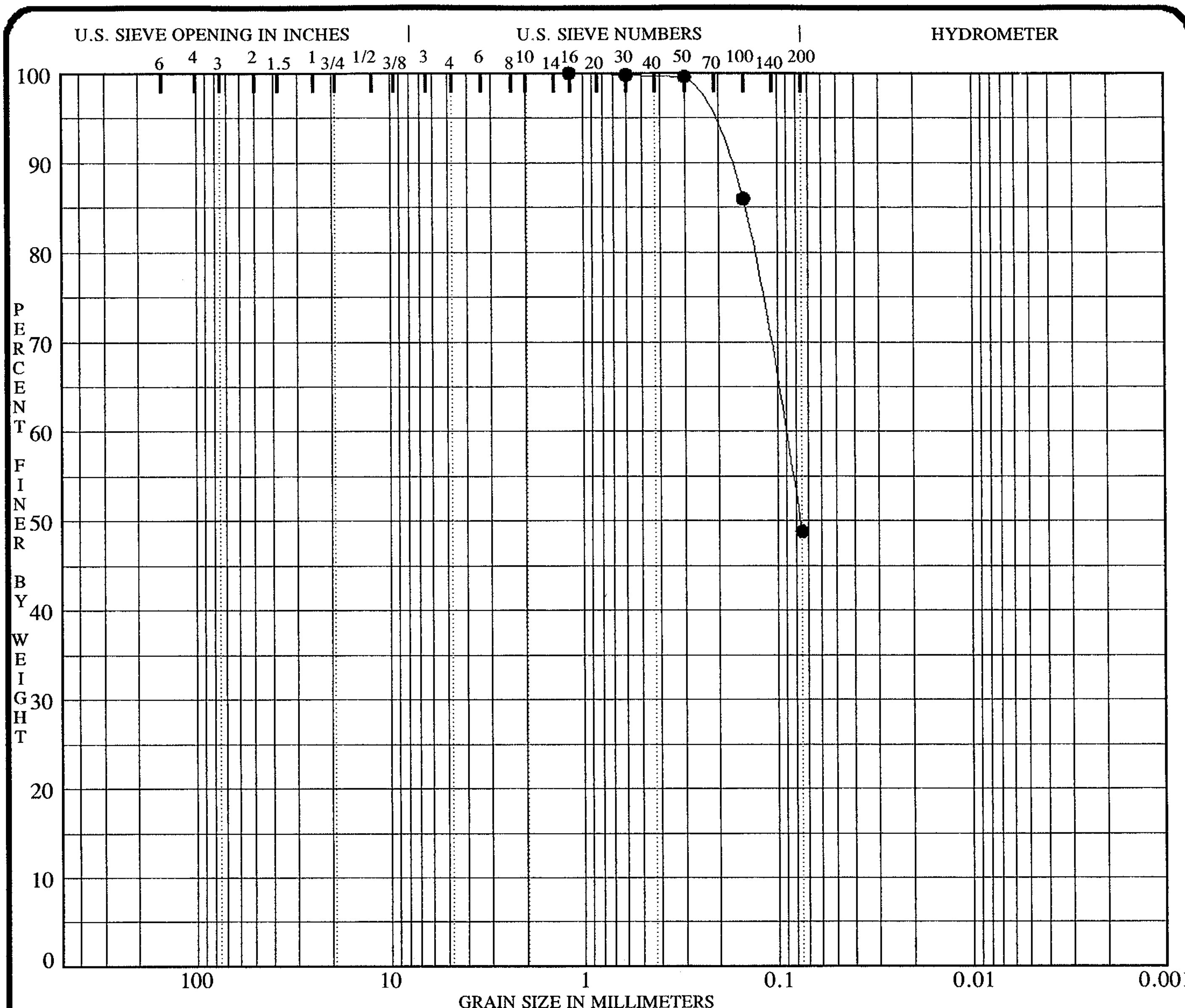
PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.
Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-105	41.5		11.9	NP	NP	NP		
			SILTY SAND SM						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
●	96-105	41.5	1.180	0.093			0.0	51.2	48.8	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

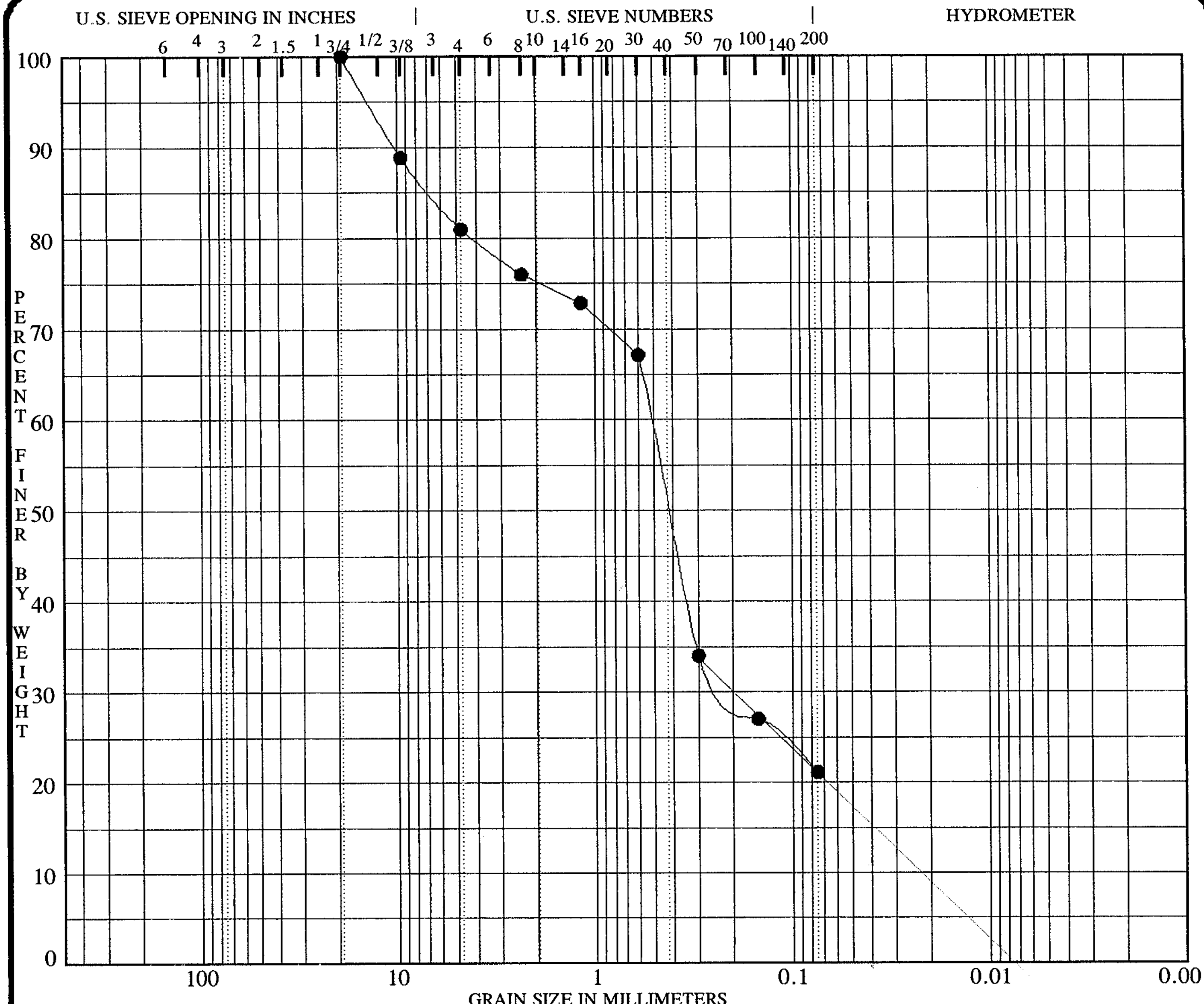
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	**96-106**	**11.5**		**5.5**	**NP**	**NP**	**NP**		
			SILTY SAND with GRAVEL SM						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	**96-106**	**11.5**	**19.000**	**0.517**	**0.202**		**19.1**	**59.8**	**21.1**	

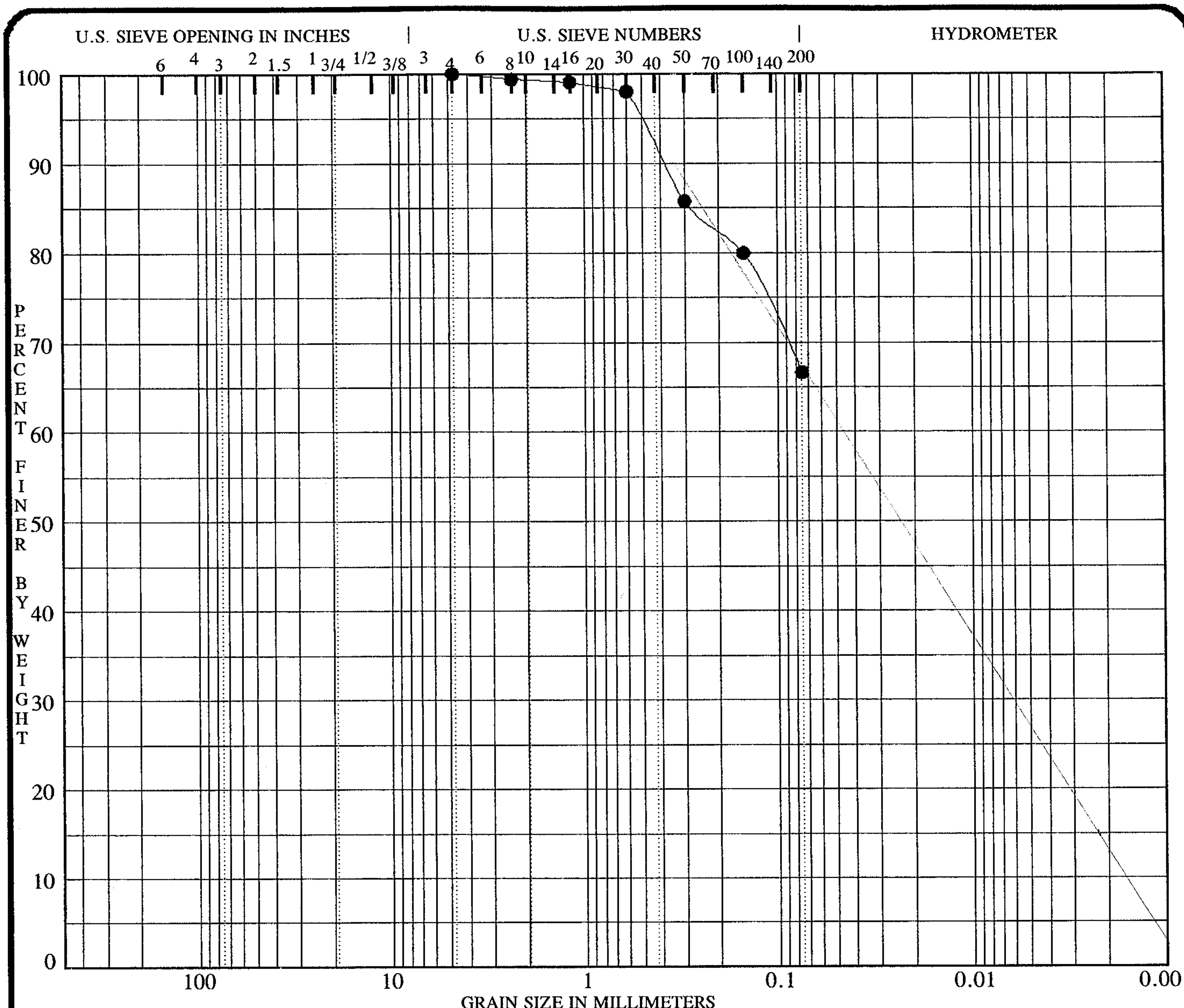
PROJECT **SPORN PLANT - FLY ASH POND DIKES**　　JOB NO.
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.
Groveport, Ohio

AEP

AEPSPP-000690



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	**96-106**	**21.5**		**11.1**	**26.1**	**17.5**	**8.6**		
			SANDY LEAN CLAY CL						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
●	**96-106**	**21.5**	**4.750**				**0.0**	**33.4**	**66.6**	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

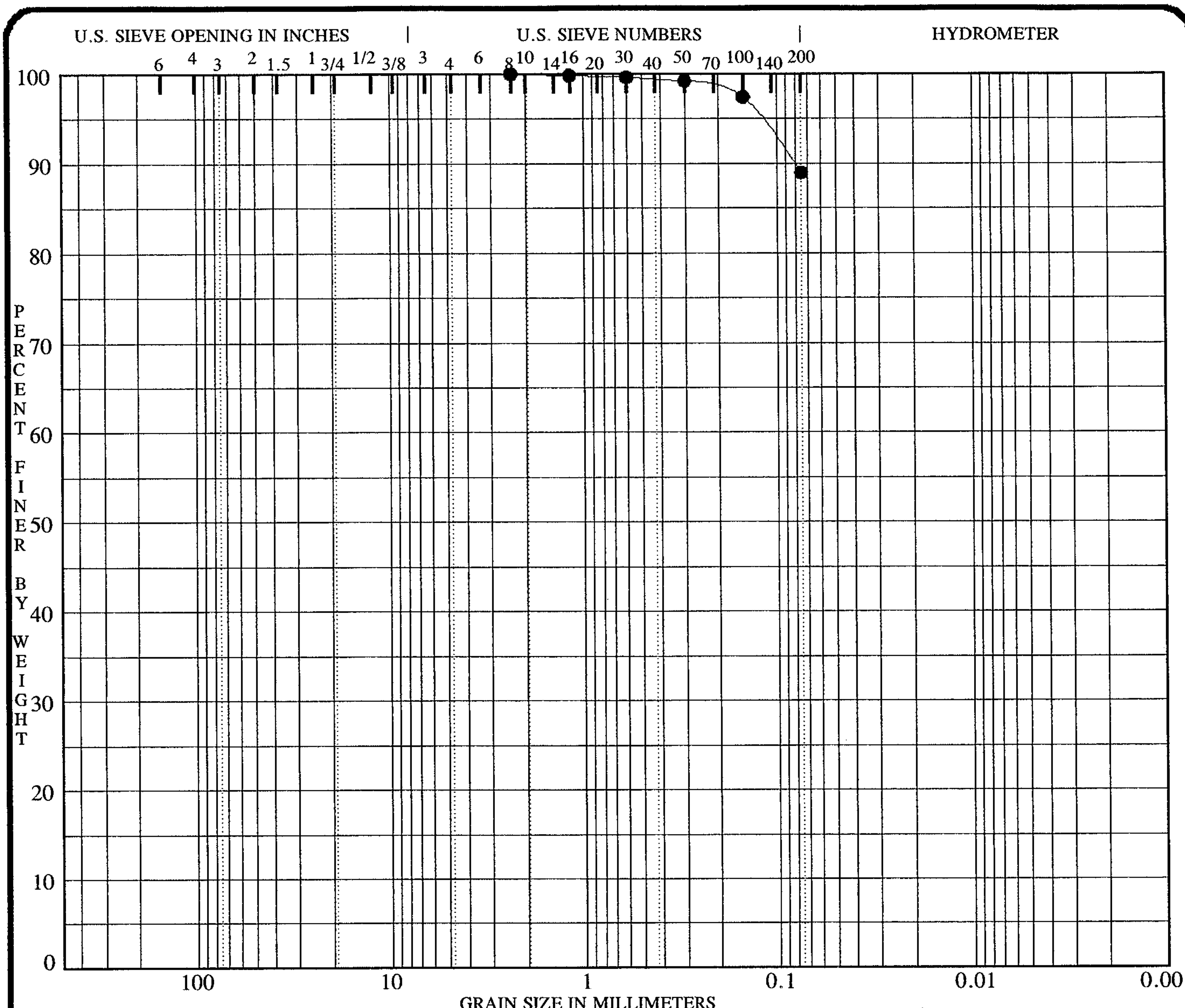
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
● 96-106	31.5		42.6	NP	NP	NP	2.29	
		SILT ML						

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
● 96-106	31.5	2.360				0.0	11.1	88.9	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

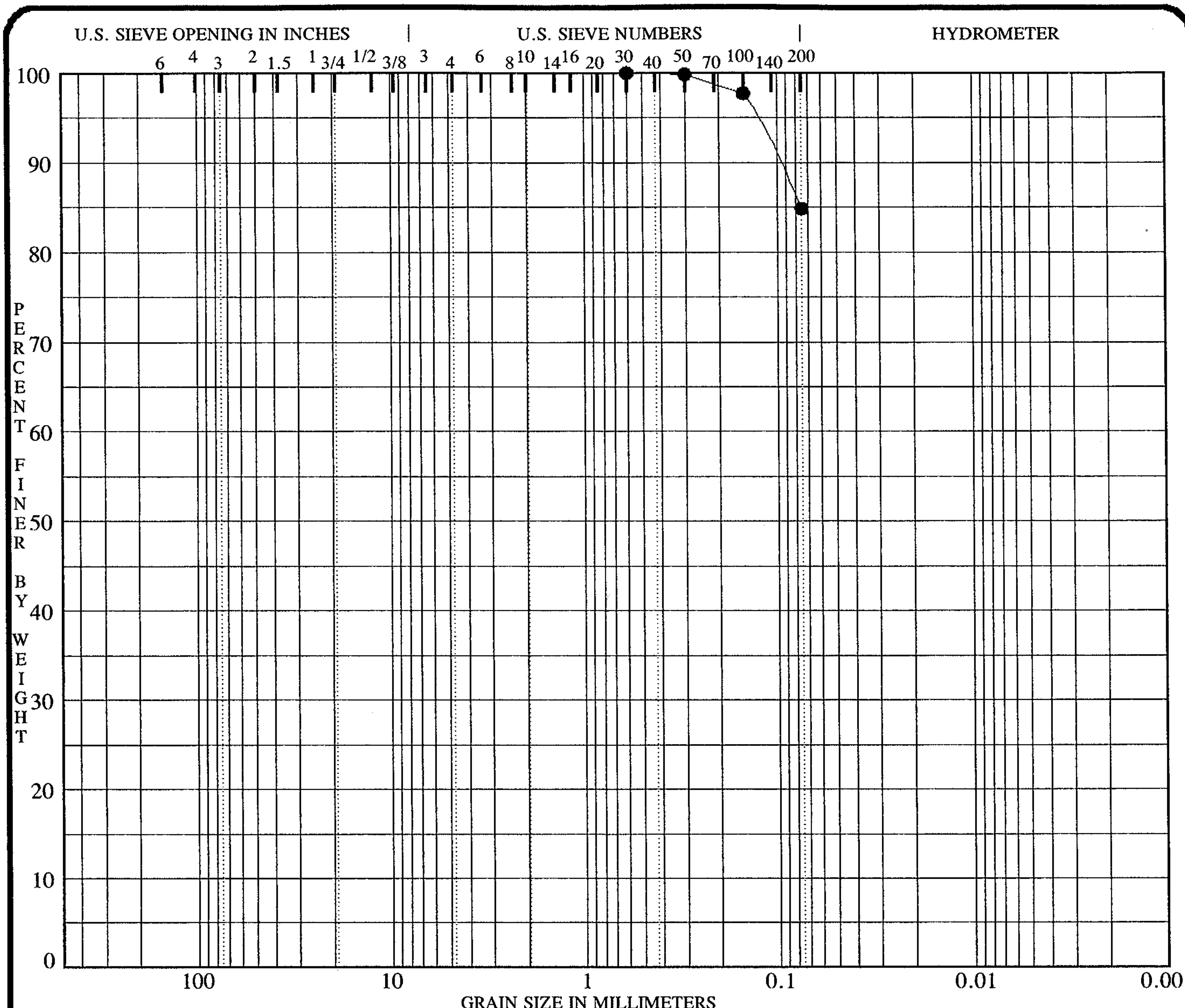
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEPSPP-000692



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
● 96-106	51.5		35.7	NP	NP	NP	2.42	
		SILT with SAND ML						

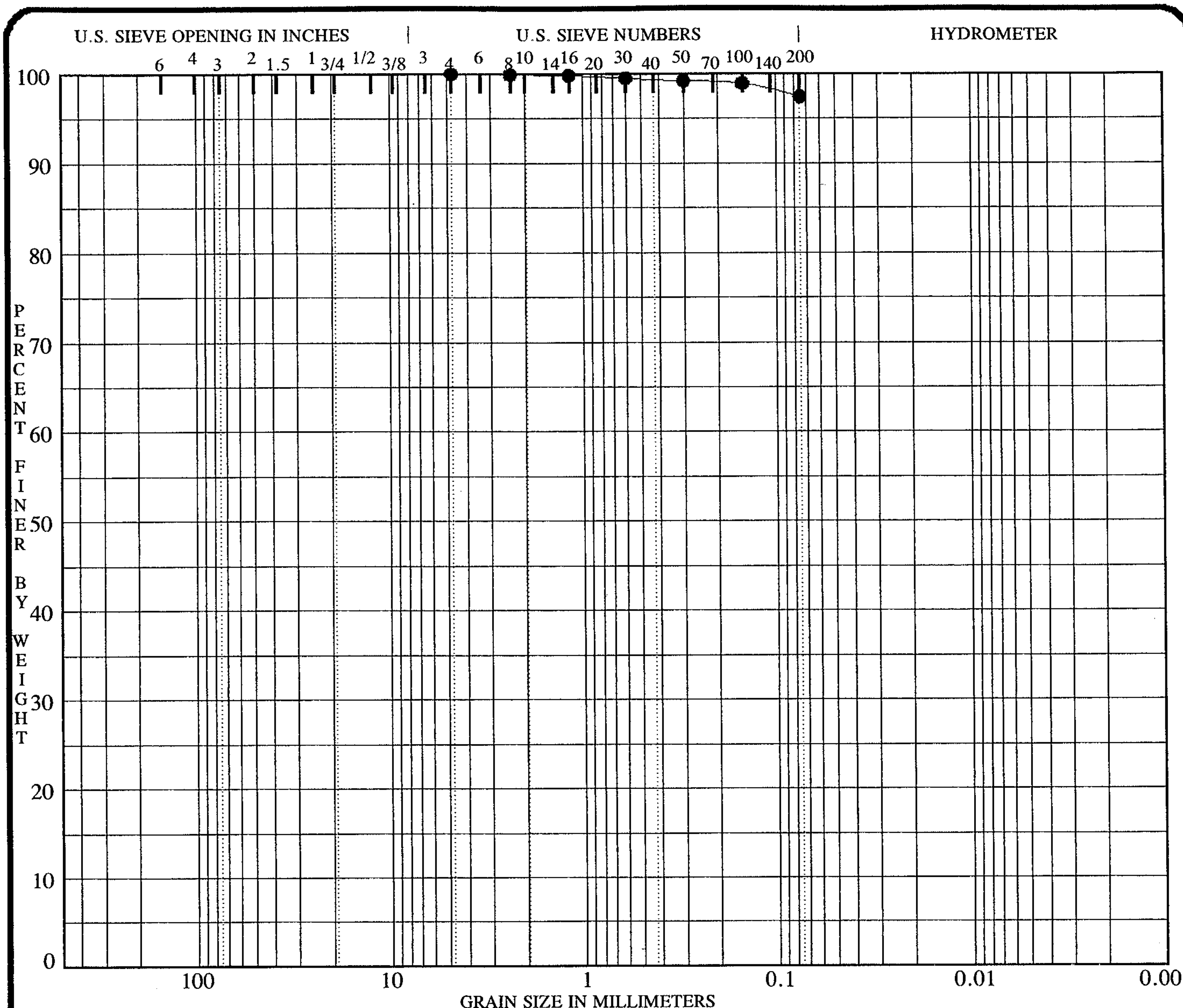
Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● 96-106	51.5	0.600				0.0	15.2	84.8	

PROJECT **SPORN PLANT - FLY ASH POND DIKES** JOB NO.
DATE 05/21/97

GRADATION CURVES

American Electric Power Service Corp.
Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-106	56.5		31.9	43.6	25.6	18.0		
			LEAN CLAY CL						

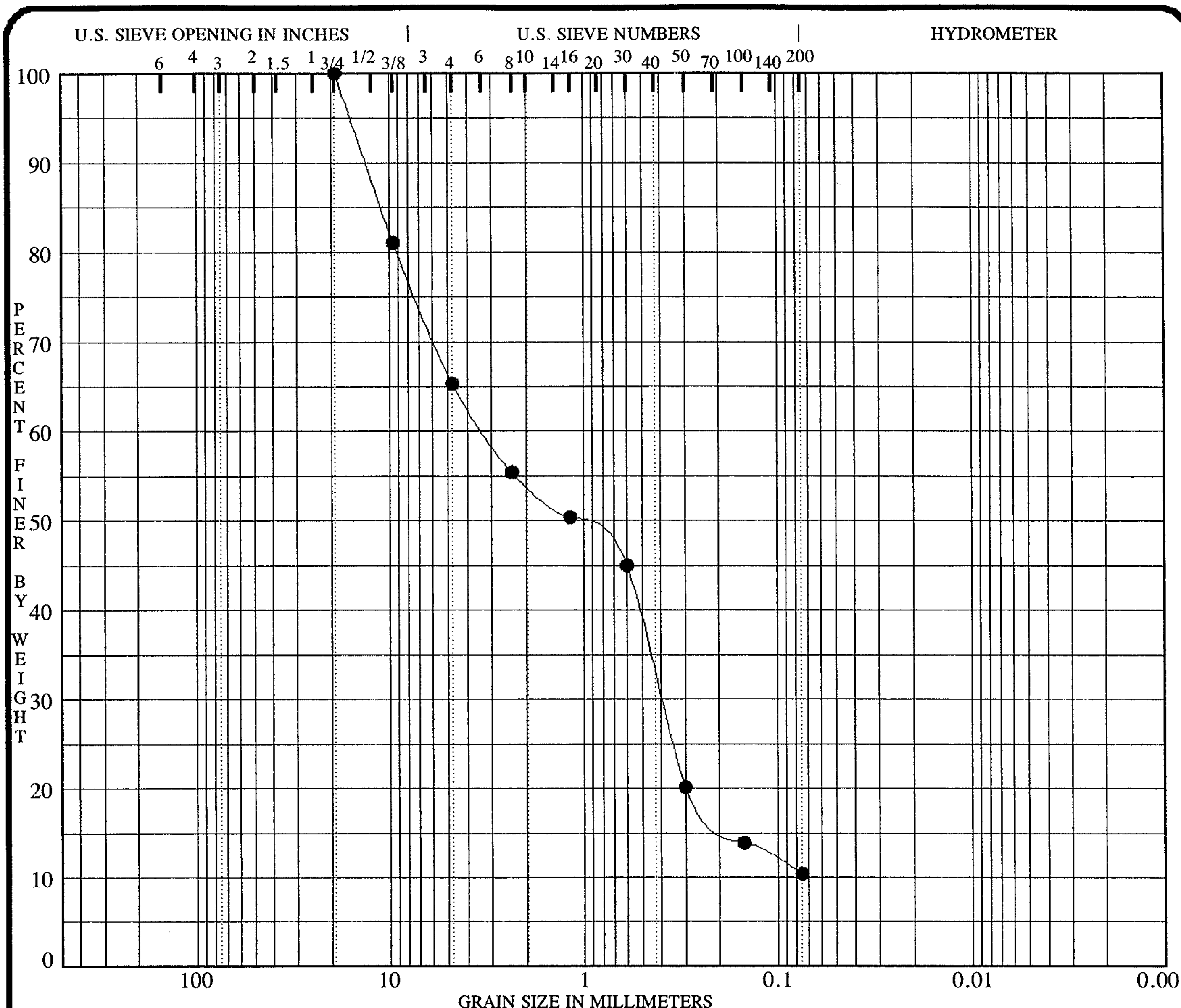
	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-106	56.5	4.750				0.0	2.6	97.4	

PROJECT SPORN PLANT - FLY ASH POND DIKES

JOB NO.
DATE 05/21/97

GRADATION CURVES

American Electric Power Service Corp.
Groveport, Ohio



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
● 96-107	11.6		3.9	NP	NP	NP		
		POORLY GRADED SAND with SILT and GRAVEL SP-SM						

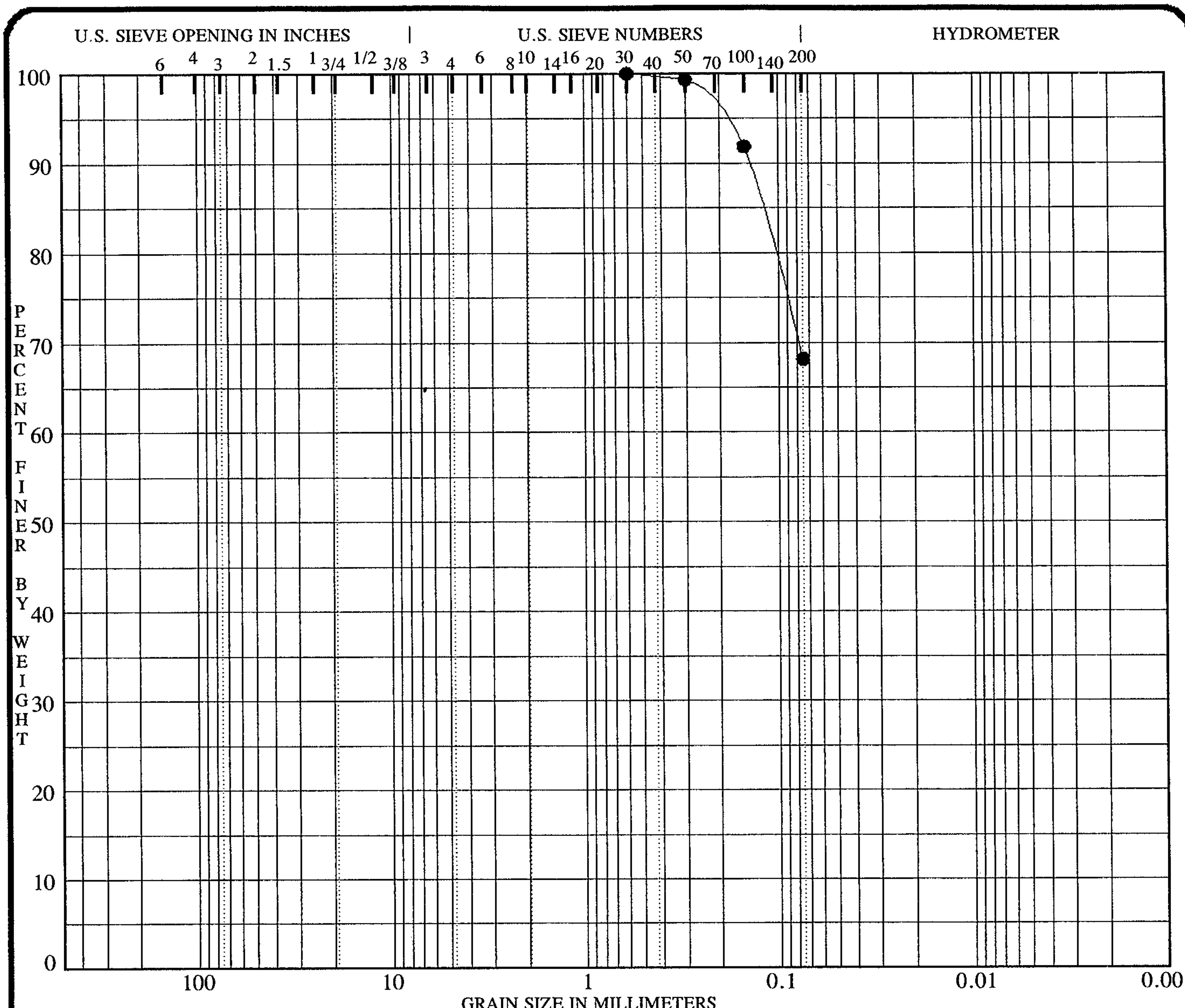
Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
● 96-107	11.6	19.000	3.266	0.395		34.7	54.9	10.4	

PROJECT **SPORN PLANT - FLY ASH POND DIKES** JOB NO.
DATE **05/21/97**

GRADATION CURVES
American Electric Power Service Corp.
Groveport, Ohio

AEP

AEPSPP-000695



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-107	16.6		14.0	25.2	18.1	7.1		
			SANDY LEAN CLAY CL						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-107	16.6	0.600				0.0	31.9	68.1	

PROJECT SPORN PLANT - FLY ASH POND DIKES

JOB NO.

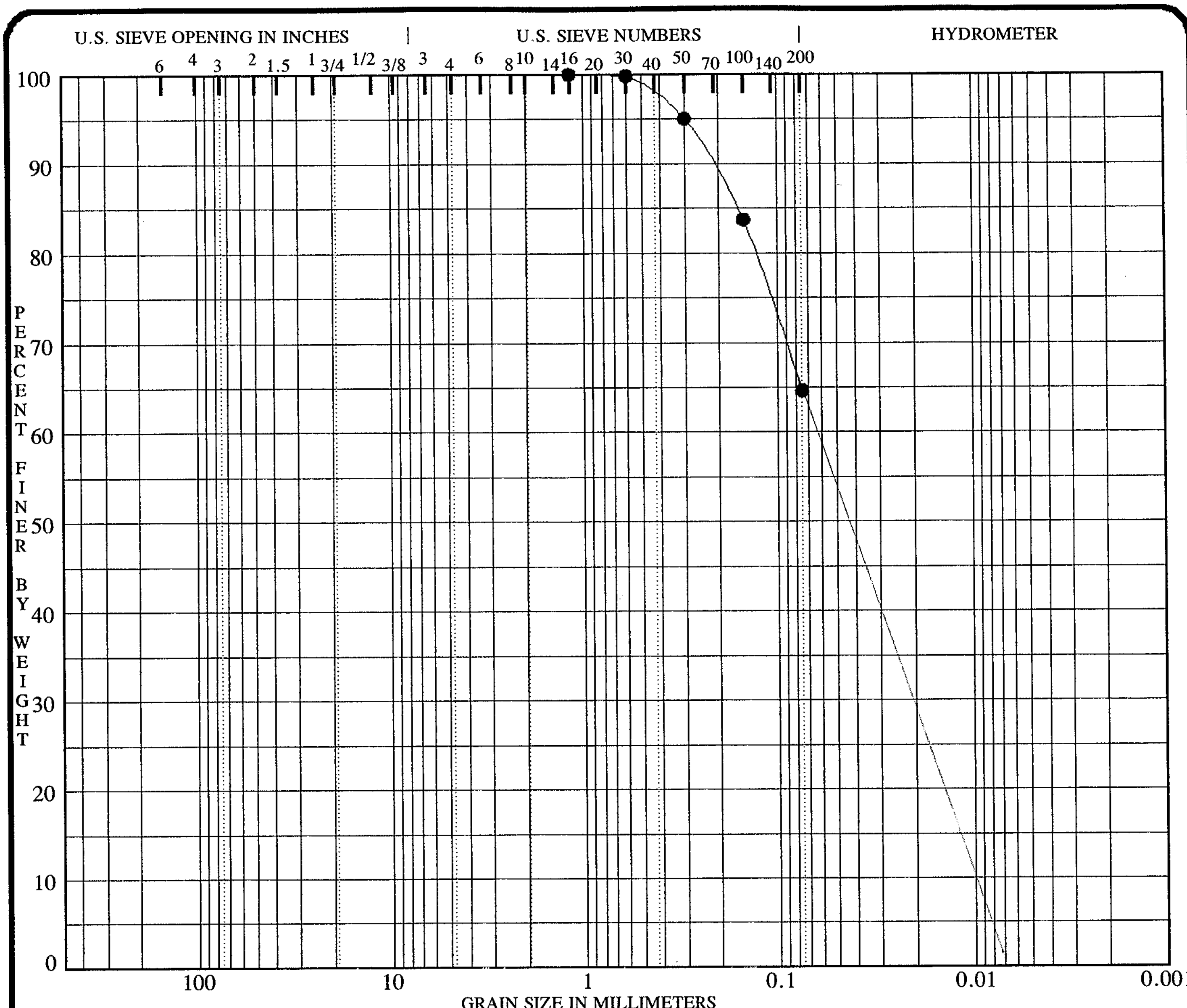
DATE 05/21/97

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-107	21.6		11.4	NP	NP	NP		
			SANDY SILT ML						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-107	21.6	1.180				0.0	35.4	64.6	

PROJECT SPORN PLANT - FLY ASH POND DIKES

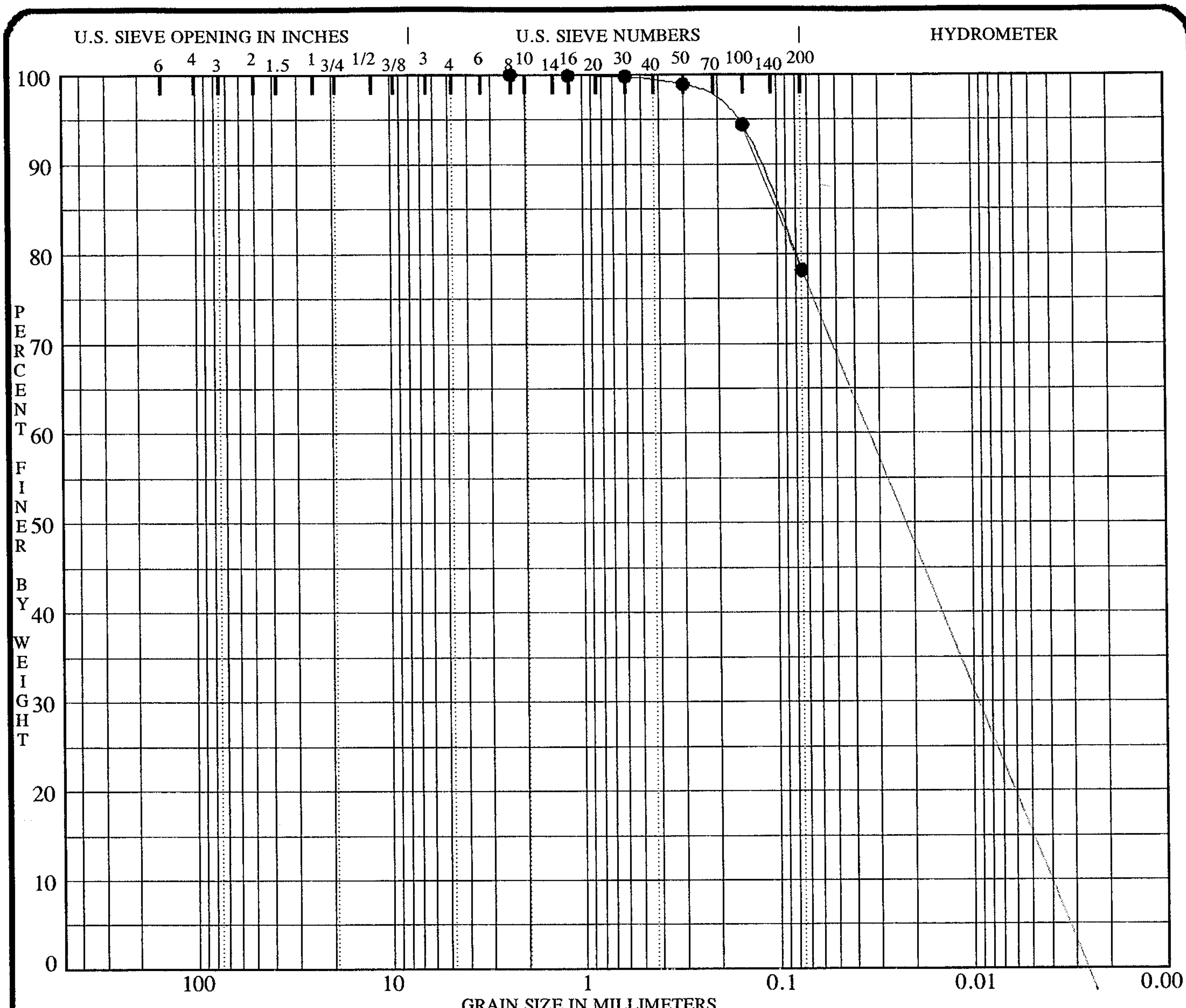
JOB NO.

DATE 05/21/97

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	**96-107**	**36.6**		**37.6**	**NP**	**NP**	**NP**	**2.38**	
			SILT with SAND ML						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	**96-107**	**36.6**	**2.360**				**0.0**	**21.9**	**78.1**	

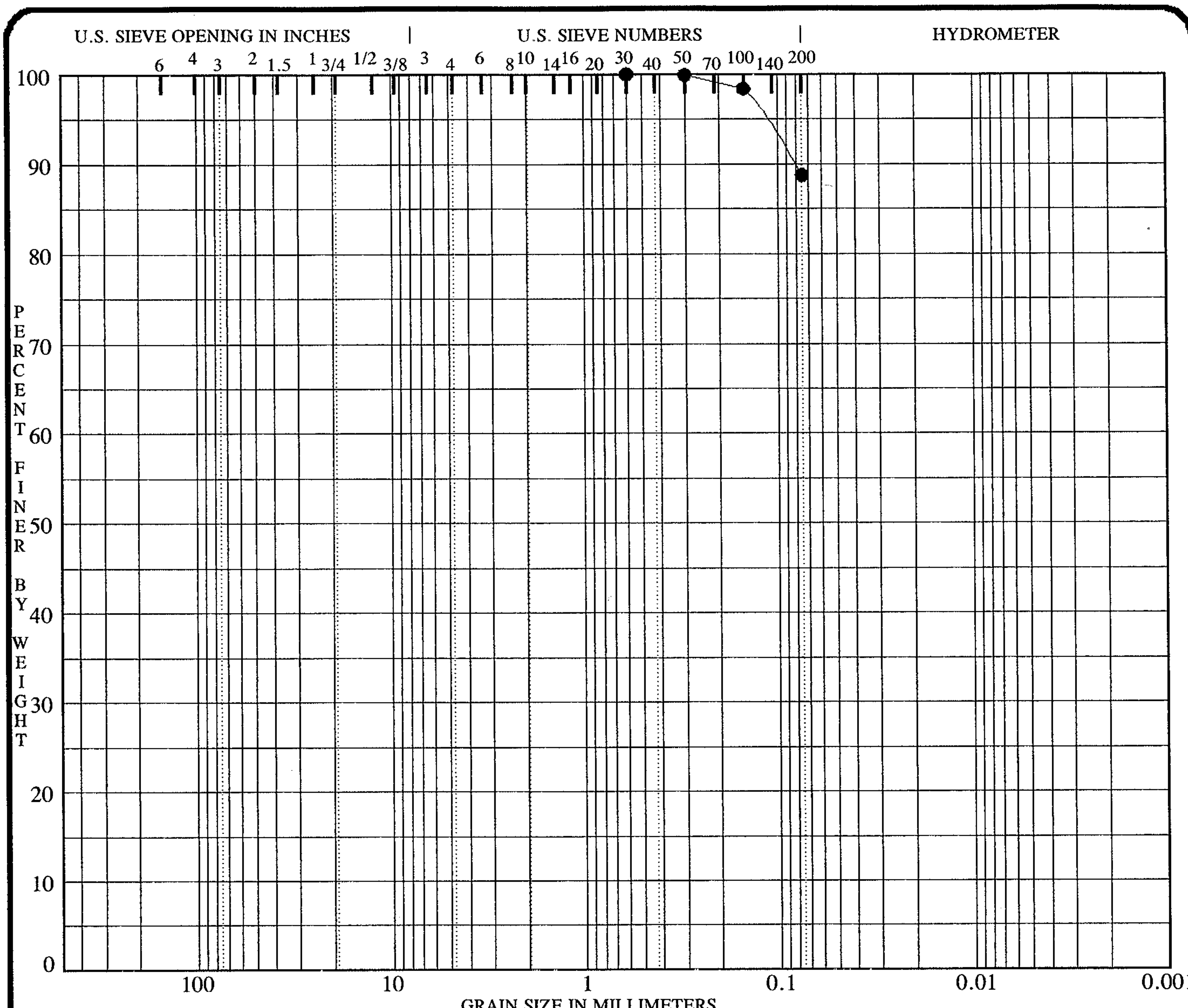
PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.
Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	**96-107**	**56.6**		**36.2**	**NP**	**NP**	**NP**	**2.31**	
			SILT ML						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	**96-107**	**56.6**	**0.600**				**0.0**	**11.3**	**88.7**	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

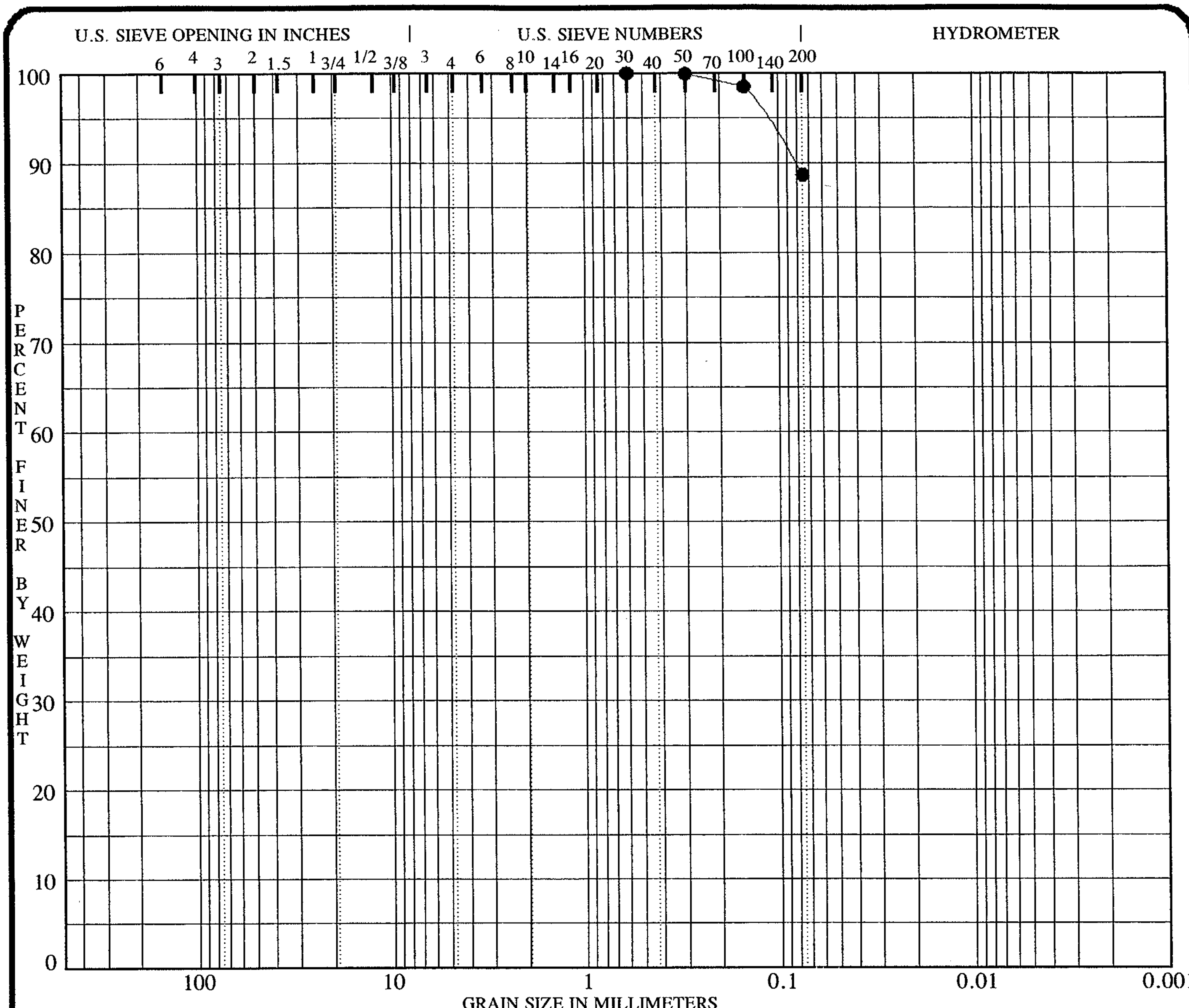
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-107	71.6		25.2	41.3	21.1	20.2		
			LEAN CLAY CL						

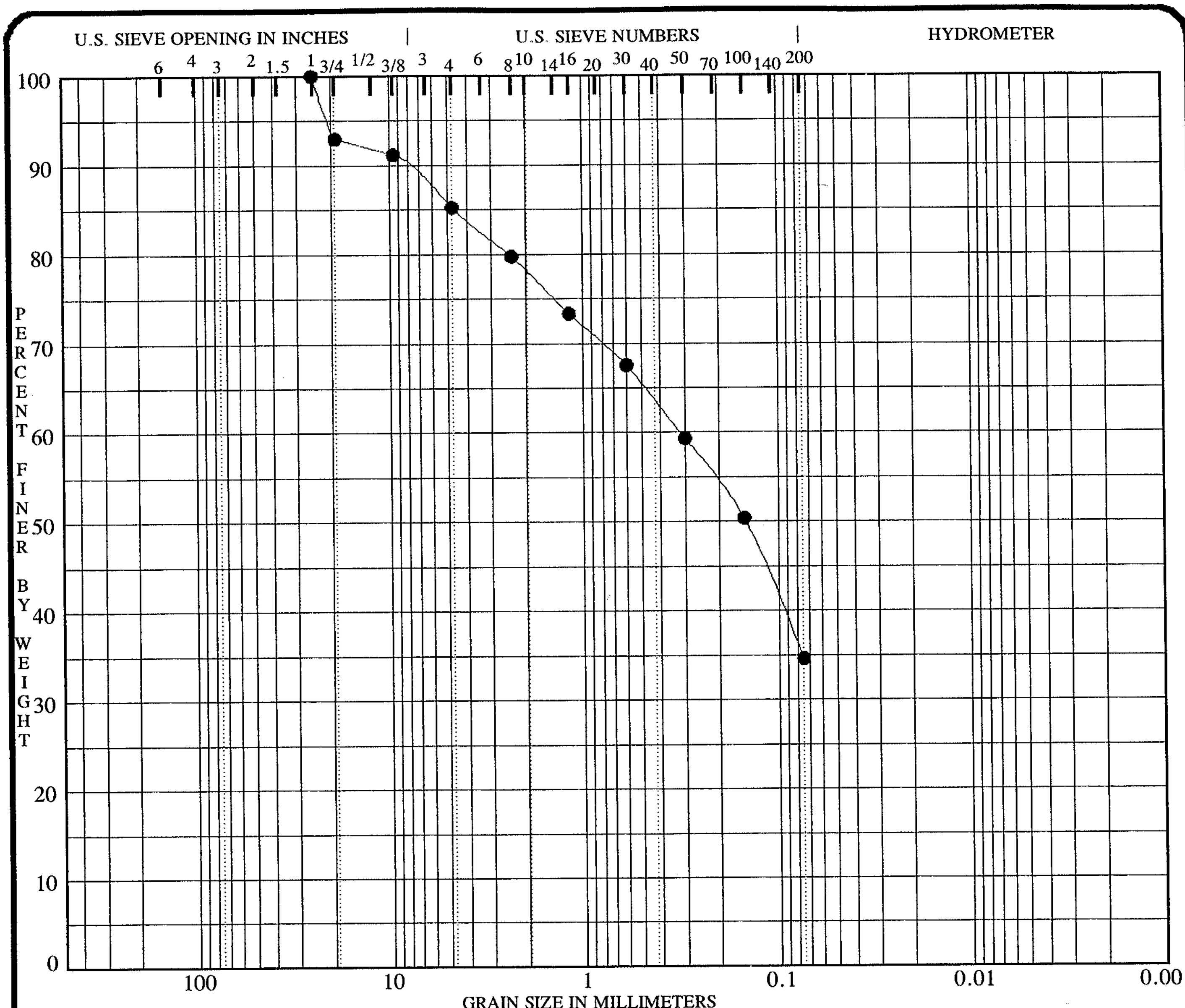
	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
●	96-107	71.6	0.600				0.0	11.4	88.6	

PROJECT SPORN PLANT - FLY ASH POND DIKES
JOB NO.
DATE 05/21/97

GRADATION CURVES

American Electric Power Service Corp.
Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-108	3.0		9.1	NP	NP	NP		
			SILTY SAND with GRAVEL SM						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-108	3.0	25.000	0.318			14.8	50.6	34.6	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

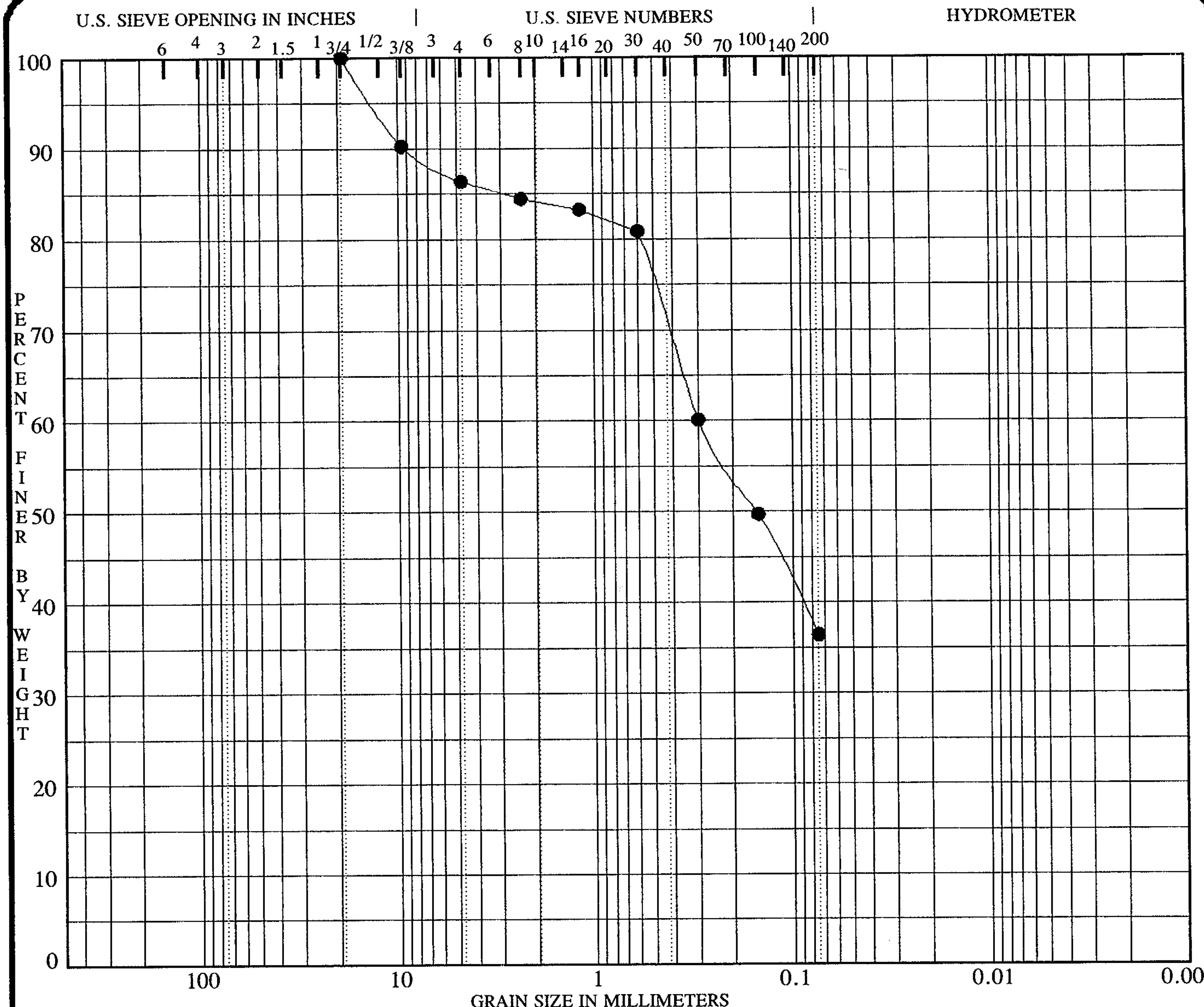
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-108	8.5		6.2	NP	NP	NP		
			SILTY SAND SM						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-108	8.5	19.000	0.298			13.7	49.9	36.4	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

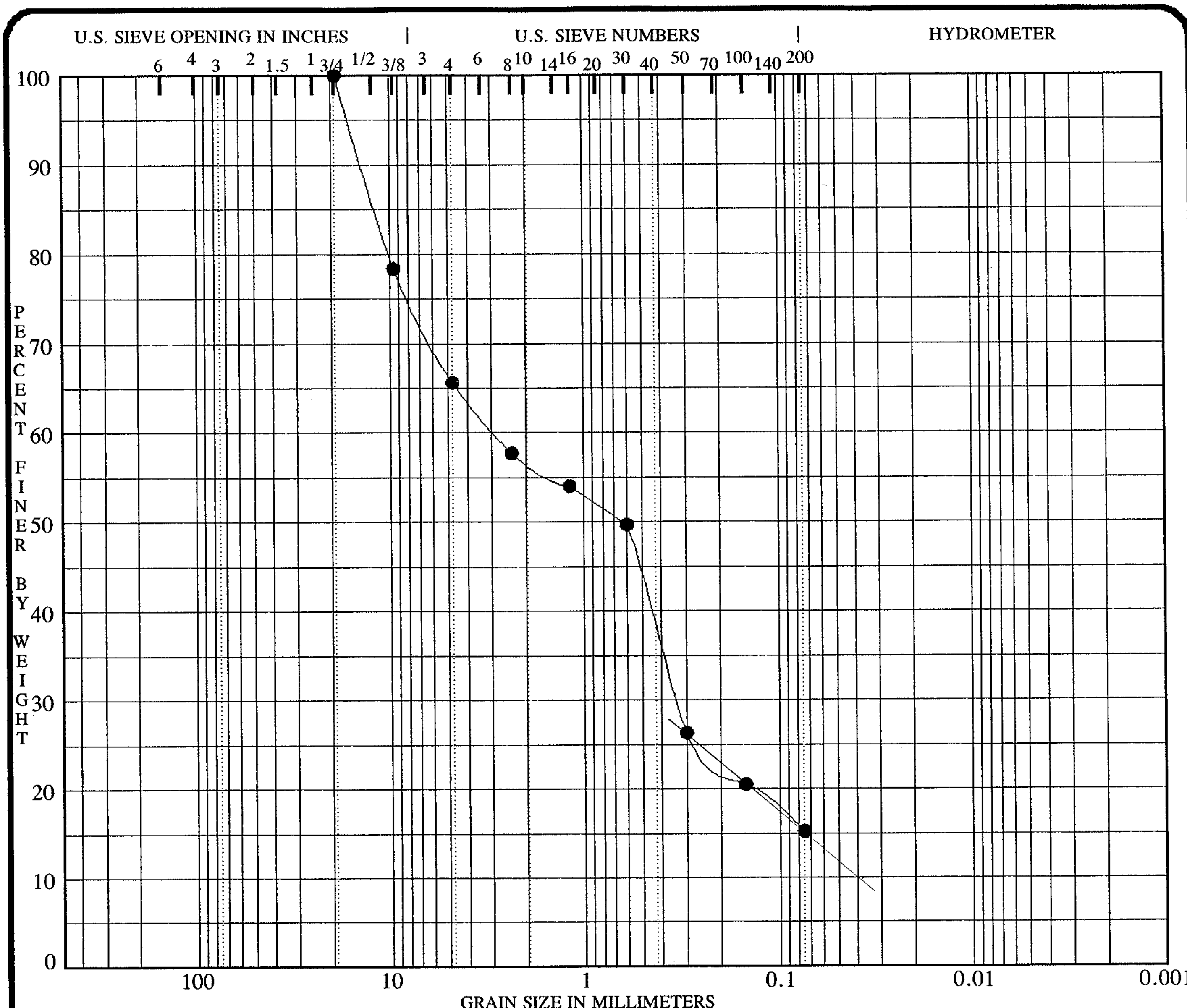
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.
●	96-108	11.6		3.0	NP	NP	NP	
			SILTY SAND with GRAVEL SM					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
●	96-108	11.6	19.000	2.893	0.335		34.4	50.4	15.2	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

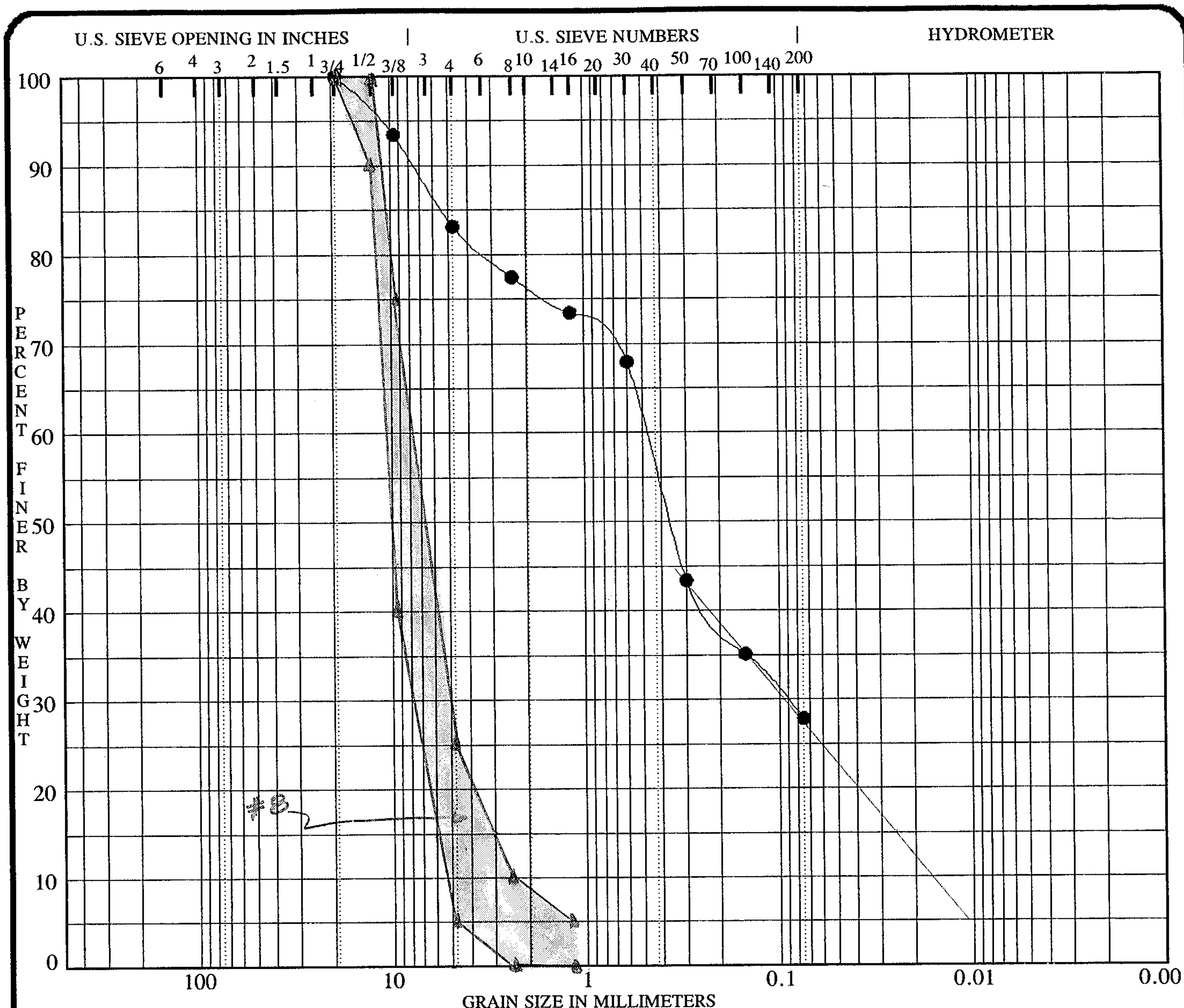
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-108	16.6		1.9	NP	NP	NP		
			SILTY SAND with GRAVEL SM						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
●	96-108	16.6	19.000	0.480	0.092		16.9	55.3	27.8	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

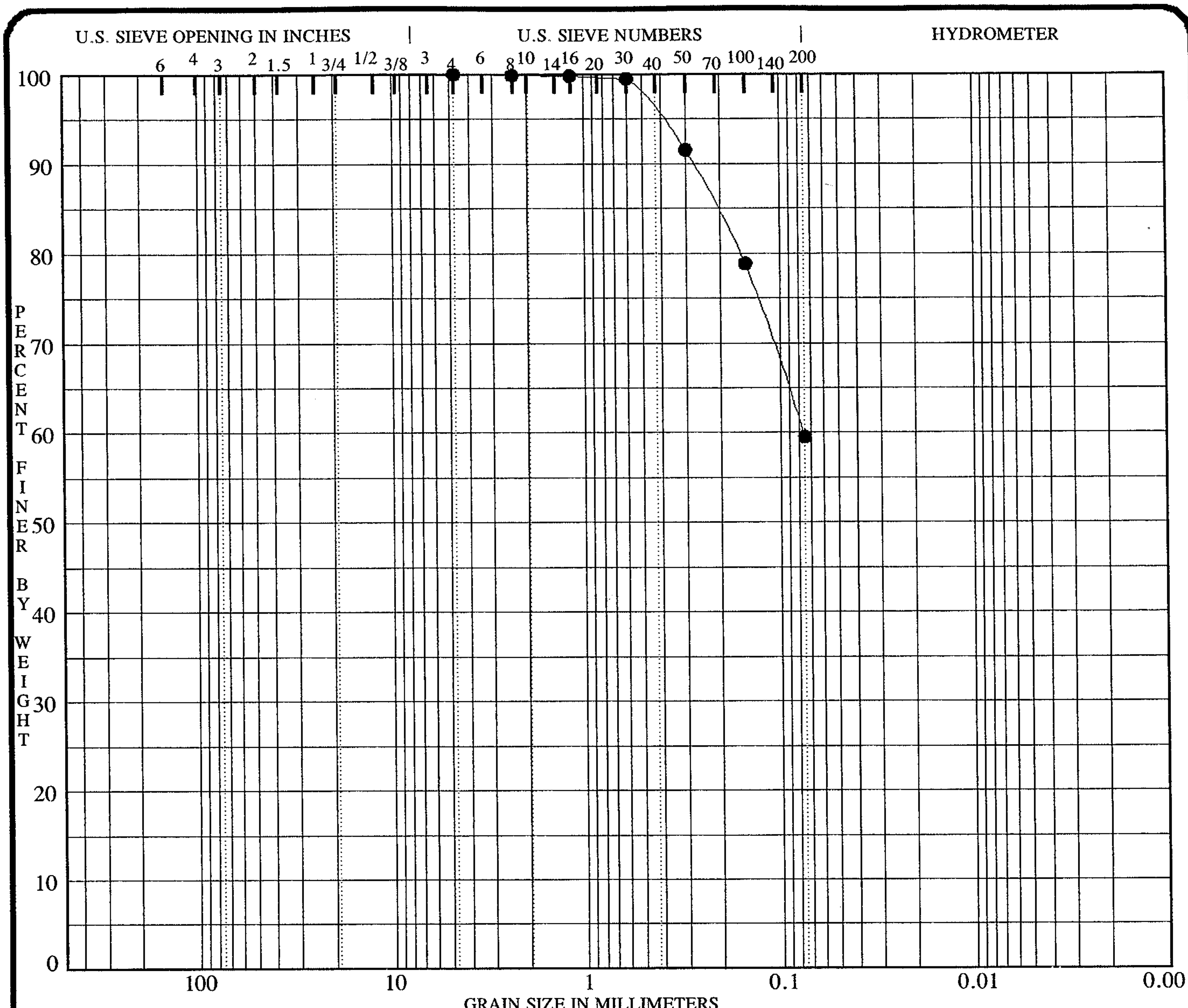
JOB NO.
DATE 05/21/97

GRADATION CURVES

American Electric Power Service Corp.
Groveport, Ohio

AEP

AEPSPP-000704



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-108	21.6		12.2	23.3	16.5	6.7		
			SANDY SILTY CLAY CL-ML						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-108	21.6	4.750	0.076			0.0	40.5	59.5	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

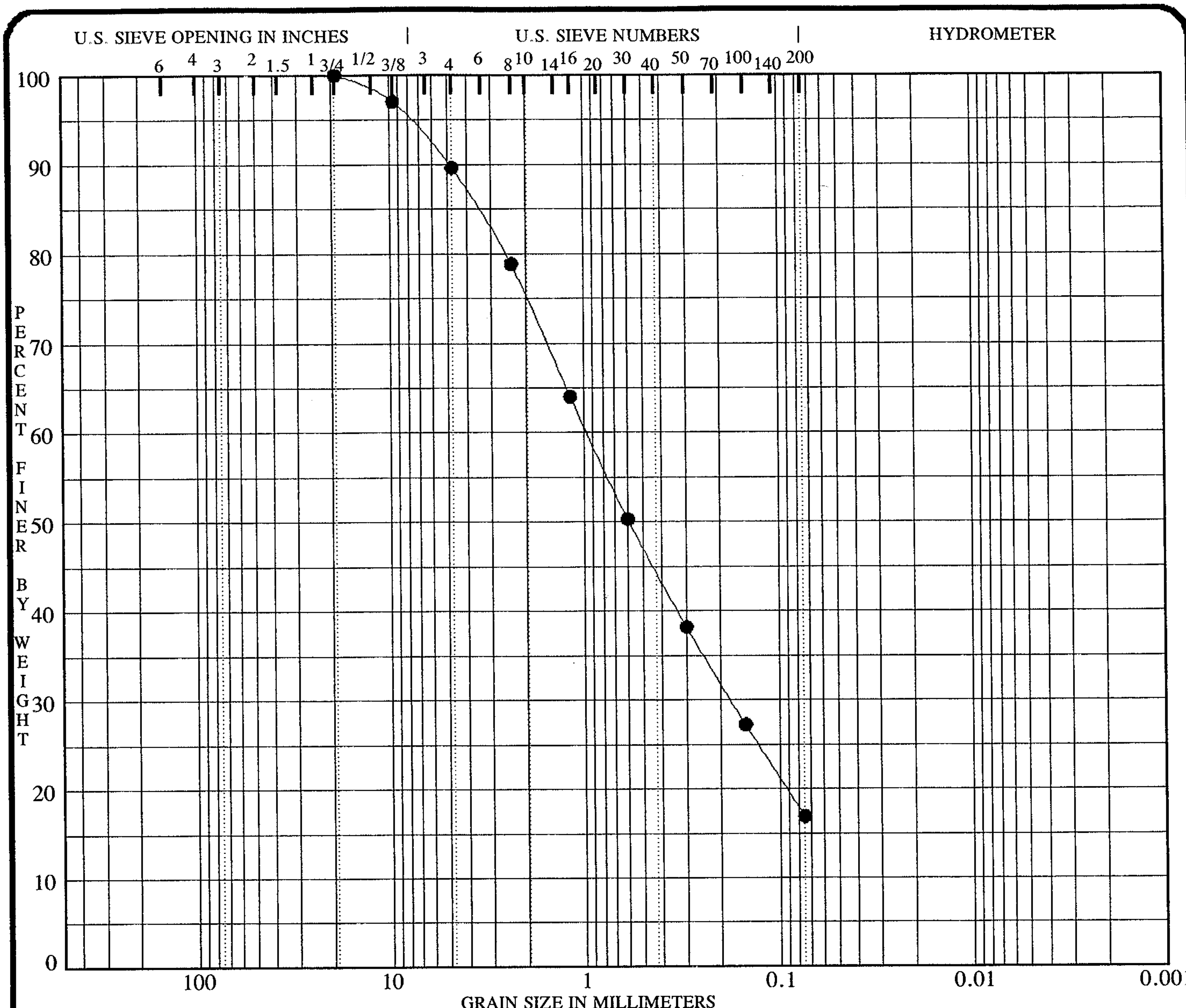
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-108	26.6		20.6	NP	NP	NP		
			SILTY SAND SM						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-108	26.6	19.000	0.969	0.179		10.4	72.7	16.9	

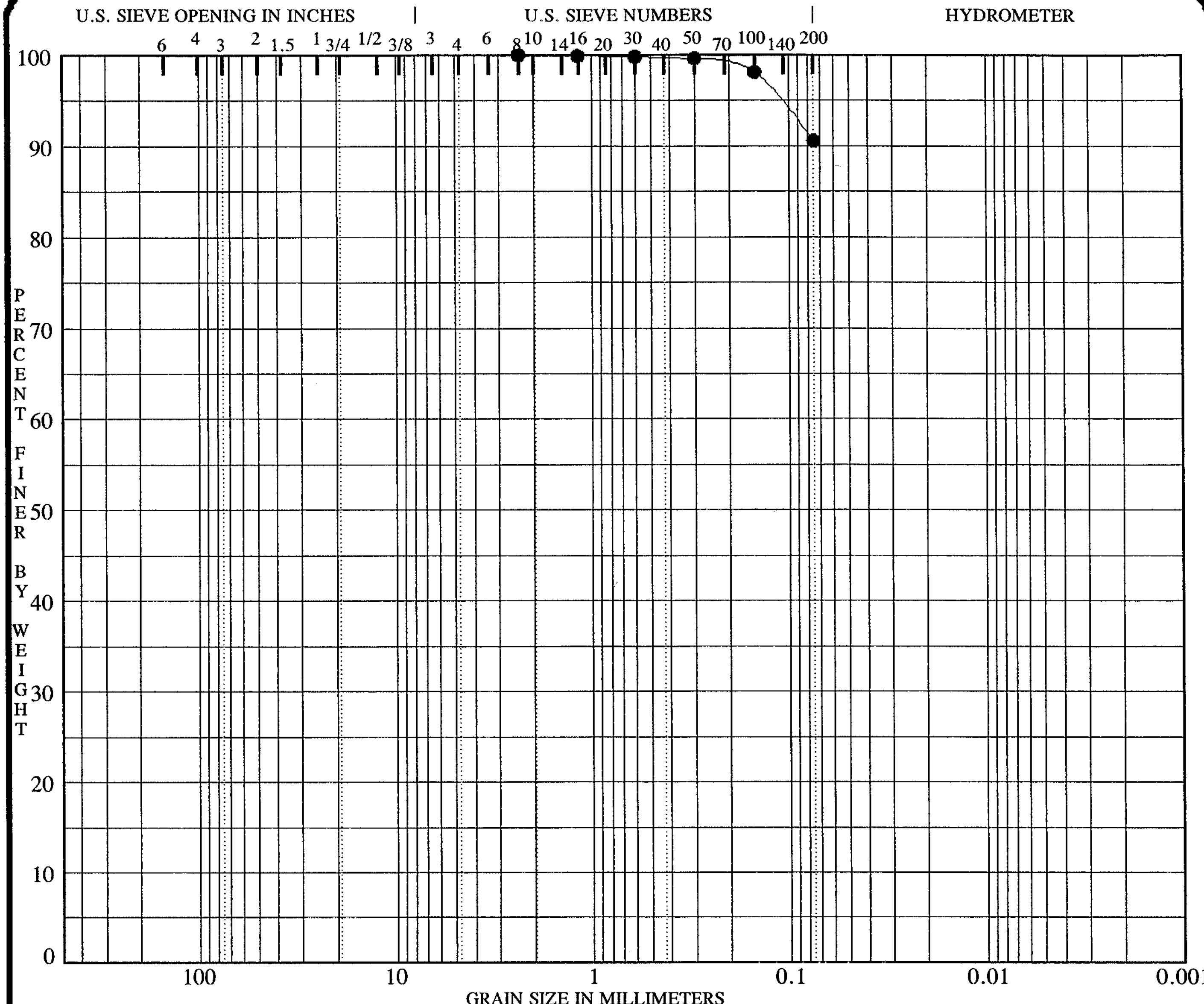
PROJECT SPORN PLANT - FLY ASH POND DIKES

JOB NO.
DATE 05/21/97

GRADATION CURVES

American Electric Power Service Corp.
Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-108	41.6		23.2	38.7	20.3	18.4		
			LEAN CLAY CL						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
●	96-108	41.6	2.360				0.0	9.5	90.5	

PROJECT SPORN PLANT - FLY ASH POND DIKES

JOB NO.

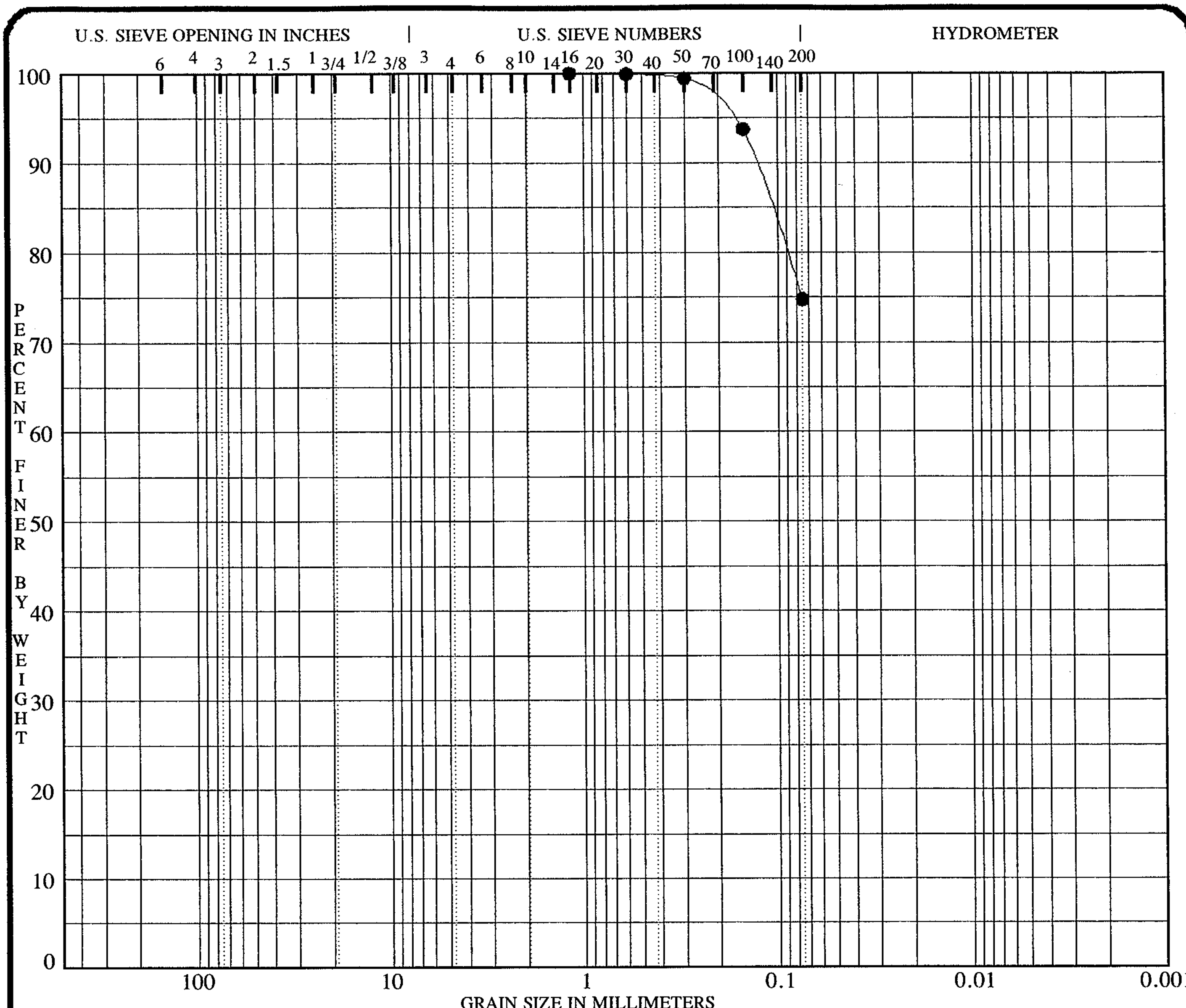
DATE 05/21/97

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEPSPP-000707



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	MC%	LL	PL	PI	Sp.Gr.
●	96-108	56.6		25.1	34.9	20.1	14.9	
			LEAN CLAY with SAND CL					

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-108	56.6	1.180				0.0	25.3	74.7	

PROJECT SPORN PLANT - FLY ASH POND DIKES

JOB NO.

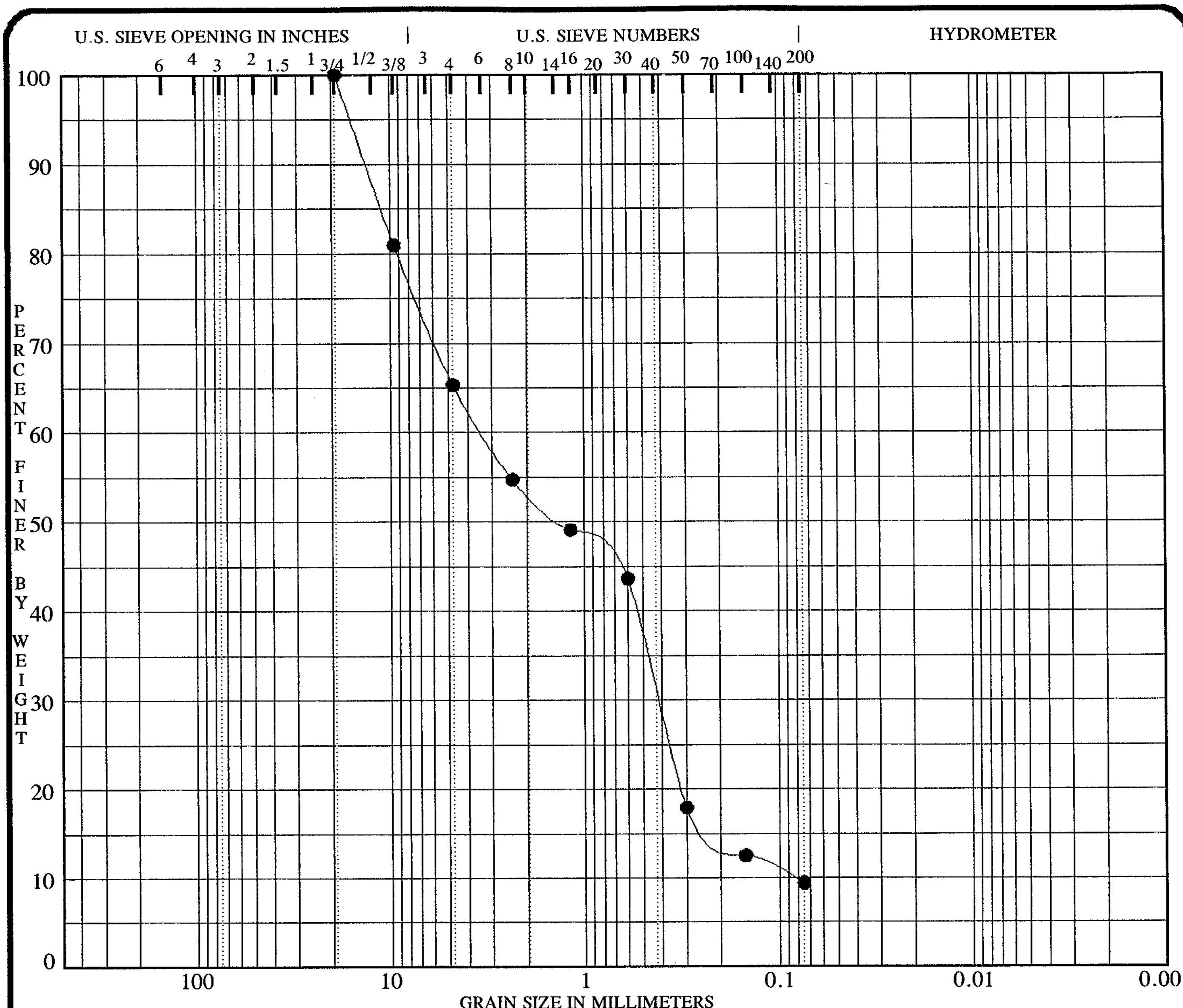
DATE 05/21/97

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
● 96-109	8.5		0.4	NP	NP	NP		
		POORLY GRADED SAND with SILT and GRAVEL SP-SM						

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● 96-109	8.5	19.000	3.348	0.416	0.086	34.7	55.9	9.4	

PROJECT SPORN PLANT - FLY ASH POND DIKES

JOB NO.

DATE 05/21/97

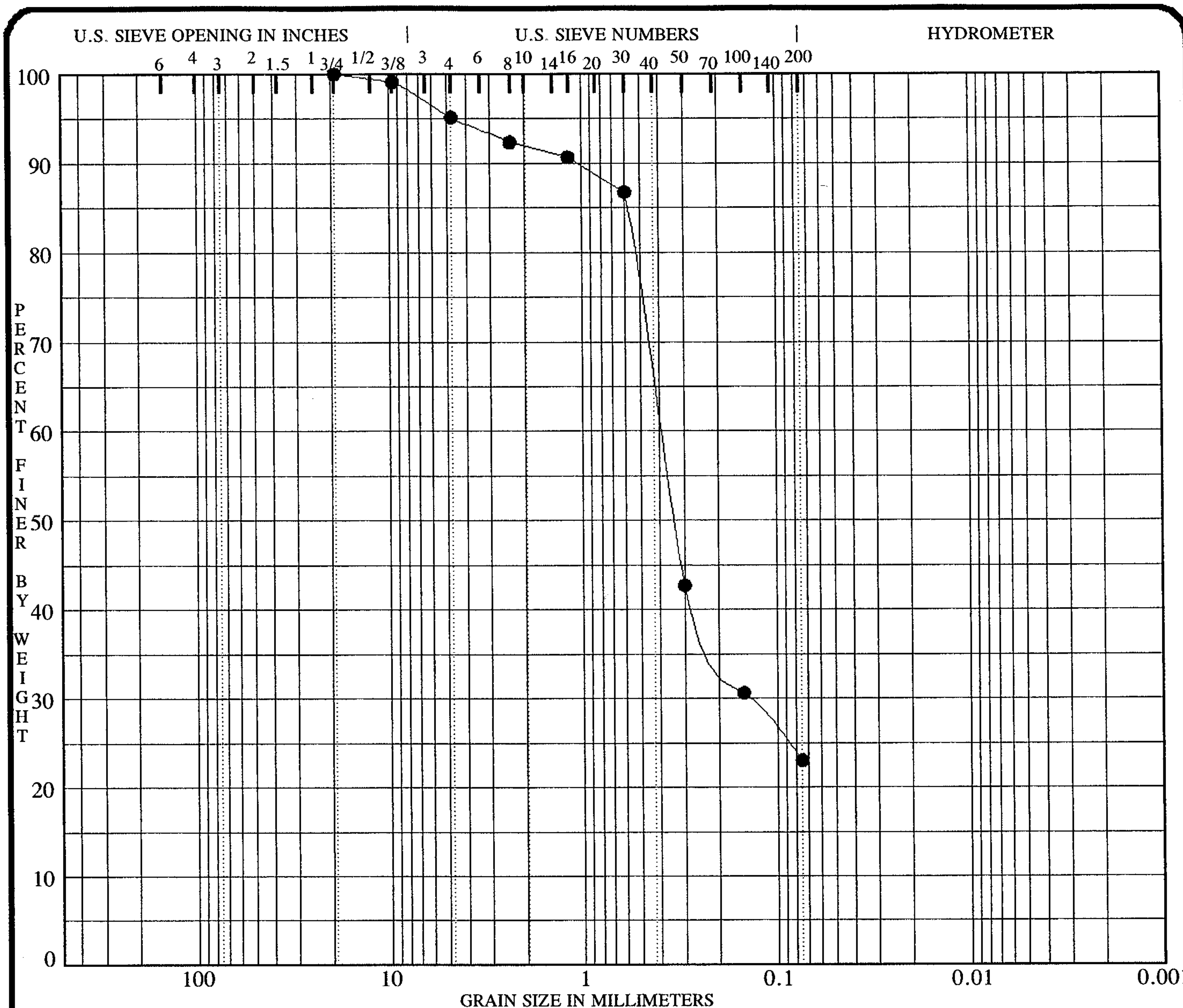
GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP

AEPSPP-000709



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	**96-109**	**11.7**		**4.3**	**NP**	**NP**	**NP**		
			SILTY SAND SM						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	**96-109**	**11.7**	**19.000**	**0.394**	**0.142**		**4.9**	**72.1**	**23.0**	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

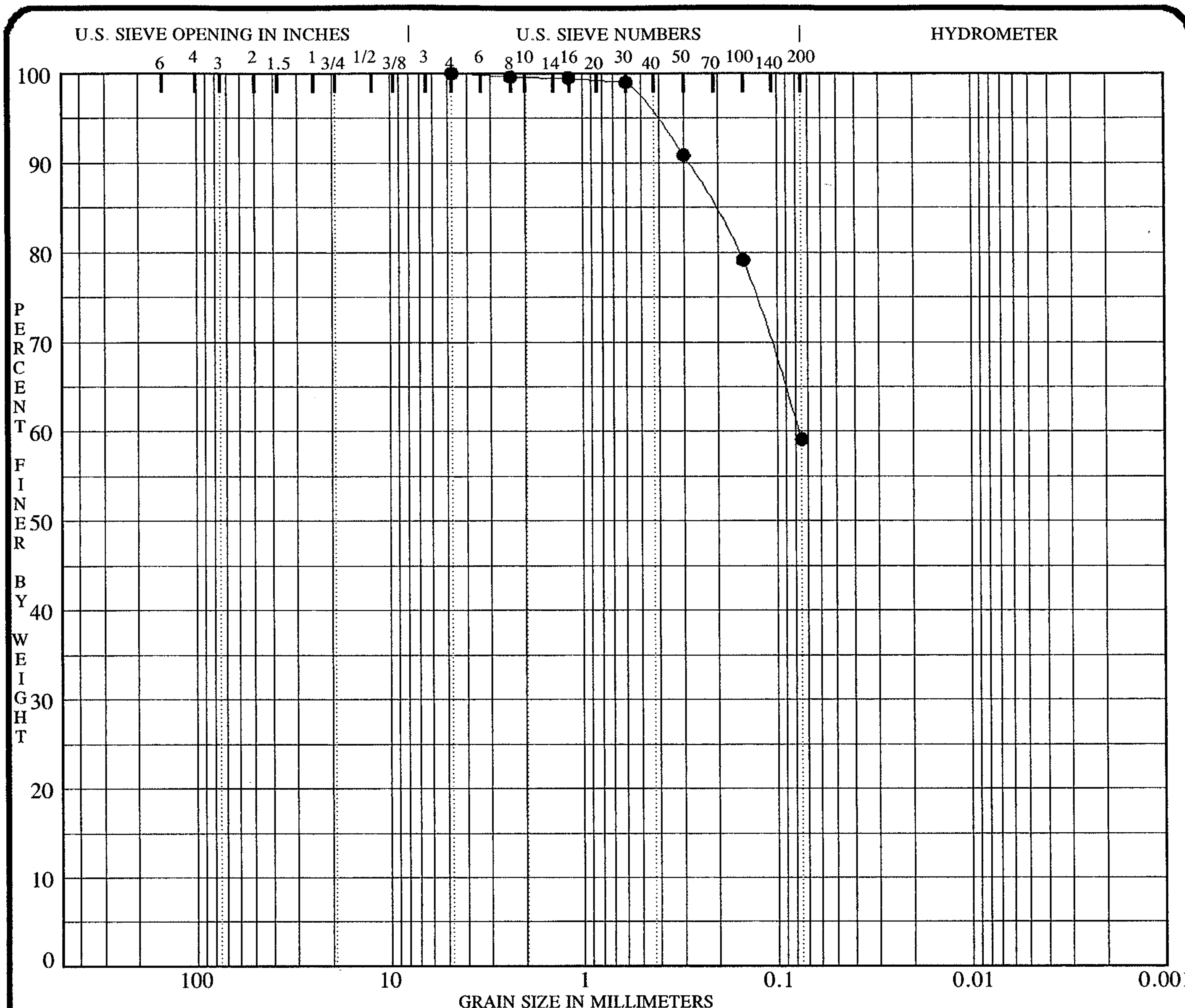
JOB NO.

DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.
●	**96-109**	**16.7**		**9.0**	**22.9**	**17.1**	**5.7**	
			SANDY SILTY CLAY CL-ML					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
●	**96-109**	**16.7**	**4.750**	**0.077**			**0.0**	**40.9**	**59.1**	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

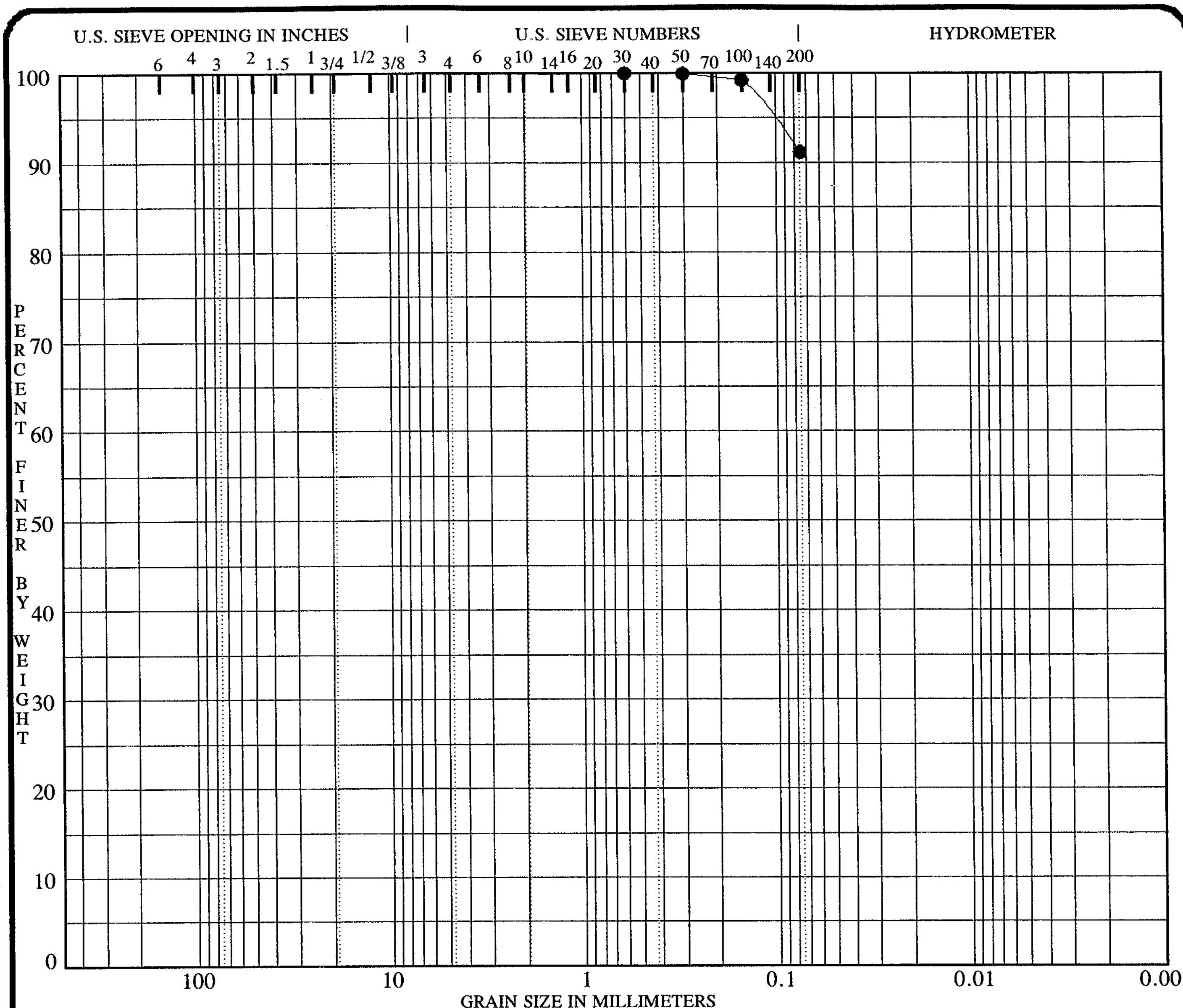
JOB NO.

DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-109	36.7		38.1	NP	NP	NP	2.34	
			SILT ML						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-109	36.7	0.600				0.0	8.9	91.1	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

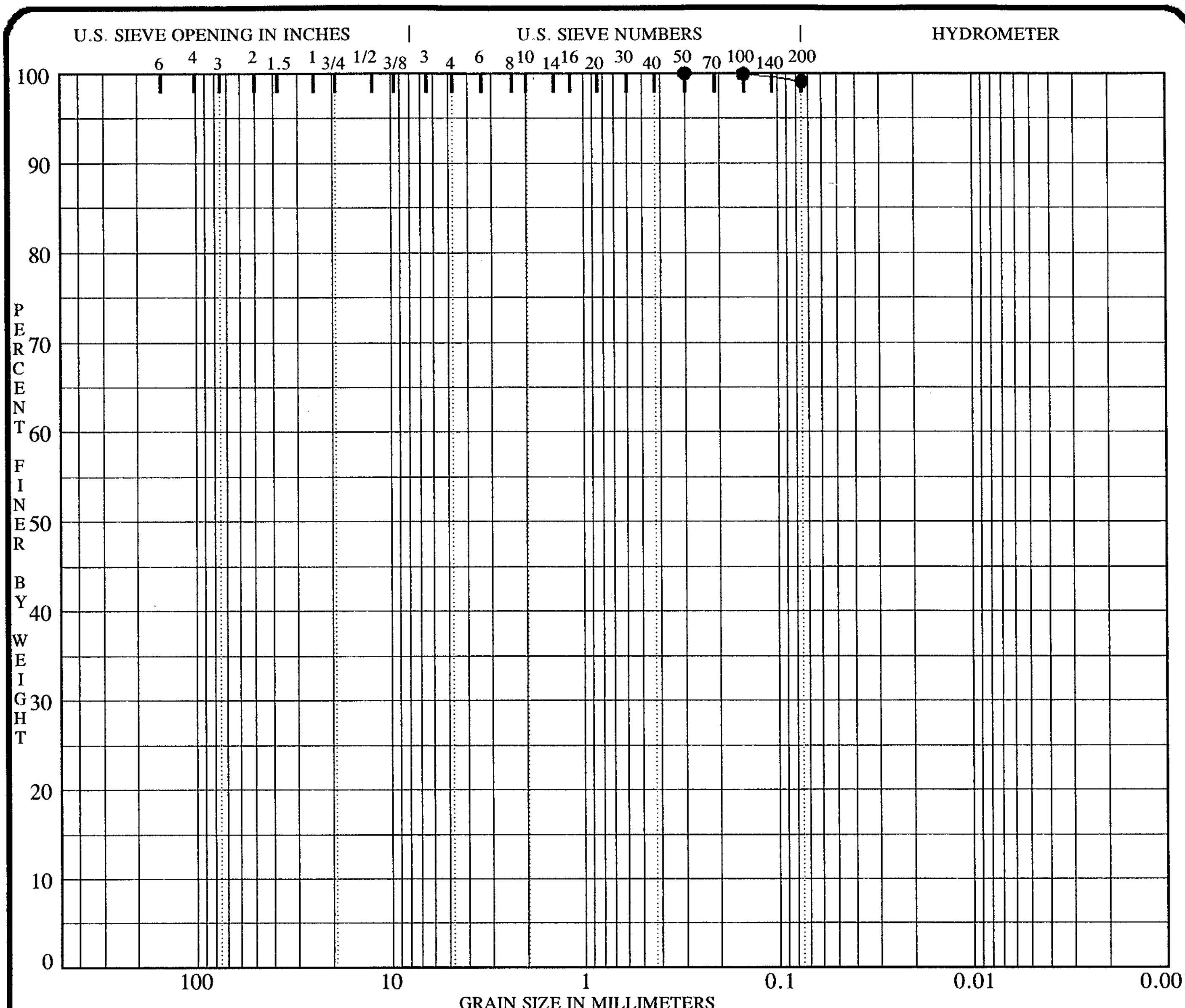
JOB NO.

DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

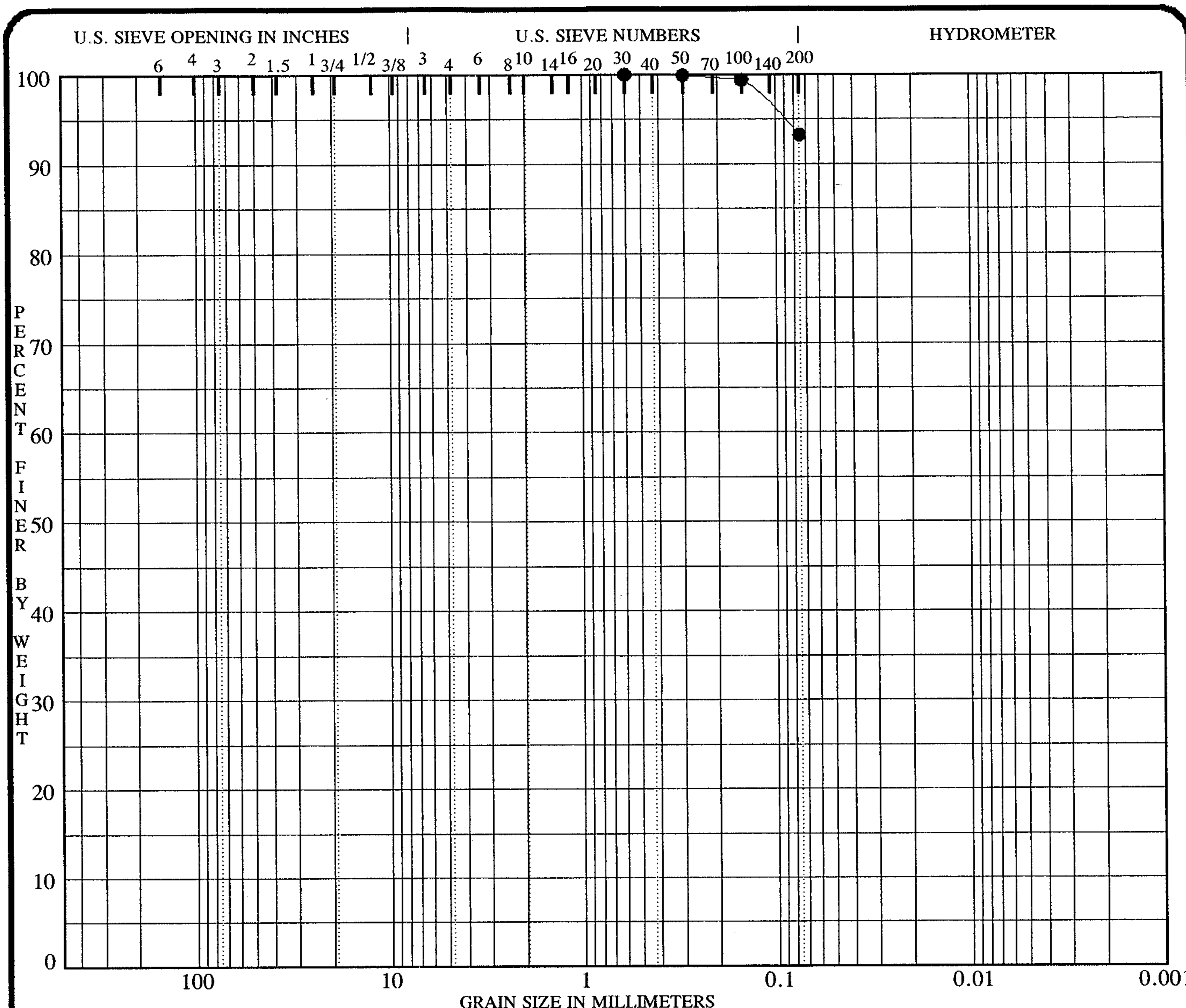
Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
● 96-109	56.7		34.3	NP	NP	NP	2.29	
		SILT ML						

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● 96-109	56.7	0.300				0.0	0.9	99.1	

PROJECT **SPORN PLANT - FLY ASH POND DIKES** JOB NO.
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.
Groveport, Ohio



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-109	71.7		23.7	40.3	21.8	18.5		
			LEAN CLAY CL						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-109	71.7	0.600				0.0	6.8	93.2	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

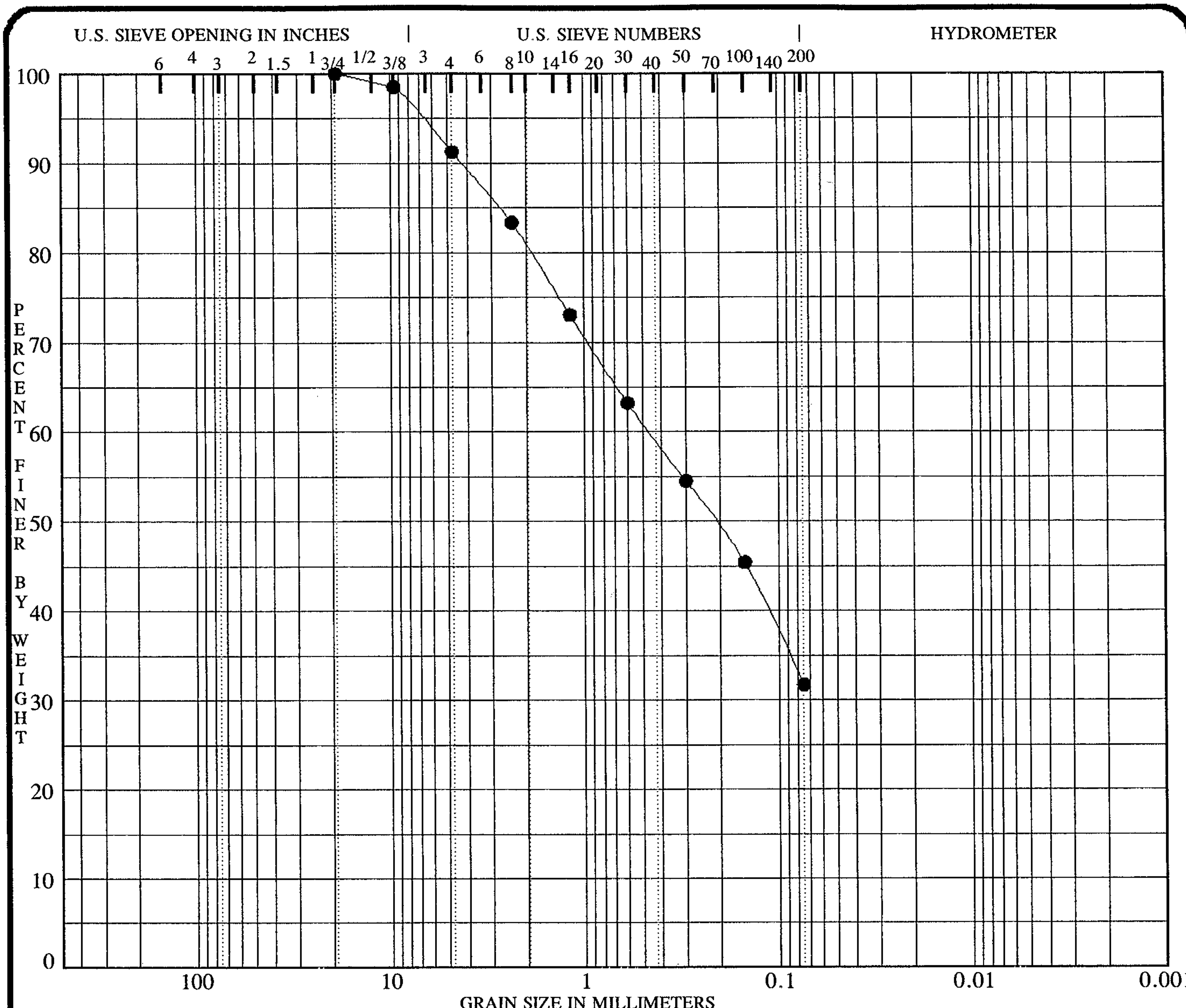
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-110	5.0		6.8	NP	NP	NP		
			SILTY SAND SM						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
●	96-110	5.0	19.000	0.465			8.8	59.5	31.7	

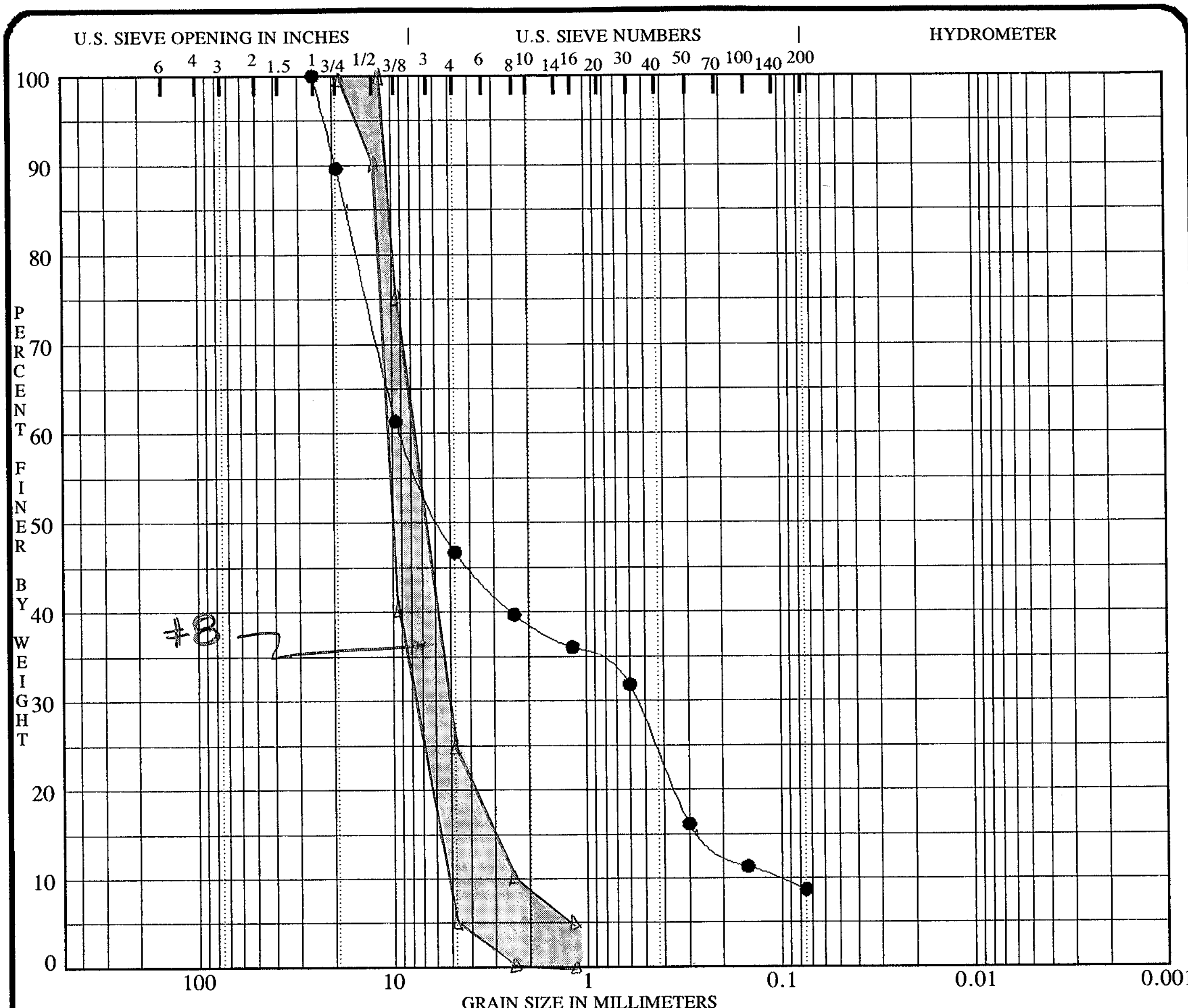
PROJECT SPORN PLANT - FLY ASH POND DIKES

JOB NO.
DATE 05/21/97

GRADATION CURVES

American Electric Power Service Corp.
Groveport, Ohio

AEPSPP-000715



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.
●	96-110	8.5		0.1	NP	NP	NP	
			POORLY GRADED GRAVEL with SILT and SAND GP-GM					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-110	8.5	25.000	8.931	0.554	0.106	53.3	38.0	8.7	

PROJECT SPORN PLANT - FLY ASH POND DIKES

JOB NO.

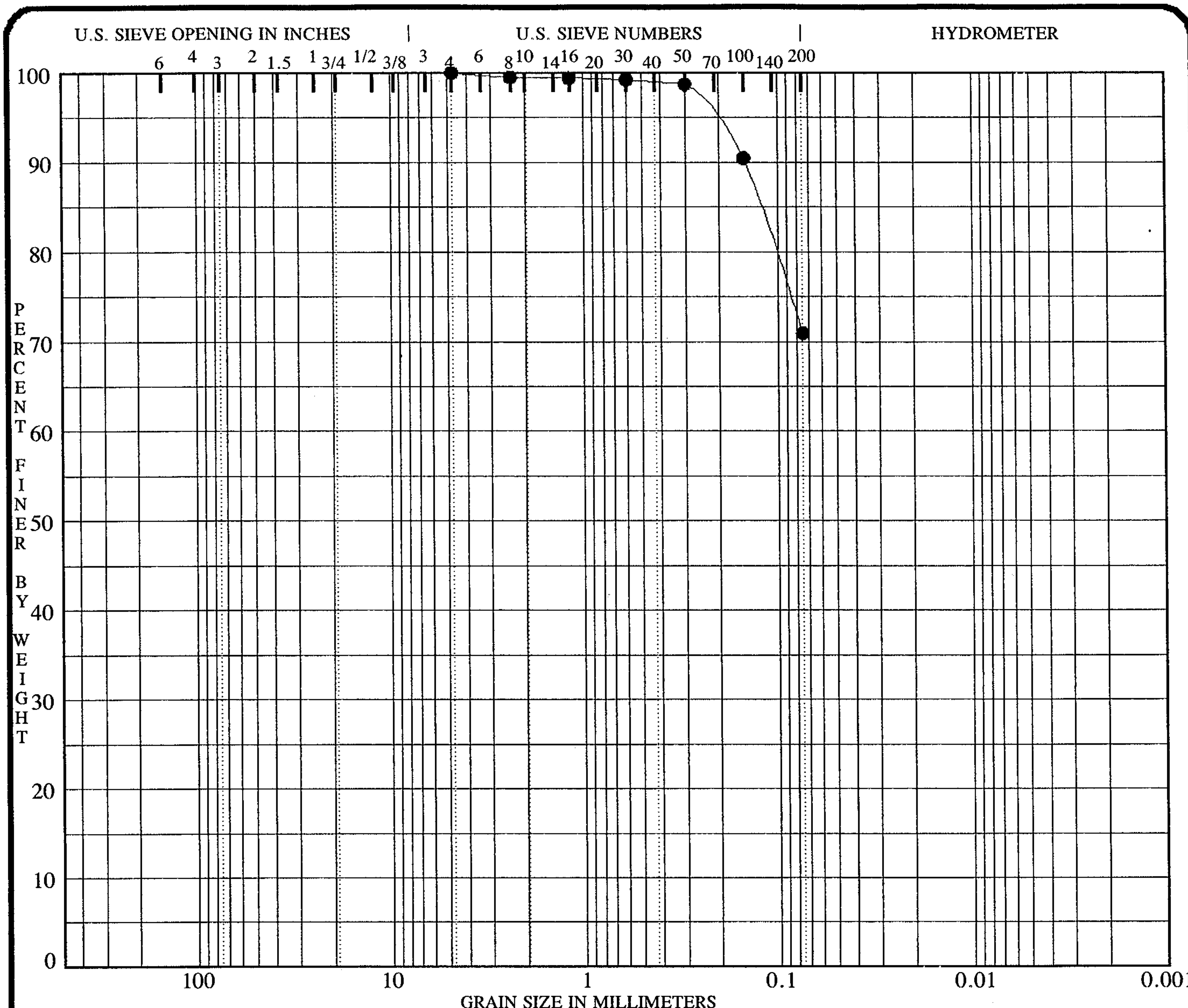
DATE 05/21/97

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEPSPP-000716



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-110	16.6		11.5	25.5	17.6	8.0		
			LEAN CLAY with SAND CL						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
●	96-110	16.6	4.750				0.0	29.1	70.9	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

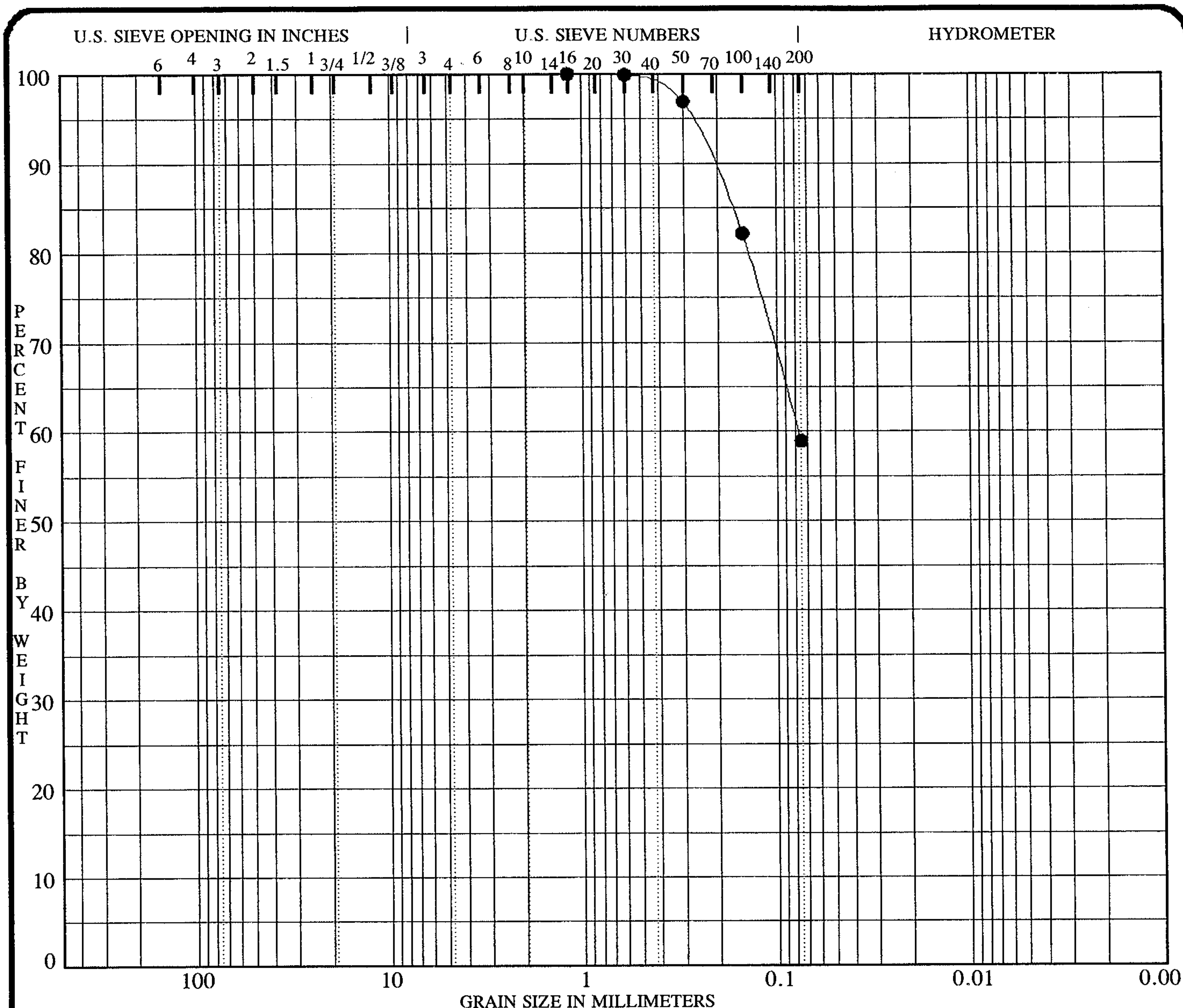
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.
●	96-110	21.6		12.5	24.0	17.0	7.0	
			SANDY SILTY CLAY CL-ML					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-110	21.6	1.180	0.078			0.0	41.1	58.9	

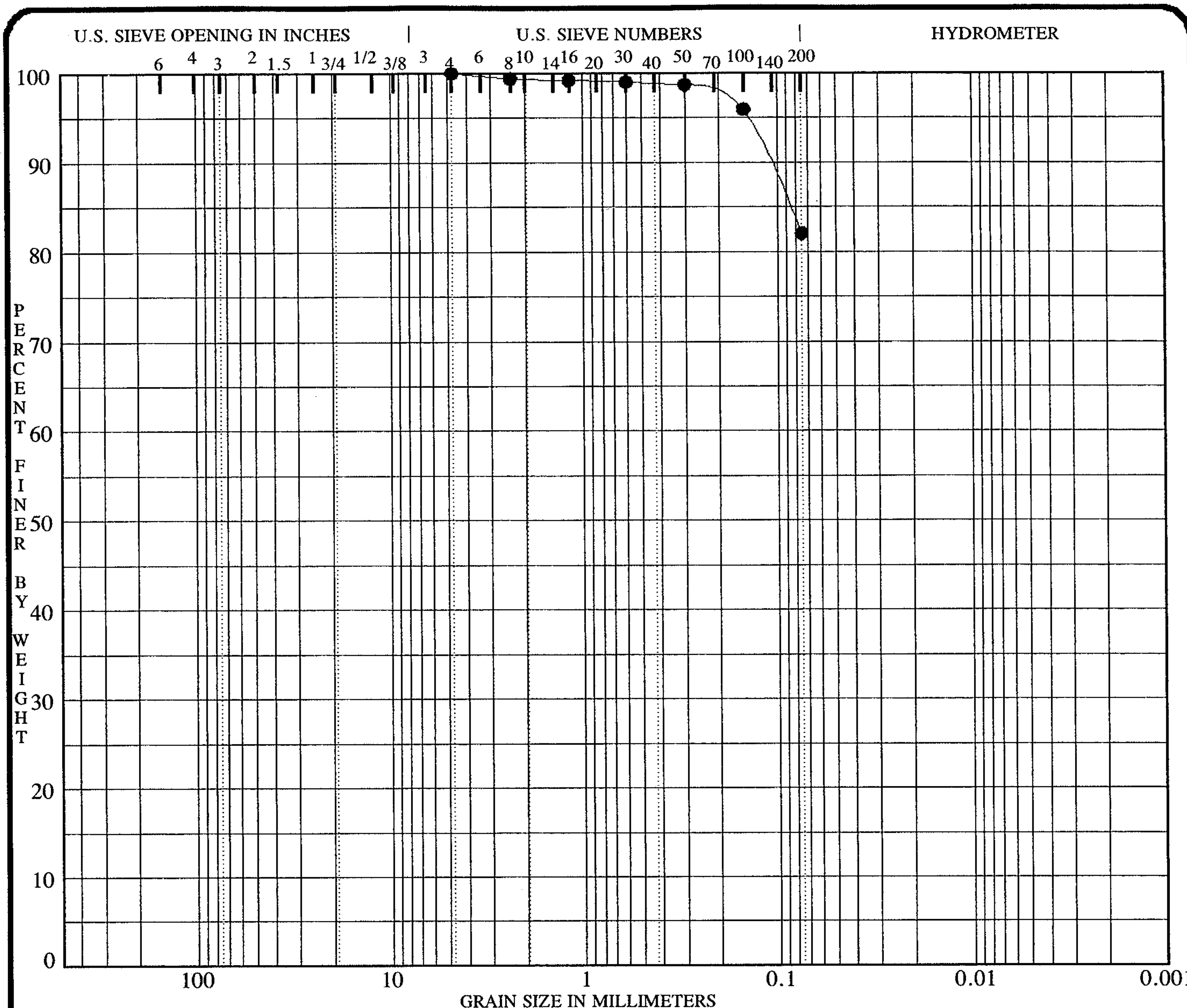
PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.
Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	**96-110**	**31.6**		**14.7**	**30.7**	**18.4**	**12.3**		
			LEAN CLAY with SAND CL						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
●	**96-110**	**31.6**	**4.750**				**0.0**	**18.0**	**82.0**	

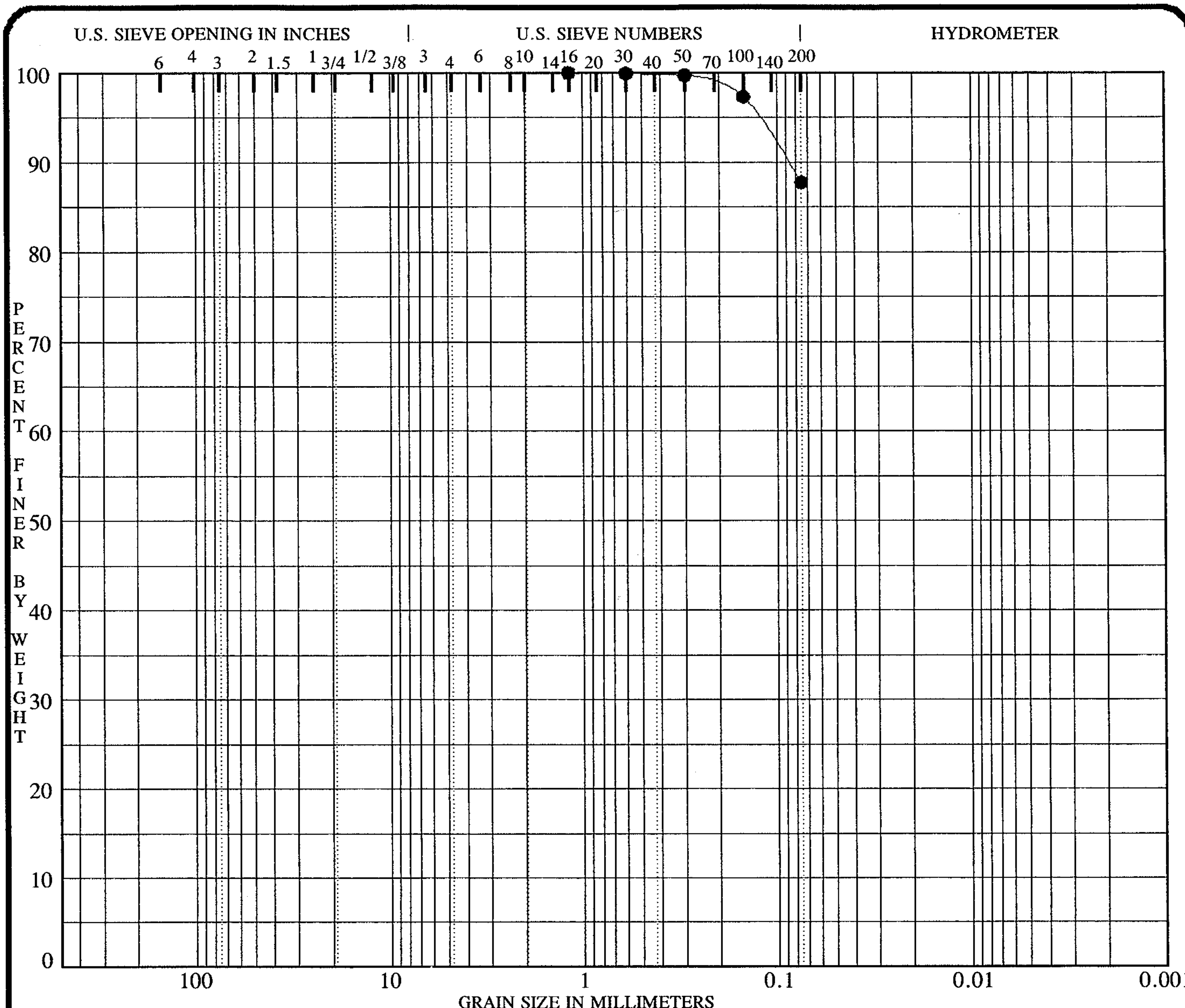
PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.
Groveport, Ohio

AEPSPP-000719



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	**96-110**	**46.6**		**25.1**	**36.2**	**21.3**	**14.9**		
			LEAN CLAY CL						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	**96-110**	**46.6**	**1.180**				**0.0**	**12.3**	**87.7**	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

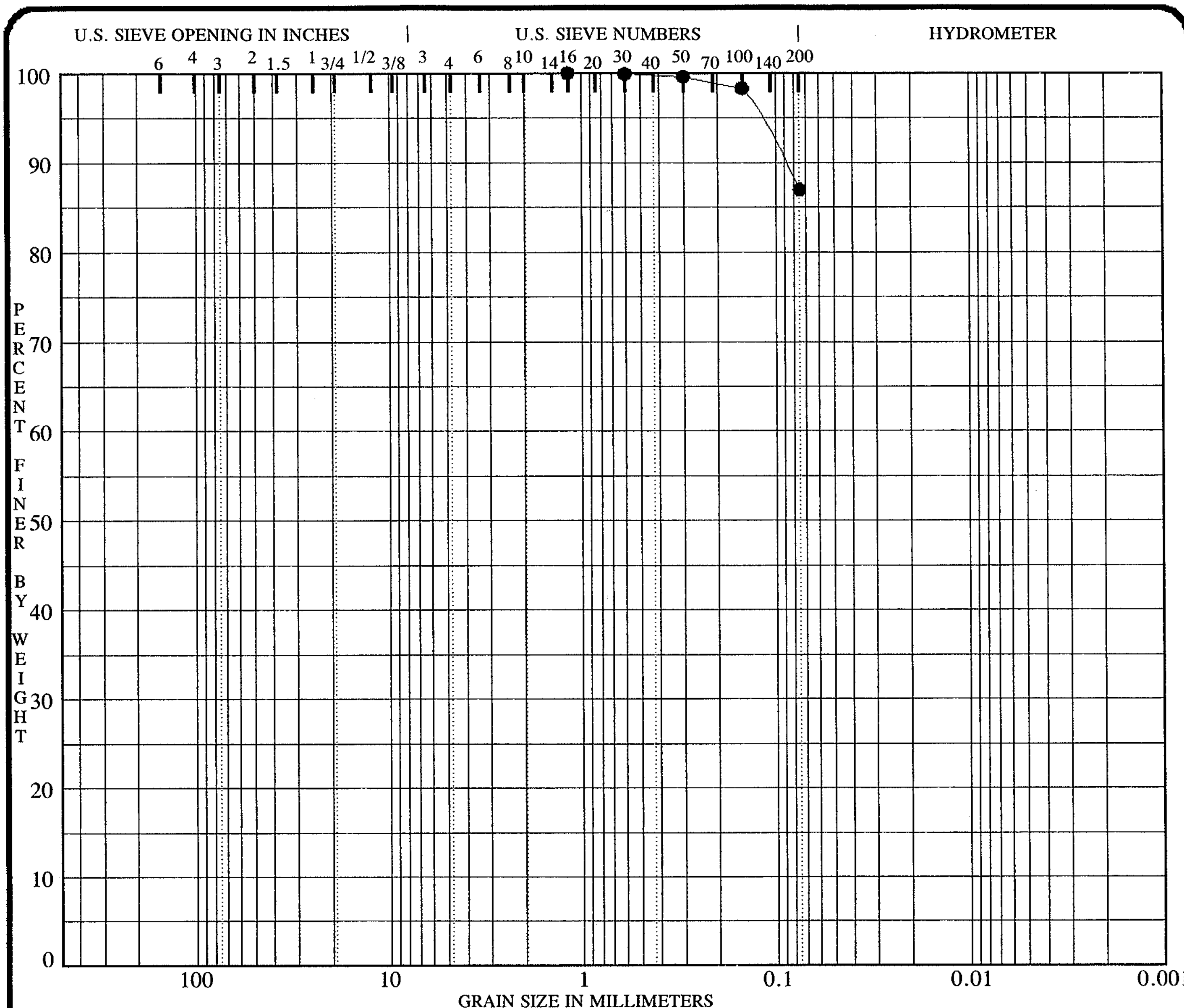
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-110	56.6		24.4	37.5	20.3	17.1		
			LEAN CLAY CL						

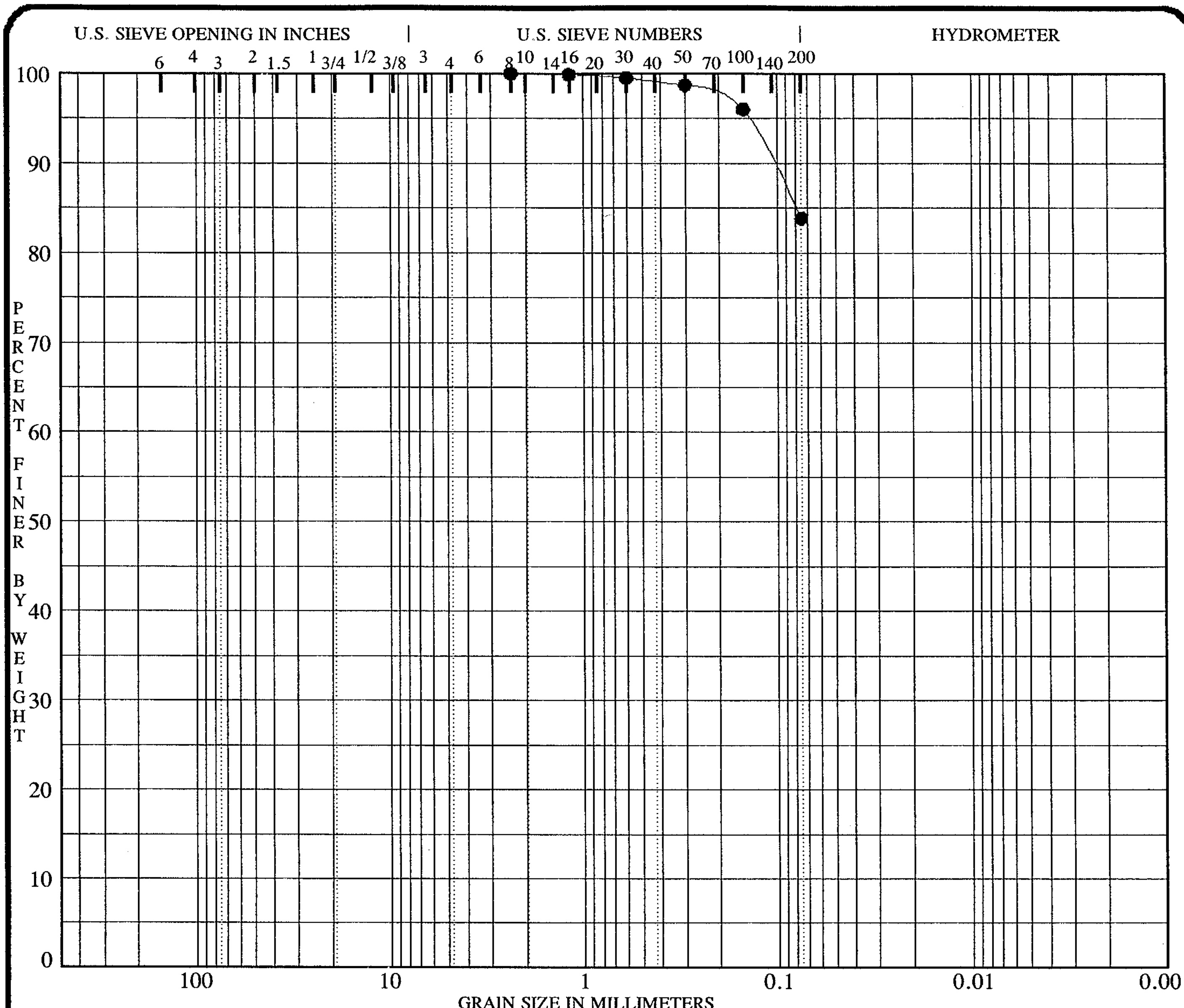
	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	96-110	56.6	1.180				0.0	13.1	86.9	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.
DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.
Groveport, Ohio



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	96-110	66.6		25.6	38.7	21.7	17.0		
			LEAN CLAY with SAND CL						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	% < .002
●	96-110	66.6	2.360				0.0	16.2	83.8	

PROJECT **SPORN PLANT - FLY ASH POND DIKES**

JOB NO.

DATE **05/21/97**

GRADATION CURVES

American Electric Power Service Corp.

Groveport, Ohio

AEPSPP-000722

APPENDIX 5

TABLE 3.7
COMMON PROPERTIES OF CLAY SOILS‡

Consistency	N	Hand test	γ_{sat},* g/cm³	Strength† U_c, kg/cm²
Hard	>30	Difficult to indent	>2.0	>4.0
Very stiff	15-30	Indented by thumbnail	2.08-2.24	2.0-4.0
Stiff	8-15	Indented by thumb	1.92-2.08	1.0-2.0
Medium (firm)	4-8	Molded by strong pressure	1.76-1.92	0.5-1.0
Soft	2-4	Molded by slight pressure	1.60-1.76	0.25-0.5
Very soft	<2	Extrudes between fingers	1.44-1.60	0-0.25

*$\gamma_{sat} = \gamma_{dry} + \gamma_w \left(\frac{e}{1+e}\right)$

†Unconfined compressive strength U_c is usually taken as equal to twice the cohesion c or the undrained shear strength s_u. For the drained strength condition, most clays also have the additional strength parameter ϕ, although for most normally consolidated clays c = 0 (Lambe and Whitman (1969)). Typical values for s_u and drained strength parameters are given in Table 3.30, Hunt (1984).[1]

‡From Hunt (1984).[1] Reprinted with permission of McGraw-Hill Book Company.

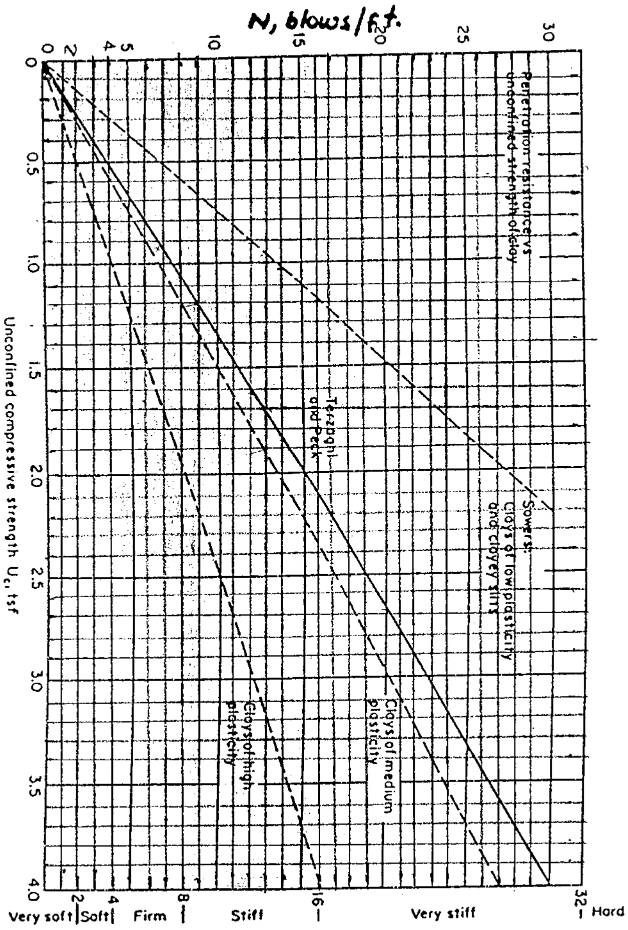


FIG. 3.35 Correlations of SPT N values with U_c for cohesive soils of varying plasticities. (From NAVFAC 1971)[41]

TABLE 3.5
COMMON PROPERTIES OF COHESIONLESS SOILS**

Material	Compactness	D_R, %	N*	γ_{dry},† g/cm³	Void ratio e	Strength‡ ϕ
GW: well-graded gravels, gravel-sand mixtures	Dense	75	90	2.21	0.22	40
	Medium dense	50	55	2.08	0.28	36
	Loose	25	<28	1.97	0.36	32
GP: poorly graded gravels, gravel-sand mixtures	Dense	75	70	2.04	0.33	38
	Medium dense	50	50	1.92	0.39	35
	Loose	25	<20	1.83	0.47	32
SW: well-graded sands, gravelly sands	Dense	75	65	1.89	0.43	37
	Medium dense	50	35	1.79	0.49	34
	Loose	25	<15	1.70	0.57	30
SP: poorly graded sands, gravelly sands	Dense	75	50	1.76	0.52	36
	Medium dense	50	30	1.67	0.60	33
	Loose	25	<10	1.59	0.65	29
SM: silty sands	Dense	75	45	1.65	0.62	35
	Medium dense	50	25	1.55	0.74	32
	Loose	25	<8	1.49	0.80	29
ML: inorganic silts, very fine sands	Dense	75	35	1.49	0.80	33
	Medium dense	50	20	1.41	0.90	31
	Loose	25	<4	1.35	1.0	27

*N is blows per foot of penetration in the SPT. Adjustments for gradation are after Burmister (1962).[24] See Table 6.4 for general relationships of D_R vs. N.

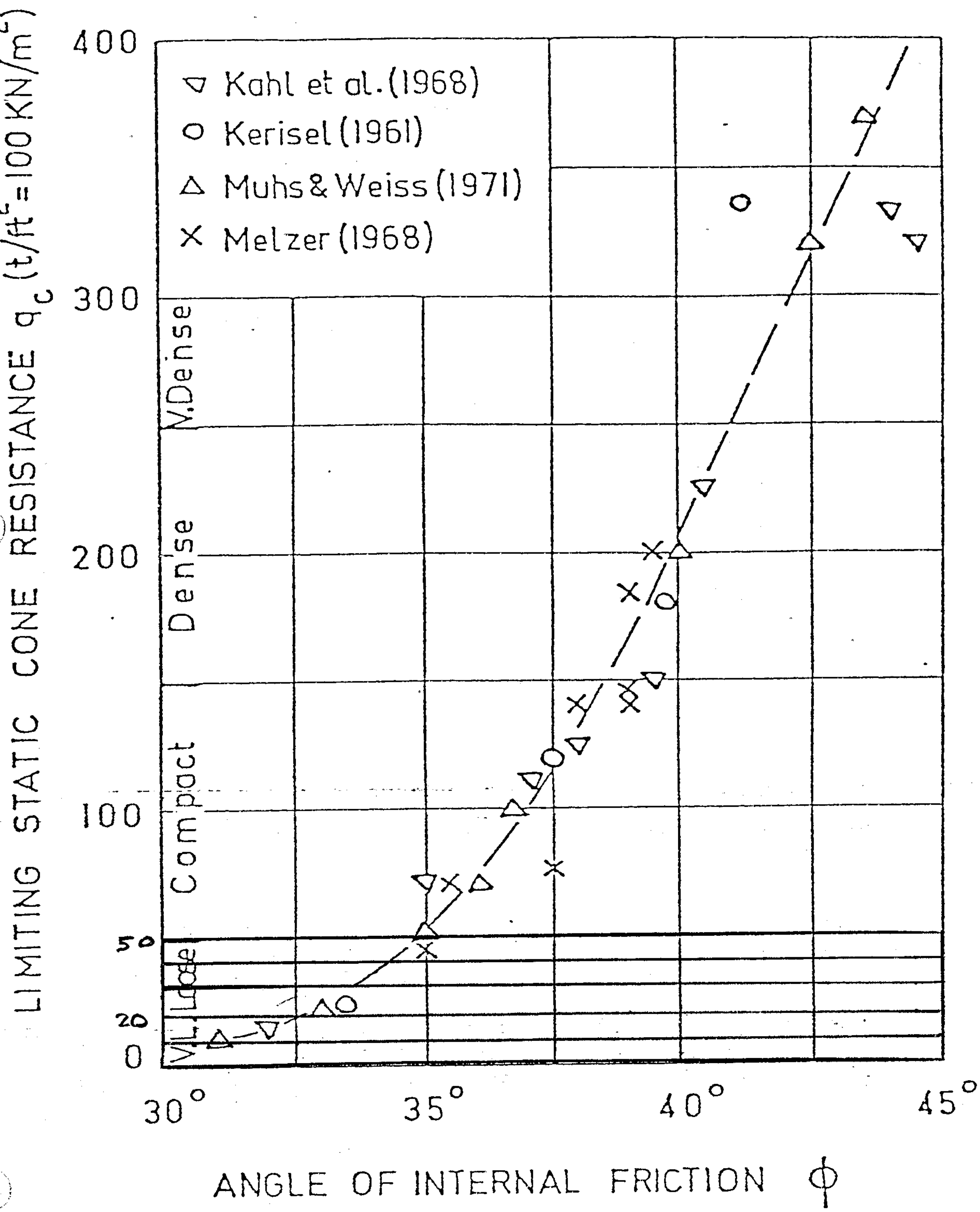
†Density given is for G_s = 2.68 (quartz grains).

‡Friction angle ϕ depends on mineral type, normal stress, and grain angularity as well as D_R and gradation (see Fig. 3.29).

**From Hunt (1984).[1] Reprinted with permission of McGraw-Hill Book Company.

"GEOTECHNICAL ENGINEERING TECHNIQUES AND PRACTICES", ROY. E. HUNT, McGRAW-HILL, INC., 1986, USA

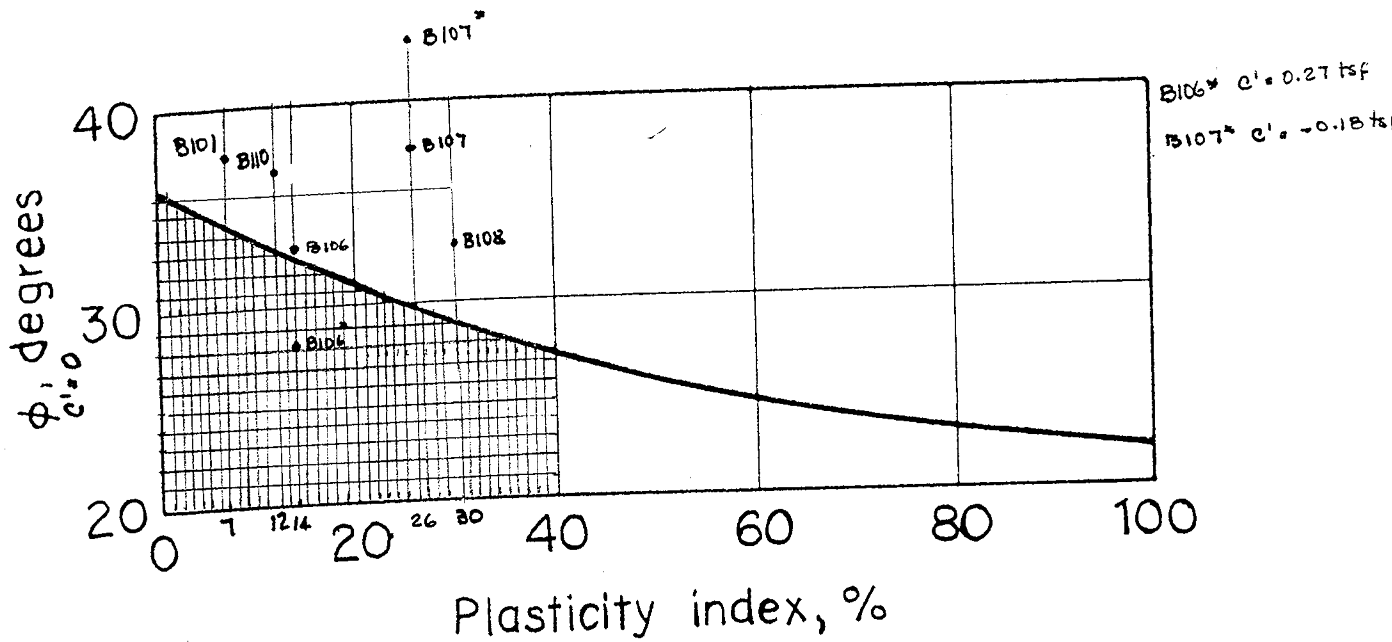
FIG. 11 APPROXIMATE RELATION BETWEEN STATIC CONE RESISTANCE AND ANGLE OF INTERNAL FRICTION OF SAND.



Meyerhof (1974)

SPORN FLY ASH FACILITY

ACTUAL
ϕ' Vs. PI
(BASED ON TRIAXIAL $\overline{CU}$ TESTS)



F3.30 Approximate relationship between ϕ and PI clays of moderate to low sensitivity under drained Conditions. [From Terzaghi and Peck (1967).[21] Reprinted with permission of John Wiley & Sons, Inc.]

Roy E. Hunt, "Geotechnical Engineering Techniques and Practices", McGraw-Hill, Inc., 1986, USA.

7222(R3-84)IAP50
FORM GE-8 (C)

ENGINEERING DEPT.
AMERICAN ELECTRIC POWER SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OHIO

SHEET 1 OF
DATE 5/5/97 BY PJ Amaya CK.
COMPANY CENTRAL OPERATING G.O.
PLANT SPORN

SUBJECT Unit 5 Fly Ash Facility

STRENGTH PARAMETERS

NORTHERN DIKE:

BORING B-101 - ELEV. = 619.0

DEPTH	SN	DESCRIPTION	N	γ_d (pcf)	STRENGTH PARAMETER	SOURCE
3.0 to 4.5		Si-Gravelly Sand (SM) Mc = 6.5%	29	1.65 g/cm³	ϕ = 35°	TABLE 3.5 (1)
5.0 to 6.5		" "	18	1.55 g/cm³	ϕ = 32°	TABLE 3.5 (1)
8.5 to 10.0	4	Si, Gravelly Sand (SM) Mc 10%	9	1.49 g/cm³	ϕ 29°	TABLE 3.5 (1)
11.5 to 13.0	2	Si - Gravelly Sand (SM) Mc = 4.2%	65	1.65 g/cm³	ϕ = 35°	TABLE 3.5 (1)
16.5 to 18.0		" " "	45	1.65 g/cm³	ϕ = 35°	TABLE 3.5 (1)
21.5 to 23.0		Si, Gravelly Sand (SP-SM) Mc = [illegible]	48	1.65 g/cm³	ϕ = 35°	TABLE 3.5 (1)
26.5 to 28.0		Si, [illegible] Sand (SP-SM) Mc = 6.8%	43	1.65 g/cm³	ϕ = 35°	TABLE 3.5 (1)
31.5 to 33.0	3	Br/Gr SiCL w Sa (CL-ML)	12	2.08 g/cm³ *	U_c = 0.9 tsf, ϕ = 34°	Fig 3.35 & 3.30 (1)
33.5 to 35.5	1	PI = 7.0, Mc = 17%	ST	111	C = 1600 psf ϕ = 26; C' = 0 - ϕ' = 38°	TRIAXIAL TESTING PERFORMED BY H.C. Nutting.
36.5 to 38.0		PI = 10, Mc = 17%	14	2.08 g/cm³	U_c = 1.0 tsf; ϕ = 34°	Fig. 3.35 & 3.30 (1)
41.5 to 43.0	5	Gr Silty Sand (SM)	11	1.55 g/cm³	ϕ = 32°	TABLE 3.5 (1)
[illegible]5 to 45.5	6	Gray Clay (CL)	ST	86.0	C = 750 psf ϕ = 15°; C' = 0 psf ϕ' = 33°	TRIAXIAL TESTING B-108
46.5 to 48.0	7	Gr Gravelly Sand (SP)	20	1.67 g/cm³	ϕ = 33°	TABLE 3.5 (1)

* SATURATED

7222(R3-84)IAP50
FORM GE-8 (C)

ENGINEERING DEPT.
AMERICAN ELECTRIC POWER SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OHIO

SHEET 2 OF
DATE 5/15/97 BY P.J. Amaya CK.
COMPANY CENTRAL OPERATING G.O.
PLANT SPORN

SUBJECT Unit 5 Fly Ash Facility

STRENGTH PARAMETERS

NORTHERN DIKE (CONTINUED)

BORING B-102 - Elev. = 619.6

DEPTH	SN	DESCRIPTION	N	γ_d (PCF)	STRENGTH PARAMETERS	SOURCE
3.0 to 4.5	5	Si, Gravelly Sand (SM) Mc = 6.5%	35	1.67 g/cm^3	ϕ = 33°	TABLE 3.5 (1)
5.0 to 6.5		" "	47	1.76 g/cm^3	ϕ = 35°	TABLE 3.5 (1)
8.5 to 10.0	7	Si Gravelly Sand (SM) Mc = 6.5%	35	1.67 g/cm^3	ϕ = 33°	TABLE 3.5 (1)
11.7 to 13.2		" "	60	1.76 g/cm^3	ϕ = 35	TABLE 3.5 (1)
16.7 to 18.2	3	Si Sandy Gravel (GP) Mc = 2.8%	47	1.76 g/cm^3	ϕ = 35°	TABLE 3.5 (1)
21.7 to 23.2		" "	45	1.76 g/cm^3	ϕ = 35°	TABLE 3.5 (1)
26.7 to 28.2	2	SANDY SILT (ML) Mc = 11.8%	20	1.55 g/cm^3	ϕ = 31°	TABLE 3.5 (1)
31.7 to 33.2	4	SANDY CLAY (CL) PI = 9, Mc = 18.%	9	1.92 g/cm^3 *	Uc = 0.7 ksf; ϕ = 34°	Fig. 3.35 & 3.30 (1)
33.7 to 35.7	1	" " "	ST	↑↑↑	C = 1600 PSF, C' = 0; ϕ = 26°, ϕ' = 38	TRIAXIAL TESTING — B-101 —
36.7 to 38.2		Sandy Clay (CL) PI = 8 Mc = 16%	9	1.92 g/cm^3 *	Uc = 0.7 ksf; ϕ = 34°	Fig. 3.35 & 3.30 (1)
41.7 to 43.2	6	GRAVELLY SAND (SP) Mc = 5%	13	1.59 g/cm^3	ϕ = 29°	TABLE 3.5 (1)
[illegible]6.7 to 48.2		" " "	36	1.67 g/cm^3	ϕ = 33°	TABLE 3.5 (1)

* SATURATED

7222(R3-84)IAP50
FORM GE-8 (C)

ENGINEERING DEPT.
AMERICAN ELECTRIC POWER SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OHIO

SHEET 1 OF
DATE 5/15/97 BY PJ Amaya CK.
COMPANY Central Operating G.O.
PLANT Sporn

SUBJECT Unit 5 Fly Ash Facility

Strength Parameters

Western Dike

Boring B-103 - Elev. - 618.

Depth	SN	Description	N	γ_d (pcf)	Strength Parameter	Source
3.0 to 4.5	2	Gravelly Sand (SP) Mc = 4.7%	43	1.76 g/cm³	$\phi = 35°$	Table 3.5 (1)
5.0 to 6.5	3	" " "	36	1.67 g/cm³	$\phi = 33°$	Table 3.5 (1)
8.5 to 10.0		" " "	46	1.76 g/cm³	$\phi = 36°$	Table 3.5 (1)
11.6 to 13.1		" " "	53	1.76 g/cm³	$\phi = 36°$	Table 3.5 (1)
16.6 to 18.1			44	1.76 g/cm³	$\phi = 35°$	Table 3.5 (1)
21.6 to 23.1		" " "	45	1.76 g/cm³	$\phi = 36°$	Table 3.5 (1)
26.6 to 28.1		" " "	45	1.76 g/cm³	$\phi = 36°$	Table 3.5 (1)
31.6 to 33.1	1	Br Silty Clay (CL) PI = 10 Mc 14.5	19	2.08 g/cm³*	$U_c = 1.4$ tsf, $\phi = 34°$	Figures 3.3 & 3.3
36.6 to 38.6	4	Silty Sand (SM)	5T	1.59 g/cm³	$\phi = 29°$	Table 3.5 (1)
41.6 to 43.1		" Mc = 11% "	11	1.59 g/cm³	$\phi = 29°$	Table 3.5 (1)
46.6 to 48.1		Silty Sand (SM)	11	1.59 g/cm³	$\phi = 29°$	Table 3.5 (1)

* Saturated

7222(R3-84)IAP50
FORM GE-8 (C)

ENGINEERING DEPT.
AMERICAN ELECTRIC POWER SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OHIO

SHEET 2 OF
DATE 5/15/97 BY PJAMaya CK.
COMPANY Central Operating G.O.
PLANT Sporn.

SUBJECT Unit 5 Fly Ash Facility

STRENGTH PARAMETERS (continue)

WESTERN DIKE (continue)

BORING B-104 - ELEV. 618.7

DEPTH	SN	DESCRIPTION	N	γ tot (pcf)	STRENGTH PARAMETER	SOURCE
	4					
0.0 to 1.5		Br silty Clay (CL)	12	1.92 g/cm³*	Uc 0.8 tsf ; ϕ = 32°	FIGURE 3.3S (1)
3.0 to 4.5	3	Gravelly SAND (SP) Mc = 1%	32	1.67 g/cm³	ϕ = 33°	TABLE 3.5 (1)
5.0 to 6.5		" " "	73	2.08 g/cm³	ϕ = 36°	TABLE 3.5 (1)
8.5 to 10.0		" Mc = 1% "	43	1.97 g/cm³	ϕ = 35°	TABLE 3.5 (1)
11.7 to 13.2		Gravelly SAND (SP) Mc = 1%	57	1.76 g/cm³	ϕ = 36°	TABLE 3.5 (1)
16.7 to 18.2	2	Gr. silty Sand (SM) Mc = 5%	47	1.65 g/cm³	ϕ = 35°	TABLE 3.5 (1)
21.7 to 23.2		" Mc = 3% " "	46	1.65 g/cm³	ϕ = 35°	TABLE 3.5 (1)
26.7 to 28.2	1	Br Silty Clay (CL) PI = 8 , Mc = 19%	14	2.08 g/cm³*	Uc = 1.0 tsf ; ϕ = 34°	FIGURE 3.3S (1)
31.7 to 33.7	5	Br. Silty SAND (SM) Mc = 9% NP	ST	116	ϕ = 31°	TRIAXIAL TEST H.C. NUTTING COMP.
36.7 to 38.2		" " "	8	116	ϕ = 29°	TABLE 3.5 (1)
41.7 to 43.2	6	Br. Sandy Silt (ML) Mc = 8%	11	116	ϕ = 27°	TABLE 3.5 (1)
[illegible]7 to 48.7		Br " "	ST	116	ϕ = 27°	TABLE 3.5 (1)

* SATURATED

AEPSPP-000730

7222(R3-84)IAP50
FORM GE-8 (C)

ENGINEERING DEPT.
AMERICAN ELECTRIC POWER SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OHIO

SHEET 3 OF
DATE 5/15/97 BY P.J. Amaya CK.
COMPANY Central Operating G.O.
PLANT Sporn

SUBJECT Unit 5 Fly Ash Facility

STRENGTH PARAMETERS (CONTINUED)

WESTERN DIKE (CONTINUED)

BORING B-105 - ELEV. = 619.3

DEPTH	SN	DESCRIPTION	N	γ_d (pcf)	STRENGTH PARAMETER	SOURCE
3.0 to 4.5	4	Si, Gravelly Sand (SM) Mc 2%	21	1.59 g/cm³	$\phi = 31°$	TABLE 3.5 (1)
5.0 to 6.5	3	" " "	37	1.55 g/cm³	$\phi = 35°$	TABLE 3.5 (1)
8.5 to 10.0		" " "	32	1.55 g/cm³	$\phi = 34°$	TABLE 3.5 (1)
11.5 to 13.0		" " "	35	1.55 g/cm³	$\phi = 34°$	TABLE 3.5 (1)
16.5 to 18.0		" Mc 3% "	31	1.55 g/cm³	$\phi = 33°$	TABLE 3.5 (1)
21.5 to 23.0	2	Br. SILTY SAND (SM) Mc 7%	23	1.49 g/cm³	$\phi = 32°$	TABLE 3.5 (1)
26.5 to 28.0	1	Br. silty clay (CL) PI = 10, Mc 33	13	2.08 g/cm³*	$U_c = 0.95$ tsf, $\phi = 34°$	FIGURE 3.35 (1)
31.5 to 33.5		" " "	ST	2.08 g/cm³*	$U_c = 0.95$ tsf, $\phi = 34°$	Figure 3.35 (1)
36.5 to 38.0	5	" " " PI = 10", Mc = 22%	8	1.92 g/cm³*	$U_c = 0.6$ tsf; $\phi = 34°$	Figure 3.35 (1)
41.5 to 43.0	6	Br. Silty Sand (SM) Mc 12%	9	1.49 g/cm³	$\phi = 29°$	TABLE 3.5 (1)
46.5 to 48.0		" "	ST	1.49 g/cm³	$\phi = 29°$	TABLE 3.5 (1)

* SATURATED

7222(R3-84)IAP50
FORM GE-8 (C)

ENGINEERING DEPT.
AMERICAN ELECTRIC POWER SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OHIO

SHEET 1 OF
DATE 5/16/97 BY PJ Amaya CK.
COMPANY Central Operating G.O.
PLANT Sporn Plant

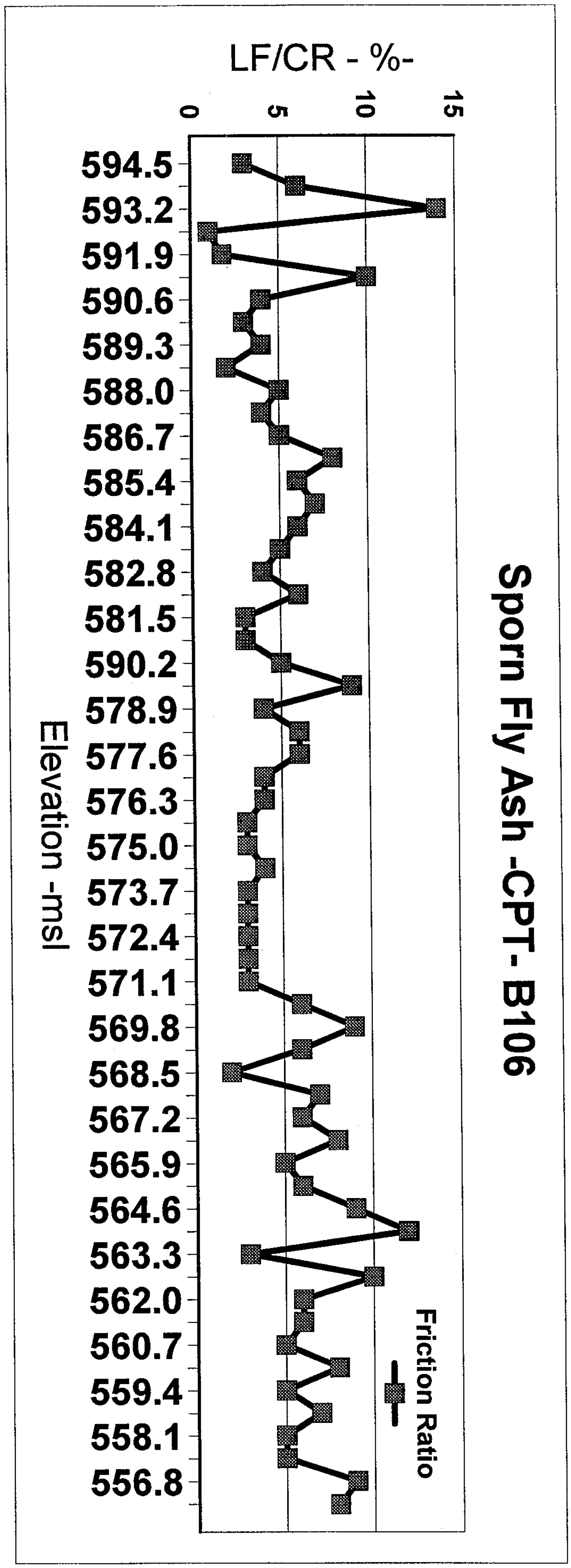
SUBJECT Unit 5 Fly Ash Facility

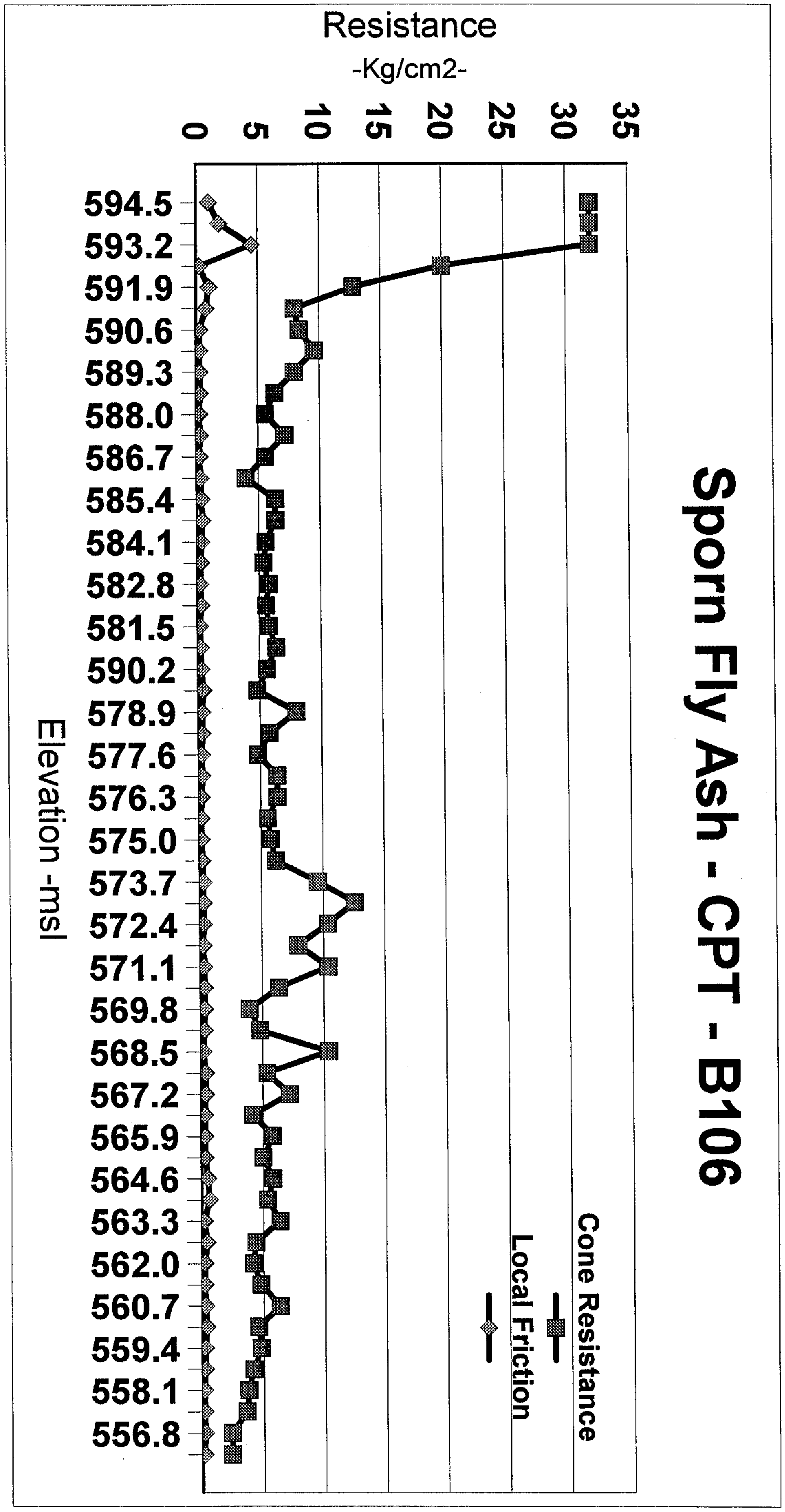
STRENGTH PARAMETERS

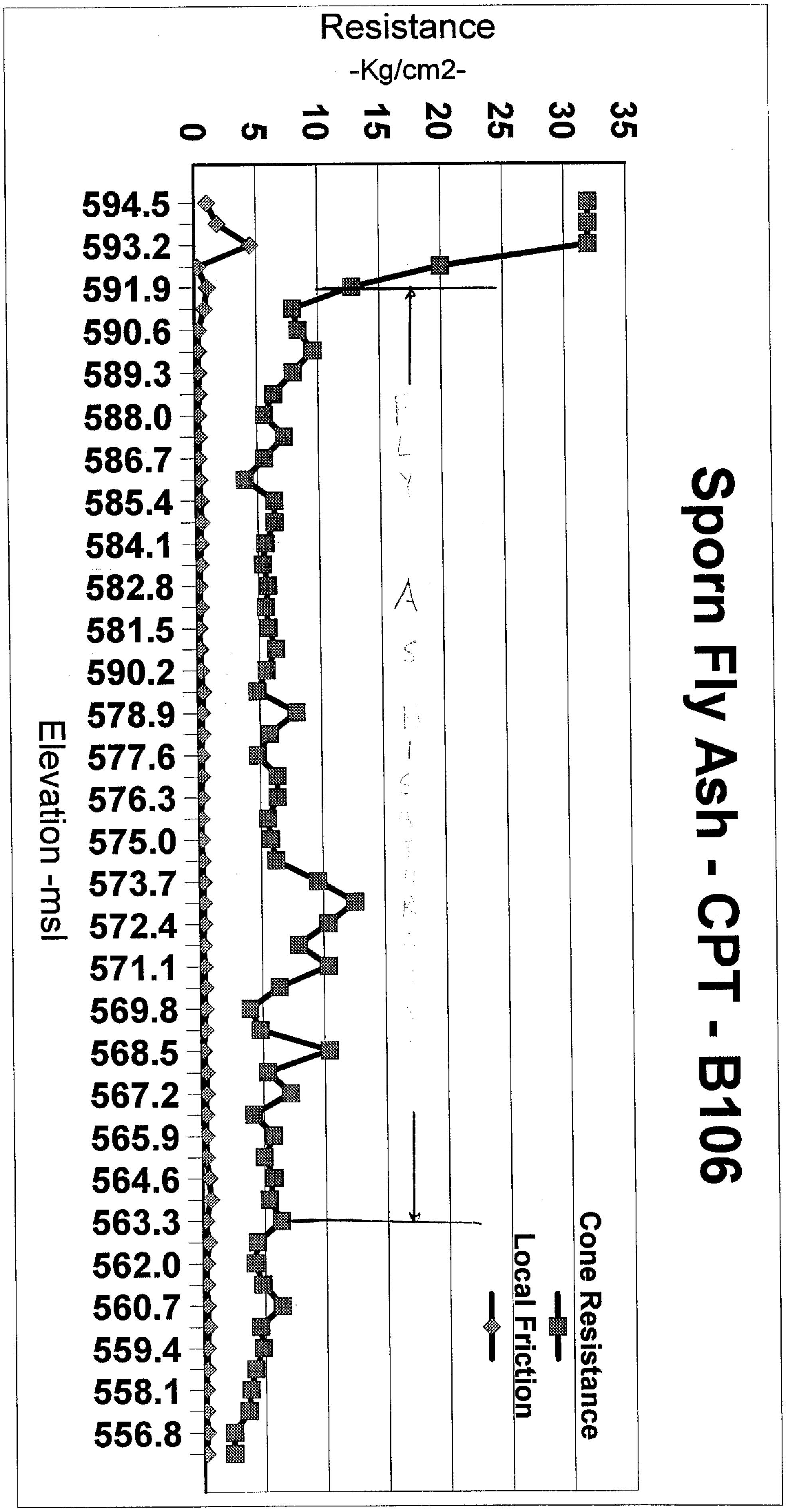
SOUTHERN DIKE

BORING B-106 - Elev.=618.9.

DEPTH	SN	DESCRIPTION	N	γ_d (PCF)	STRENGTH PARAMETERS	SOURCE
3.0 to 4.5	5	Gravelly silty sand (SM)	38	1.55 g/cm³	$\phi = 33°$	TABLE 3.5(1)
		" " "				
5.0 to 6.5		" " "	54	1.65 g/cm³	$\phi = 35°$	TABLE 3.5(1)
8.5 to 10.	4	" " "	37	1.55 g/cm³	$\phi = 33°$	TABLE 3.5(1)
11.5 to 13.	6	" Mc: 6% " "	25	1.55 g/cm³	$\phi = 32°$	TABLE 3.5(1)
16.5 to 18.		" " "	32	1.55 g/cm³	$\phi = 33°$	TABLE 3.5(1)
21.5 to 23.	3	SANDY Clay (CL)	18	2.08 g/cm³ *	$U_c = 1.3$ tsf; $\phi = 34°$	FIGURE 3.35(1)
		PI = 9, Mc = 11%				
26.5 to 28.		Fly Ash (ML)	12	74	$\phi = 29°$	TABLE 3.5(1)
		Mc = 4%				
31.5 to 33		" " "	2	74	$\phi = 27°$	TABLE 3.5(1)
	2	SG = 2.29 Mc = 43%				
36.5 to 38		" " "	2	74	$\phi = 27°$	TABLE 3.5(1)
41.5 to 43		" " "	2	74	$\phi = 27°$	TABLE 3.5(1)
46.5 to 48		" "	4	74	$\phi = 27°$	TABLE 3.5(1)
[illegible]5 to 53.0		SG = 2.42 Mc = 36%	4	74	$\phi = 27°$	TABLE 3.5(1)
56.5 to 58		Gray Silty Clay (CL)	8	1.92 g/cm³ *	$U_c = 1.0$ tsf, $\phi = 32°$	Figure 3.35(1)
	7	PI = 18 Mc = 32%			C = 1200 psf $\phi = 9°$	TRIAXIAL TEST
61.5 to 63.5	1	PI = 74, Mc = 26%	ST	98	$c' = 0$ $\phi' = 33°$	By H.C. Nutting.
66.5 to 68		" "	9	1.92 g/cm³ *	$U_c = 1.2$ tsf, $\phi = 32°$	Figure 3.35(1)


Sporn Fly Ash -CPT- B106
LF/CR - %-
0
5
10
15
Elevation -msl
594.5
593.2
591.9
590.6
589.3
588.0
586.7
585.4
584.1
582.8
581.5
590.2
578.9
577.6
576.3
575.0
573.7
572.4
571.1
569.8
568.5
567.2
565.9
564.6
563.3
562.0
560.7
559.4
558.1
556.8
Friction Ratio


Sporn Fly Ash - CPT - B106
Resistance
-Kg/cm2-
0
5
10
15
20
25
30
35
594.5
593.2
591.9
590.6
589.3
588.0
586.7
585.4
584.1
582.8
581.5
590.2
578.9
577.6
576.3
575.0
573.7
572.4
571.1
569.8
568.5
567.2
565.9
564.6
563.3
562.0
560.7
559.4
558.1
556.8
Elevation -msl
Cone Resistance
Local Friction



Sporn Fly Ash - CPT - B106
Resistance
-Kg/cm2-
0
5
10
15
20
25
30
35
Elevation -msl
594.5
593.2
591.9
590.6
589.3
588.0
586.7
585.4
584.1
582.8
581.5
590.2
578.9
577.6
576.3
575.0
573.7
572.4
571.1
569.8
568.5
567.2
565.9
564.6
563.3
562.0
560.7
559.4
558.1
556.8
Cone Resistance
Local Friction

7222(R3-84)IAP50
FORM GE-8 (C)

ENGINEERING DEPT.
AMERICAN ELECTRIC POWER SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OHIO

SHEET 1 OF ____
DATE 5/5/97 BY PJ Amaya CK. ____
COMPANY Central Operating G.O. ____
PLANT Sporn

SUBJECT Unit 5 Fly Ash Facility

STRENGTH PARAMETERS.

EASTERN DIKE:

BORING B-107 - ELEV. = 618.8.

Depth	SN	Description	N	γ_d (pcf)	Strength Parameter	Source.
3.0 to 4.5	2	Gr. silty Sand (SP)	38	1.67 g/cm³	$\phi = 33°$	TABLE 3.5 (1)
5.0 to 6.5	3	Sand and Gravel	49	1.76 g/cm³	$\phi = 36°$	TABLE 3.5 (1)
8.5 to 10.		" "	42	1.74 g/cm³	$\phi = 35°$	TABLE 3.5 (1)
11.6 to 13.1		Mc 8% "	37	1.83 g/cm³	$\phi = 33°$	TABLE 3.5 (1)
16.6 to 18.1	1	Silty clay (OL) PI = 7, Mc = 16%	18	2.08 g/cm³ *	U_c 1.3 tsf ; $\phi' = 36°$	Fig 3.3 [illegible] (1)
21.6 to 23.1	9	Sandy Silt (ML) Mc = 11%	19	1.41 g/cm³	$\phi = 31°$	TABLE 3.5 (1)
26.6 to 28.1	8	Gray Fly Ash (ML)	14	74.3	$\phi = 30°$	TABLE 3.5 (1)
31.6 to 33.1		" "	19	74.3	$\phi = 31°$	TABLE 3.5 (1)
36.6 to 38.1		" " SG = 2.38 Mc = 38%	2	74.3	$\phi = 27°$	TABLE 3.5 (1)
41.6 to 43.1		" "	2	74.3	$\phi = 27°$	TABLE 3.5 (1)
46.6 to 48.1		" "	2	74.3	$\phi = 27°$	TABLE 3.5 (1)
51.6 to 53.1		" "	2	74.3	$\phi = 27°$	TABLE 3.5 (1)
56.6 to 58.1		SG = 2.31 Mc = 32%	0	74.3	$\phi = 27°$	TABLE 3.5 (1)
61.6 to 73.1	11	PI = 20 Mc 25% DARK BROWN CLAY (CL) PI = 26, Mc = 27%	17 - 13 ST	97.3	U_c = 1.7 tsf ; $\phi' = 30°$ C = 700 psf $\phi' = 17°$ C = 0 $\phi' = 39°$	Fig 3.35 & 3.30 (1) PEAK STRENGTH H.C. NUTTING Co. TRIAXIAL TESTING

7222(R3-84)IAP50
FORM GE-8 (C)

ENGINEERING DEPT.
AMERICAN ELECTRIC POWER SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OHIO

SHEET 2 OF ______
DATE 5/5/97 BY PJ Amaya CK. ______
COMPANY Central Operations G.O. ______
PLANT Sporn.

SUBJECT Unit 5 Fly Ash Facility

STRENGTH PARAMETERS (CONTINUED)

BORING B-108 - EL. 603.4

DEPTH	SN	DESCRIPTION	N	γ_d (pcf)	STRENGTH PARAMETERS	SOURCE
3.0 TO 4.5	4	BOTTOM ASH (SM) Mc = 9%	31	56.0	$\phi = 32°$	TABLE 3.5 (1)
5.0 to 6.5		" "	38	60.5	$\phi = 34°$	TABLE 3.5 (1)
8.5 to 10.0	5	Silty Sand (SM) Mc = 6.%	45	1.65 g/cm³	$\phi = 35°$	TABLE 3.5 (1)
11.6 to 13.1		Gr. Silty Sand (SM) Mc = 3%	40	1.55 g/cm³	$\phi = 34°$	TABLE 3.5 (1)
16.6 to 18.1		Gr. Silty Sand (SM) Mc = 2%	45	1.65 g/cm³	$\phi = 3$[illegible]	TABLE 3.5 (1)
21.6 to 23.1	6	Silty Clay (CL) PI = 7 Mc = [illegible]	14	2.06 g/cm³	U_c 1.0 tsf; ϕ 34°	Fig. 3.35 & 3.30 (1)
26.6 to 28.1	7, 8	Bottom Ash (SM)	8	52.2	$\phi = 29°$	TABLE 3.5 (1)
31.6 to 33.1		Gray Fly Ash (ML) Mc = 4%	3	74.3	$\phi = 27$	TABLE 3.5 (1)
36.6 to 38.1		" "	2	74.3	$\phi = 27°$	TABLE 3.5 (1)
41.6 to 53.1	10	PI = 18, Mc = 23, GRAY CLAY (CL) PI = 30, Mc = 37%	ST 5-12	86.0	U_c 0.7[illegible] ϕ = 32°; $c = 750$ psf $\phi = 15°$; $c' = 0$ psf $\phi' = 33°$	Fig. 3.3[illegible] & 3.3[illegible] (1); PEAK STRENGTH H.C. NUTTING Co. TRIAXIAL TESTING
56.6 to 73.1	12	GRAY Silty Clay (CL) PI [illegible], Mc 25%	ST * 5-11	94.2	$c = 100$ psf $\phi = 17°$; $c' = 0$ psf $\phi' = 37°$; U_c [illegible] ϕ [illegible]	TRIAXIAL TESTING - B-110 -; Fig. 3.3[illegible] & 3.[illegible]

* - $\gamma_{saturated}$

7222(R3-84)IAP50
FORM GE-8 (C)

ENGINEERING DEPT.
AMERICAN ELECTRIC POWER SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OHIO

SHEET 3 OF
DATE 5/5/97 BY P.J. Amaya CK.
COMPANY Central Operating G.O.
PLANT Sporn

SUBJECT Unit 5 Fly Ash Facility

STRENGTH PARAMETERS (CONTINUED)

BORING B-109 - ELEV. = 619.6

DEPTH	SN	DESCRIPTION	N	γ_d (PCF)	STRENGTH PARAMETER	SOURCE
3.0 to 4.5	2	Gr. Silty Sand (SP)	43	1.76 g/cm³	$\phi = 35°$	TABLE 3.5 (1)
5.0 to 6.5	3	" "	39	1.76 g/cm³	$\phi = 34°$	TABLE 3.5 (1)
8.5 to 10.0		" Mc = 1% "	39	1.76 g/cm³	$\phi = 34°$	TABLE 3.5 (1)
	4					
11.7 to 13.2		Si SAND (SM) Mc = 4%	27	1.55 g/cm³	$\phi = 32°$	Table 3.5 (1)
16.7 to 18.2	1	Sandy Silty Clay (CL) Mc = 9%	11	1.92 g/cm³ *	$U_c = 0.8$ tsf ; $\phi' = 34°$	Fig. 3.31 & 3.30 (1)
21.7 to 23.2		" PI = 6 "	14	2.08 g/cm³	$U_c = 1.0$ tsf ; $\phi' = 34°$	Fig. 3.31 & 3.30
26.7 to 28.7	11	Gray Fly Ash (ML) Mc = 4%	ST	74.3	$\phi = 30°$	H.C. Nutting Comp Testing & Table 3.5
31.7 to 33.2		" "	17	74.3	$\phi = 30°$	TABLE 3.5 (1)
36.7 to 38.2		SG = 2.34 Mc = 38%	2	74.3	$\phi = 27°$	TABLE 3.5 (1)
41.7 to 43.2		" "	2	74.3	$\phi = 27°$	TABLE 3.5 (1)
46.7 to 48.2		" "	4	74.3	$\phi = 27°$	TABLE 3.5 (1)
51.7 to 66.7		" "	3	74.3	$\phi = 27°$	TABLE 3.5 (1)
56.7 to 58.2		SG = [illegible] [illegible]	5	74.3	$\phi = 27°$	TABLE 3.5 (1)
61.7 to 73.2	12	Brown Clay (CL) LL = 18%, [illegible]	ST 9-14	97.3	$c = 700$ psf $\phi = 17°$; $c' = 0$ $\phi' = 39°$; $U_c = 1.2$ tsf, $\phi' = 32°$	Triaxial Testing = B-107 —

* SATURATED

7222(R3-84)IAP50
FORM GE-8 (C)

ENGINEERING DEPT.
AMERICAN ELECTRIC POWER SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OHIO

SHEET 4 OF
DATE 5/5/97 BY P.J. Amaya CK.
COMPANY Central Operating G.O.
PLANT Sporn

SUBJECT Unit 5 Fly Ash Facility

STRENGTH PARAMETERS (CONTINUED)

BORING B-110 - ELEV: 602.3

DEPTH	SN	DESCRIPTION	N	γ_d (PCF)	STRENGTH PARAMETERS	SOURCE
3.0 to 4.5	5	BOTTOM ASH (SM)	42	60.5	$\phi = 35°$	TABLE 3.5 (1)
5.0 to 6.5		" Mc 7% "	25	56.0	$\phi = 32°$	TABLE 3.5 (1)
8.5 to 10.0	6	SAND & GRAVEL (GP) Mc 11%	16	1.83 g/cm³	$\phi = 32°$	TABLE 3.5 (1)
11.6 to 13.1		" "	17	1.83 g/cm³	$\phi = 32°$	TABLE 3.5 (1)
16.6 to 18.1	9	Sandy silty clay (CL) PI = 8, Mc 12%	20	2.08 g/cm³ *	Uc = 1.5 tsf; $\phi = 31°$	Fig. 3.35 & 3.30 (1)
18.6 to 20.1		Sandy silty Clay (CL) PI = 7, Mc = 12%	23	2.08 g/cm³ *	Uc = 1.7 tsf; $\phi = 31°$	Fig. 3.35 & 3.30 (1)
21.6 to 23.1		" "	18	2.08 g/cm³ *	Uc = 1.3 tsf; $\phi = 31$	Fig. 3.35 & 3.30 (1)
26.6 to 28.1		" "	18	2.08 g/cm³ *	Uc = 1.3 tsf; $\phi = 31$	Fig. 3.35 & 3.30 (1)
31.6 to 33.1	10	Reddish Br. Clay (CL) PI = 12, Mc = 15%	19	2.08 g/cm³ *	Uc = 1.4 tsf; $\phi = 33°$	Fig. 3.35 & 3.30 (1)
36.6 to 50.0	7	GRAY CLAY (CL) PI = 15, Mc = 25%	ST 8 to 12	86.0	Uc = 1.2 tsf; ϕ = [illegible] C = 750 psf $\phi = 15°$ C' = 0 $\phi' = 33°$	Fig. 3.30 & 3.30 (1) TRIAXIAL TESTING - B108 -
51.6 to 73.1	8	Gray Silty Clay (CL) PI = 12, Mc = 28% PI = 17, Mc = 24% PI = 17, Mc = 26%	ST. 8 to 19	94.2	C = 100 psf $\phi = 17°$ C' = 0 $\phi' = 37°$ Uc = 1.2 tsf; $\phi = 31°$	PEAK STRENGTH H.C. NUTTING CO. TRIAXIAL TESTING Fig. 3.35 & 3.30 (1)
	13			* SATURATED		

AEPSPP-000739

7222(R3-84)IAP50
FORM GE-8 (C)

ENGINEERING DEPT.
AMERICAN ELECTRIC POWER SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OHIO

SHEET 1 OF
DATE 5/6/97 BY P J Amaya CK
COMPANY CENTRAL OPERATING G.O.
PLANT SPORN

SUBJECT Unit 5 Fly Ash Facility

STRENGTH PARAMETERS

BORING SI-3 (1988)

DEPTH	SN	DESCRIPTION	N	γ_d (PCF)	STRENGTH PARAMETERS	SOURCE
3.0 to 4.5	5	Silty Sand (SM)	30	1.55 g/cm³	ϕ = 32°	TABLE 3.5 (1)
8.0 to 9.5		Gravelly Sand (SP)	7	1.59 g/cm³	ϕ = 29°	TABLE 3.5 (1)
13.0 to 14.5		Silty Sand-Gravel (GF	9	1.97 g/cm³	ϕ = 32°	TABLE 3.5 (1)
18.0 to 19.5	6	Sandy Silt (ML)	23	1.41 g/cm³	ϕ = 31	TABLE 3.5 (1)
23.0 to 24.5		" " "	14	1.41 g/cm³	ϕ = 31°	TABLE 3.5 (1)
28.0 to 29.5		" " "	17	1.41 g/cm³	ϕ = 31°	TABLE 3.5 (1)
33.0 to 34.5	7	Brown Clay	20	2.08 g/cm³ *	Uc 1.4 tsf; ϕ = 33°	B-110 (31.6 - 33)
38.0 to 39.5	8	Organic Silty Clay	17	2.08 g/cm³ *	Uc 1.2 tsf; ϕ = 32°	B-110 (36.6 - 50)
43.0 to 49.0	9	Gray Clay	9	1.92 g/cm³ *	c' = 0 ϕ' = 33°	B-110 (36.6 - 50)
53.0 to 54.5	12	Silty Sand & Gravel (GW)	>50	2.08 g/cm³	ϕ = 36°	TABLE 3.5 (1)
58.0 to 59.5		" " "	55	2.08 g/cm³	ϕ = 36°	TABLE 3.5 (1)
63. to 64.5		Sand & Gravel (GP)	53	1.92 g/cm³	ϕ = 35°	TABLE 3.5 (1)
[illegible]3. to 69.5		" " "	24	1.83 g/cm³	ϕ = 32°	TABLE 3.5 (1)
73.0 to 74.5		Silty Sand (SM)	29	1.55 g/cm³	ϕ = 32°	TABLE 3.5 (1)
78. to 89.5		Sand (SP)	27	1.67 g/cm³	ϕ = 33°	TABLE 3.5 (1)
93. to 94.5		Silty Sand & Gravel (GW)	35	1.97 g/cm³	ϕ = 32	TABLE 3.5 (1)

• 10 Feet REPLACED WITH REINFORCED BOTTOM ASH - 1995

• UNDERDRAIN PLACED IN THE SANDY SILT SOIL - 1995

7222(R3-84)IAP50
FORM GE-8 (C)

ENGINEERING DEPT.
AMERICAN ELECTRIC POWER SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OHIO

SHEET 2 OF
DATE 5/6/97 BY PJ Arnage CK.
COMPANY CENTRAL OPERATING G.O.
PLANT SPORN

SUBJECT Unit 5 Fly Ash Facility

STRENGTH PARAMETERS (CONTINUED)

BORING 9301 (1993)

DEPTH	SN	DESCRIPTION	N	γ_d (pcf)	STRENGTH PARAMETERS	SOURCE
0.0 to 1.5	1	Silty Clay (cl)	7	1.92 g/cm³ *	U_c = 1.1 tsf ; ϕ = 30°	TABLE 3.35 (1)
1.5 to 3.0		Sandy Clay (?)	30	2.24 g/cm³ *	U_c = 4.0 tsf ; ϕ = 30°	TABLE 3.35 (1)
3.0 to 4.5	4	BOTTOM ASH (SM)	25	52.2	ϕ = 32°	TABLE 3.5 (1)
4.5 to 6.0	11	GRAY FLY ASH (ML)	42	74.3	ϕ = 33°	TABLE 3.5 (1)
6.0 to 7.5		" " "	38	74.3	ϕ = 33°	TABLE 3.5 (1)
7.5 to 9.0		" " "	36	74.3	ϕ = 33°	TABLE 3.5 (1)
9.0 to 10.5		" " "	29	74.3	ϕ = 33°	TABLE 3.5 (1)
10.5 to 12.0		" " "	21	74.3	ϕ = 31°	TABLE 3.5 (1)
12.0 to 13.5		" " "	25	74.3	ϕ = 31°	TABLE 3.5 (1)
13.5 to 15.0		" " "	16	74.3	ϕ = 31°	TABLE 3.5 (1)
15.0 to 16.5		" " "	6	74.3	ϕ = 27°	TABLE 3.5 (1)
16.5 to 18.0		" " "	2	74.3	ϕ = 27°	TABLE 3.5 (1)
18.0 to 19.5		" " "	0	74.3	ϕ = 27°	TABLE 3.5 (1)
19.5 to 21.0		" " "	5	74.3	ϕ = 27°	TABLE 3.5 (1)
21.0 to 22.5		SAND and Gravel (GP)	15	1.83 g/cm³	ϕ = 32°	TABLE 3.5 (1)

7222(R3-84)IAP50
FORM GE-8 (C)

ENGINEERING DEPT.
AMERICAN ELECTRIC POWER SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OHIO

SHEET 3 OF
DATE 5/7/97 BY PJ Amaya CK.
COMPANY Central Operating G.O.
PLANT Sporn.

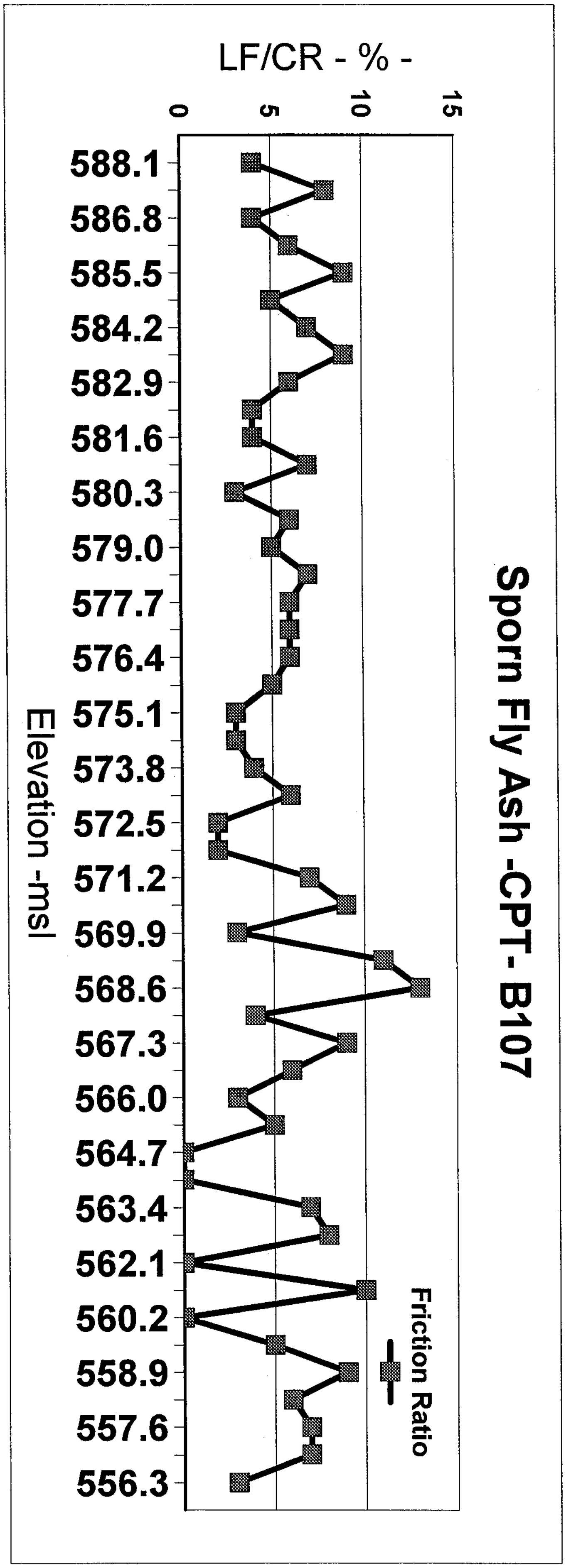
SUBJECT Unit 5 Fly Ash Facility

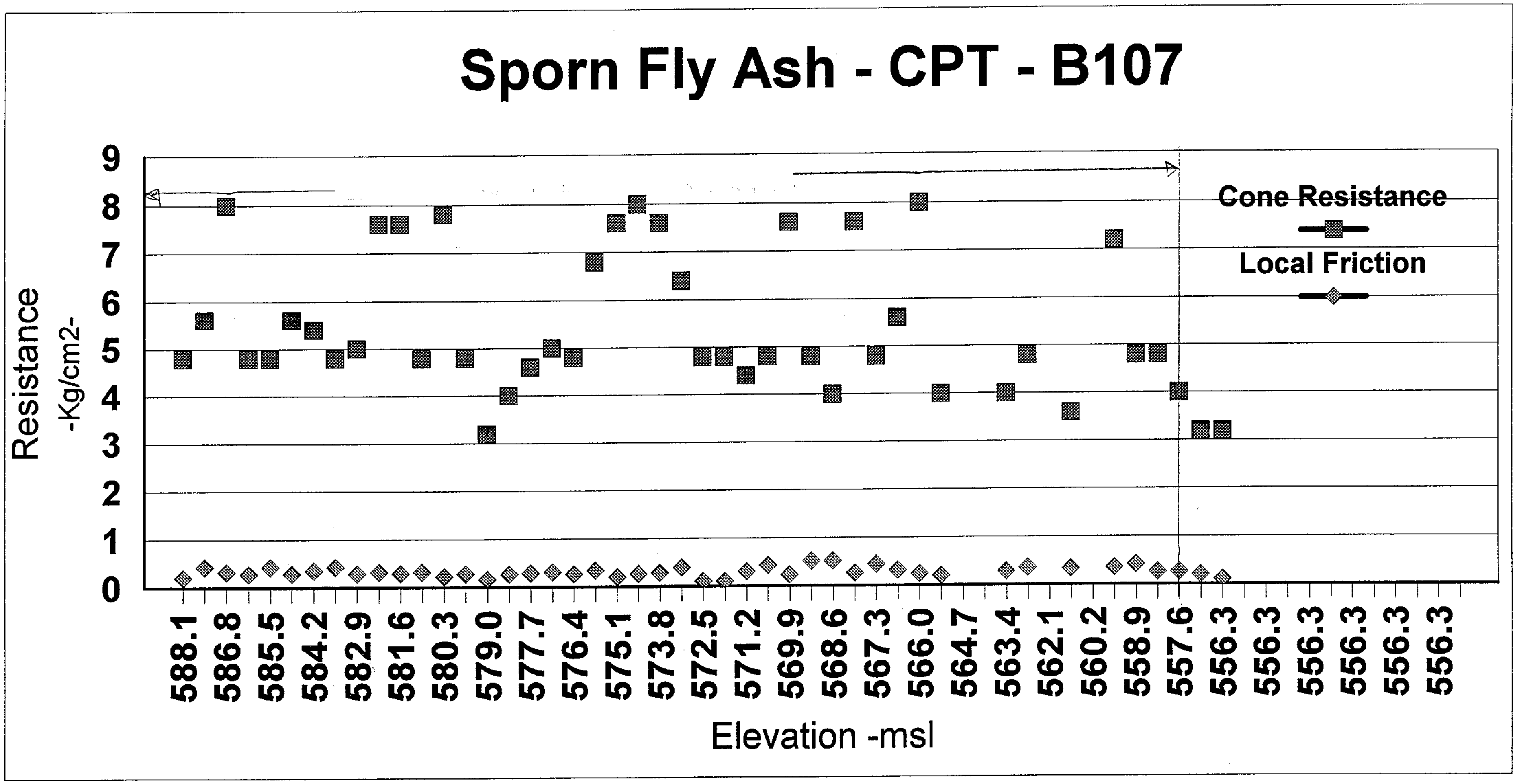
STRENGTH PARAMETERS (CONTINUED)

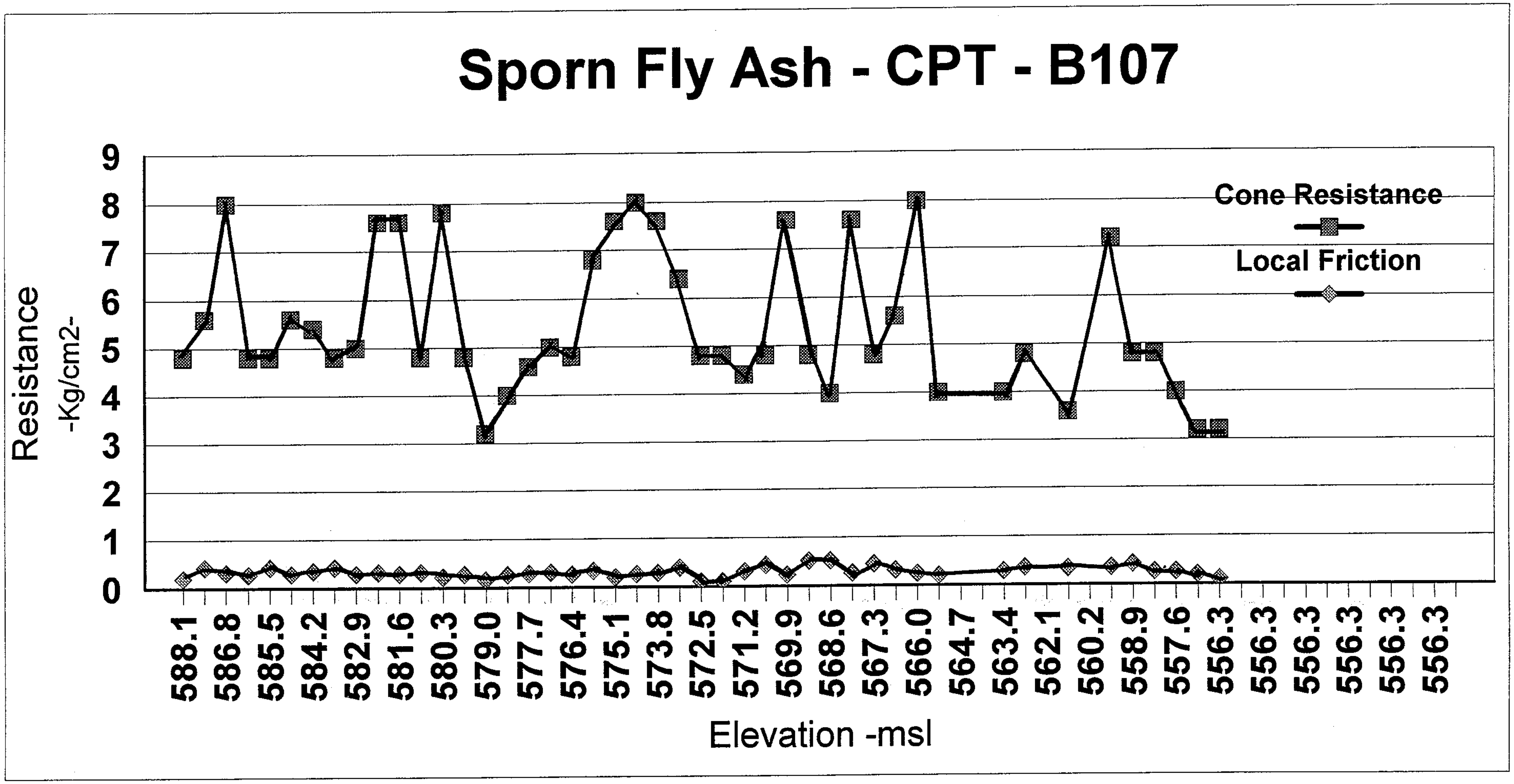
BORING 9301 (Continued)

DEPTH	SU	DESCRIPTION	N	γ_d (pcf)	STRENGTH PARAMETERS	SOURCE
22.5 to 24.0	10	Sandy silty clay (CL)	11	1.92 g/cm³*	U_c = 0.6; ϕ' = 34°	B-110 (21.6-23.6
24.0 to 27.5		Brown silty clay (CL)	20	2.08 g/cm³*	U_c 1.4 tsf; ϕ' 33°	B-110
27.5 to 31.0		" " "	14	2.08 g/cm³*	U_c 1.0 tsf; ϕ' = 32°	B-110
31.0 to 34.5		" " "	16	2.08 g/cm³*	U_c = 1.2 tsf; ϕ' = 32°	B-110
34.5 to 38.0		" " "	16	2.08 g/cm³*	U_c 1.2 tsf; ϕ = 32°	B-110
38.0 to 41.5		" " "	15	2.08 g/cm³*	U_c 1.1 tsf; ϕ = 32°	B-110
41.5 to 45	9	gray clay (CL)	10	1.92 g/cm³*	U_c = 0.75 tsf; ϕ = 33°	TABLE 3.3 "
45.0 to 46.5	12	Sand & Gravel (GP)	7	1.83 g/cm³	ϕ = 32°	TABLE 3.5 "

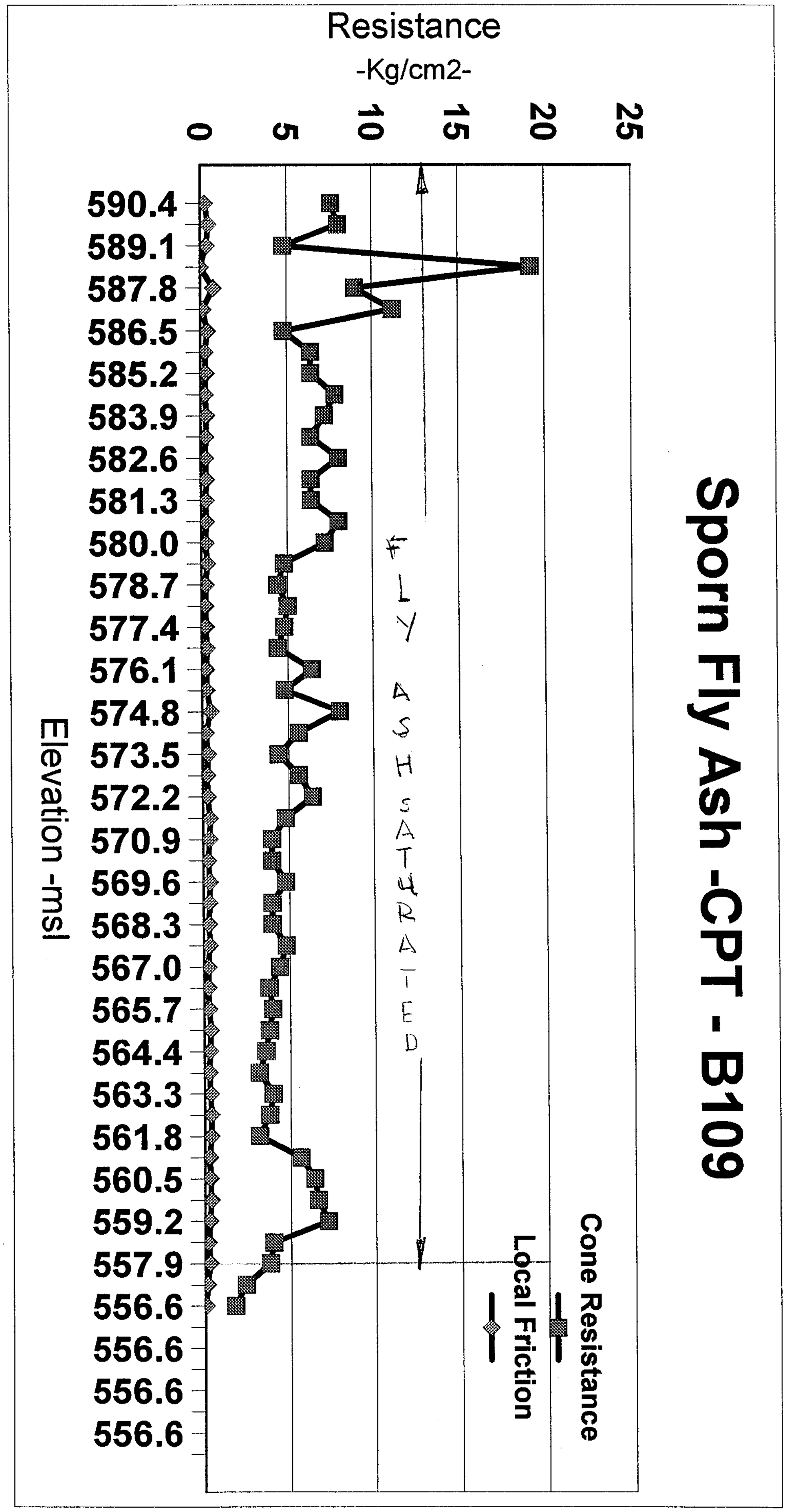
* Saturated

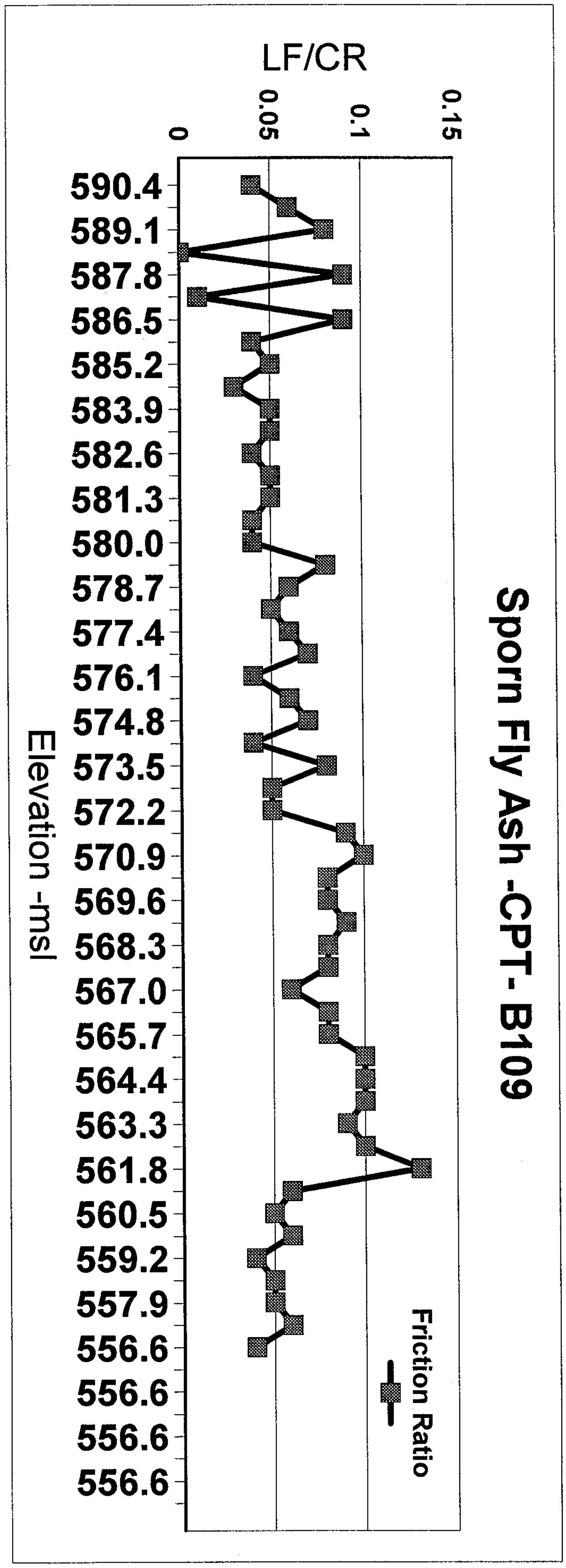

Sporn Fly Ash -CPT- B107
LF/CR - % -
0
5
10
15
588.1
586.8
585.5
584.2
582.9
581.6
580.3
579.0
577.7
576.4
575.1
573.8
572.5
571.2
569.9
568.6
567.3
566.0
564.7
563.4
562.1
560.2
558.9
557.6
556.3
Elevation -msl
Friction Ratio


Sporn Fly Ash - CPT - B107
Resistance
-Kg/cm2-
0
1
2
3
4
5
6
7
8
9
Cone Resistance
Local Friction
588.1
586.8
585.5
584.2
582.9
581.6
580.3
579.0
577.7
576.4
575.1
573.8
572.5
571.2
569.9
568.6
567.3
566.0
564.7
563.4
562.1
560.2
558.9
557.6
556.3
556.3
556.3
556.3
556.3
556.3
Elevation -msl



Sporn Fly Ash - CPT - B107
Resistance
-Kg/cm2-
0
1
2
3
4
5
6
7
8
9
Cone Resistance
Local Friction
588.1
586.8
585.5
584.2
582.9
581.6
580.3
579.0
577.7
576.4
575.1
573.8
572.5
571.2
569.9
568.6
567.3
566.0
564.7
563.4
562.1
560.2
558.9
557.6
556.3
556.3
556.3
556.3
556.3
556.3
Elevation -msl


Sporn Fly Ash -CPT - B109
Resistance
-Kg/cm2-
0
5
10
15
20
25
Elevation -msl
590.4
589.1
587.8
586.5
585.2
583.9
582.6
581.3
580.0
578.7
577.4
576.1
574.8
573.5
572.2
570.9
569.6
568.3
567.0
565.7
564.4
563.3
561.8
560.5
559.2
557.9
556.6
556.6
556.6
556.6
Cone Resistance
Local Friction
FLY ASH SATURATED


Sporn Fly Ash -CPT- B109
LF/CR
0
0.05
0.1
0.15
Elevation -msl
590.4
589.1
587.8
586.5
585.2
583.9
582.6
581.3
580.0
578.7
577.4
576.1
574.8
573.5
572.2
570.9
569.6
568.3
567.0
565.7
564.4
563.3
561.8
560.5
559.2
557.9
556.6
556.6
556.6
556.6
Friction Ratio

BORING B-106 - CPT - STRENGTH PARAMETERS. - FLY-ASH

AVERAGE $\gamma' = 119.7$ lbs/ft³

@ 27' ELEVATION = 591.9 ; $\sigma_v' = 27' \times 119.7 \frac{lbs}{ft^3} = 3{,}231.9$ lbs/ft²

$= 1.62$ tsf $= 1.6$ Kg/cm²

USING FIG. 3.28 (or 5)[2] [1] STATIC CONE RESISTANCE q_c VS. Dr, THE FLY ASH AT THIS LOCATION HAS A RELATIVE DENSITY Dr = 0%.

FROM FIG. 3.29 (or 11)[2] [1] FRICTION ANGLE AND RELATIVE DENSITY RELATIONSHIPS FOR GRANULAR SOILS, THE FLY ASH AT THIS LOCATION HAS A $\phi'_{MAX.} = 28°$ (1) or $\phi = 30°$ (2)

$\boxed{\phi \text{ BASED ON SPT} = 27° \text{ to } 29°}$

BORING B-107 - CPT - STRENGTH PARAMETERS

AVERAGE $\gamma' = 1.69$ Kg/cm³ $= 105.7$ lbs/ft³

@ 26.6', ELEVATION 592.2 ; $\sigma_v' = 26.6 \times 105.7$ 2,811.6 lbs/ft²

$= 1.4$ tsf $= 1.4$ Kg/cm²

USING FIG. 3.28 (1) or FIG (5) (2) STATIC CONE RESISTANCE q_c V.S. Dr, THE FLY ASH AT THIS LOCATION HAS A RELATIVE DENSITY, Dr = 0%

FROM FIG. 3.29 (1) or FIG. 11 (2) THE FLY ASH AT THIS LOCATION HAS A $\phi'_{max} = 28°$ (1) or $\phi = 30°$ (2)

$\boxed{\phi \text{ BASED ON SPT} = 27° \text{ to } 31°}$

---

(1) "GEOTECHNICAL ENGINEERING, TECHNIQUES AND PRACTICE" Roy E. Hunt.

(2) "INTERPRETATION OF THE CONE PENETRATION TEST" - THE DUTCH CONE PENETROMETER CONVERSION KIT - Hogentogler & Co. INC.

BORING B-109 – CPT – STRENGTH PARAMETERS

AVERAGE γ = 1.71 Kg/cm³ = 106.6 lbs/ft³

@ 26.7' ELEVATION = 592.9; σ_v' = 20.5' x (106.6) + 6.2 (106.6 − 62.4) =

σ_v' = 2459.3 lbs/ft² = 1.23 tsf = 1.2 Kg/cm

USING FIG. 3.28 (1) or FIG 5. (2) STATIC CONE RESISTANCE q_c VS. D_r, THE FLY ASH AT THIS LOCATION HAS A RELATIVE DENSITY, D_r = 0%

FROM FIG. 3.29 (1) or FIG. 11 (2) THE FLY ASH AT THIS LOCATION HAS A ϕ'_{MAX} = 28° (1) or ϕ = 30° (2)

$\boxed{\phi \text{ BASED ON SPT} = 27° \text{ to } 30°}$

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER 3966

COMPANY APPALACHIAN POWER COMPANY

PROJECT Sporn fly ash pond dikes

COORDINATES N 720,983.0 E 1,734,516.1

GROUND ELEVATION 619.0 SYSTEM STATE PLANE

BORING NO. 96-101 DATE SHEET 1 OF 2

BORING START 06/05/96 BORING FINISH 06/05/96

PIEZOMETER TYPE SS WELL TYPE

HGT. RISER ABOVE GROUND DIA

DEPTH TO TOP OF WELL SCREEN 24.4 BOTTOM 33.4

WELL DEVELOPMENT NO BACKFILL QUICK GROUT

FIELD PARTY MCR-REB RIG BK-81

WATER LEVEL	▽	▼	▽
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	DRILLER'S NOTES
1		0.0			0				No sample taken boring in road way	
2	SS	3.0	4.5	12-13-16	1.1		5	SM	BROWN SILTY GRAVELLY SAND Dry to moist, 1/2" max size, rounded, quartz.	
3	SS	5.0	6.5	7-9-9	1.2					
3	SS	8.5	10.0	3-4-5	1.2		10	SC	BROWN CLAYEY SAND Moist, fine grain with trace of gravel.	
4	SS	11.5	13.0	17-27-38	1.2			SM	BROWN SILTY GRAVELLY SAND Moist, fine grain, trace of gravel, quartz.	
5	SS	16.5	18.0	12-19-26	1.1		15			
							20			20.0 Top of seal.
6	SS	21.5	23.0	16-21-27	1.1			SW	BROWN GRAVELLY SAND Moist, trace of small gravel, quartz, rounded.	22.0 Top of sand.
							25			24.4 Top of screen.
7	SS	26.5	28.0	12-20-23	1.2			GP	BROWN SAND AND GRAVEL Moist to wet, quartz, rounded, 3/4" max size, some fines.	
							30			
8	SS	31.5	33.0	4-5-7	1.1			SM	BROWN SILTY SAND Moist, 100% fine grain.	
9	ST	33.5	35.5		1.6				Push 2.0 Time 5 sec. PSI 800 Top of sample, BROWN SILTY SAND	34.0 Bottom of pipe.
10	SS	36.5	38.0	4-6-8	1.1		35	CL	Bottom of sample, LIGHT GRAY CLAY Moist, low to medium plasticity.	34.4 Bottom of screen. 584.6 35.0 Bottom of sand.
							40			
11	SS	41.5	43.0	4-5-6	1.1			SM	DARK GRAY SILTY SAND Wet, non to slight plasticity, with reddish brown quartz sand lens	
12	ST	43.5	45.5		1.5		45	ML	PUSH 2.0 TIME 5 SEC PSI 800	
13	SS	46.5	48.0	7-9-11	1.1			SP	Bottom of sample, Drillers identification fly ash I believe it is a light gray clay	

Continued Next Page

TYPE OF CASING USED		
	NQ-2 ROCK CORE	
X	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER REB

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

AEP

JOB NUMBER 3966

COMPANY APPALACHIAN POWER COMPANY

BORING NO. 96-101 DATE ______ SHEET 2 OF 2

PROJECT Sporn fly ash pond dikes

BORING START 06/05/96 BORING FINISH 06/05/96

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										????????????????????????????????????		
										Top of sample, BROWN SILTY		
										BROWN GRAVELLY SAND Moist, 1/2" max size, rounded, quartz.		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER 3966

COMPANY APPALACHIAN POWER COMPANY

PROJECT Sporn fly ash pond dikes

COORDINATES N 720,707.5 E 1,734,001.7

GROUND ELEVATION 619.6 SYSTEM STATE PLANE

BORING NO. 96-102 DATE ______ SHEET 1 OF 1

BORING START 06/05/96 BORING FINISH 06/05/96

PIEZOMETER TYPE ______ WELL TYPE ______

HGT. RISER ABOVE GROUND ______ DIA ______

DEPTH TO TOP OF WELL SCREEN ______ BOTTOM ______

WELL DEVELOPMENT ______ BACKFILL QUICK GROUT

FIELD PARTY MCR-REB RIG BK-81

WATER LEVEL	▽	▼	▽
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1		0.0			0					NO SAMPLE TAKEN BORING IN ROAD AUGER CUTTINGS INDICATE BROWN SAND AND GRAVEL		Boring was grouted from grade to 48.2' with quick grout.
2	SS	3.0	4.5	12-16-19	1.1				SP	BROWN GRAVELLY SAND Moist, 1/2" max size, rounder, quartz with fines.		
3	SS	5.0	6.5	17-21-26	1.2		5					
4	SS	8.5	10.0	13-16-19	1.2		10					
5	SS	11.7	13.2	15-28-32	1.2		15					
6	SS	16.7	18.2	17-21-26	1.2		20					
7	SS	21.7	23.2	19-21-24	1.1		25			Sample moist to wet.		
8	SS	26.7	28.2	9-9-11	1.1		30		SM	DARK BROWN SANDY SILT Moist, non-plastic.		
9	SS	31.7	33.2	3-4-5	1.1				SC	BROWN SANDY CLAY Moist, low plasticity, with v-fine sand lens.		
10	ST	33.7	35.7		?		35			Time 5 sec. Push 2.0 PSI 1000		
11	SS	36.7	38.2	4-4-5	1.1		40		SM	BROWN SILTY SAND Moist, with very fine sand lens.		
12	SS	41.7	43.2	3-5-8	1.1		45		SP	BROWN GRAVELLY SAND Moist, 3/4" max size, rounded, quartz.		
13	SS	46.7	48.2	13-15-21	1.2							

TYPE OF CASING USED		
X	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER REB

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER 3966
COMPANY APPALACHIAN POWER COMPANY
PROJECT Sporn fly ash pond dikes
COORDINATES N 719,785.3 E 1,734,133.3
GROUND ELEVATION 618.0 SYSTEM STATE PLANE

BORING NO. 96-103 DATE ____ SHEET 1 OF 1
BORING START 06/04/96 BORING FINISH 06/04/96
PIEZOMETER TYPE ____ WELL TYPE ____
HGT. RISER ABOVE GROUND ____ DIA ____
DEPTH TO TOP OF WELL SCREEN ____ BOTTOM ____
WELL DEVELOPMENT ____ BACKFILL QUICK GROUT
FIELD PARTY MCR-REB RIG BK-81

WATER LEVEL	∇	▼	∇
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1		0.0			0					NO SAMPLE TAKEN BORING LOCATED IN ROAD CUTTINGS INDICATE BROWN SAND AND GRAVEL		Boring grouted from grade to 48.1 w\ 60 gallons of quick grout.
2	SS	3.0	4.5	12-19-24	1.1				SP	DARK BROWN GRAVELLY SAND Moist, rounded, quartz, with fines, 3/4" max size.		
3	SS	5.0	6.5	14-17-19	1.2		5					
4	SS	8.5	10.0	17-21-25	1.1		10					
5	SS	11.6	13.1	19-25-28	1.1							
6	SS	16.6	18.1	12-19-25	1.2		15					
7	SS	21.6	23.1	5-14-21	1.1		20					
8	SS	26.6	28.1	11-17-28	1.2		25					
9	SS	31.6	33.1	8-9-10	1.1		30		CL	BROWN SILTY CLAY Moist, with fine grin sand lens, low plasticity.		
10	ST	36.6	38.6		1.6		35		SP	time 5 sec. Push 2.0 PSI 700 LIGHT BROWN SAND Fine grain.		
11	SS	41.6	43.1	4-5-6	1.1		40			BROWN SAND Moist, 100% fine grain, with fines.		
12	SS	46.6	48.1	6-6-5	?		45					

TYPE OF CASING USED		
X	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER REB

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER 3966

COMPANY APPALACHIAN POWER COMPANY

PROJECT Sporn fly ash pond dikes

COORDINATES N 719,229.2 E 1,734,600.2

GROUND ELEVATION 618.7 SYSTEM STATE PLANE

WATER LEVEL	▽	▼	▽
TIME			
DATE			

BORING NO. 96-104 DATE ____ SHEET 1 OF 2

BORING START 06/04/96 BORING FINISH 06/04/96

PIEZOMETER TYPE SS WELL TYPE ____

HGT. RISER ABOVE GROUND ____ DIA ____

DEPTH TO TOP OF WELL SCREEN 24.1 BOTTOM 33.1

WELL DEVELOPMENT NO BACKFILL QUICK GROUT

FIELD PARTY MCR-REB RIG BK-81

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	DRILLER'S NOTES
1	SS	0.0		2-4-8	1.1			CL	-	
2	SS	3.0	4.5	9-14-18	1.2			SP	**DARK BROWN CLAY** Moist, medium to high plasticity trace of sand.	
3	SS	5.0	6.5	73	1.1		5	GW	**BROWN GRAVELLY SAND** Dry, quartz, 1/2" max, rounded.	
4	SS	8.5	10.0	9-18-25	1.2		10		**DARK BROWN SAND AND GRAVEL** Dry, quartz, 1/2" max, rounded. **Same as above some fines, moist**	
5	SS	11.7	13.2	19-26-31	1.2			SP	**DARK BROWN GRAVELLY SAND** Dry, 3/4" max, rounded, quartz.	
6	SS	16.7	18.2	18-21-26	1.2		15	SC	**DARK BROWN CLAYEY SAND** Moist, trace of gravel.	
7	SS	21.7	23.2	17-21-25	1.2		20	SP	**LIGHT BROWN GRAVELLY SAND** Dry, quartz, 3/4" max, rounded.	20.4 Top seal. 22.5 Top of sand. 24.1 Top of screen.
8	SS	26.7	28.2	4-6-8	1.1		25	CL	**LIGHT BROWN SILTY CLAY** Moist, low to medium plasticity.	
9	ST	31.7	33.7		1.6		30		**PUSH 2.0** **PSI 900** **TIME 6 SEC.** **BROWN CLAYEY SAND** Fine grain?	33.1 Bottom of screen. 34.7 Bottom of sand.
10	SS	36.7	38.2	3-3-5	1.2		35		**LIGHT BROWN SILTY CLAY** Moist, low to medium plasticity.	
11	SS	41.7	43.2	4-4-7	1.1		40	SM	**LIGHT BROWN SILTY SAND** Moist. v-fine grain 100%.	
12	ST	46.7	48.7		1.5		45		**PUSH 2.0** **PSI 1200** **TIME 6 SEC.**	

Continued Next Page

TYPE OF CASING USED		
X	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER REB

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 3966

COMPANY APPALACHIAN POWER COMPANY

BORING NO. 96-104 DATE ____ SHEET 2 OF 2

PROJECT Sporn fly ash pond dikes

BORING START 06/04/96 BORING FINISH 06/04/96

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										DARK BROWN SANDY CLAY Fine grain.		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER 3966

COMPANY APPALACHIAN POWER COMPANY

PROJECT Sporn fly ash pond dikes

COORDINATES N 718,782.8 E 1,735,084.7

GROUND ELEVATION 619.3 SYSTEM STATE PLANE

BORING NO. 96-105 DATE ______ SHEET 1 OF 1

BORING START 06/03/96 BORING FINISH 06/03/96

PIEZOMETER TYPE ______ WELL TYPE ______

HGT. RISER ABOVE GROUND ______ DIA ______

DEPTH TO TOP OF WELL SCREEN ______ BOTTOM ______

WELL DEVELOPMENT ______ BACKFILL QUICK GROUT

FIELD PARTY MCR-REB RIG BK-81

WATER LEVEL	▽	▼	▽
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										No sample taken. Boring located in road bed. Auger cuttings sand and gravel.		Boring grouted from grade to 48.5' with 75 gallons of quick grout
1	SS	3.0	4.5	7-10-11	1.1				SW	BROWN SAND Dry, quartz, rounded with trace of gravel.		
2	SS	5.0	6.5	12-16-21	1.2		5			BROWN GRAVELLY SAND Dry quartz, rounded, 1/2" max size.		
3	SS	8.5	10.0	9-15-17	1.2					3/4" max size trace of fines.		
4	SS	11.5	13.0	9-16-19	1.1		10					
5	SS	16.5	18.0	9-14-17	1.2		15			Moist		
6	SS	21.5	23.0	7-9-14	1.1		20		SM	DARK BROWN SILTY SAND Moist, with trace of small gravel.		
7	SS	26.5	28.0	5-6-7	1.2		25		CL	BROWN SILTY CLAY Moist, low to medium plasticity.		
8	ST	31.5	33.5		1.7		30			PUSH 2.0 PSI 700 TIME 8 SEC.		
9	SS	36.5	38.0	3-3-5	1.1		35					
10	SS	41.5	43.0	4-4-5	1.2		40		SP SC	LIGHT BROWN CLAYEY SAND Moist, 100% v-fine grain.		
11	ST	46.5	48.0		1.8		45			TIME 5 SEC PSI 800 PUSH 2.0		

TYPE OF CASING USED		
X	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER REB

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER 3966

COMPANY APPALACHIAN POWER COMPANY

PROJECT Sporn fly ash pond dikes

COORDINATES N 719,271.8 E 1,735,858.4

GROUND ELEVATION 618.9 SYSTEM STATE PLANE

BORING NO. 96-106 DATE SHEET 1 OF 2

BORING START 05/28/96 BORING FINISH 05/28/96

PIEZOMETER TYPE WELL TYPE

HGT. RISER ABOVE GROUND DIA

DEPTH TO TOP OF WELL SCREEN BOTTOM

WELL DEVELOPMENT BACKFILL QUICK GROUT

FIELD PARTY MCR-REB RIG BK-81

WATER LEVEL	▽ 60.2	▼	▽
TIME			
DATE	5-28-96		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										NO SAMPLE TAKEN BORING IN ROAD BED.		
1	SS	3.0	4.5	15-17-21	1.1				GP	DARK BROWN SAND AND GRAVEL Moist, 1/2" max, rounded, quartz, some fines.		
2	SS	5.0	6.5	17-24-30	1.1		5			1" max size		
3	SS	8.5	10.0	13-17-20	1.2					1/2" max size		
4	SS	11.5	13.0	11-11-14	1.2		10					
5	SS	16.5	18.0	13-15-17	1.1		15			1/2" max size		
6	SS	21.5	23.0	6-8-10	1.2		20		SC	BROWN SANDY CLAY Dry, slight to low plasticity.		
7	SS	26.5	28.0	4-6-6	1.2		25			GRAY FLY ASH Dry.		
8	SS	31.5	33.0	1-1-1	1.2		30			Saturated		
9	SS	36.5	38.0	1-1-1	1.2		35					
10	SS	41.5	43.0	1-1-1	1.2		40					
11	SS	46.5	48.0	3-2-2	1.1		45					

Continued Next Page

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER REB

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

AEP

JOB NUMBER 3966

COMPANY APPALACHIAN POWER COMPANY BORING NO. 96-106 DATE ______ SHEET 2 OF 2

PROJECT Sporn fly ash pond dikes BORING START 05/28/96 BORING FINISH 05/28/96

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
12	SS	51.5	53.0	2-2-2	1.2		55					
13	SS	56.5	58.0	3-4-4	1.2				CL	DARK GRAY SILTY CLAY Wet, low to medium plasticity, trace of organic material.		
							60				∇	
14	ST	61.5	63.5		1.6					Time 7 sec. Push 2.0 PSI 600		
							65			BROWN SILTY CLAY Trace of fine sand.		
15	SS	66.5	68.0	3-4-5	1.2					BROWN CLAY Wet, medium to high plasticity.		
												Boring grouted from 68.0' to grade with 125 gallons quick grout.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER 3966

COMPANY APPALACHIAN POWER COMPANY

PROJECT Sporn fly ash pond dikes

COORDINATES N 719,691.4 E 1,736,040.0

GROUND ELEVATION 618.8 SYSTEM STATE PLANE

BORING NO. 96-107 DATE ____ SHEET 1 OF 2

BORING START 05/29/96 BORING FINISH 05/29/96

PIEZOMETER TYPE ____ WELL TYPE ____

HGT. RISER ABOVE GROUND ____ DIA ____

DEPTH TO TOP OF WELL SCREEN ____ BOTTOM ____

WELL DEVELOPMENT ____ BACKFILL QUICK GROUT

FIELD PARTY MCR-REB RIG BK-81

WATER LEVEL	▽ 39.1	▼	▽
TIME			
DATE	5-29-96		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
									NO SAMPLE TAKEN BORING IN ROAD BED. AUGER CUTTINGS INDICATE BROWN SAND AND GRAVEL		Boring was grouted from 73.1 to grade w/approximately 100 gallons of quick grout.
1	SS	3.0	4.5	14-17-21	1.1			GP	BROWN SAND AND GRAVEL Moist, quartz, rounded, some fine 3/4' max size		
2	SS	5.0	6.5	17-21-28	1.2		5				
3	SS	8.5	10.0	14-18-24	1.1				1/2" max size		
4	SS	11.6	13.1	13-16-21	1.2		10				
5	SS	16.6	18.1	5-8-10	1.1		15	ML	BROWN SILT Moist, non to v-slight plasticity.		
6	SS	21.6	23.1	8-8-11	1.2		20	SM	Attempted shelby tube lifted rig BROWN SILT SAND Moist, 100% v-fine grain.		
7	SS	26.6	28.1	4-5-9	1.2		25		GRAY FLY ASH Moist.		
8	SS	31.6	33.1	5-8-11	1.2		30		Saturated		
9	SS	36.6	38.1	1-1-1	1.1		35			▽	
10	SS	41.6	43.1	1-1-1	1.2		40				
11	SS	46.6	48.1	1-1-1	1.2		45				

Continued Next Page

TYPE OF CASING USED		
X	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER REB

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER 3966
COMPANY APPALACHIAN POWER COMPANY
PROJECT Sporn fly ash pond dikes

BORING NO. 96-107 DATE SHEET 2 OF 2
BORING START 05/29/96 BORING FINISH 05/29/96

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
12	SS	51.6	53.1	2-1-1	1.2		55					
13	SS	56.6	58.1	0	1.3		60					Weight of 140# hammer.
14	SS	61.6	63.1	4-7-10	1.2		65		CL	DARK BROWN CLAY Moist. medium to high plasticity.		
15	ST	66.6	68.6		1.5		70			Push 2.0 Time 5 sec. PSI 600 BROWN CLAY		
16	SS	71.6	73.1	4-6-7	1.2							

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

AEP

JOB NUMBER 3966
COMPANY APPALACHIAN POWER COMPANY
PROJECT Sporn fly ash pond dikes
COORDINATES N 719,761.8 E 1,736,125.4
GROUND ELEVATION 603.4 SYSTEM STATE PLANE

BORING NO. 96-108 DATE ______ SHEET 1 OF 2
BORING START 06/11/96 BORING FINISH 06/11/96
PIEZOMETER TYPE SS WELL TYPE ______
HGT. RISER ABOVE GROUND ______ DIA ______
DEPTH TO TOP OF WELL SCREEN 63.3 BOTTOM 72.3
WELL DEVELOPMENT NO BACKFILL QUICK GROUT
FIELD PARTY MCR-WEB RIG BK-81

WATER LEVEL	∇	▼	∇
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	DRILLER'S NOTES
									No sample road base	
1	SS	3.0	4.5	11-15-16	1.2				BLACK SAND AND BOTTOM ASH Moist.	
3	SS	5.0	6.5	12-17-21	1.5		5			
4	SS	8.5	10.0	12-16-29	.9		10	SC	DARK BROWN CLAYEY SAND Moist, with fine sand lens.	
5	SS	11.6	13.1	9-18-22	1.2			SP	DARK BROWN GRAVELLY SAND Moist, quartz, some fine, 1/2" max size.	
6	SS	16.6	18.1	18-24-21	.8		15	SC	DARK BROWN CLAYEY SAND Moist, trace of small gravel and ash.	
7	SS	21.6	23.1	6-6-8	1.5		20	CL	LIGHT BROWN SILTY CLAY Moist, low plasticity.	
8	SS	26.6	28.1	4-4-4	1.0		25		BLACK BOTTOM ASH Saturated.	
9	SS	31.6	33.1	2-1-2	1.1		30		GRAY FLY ASH Saturated.	
10	SS	36.6	38.1	2-1-1	1.5		35			
11	SS	41.6	43.1	3-5-7	.8		40	CL	LIGHT GRAY CLAY Moist to wet, medium to high plasticity.	
12	ST	46.6	48.6		2.0		45		PUSH 2.0 TIME 7 SEC. PSI 1000	

Continued Next Page

TYPE OF CASING USED		
X	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER REB

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER 3966

COMPANY APPALACHIAN POWER COMPANY

BORING NO. 96-108 DATE ______ SHEET 2 OF 2

PROJECT Sporn fly ash pond dikes

BORING START 06/11/96 BORING FINISH 06/11/96

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
13	SS	51.6	53.1	2-2-3	?				CL	**DARK GRAY SILTY CLAY** Wet, low plasticity, trace of organic and sand.		
14	SS	56.6	58.1	2-2-3	1.5		55					57.0 Top of seal.
15	SS	61.6	63.1	3-4-5	1.5		60					60.6 Top of sand. 63.3 Top screen.
16	SS	66.6	68.1	4-4-5	1.5		65					
17	SS	71.6	73.1	4-5-6	1.5		70					72.3 Bottom of screen. 74.0 Bottom of sand.

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

AEP

JOB NUMBER 3966
COMPANY APPALACHIAN POWER COMPANY
PROJECT Sporn fly ash pond dikes
COORDINATES N 720,227.5 E 1,735,579.0
GROUND ELEVATION 619.6 SYSTEM STATE PLANE

WATER LEVEL	▽ 20.5	▼	▽
TIME			
DATE	5-30-96		

BORING NO. 96-109 DATE SHEET 1 OF 2
BORING START 05/29/96 BORING FINISH 05/30/96
PIEZOMETER TYPE WELL TYPE
HGT. RISER ABOVE GROUND DIA
DEPTH TO TOP OF WELL SCREEN BOTTOM
WELL DEVELOPMENT BACKFILL QUICK GROUT
FIELD PARTY MCR-REB RIG BK-81

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										NO SAMPLE TAKEN BORING LOCATED IN ROAD BASE. AUGER CUTTINGS INDICATE BROWN SAND AND GRAVEL		Boring grouted from 73.2 to grade with 150 gallons quick grout.
1	SS	3.0	4.5	13-19-24	1.2				GP	DARK BROWN SAND AND GRAVEL Moist, 1/2" max size, quartz, rounded, some fines.		
2	SS	5.0	6.5	15-18-21	1.1		5					
3	SS	8.5	10.0	15-18-21	1.2		10					
4	SS	11.7	13.2	12-13-14	1.0				SP	DARK BROWN SAND Moist, fine grain.		
5	SS	16.7	18.2	4-5-6	1.1		15		ML	BROWN SANDY SILT Moist, non plasticity.		
6	SS	21.7	23.2	4-6-8	1.2		20				▽	
7	ST	26.7	28.7		1.5		25			Time 10 sec PSI 1200 Push 2.0 By watching rig psi possible .4 to .5 of fly ash in bottom of tube.		
8	SS ~~ST~~	31.7	33.2	4-7-10	1.1		30			GRAY FLY ASH Moist.		
9	SS	36.7	38.2	1-1-1	1.2		35			Saturated		
10	SS	41.7	43.2	1-1-1	1.2		40					
11	SS	46.7	48.2	1-1-3	?		45					

Continued Next Page

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER REB

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER 3966

COMPANY APPALACHIAN POWER COMPANY

BORING NO. 96-109 DATE ______ SHEET 2 OF 2

PROJECT Sporn fly ash pond dikes

BORING START 05/29/96 BORING FINISH 05/30/96

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
12	SS	51.7	66.7	1-1-2	1.2		55					
13	SS	56.7	58.2	1-1-4	1.2		60					
14	SS	61.7	63.2	4-6-8	?				CL	DARK BROWN CLAY Moist, medium to high plasticity.		
15	ST	66.7	68.7		1.7		65			Time 8 sec. Push 2.0 PSI 1000 Material same as sample no. 14		
16	SS	71.7	73.2	3-4-5	1.2		70					

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER 3966
COMPANY APPALACHIAN POWER COMPANY
PROJECT Sporn fly ash pond dikes
COORDINATES N 720,277.1 E 1,735,665.6
GROUND ELEVATION 602.3 SYSTEM STATE PLANE

BORING NO. 96-110 DATE ____ SHEET 1 OF 2
BORING START 06/06/96 BORING FINISH 06/10/96
PIEZOMETER TYPE SS WELL TYPE ____
HGT. RISER ABOVE GROUND ____ DIA ____
DEPTH TO TOP OF WELL SCREEN 43.7 BOTTOM 52.7
WELL DEVELOPMENT NO BACKFILL QUICK GROUT
FIELD PARTY MCR-REB RIG BK-81

WATER LEVEL	DRY		
TIME			
DATE	6-10-96		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	DRILLER'S NOTES
									No sample taken, boring in road.	Grouted grade to 73.1' with approximately 80 gallons.
1	SS	3.0	4.5	13-18-24	1.1				DARK GRAY BOTTOM ASH Dry	
2	SS	5.0	6.5	10-11-14	1.2		5			
3	SS	8.5	10.0	5-7-9	1.1			GP	DARK BROWN SAND AND GRAVEL Dry, quartz, rounded, 3/4" max.	
4	SS	11.6	13.1	6-7-10	1.1		10			
5	SS	16.6	18.1	8-10-10	1.2		15	CL	BROWN CLAY Dry, low to medium plasticity with trace of v-fine sand.	
6	SS	18.6	20.1	9-11-12	1.2			SC	Attempted to push tube lifted drill, destroyed end of tube.	
7	SS	21.6	23.1	5-7-11	1.2		20		BROWN SANDY CLAY Moist, low to medium plasticity with v-fine grain sand lens.	
		23.6							Grading to more sand	
							25		Attempted to push tube, top hole broken in tube, pushed approximately 1' lifted rig.	
9	SS	26.6	28.1	5-7-11	1.2				GRAYISH BROWN SILTY CLAY Moist, low to medium plasticity.	
							30		Could not move or knock tube off to the side of lead auger, pulled augers grouted hole moved approximately three feet down stream to start new hole. No spt taken on new hole untill this point. SWL dry augers to 26.6'. Auger set all weekend at this point.	
10	SS	31.6	33.1	7-10-9	1.3			CL		
11	SS	36.6	38.1		1.5		35	CL	REDDISH BROWN CLAY Dry to moist, medium to high plasticity.	
12	ST	38.6	40.6		2.0				MEDIUM GRAY CLAY Moist to dry, medium to high plasticity, with odor of organic.	39.1 Top of seal.
13	SS	41.6	43.1	3-5-7	1.5		40		PUSH 2.0 PSI 1200 TIME 6 SEC.	41.7 Top of sand. 43.7 Top of screen.
14	SS	46.6	48.1	3-4-4	1.5		45		Top DARK BROWNISH GRAY SANDY CLAY Bottom BROWN SANDY CLAY DARK GRAY CLAY Moist to wet, medium to high plasticity, strong odor of organic.	

Continued Next Page

TYPE OF CASING USED		
X	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER REB

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

AEP

JOB NUMBER 3966

COMPANY APPALACHIAN POWER COMPANY | BORING NO. 96-110 | DATE | SHEET 2 OF 2

PROJECT Sporn fly ash pond dikes | BORING START 06/06/96 | BORING FINISH 06/10/96

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	SS	51.6	53.1	3-3-5	1.5					GRAY BROWN CLAY Moist to wet, medium to high plasticity, odor of organic with v-fine grain sand lens, water on out side of spoon.		52.7 Bottom of screen. 53.3 Bottom of sand.
							55					
16	SS	56.6	58.1	3-4-4	1.5							
17	ST	58.6	60.6		2.0					PUSH 2.0 TIME 7 SEC. PSI 770		
							60			DARK GRAY SILTY CLAY		
18	SS	61.6	63.1	10	?					DARK GRAY CLAY Moist to wet, medium to high plasticity, strong odor of organic material.		
							65					
19	SS	66.6	68.1	3-4-5	1.5							
							70					
20	SS	71.6	73.1	4-7-11	1.4							

Figure 8

DUTCH CONE PENETROMETER
Field Data Form

Date: 7-26-96

Project: Sporn Plant Ash Dike

Test No.: 96101 DCR

Location:

Tested by: Roush-Bowles

Remarks:

Test Procedure:
Rate of Feed: 2cm/sec or no more than 1 in/sec
Run test every 20 cm or approx. 8 inches

C = Cone F = Friction R = Resistance
CR = Cone Resistance LF = Local Friction
Weight of inner rod = 0.14 Kg/cm^2/rod length

Depth ①	C Kg/cm^2 ②	F + C Kg/cm^2 ③	F ③ – ② Kg/cm^2 ④	CR ② x 2 Kg/cm^2 ⑤	LF ④ x 0.133 Kg/cm^2 ⑥	Friction Ratio* ⑥ / ⑤ ⑦
35.1	5.6	12.3				
35.9	4.0					
36.7						
37.5	4.0	6.3				
38.3	6.6	10.6				
[illegible]1	5.0	8.3				
[illegible].9	4.3	9.3				
40.7	3.3	7.3				
41.5	4.6	7.6				
42.3	4.3	8.3				
43.1	4.3	7.3				
43.9	7.6	8.9				
44.7	8.0	14.0				
45.3	8.3	12.0				
46.3	15.3	28.0				
47.1		48.0				

Top Cone

Friction Resistance

Cone Resistance

Friction Ratio

DEPTH

Note: The friction ratio is computed by dividing the local friction by the cone resistance measured 20 cm above the local friction during the previous test.

Figure 8 Page 1-3

DUTCH CONE PENETROMETER
Field Data Form

Date: 7-30-96

[illegible]ct: Spown Plant

Test No.: B-96106 DCP

[illegible]ocation: Fly Ash Dike

Tested by: Roush + Barkes Remarks:

Test Procedure:
Rate of Feed: 2cm/sec or no more than 1 in/sec
Run test every 20 cm or approx. 8 inches

C = Cone F = Friction R = Resistance
CR = Cone Resistance LF = Local Friction
Weight of inner rod = 0.14 Kg/cm^2/rod length

Depth ①	C Kg/cm2 ②	F + C Kg/cm2 ③	F ③ – ② Kg/cm2 ④	CR ② x 2 Kg/cm2 ⑤	LF ④ x 0.133 Kg/cm2 ⑥	Friction Ratio* ⑥ / ⑤ ⑦
24.40	16.0	24.0				
25.15	16.0	30.0				
25.70	16.0	50.0				
26.35	10.0	12.0				
27.00	6.4	14.4				
[illegible]5	4.0	10.0				
[illegible].30	4.2	6.6				
28.95	4.8	7.2				
29.60	4.0	6.2				
30.25	3.2	5.6				
30.90	2.8	4.7				
31.55	3.6	5.8				
32.20	2.8	4.8				
32.85	2.0	4.4				
33.50	3.2	6.3				
34.15	3.2	6.4				
34.80	2.8	5.6				
35.45	2.7	4.9				
36.10	2.9	4.7				
36.75	2.8	5.2				
37.40	2.9	4.3				
38.05	3.2	4.8				
3[illegible]0	2.8	4.7				
[illegible]5	2.4	5.8				
40.00	4.0	6.4				

Friction Resistance

Cone Resistance

Friction Ratio

DEPTH

Note: The friction ratio is computed by dividing the local friction by the cone resistance measured 20 cm above the local friction during the previous test.

Figure 8 2-3

DUTCH CONE PENETROMETER
Field Data Form

Project: ______________________ Date: 7-30-96

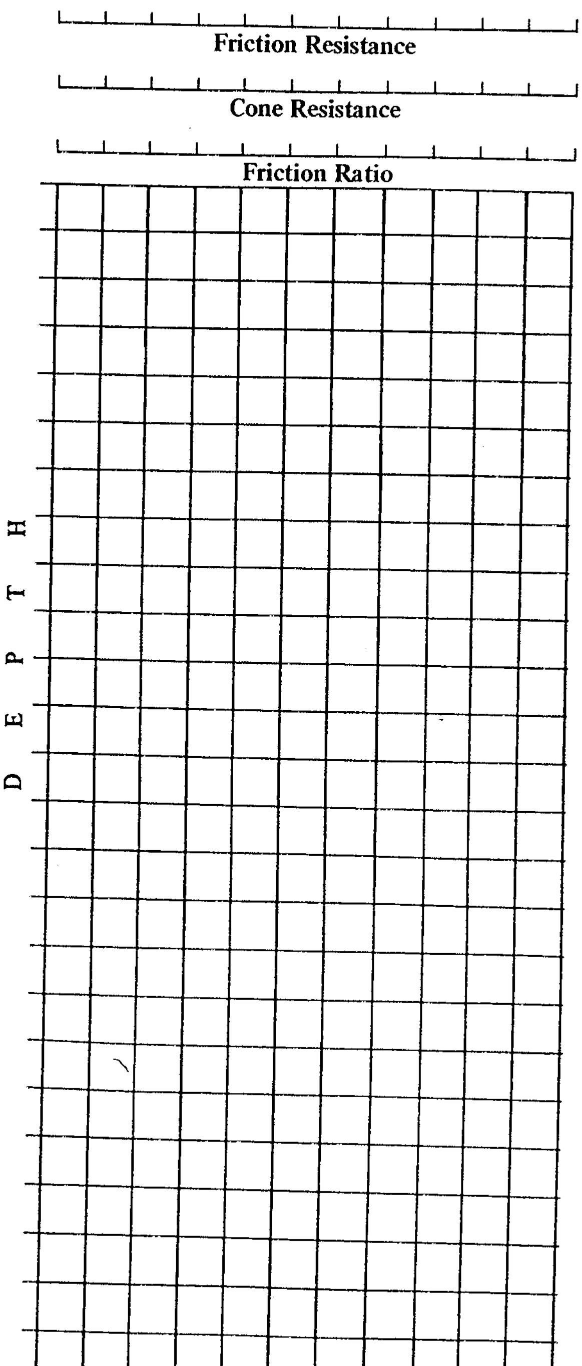
Location: ______________________ Test No. B-96106 DCP

Tested by: ______________ Remarks: ______________

Test Procedure:
Rate of Feed: 2cm/sec or no more than 1 in/sec
Run test every 20 cm or approx. 8 inches

C = Cone F = Friction R = Resistance
CR = Cone Resistance LF = Local Friction
Weight of inner rod = 0.14 Kg/cm^2/rod length

Depth ①	C Kg/cm2 ②	F + C Kg/cm2 ③	F ③ − ② Kg/cm2 ④	CR ② × 2 Kg/cm2 ⑤	LF ④ × 0.133 Kg/cm2 ⑥	Friction Ratio* ⑥ / ⑤ ⑦
40.65	2.9	5.4				
41.30	2.4	4.5				
41.95	3.2	5.3				
42.60	3.2	4.9				
43.25	2.8	5.1				
.90	2.9	4.3				
44.55	3.1	4.8				
45.20	4.8	7.2				
45.85	6.3	8.8				
46.50	5.2	7.6				
47.15	4.0	5.9				
47.80	5.2	7.6				
48.45	3.2	6.0				
49.10	2.0	4.8				
49.75	2.4	4.6				
50.40	5.2	6.6				
51.05	2.7	5.7				
51.70	3.6	6.7				
52.35	2.1	4.6				
53.00	2.9	5.2				
53.65	2.5	4.7				
54.30	2.9	6.8				
95	2.7	7.6				



Note: The friction ratio is computed by dividing the local friction by the cone resistance measured 20 cm above the local friction during the previous test.

AEPSPP-000625

Figure 8 3-3

DUTCH CONE PENETROMETER
Field Data Form

Date: 7-30-96

Project:

Test No.: B-96106 DCP

Location:

Tested by:

Remarks:

Test Procedure:
Rate of Feed: 2cm/sec or no more than 1 in/sec
Run test every 20 cm or approx. 8 inches

C = Cone F = Friction R = Resistance
CR = Cone Resistance LF = Local Friction
Weight of inner rod = 0.14 Kg/cm^2/rod length

Depth ①	C Kg/cm2 ②	F + C Kg/cm2 ③	F ③ – ② Kg/cm2 ④	CR ② x 2 Kg/cm2 ⑤	LF ④ x 0.133 Kg/cm2 ⑥	Friction Ratio* ⑥ / ⑤ ⑦
55.60	3.2	4.8				
56.25	2.2	5.4				
56.90	2.1	4.0				
57.55	2.4	4.4				
58.20	3.2	5.5				
[illegible]85	2.3	5.2				
[illegible].50	2.4	4.3				
60.15	2.1	4.2				
60.80	1.9	3.4				
61.45	1.8	3.1				
62.10	1.2	2.8				
62.75	1.2	2.6				

Friction Resistance

Cone Resistance

Friction Ratio

DEPTH

Note: The friction ratio is computed by dividing the local friction by the cone resistance measured 20 cm above the local friction during the previous test.

Figure 8

DUTCH CONE PENETROMETER
Field Data Form

[illegible]ect: Sporn Plant

Location: Fly Ash Dike

Tested by: Roush- Bawkes

Date: 7-29-96

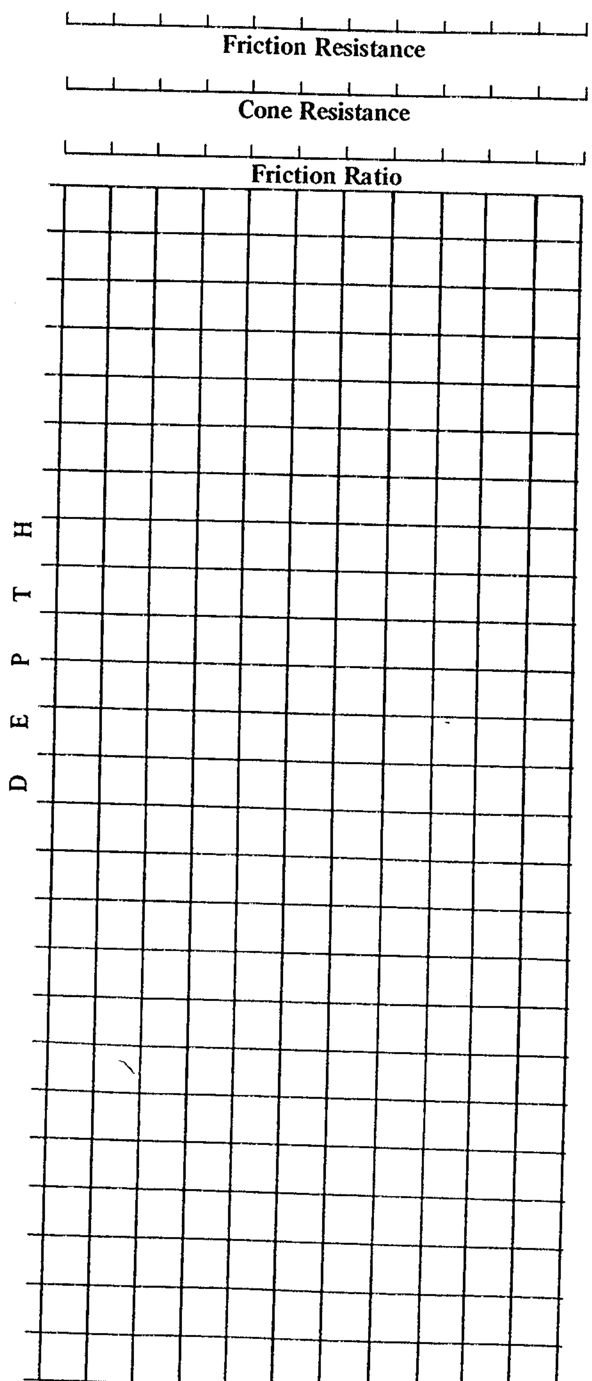
Test No.: B-96107 DCP

Remarks:

Test Procedure:
Rate of Feed: 2cm/sec or no more than 1 in/sec
Run test every 20 cm or approx. 8 inches

C = Cone F = Friction R = Resistance
CR = Cone Resistance LF = Local Friction
Weight of inner rod = 0.14 Kg/cm^2/rod length

Depth ①	C Kg/cm2 ②	F + C Kg/cm2 ③	F ③ — ② Kg/cm2 ④	CR ② × 2 Kg/cm2 ⑤	LF ④ × 0.133 Kg/cm2 ⑥	Friction Ratio* ⑥ / ⑤ ⑦
30.70	2.4	6.0				
31.35	2.8	6.0				
32.00	4.0	6.4				
32.65	2.4	4.5				
33.30	2.4	5.6				
[illegible]95	3.8	6.0				
34.60	3.7	6.4				
35.25	2.4	5.6				
35.90	2.5	4.7				
36.55	3.8	6.2				
37.20	3.8	6.0				
37.85	2.4	4.8				
38.50	3.9	5.6				
39.15	2.4	4.5				
39.80	1.6	2.8				
40.45	2.0	4.0				
41.10	2.3	4.5				
41.75	2.5	4.8				
42.40	2.4	4.4				
43.05	3.4	5.6				
43.70	3.8	5.6				
44.35	4.0	6.0				
[illegible]00	3.8	6.0				
[illegible]65	3.2	5.2				
46.30	2.4	3.2				



Note: The friction ratio is computed by dividing the local friction by the cone resistance measured 20 cm above the local friction during the previous test.

Figure 8 2-2

DUTCH CONE PENETROMETER
Field Data Form

Date: 7-29-96

Project: ____________________ Test No.: B-96107 DCP

Location: ____________________

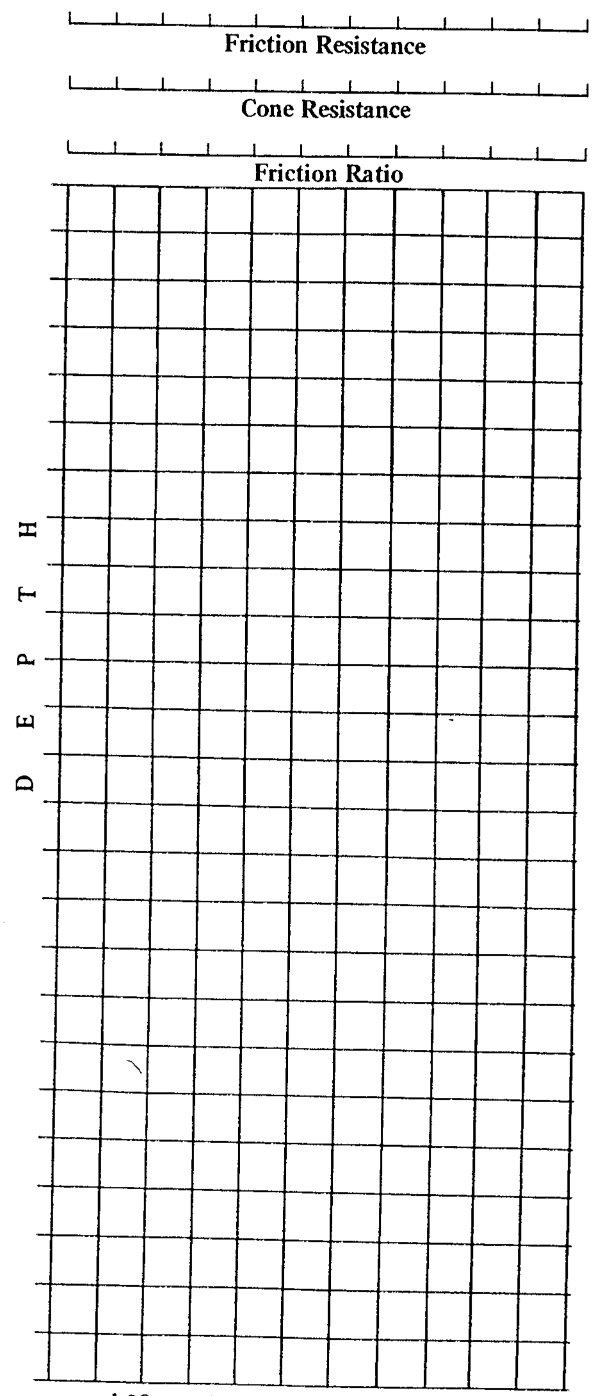
Tested by: ____________________ Remarks: ____________________

Test Procedure:
Rate of Feed: 2cm/sec or no more than 1 in/sec
Run test every 20 cm or approx. 8 inches

C = Cone F = Friction R = Resistance
CR = Cone Resistance LF = Local Friction
Weight of inner rod = 0.14 Kg/cm^2/rod length

Depth ①	C Kg/cm^2 ②	F + C Kg/cm^2 ③	F ③ − ② Kg/cm^2 ④	CR ② × 2 Kg/cm^2 ⑤	LF ④ × 0.133 Kg/cm^2 ⑥	Friction Ratio* ⑥ / ⑤ ⑦
46.95	2.4	3.2				
47.60	2.2	4.5				
48.25	2.4	5.7				
48.90	3.8	5.6				
49.55	2.4	6.4				
[illegible]20	2.0	6.0				
[illegible]0.85	3.6	5.6				
51.50	2.4	5.8				
52.15	2.8	5.2				
52.80	4.0	5.9	Pulled Rod Run			
53.45	2.0	3.6	Augers to 49.0'			
54.10	0.0	5.2				
54.75	0.0	4.4				
55.40	2.0	4.2				
56.05	2.4	5.2				
56.70	0.0	5.2				
57.35	1.8	4.4				
58.65	00	6.4				
59.30	3.6	6.4				
59.95	2.4	5.6				
60.60	2.4	4.4				
61.25	2.0	4.0				
[illegible]90	1.6	3.2				
[illegible].55	1.6	2.4				

Stopped Boring



Note: The friction ratio is computed by dividing the local friction by the cone resistance measured 20 cm above the local friction during the previous test.

DUTCH CONE PENETROMETER
Field Data Form

Date: 7-30-96

[illegible]ct: Sponn PlanT

Test No.: 96109 DCP

[illegible]cation: Fly Ash DiKe

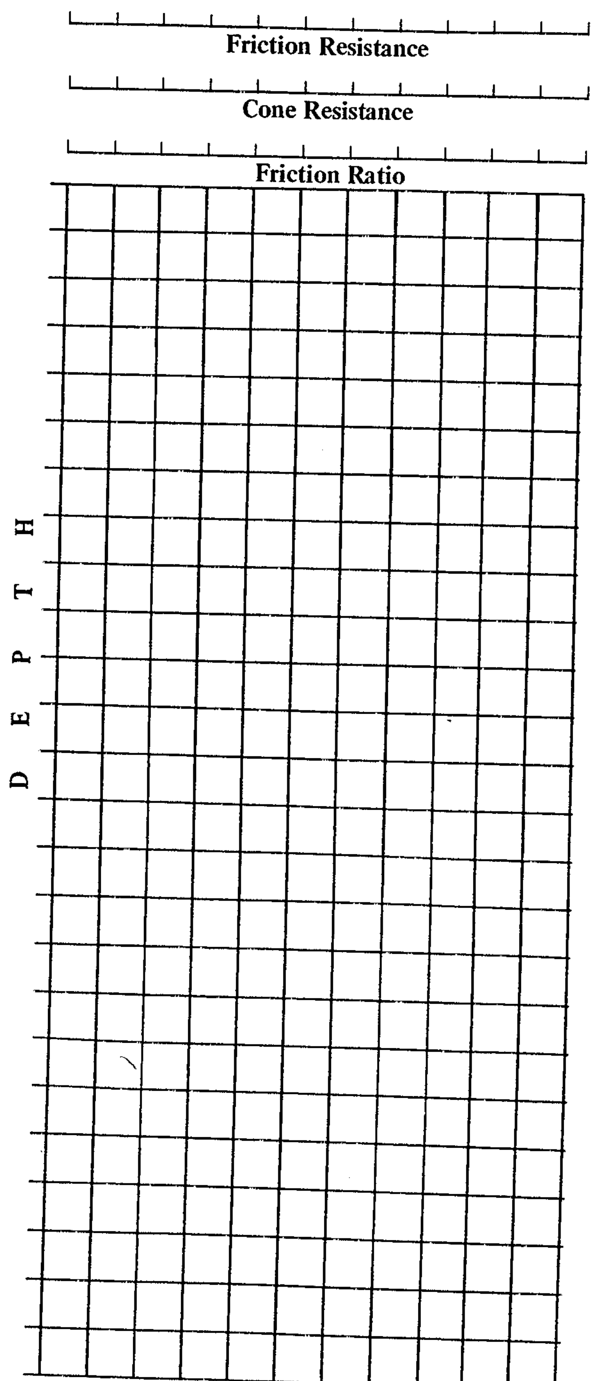
Tested by: Roush + Brrkes

Remarks:

Test Procedure:
Rate of Feed: 2cm/sec or no more than 1 in/sec
Run test every 20 cm or approx. 8 inches

C = Cone F = Friction R = Resistance
CR = Cone Resistance LF = Local Friction
Weight of inner rod = 0.14 Kg/cm^2/rod length

Depth ①	C Kg/cm2 ②	F + C Kg/cm2 ③	F ③ — ② Kg/cm2 ④	CR ② × 2 Kg/cm2 ⑤	LF ④ × 0.133 Kg/cm2 ⑥	Friction Ratio* ⑥ / ⑤ ⑦
29.20	3.8	6.0				
29.85	4.0	7.6				
30.50	2.4	5.2				
31.15	9.6	10.4				
31.80	4.5	10.4				
[illegible]45	5.6	6.4				
[illegible]10	2.4	5.7				
33.75	3.2	5.2				
34.40	3.2	4.8				
35.05	3.9	5.9				
35.70	3.6	6.4				
36.35	3.2	5.6				
37.00	4.0	6.2				
37.65	3.2	5.7				
38.30	3.2	5.6				
38.95	4.0	6.4				
39.60	3.6	5.6				
40.25	2.4	5.2				
40.90	2.2	4.3				
41.55	2.5	4.4				
42.20	2.4	4.5				
42.85	2.2	5.6				
4[illegible]50	3.2	5.2				
[illegible]5	2.4	5.6				
44.80	4.0	8.0				



Note: The friction ratio is computed by dividing the local friction by the cone resistance measured 20 cm above the local friction during the previous test.

Figure 8 Page 2-3

DUTCH CONE PENETROMETER
Field Data Form

Date:

[illegible]ct: Sporn Plant

Test No.:

[illegible]cation:

Tested by: Remarks:

Test Procedure:

Rate of Feed: 2cm/sec or no more than 1 in/sec
Run test every 20 cm or approx. 8 inches

C = Cone F = Friction R = Resistance
CR = Cone Resistance LF = Local Friction
Weight of inner rod = 0.14 Kg/cm²/rod length

Depth ①	C Kg/cm2 ②	F + C Kg/cm2 ③	F ③ — ② Kg/cm2 ④	CR ② x 2 Kg/cm2 ⑤	LF ④ x 0.133 Kg/cm2 ⑥	Friction Ratio* ⑥ / ⑤ ⑦
45.45	2.8	4.4				
46.10	2.2	4.8				
46.75	2.8	4.9				
47.4	3.2	5.6				
48.05	2.4	5.6				
[illegible]70	2.0	4.9				
[illegible].35	2.0	4.4				
50.00	2.4	5.3				
50.65	2.0	4.8				
51.30	2.0	4.5				
51.95	2.4	5.2				
52.60	2.2	4.3				
53.25	1.9	4.0				
53.90	2.0	4.3				
54.55	1.4	4.8				
55.20	1.8	4.4				
55.85	1.6	4.0				
56.30	2.0	4.7				
57.15	1.9	4.8				
57.80	1.6	4.7				
58.45	2.8	5.2				
59.10	3.2	5.8				
5[illegible]75	3.3	6.4				
[illegible]10	3.6	6.0				
61.05	2.0	3.6				

Friction Resistance

Cone Resistance

Friction Ratio

DEPTH

Note: The friction ratio is computed by dividing the local friction by the cone resistance measured 20 cm above the local friction during the previous test.

Figure 8 Page 3-3

DUTCH CONE PENETROMETER
Field Data Form

Project: Sporn Plant

Date:

Test No.:

Location:

Tested by: Remarks:

Test Procedure:

Rate of Feed: 2cm/sec or no more than 1 in/sec
Run test every 20 cm or approx. 8 inches

C = Cone F = Friction R = Resistance
CR = Cone Resistance LF = Local Friction
Weight of inner rod = 0.14 Kg/cm^2/rod length

Depth ①	C Kg/cm2 ②	F + C Kg/cm2 ③	F ③ − ② Kg/cm2 ④	CR ② × 2 Kg/cm2 ⑤	LF ④ × 0.133 Kg/cm2 ⑥	Friction Ratio* ⑥ / ⑤ ⑦
61.76	1.9	3.2				
62.35	1.2	2.3				
63.00	.9	1.4				

Friction Resistance

Cone Resistance

Friction Ratio

DEPTH

Note: The friction ratio is computed by dividing the local friction by the cone resistance measured 20 cm above the local friction during the previous test.

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 3015

COMPANY APPALACHIAN POWER COMPANY

PROJECT SPORN PLANT ASH HAUL ROAD

COORDINATES

GROUND ELEVATION SYSTEM

WATER LEVEL	DRY		
TIME			
DATE	9-9-93		

BORING NO. 9301 DATE SHEET 1 OF 2

BORING START 09/13/93 BORING FINISH 09/14/93

PIEZOMETER TYPE SS WELL TYPE

HGT. RISER ABOVE GROUND 2.5 DIA 1"

DEPTH TO TOP OF WELL SCREEN 3.5 BOTTOM 12.5

WELL DEVELOPMENT BACKFILL BENTONITE

FIELD PARTY MCR-TLS RIG BK-81

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %
1	SS	0.0	1.5	3-3-4	1.2	
2	SS	1.5	3.0	5-15-15	.9	
3	SS	3.0	4.5	10-12-13	1.1	
4	SS	4.5	6.0	7-20-22	1.2	
5	SS	6.0	7.5	10-18-20	1.4	
6	SS	7.5	9.0	18-20-16	1.4	
7	SS	9.0	10.5	25-16-13	1.5	
8	SS	10.5	12.0	1-11-10	1.4	
9	SS	12.0	13.5	13-12-13	1.3	
10	SS	13.5	15.0	14-11-5	1.4	
11	SS	15.0	16.5	5-4-2	1.3	
12	SS	16.5	18.0	1-1-1	1.5	
13	SS	18.0	19.5	0	1.5	
14	SS	19.5	21.0	1-1-4	1.5	
15	SS	21.0	22.5	8-7-8	1.5	
16	SS	22.5	24.0	6-5-6	.8	
17	SS	24.0	25.5	7-10-10	1.2	
18	ST	25.5	27.5		1.3	
19	SS	27.5	29.0	5-5-9	1.5	
20	ST	29.0	31.0		1.7	
21	SS	31.0	32.5	5-7-9	1.2	
22	ST	32.5	34.5		1.4	
23	SS	34.5	36.0	6-7-9	1.5	
24	ST	36.0	38.0		2.0	
25	SS	38.0	39.5	5-7-8	?	
26	ST	39.5	41.5		2.0	
27	SS	41.5	43.0	4-5-5	?	
28	ST	43.0	45.0		2.0	
29	SS	45.0	46.5	3-3-4	?	
30	ST	46.5	48.5		1.6	

DEPTH IN FEET	SOIL / ROCK IDENTIFICATION	DRILLER'S NOTES
0	BROWN SILTY CLAY Dry.	Inside of augers dry untill hitting sand and gravel.
	BROWN SANDY CLAY Moist, with some gravel.	3.0 Top of gravel.
	GRAY BOTTOM ASH Moist.	3.5 Top of screen.
5		
10	GRAY FLY ASH Moist.	12.5 Bottom of screen. 13.0 Bottom of gravel and bottom of hole.
15		
20	BROWN SAND AND GRAVEL	
	GRAY FLY ASH	
	BLACK BOTTOM ASH	
25	BROWN SILTY CLAY Wet.	
	BLACK BOTTOM ASH Wet.	
	BROWN SILTY CLAY Moist.	
	BROWN SANDY CLAY Moist.	
30	BROWN AND GRAY SILTY CLAY Mottled,moist	
	BROWN SILTY CLAY Moist.	
	BROWN AND GRAY SILTY CLAY Moist.	
35	BROWN/GRAY CLAY	
	BROWN SILTY CLAY Moist.	
40		
	BROWN SANDY CLAY Moist.	
	BROWN CLAYEY SAND Moist.	
45		
	BROWN SAND AND GRAVEL Wet.	

TYPE OF CASING USED		
	NQ-2 ROCK CORE	
X	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL EN NEERING LABOR ORY

LOG OF BORING

AEP

JOB NUMBER 3015

COMPANY APPALACHIAN POWER COMPANY

OJECT SPORN PLANT ASH HAUL ROAD

COORDINATES

GROUND ELEVATION 600.3 SYSTEM

BORING NO. SI-3 DATE SHEET 1 OF 2

BORING START 06/16/88 BORING FINISH 06/23/99

PIEZOMETER TYPE WELL TYPE

HGT. RISER ABOVE GROUND DIA 6"

DEPTH TO TOP OF WELL SCREEN BOTTOM

WELL DEVELOPMENT BACKFILL

FIELD PARTY MCR/TJH RIG B-61

WATER LEVEL	▽ 28.0	▼ 49.0	▽
TIME		0710	
DATE	06/19/88	06/23/88	

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	3.0	4.5	16-16-14	.83		5			BROWN SILTY SAND, moist, quartz, trace of small gravel		
2	SS	8.0	9.5	5-4-3	.17		10			LIMESTONE AND SAND		
3	SS	13.0	14.5	4-4-5	.5		15			SILTY SAND AND GRAVEL, wet to saturated, quartz, 1/2 " max size, rounded		
4	SS	18.0	19.5	11-12-11	1.0		20			BROWN SANDY SILT, moist		
5	SS	23.0	24.5	5-6-8	1.0		25			BROWN SANDY SILT, moist		
6	SS	28.0	29.5	7-8-9	1.0		30			BROWN SANDY SILT,moist	▽	
7	SS	33.0	34.5	8-9-11	.83		35			BROWN CLAY, moist to wet, medium to low plasticity		
8	SS	38.0	39.5	7-8-10	1.0		40			GRAY ORGANIC SILT, moist		
9	SS	43.0	44.5	4-4-5	1.3		45			GRAY BROWN SILTY SAND,moist to wet w/ organic material		
10	ST	45.0	47.0		2.0							SHELBY TUBE PUSH 2.0' REC 2.0' TIME 4 SEC
11	ST	47.0	49.0		1.2						▼	

Continued Next Page

TYPE OF CASING USED		
	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER

Figure 11

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL EN NEERING LABOR ORY
LOG OF BORING

AEP

JOB NUMBER 3015
COMPANY APPALACHIAN POWER COMPANY
BORING NO. SI-3 DATE ______ SHEET 2 OF 2
'OJECT SPORN PLANT ASH HAUL ROAD
BORING START 06/16/88 BORING FINISH 06/23/99

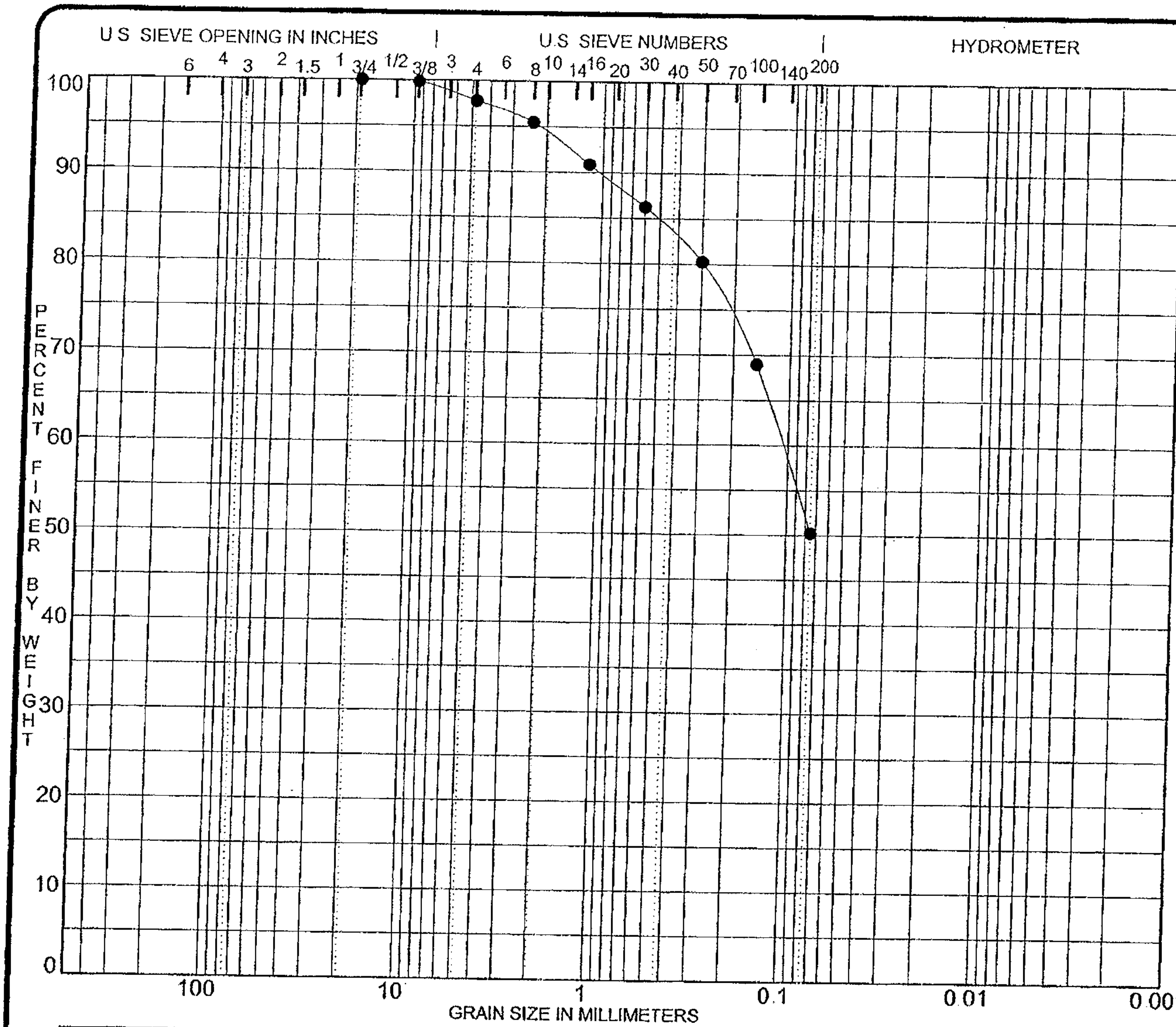
SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
												PSI 550 SHELBY TUBE PUSH 1.2' REC 1.2' TIME 7 SEC PSI 750
12	SS	53.0	54.5	34-50/.2	.5		55			BROWN SILTY SAND AND GRAVEL, saturated, 3/4" max. size , rounded, quartz		
13	SS	58.0	59.5	22-26-29	.67		60			BROWN SILTY SAND AND GRAVEL, saturated, 3/4" max. size, rounded, quartz		
14	SS	63.0	64.5	24-24-29	.83		65			BROWN SAND AND GRAVEL saturated, 1/2" max size, rounded, quartz		
15	SS	68.0	69.5	19-14-10	.25		70			DARK BROWN SAND AND GRAVEL, saturated, 3/4"max. size, rounded, quartz, some fines		
16	SS	73.0	74.5	22-19-10	.67		75			BROWN SILTY SAND, saturated, w/ some 1" max. size quartz		
17	SS	78.0	79.5	8-8-9	.5		80			BROWN SAND, saturated, quartz, trace of fines		
18	SS	83.0	84.5	12-12-15	.25		85			BROWN SAND, saturated, quartz, trace of fines		
19	SS	88.0	89.5	14-17-17	.75		90			BROWN SAND saturated, quartz, trace of fines		
20	SS	93.0	94.5	12-19-16	1.2		95			BROWN SILTY SAND AND GRAVEL, saturated, 1" max. size, quartz		
							100			GRAY SANDSTONE Auger Refusal 95.2' Set HW casing at 95' Used 3 7/8"roller bit to cut gray sandstone to 101.7' Cut rock to 99' Casing not on rock, Set casing at 96' Cut rock to 101.7' Void in sandstone at 99.2' and 100.1', both voids approx .3 to .4' Lost water 99,2 Tip of slope indicator at 101.7' Indicator casing installed in 10' lengths		

PROJECT: SPORN PLANT - FLY ASH POND DIKES - FLY ASH POND DIKES
NUMBER:

SUMMARY OF MATERIAL PROPERTIES

Sample Number	Depth ft.	ASTM Description	ASTM Class.	Max. Dry Density pcf	Optimum Moisture %	Liquid Limit %	Plastic Limit %	Gravel %	Sand %	<#200 Sieve %	<.002 mm %	Sp.G	Prmblty cm/sec	Nat. Moist. %
PZ-0901	3.5	SANDY SILT	ML			NP	NP	2.2	47.6	50.2				
PZ-0901	26.0					34.9	19.3						3.61E-07	
PZ-0902	8.5	SILTY SAND with GRAVEL	SM			NP	NP	33.0	52.9	14.0				
PZ-0902	18.5					25.6	18.2							13.3
PZ-0902	31.0	LEAN CLAY with SAND	CL			29.5	17.4	0.0	20.6	79.4	21.3			
PZ-0902	31.0					27.5	17.1							
PZ-0903	16.0					33.3	19.5							18.1
PZ-0903	23.5	SILTY SAND	SM			NP	NP	8.9	57.5	33.5				
PZ-0903	46.0	LEAN CLAY	CL			45.6	24.7	0.0	0.9	99.1	32.6		1.08E-07	
PZ-0904	8.0					29.2	19.8							16.5
PZ-0904	43.5					36.9	22.3							28.4
PZ-0905	11.0	SILTY SAND with GRAVEL	SM			NP	NP	19.6	61.2	19.2				
PZ-0905	38.0	LEAN CLAY	CL			31.2	19.1	0.0	6.5	93.5	22.6			25.0

AEP Civil Engineering Laboratory, Groveport, Ohio



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.
● PZ-0901	3.5			NP	NP	NP	
		SANDY SILT ML					
		Ash Mixture - Samples 2,3,4 Combined					

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● PZ-0901	3.5	19.000	0.108			2.2	47.6	50.2	

PROJECT SPORN PLANT - FLY ASH POND DIKES - FLY ASH POND DIKES

JOB NO

DATE 8/14/09

GRADATION CURVES

American Electric Power Service Corp

Groveport, OH 43125

AEP

JOB NO

DATE: Jul 17, 09

PROJECT SPORN PLANT - FLY ASH POND DIKES

LOCATION: FLY ASH POND DIKES

SOURCE OF MATERIAL PZ-0901 DEPTH 27.0 ft.

DESCRIPTION OF MATERIAL

ASTM DESCRIPTION

MAX. DRY DENSITY, pcf		OPTIMUM MOISTURE, %	
SPECIFIC GRAVITY	2 70		
SAMPLE HGT., mm	146 130	SAMPLE DIA., mm	72.310
CHAMBER PRESSURE, psi	70 0	BACK PRESSURE, psi	60 0
B-PARAMETER	1 00	EFFECTIVE PRESSURE, psi	10.0
INITIAL HEAD, mm	2373 2		

	BEFORE	AFTER
WATER CONTENT, %	26.7	27 0
WET DENSITY, pcf	122 4	
DRY DENSITY, pcf	96 6	
SATURATION, %	96 79	
VOID RATIO	0 7441	

PERMEABILITY COEFFICIENT K, cm/sec 3.61E-07

FLEXIBLE-MEMBRANE PERMEABILITY TEST

American Electric Power Service Corp.

Groveport, Ohio

AEP

SPP00003244

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP

Project: SPORN ASH DISP. FACILITY

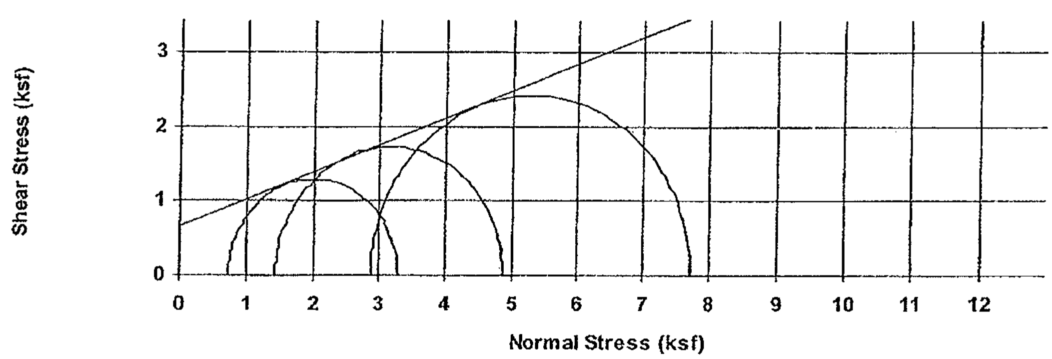
Sample No: 10906

Material Description: Boring PZ-0901, Shelby Tube - 26' - 28'; Lab # S-10906

Point Designation	Initial Conditions			Final Conditions			
	Water Content, %	Dry Density, pcf	Degree of Saturation	Water Content, %	Confining Stress, (ksf)	Deviator Stress	Induced Pore Pressure (ksf)
A	23 9%	102 1	99 2%	24 39%	0 72	2 57	0 13
B	26 7%	96 6	96 8%	27 0%	1 44	3 44	0 42
C	22 8%	104 5	100 4%	22 6%	2 88	4 84	1 35

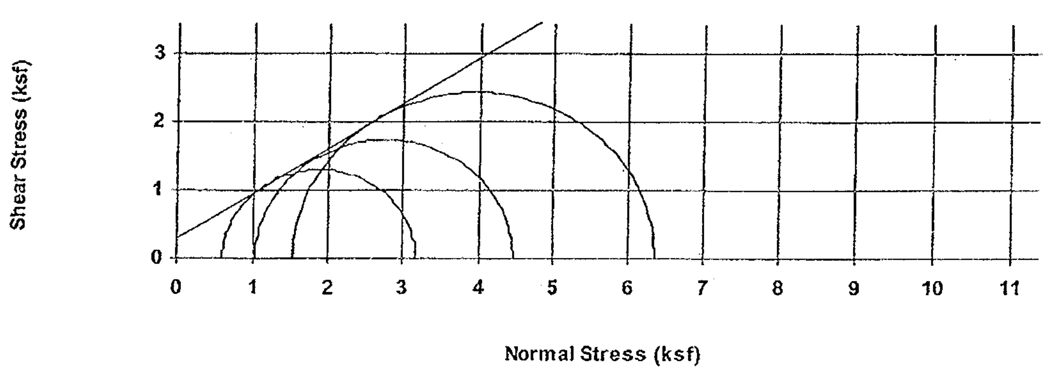
Point Designation	Axial Strain, %	q, (ksf)	Effective Stresses, (ksf)			Total Stresses, (ksf)		
			Major, (ksf)	Minor, (ksf)	p', (ksf)	Major, (ksf)	Minor, (ksf)	p, (ksf)
A	15 0%	1 29	3 16	0 59	1 88	3 29	0 72	2 01
B	15 0%	1 72	4 46	1 02	2 74	4 88	1 44	3 16
C	11 0%	2 42	6 36	1 53	3 94	7 72	2 88	5 30

Total Stress Envelope



ϕ: 19.9 °
c: 0 66 ksf

Effective Stress Envelope



ϕ ': 33 3 °
c': 0 29 ksf

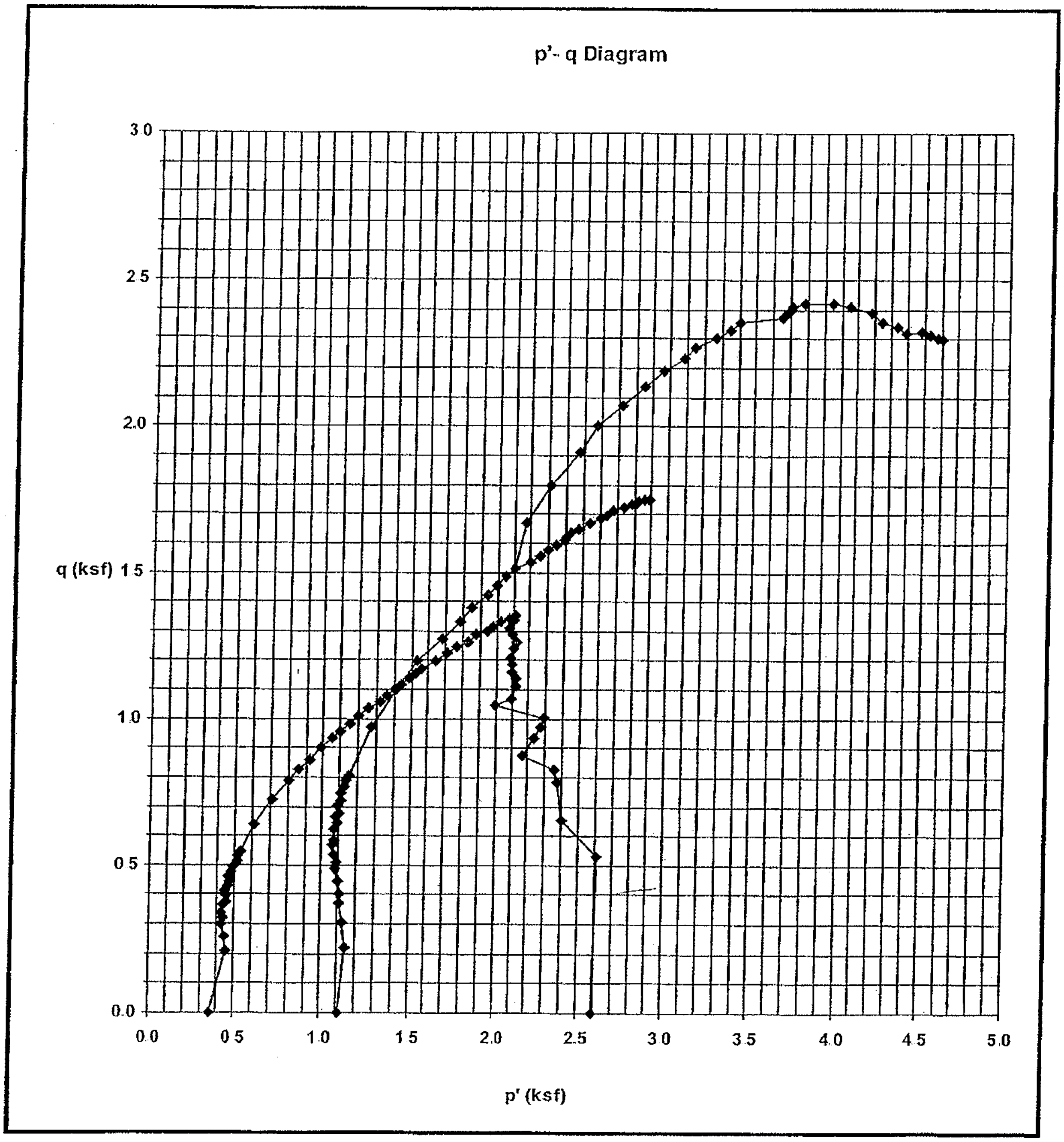
Report Date: Friday August 14, 2009

FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10906



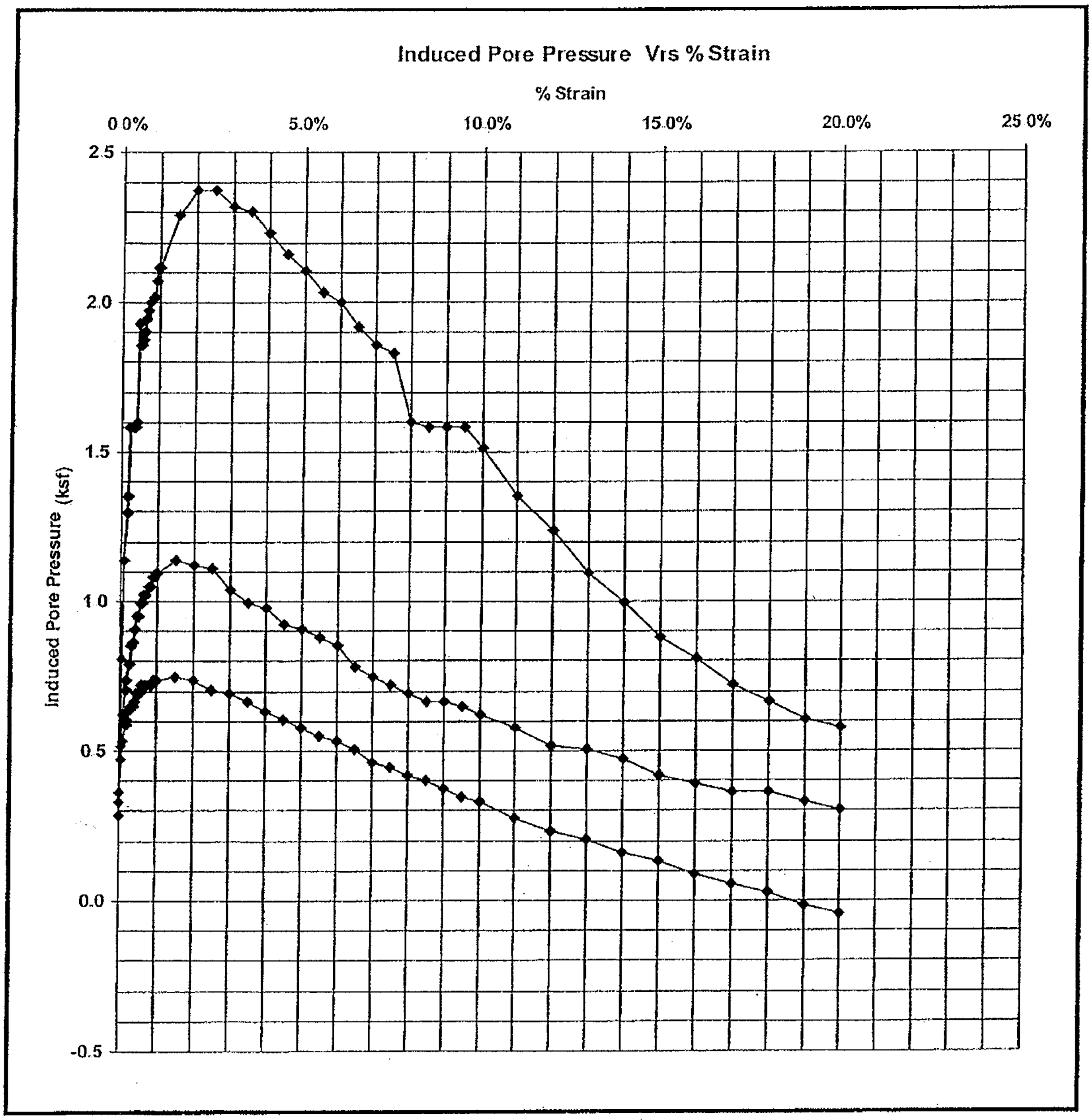
Report Date: Friday, August 14 2009

FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10906



Report Date: Friday, August 14, 2009

FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

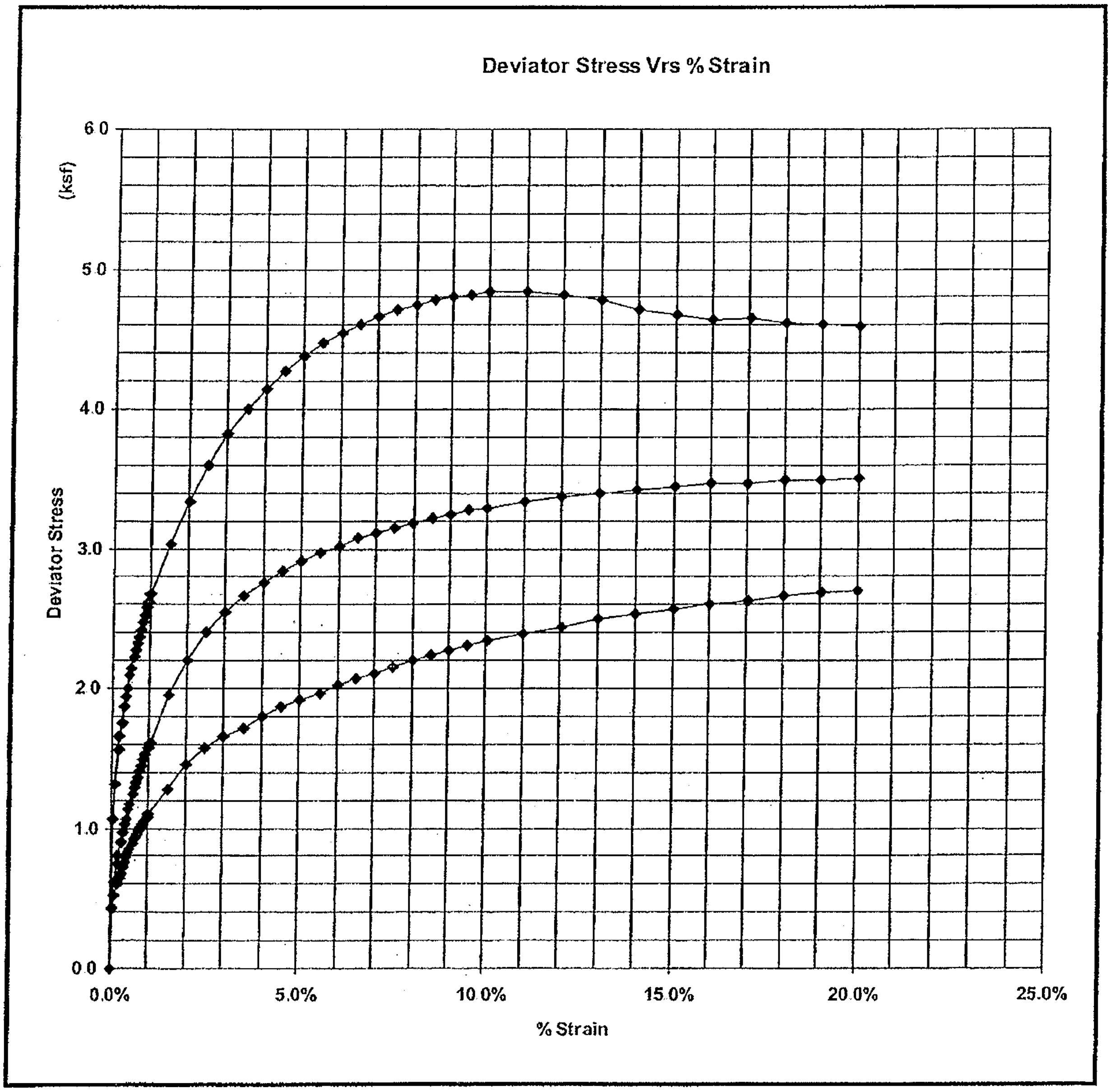
AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP

Project: SPORN ASH DISP. FACILITY

Sample No: 10906



Report Date: Friday August 14, 2009

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10906
Point: A

Material Description: Boring PZ-0901, Shelby Tube - 26' - 28'; Lab # S-10906

Moisture Determination ASTM D2216

	Before Testing	After Testing
Tare No	T-100	T-100
Mass of Container and Wet Specimen (Mcws), grams	1425 44	1429 80
Mass of Container and Over Dry Specimen (Mcs), grams	1190 68	1190 68
Mass of Container (Mc), grams	210 10	210 10
Mass of Water (Mw), grams:	234 76	239 12
Mass of Solid Particles (Ms), grams:	980 58	980 58
Moisture Content (w), %	23 94%	24 39%

Initial Condition of Speciman ASTM D2435

	(1)	(2)	(3)	Average
Diameter Measurents, Inches:	2 835	2 838	2 825	2.833
Height Measurements, Inches:	5 815	5 808	5 801	5 808
Initial Volume of Specimen (Vo), In 3:	36 60			
Dry Mass of Specimen After Testing, (Md), grams:	980 58			
Dry Unit Weight, (γ d) pcf:	102.06			
Specific Gravity of the Solids, (G):	2 70			
Volume of Solids, (Vs), Cu. In.:	22.1626			
Height of Solids,(Hs),In.:	3 5167			
Void Ratio Before Consolidation (Eo):	0 6515			
Intitall Degree of Saturation: (So)	99 21%			

Saturation - ASTM D4767 Section 8 2

Dial Indicator Reading Prior to Saturation (Rb:) In.	0
Cell Pressure AfterSaturation, psi:	63 00
Back Presssure After Saturation After, psi:	60 00
Pore Pressure Paramenter B:	1
Dial Indicator Reading After Saturation, (Ra) In.:	0 016
Change in Height during Satureation, (Delta Hs) In.	0 016
Change In Volume of Specimen during Saturation (Delta Vsat), In 3:	0 302

Report Date: Friday, August 14, 2009

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10906
Point: A

Consolidation- ASTM D2435, Section 11 5:

Sample No:	T:	Burette 2:	Burette3:	Rc:
10906	0	23.6	23.7	0.016
10906	0.25	23.5	23.5	
10906	0.5	23.5	23.5	
10906	1	23.4	23.4	
10906	2	23.4	23.3	
10906	4	23.3	23.2	
10906	8	23.2	23	
10906	15	23.1	22.8	0.019
10906	30	23	22.6	0.02
10906	60	22.9	22.5	0.021
10906	120	22.7	22.2	0.022
10906	240	22.5	22.3	0.022
10906	450	22.3	22.2	0.022
10906	1440	22.2	22.2	0.023

Specimen Height After Consolidation, (Hc), In : 5 79

Volume Change During Consolidation (Delta Vc), In 3: 0 18

Cross-Sectional Area of Specimen After Consolidation (Ac), In.2: 6 24

Triaxial Compression Testing
ASTM D 4767

Sample Depth: 0 ft

Cell Pressure: 65 psi

Back Pressure: 60 psi

Confining Pressure: 5 psi

Strain Rate: 0 006 in./min

Specimen Height After Consolidation, (Hc), In : 5 79

Correction for Vert Displacement, In.: 0

Load due to Friction and Uplift: 16 3 lbs.

Correction for Filter Paper: 0

Thickness of Membrane (tm), In.: 0.012

$\sigma 1-\sigma 3=$ Deviator Stress at Failure, ksf: 2.57

$\sigma 3$ f= Effective Consolidation Stress at Failure, ksf: 0 72

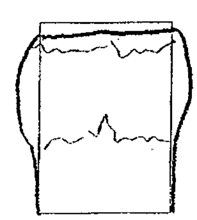
$\sigma 1=$ Total Major Principal Stress at Failure: 3 29

σ '3f= $\sigma 3-\Delta \upsilon=$ Effective Minor Principal Stress at Failure,ksf: 0.59

σ '1f= Effective Major Principal Stress at Failure, ksf: 3 16

Axial Strain at Failure: 15 01%

Failure Sketch



Report Date: Friday, August 14 2009

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10906
Point: A

Pa: Applied Force	Vertical Displacement Reading In :	Pore Pressure psi:	Axial Strain (El):	(P) - Force Adj for U and F lbs:	Corrected Vertical Displac In :	Correction for Membrane ksf:	(A) Area In 2:	(σ1−σ3) Deviator Stress ksf:	[Δu] Induced Pore Water Pressure ksf:	σ3 Effective Consolidation Stress ksf	σ1 Total Major Principal Stress ksf	σ3 Effective Minor Principal Stress ksf	σ1' Effective Major Principal Stress ksf	p'	q
16 3	0 000	62 5	0 00%	0 0	0 000	0 00002	6 244	0 00	0 3600	0 72	0 72	0 36	0 36	0 36	0 00
34 6	0 003	63 3	0 05%	18 3	0 003	0 00024	6 247	0 42	0 4752	0 72	1 14	0 24	0 67	0 46	0 21
38 7	0 006	63 7	0 10%	22 4	0 006	0 00047	6 250	0.52	0 5328	0 72	1 24	0 19	0 70	0 45	0 26
42 3	0 009	64 1	0 16%	26 0	0 009	0 00080	6 254	0 60	0 5904	0 72	1 32	0 13	0 73	0 43	0 30
44 1	0 012	64 2	0 20%	27 8	0 012	0 00100	6 257	0 64	0 6048	0 72	1 36	0 12	0 75	0 43	0 32
45 8	0 014	64 4	0 25%	29 5	0 014	0 00120	6 260	0 68	0 6336	0 72	1 40	0 09	0 76	0 43	0 34
48 0	0 018	64 5	0 31%	31 7	0 018	0 00151	6 263	0 73	0 6480	0 72	1 45	0 07	0 80	0 44	0 36
49 2	0 020	64 5	0 35%	32 9	0 020	0 00169	6 266	0 75	0 6480	0 72	1 47	0 07	0 83	0 45	0 38
50 9	0 023	64 6	0 40%	34 6	0 023	0 00197	6 269	0 79	0 6624	0 72	1 51	0 06	0 85	0 45	0 40
52 5	0 026	64 8	0 46%	36 2	0 026	0 00224	6 273	0 83	0 6912	0 72	1 55	0 03	0 86	0 44	0 41
53 7	0 029	64 8	0 50%	37 4	0 029	0 00246	6 276	0 86	0 6912	0 72	1 58	0 03	0 88	0 46	0 43
55 1	0 032	64 8	0 56%	38 8	0 032	0.00275	6 279	0 89	0 6912	0 72	1 61	0 03	0 92	0 47	0 44
56 9	0 035	65 0	0 61%	40 6	0 035	0 00300	6 283	0 93	0 7200	0 72	1 65	0 00	0 93	0 46	0 46
57 3	0 038	65 0	0 65%	41 0	0 038	0 00319	6 285	0 94	0 7200	0 72	1 66	0 00	0 94	0 47	0 47
58 4	0 041	65 0	0 70%	42 1	0 041	0 00344	6 288	0 96	0 7200	0 72	1 68	0 00	0 96	0 48	0 48
59 4	0 043	65 0	0 75%	43 1	0 043	0 00366	6 291	0 98	0 7200	0 72	1 70	0 00	0 98	0 49	0 49
60 5	0 046	65 0	0 80%	44 2	0 046	0 00392	6 294	1 01	0 7200	0 72	1 73	0 00	1 01	0 50	0 50
61 6	0 049	65 0	0 85%	45 3	0 049	0 00417	6 298	1 03	0 7200	0 72	1 75	0 00	1 03	0 52	0 52
62.8	0 053	65 1	0 91%	46 5	0 053	0 00446	6 302	1 06	0 7344	0 72	1 78	-0 01	1 04	0 51	0 53
63 8	0 056	65 1	0 96%	47 5	0 056	0.00473	6 305	1 08	0 7344	0 72	1 80	-0 01	1 07	0 53	0 54
64 5	0 058	65 1	1 00%	48 2	0 058	0 00492	6 307	1.10	0 7344	0 72	1 82	-0 01	1 08	0 53	0 55
73 0	0 087	65 2	1 50%	56 7	0 087	0 00736	6.339	1 28	0 7488	0 72	2.00	-0 03	1 25	0 61	0 64
80 9	0 116	65 1	2 00%	64 6	0 116	0 00981	6 372	1 45	0 7344	0 72	2 17	-0 01	1.44	0 71	0 73
86 9	0 145	64 9	2 50%	70 6	0 145	0 01227	6 405	1 58	0 7056	0 72	2 30	0 01	1 59	0 80	0 79
91 0	0 174	64 8	3 00%	74 7	0 174	0 01473	6 438	1 66	0 6912	0 72	2 38	0 03	1 69	0 86	0 83
94 4	0 203	64 6	3 50%	78 1	0 203	0 01717	6 471	1 72	0 6624	0 72	2 44	0 06	1 78	0 92	0 86
98 4	0 231	64 4	4 00%	82 1	0 231	0 01961	6 504	1 80	0 6336	0 72	2 52	0 09	1 88	0 99	0 90
102 2	0 261	64 2	4 50%	85 9	0 261	0.02209	6 539	1 87	0 6048	0 72	2 59	0 12	1 98	1 05	0 93
104 7	0 290	64 0	5 01%	88 4	0 290	0 02454	6 573	1 91	0 5760	0 72	2 63	0 14	2 06	1 10	0 96
107 9	0 318	63 8	5 50%	91 6	0 318	0 02698	6 608	1 97	0 5472	0 72	2 69	0 17	2 14	1 16	0 98
110 9	0 347	63 7	6 00%	94 6	0 347	0 02942	6 643	2 02	0 5328	0 72	2 74	0 19	2 21	1 20	1 01
113 7	0 376	63 5	6 51%	97.4	0 376	0 03190	6 679	2 07	0 5040	0 72	2 79	0 22	2 28	1 25	1 03
116 4	0 406	63 2	7 01%	100 1	0 406	0 03437	6 715	2 11	0 4608	0 72	2 83	0 26	2 37	1 32	1 06
119 1	0 434	63 1	7 51%	102 8	0 434	0 03680	6.751	2 16	0 4464	0 72	2 88	0 27	2 43	1 35	1 08
122 0	0 463	62 9	8 01%	105.7	0 463	0 03926	6 788	2 20	0 4176	0 72	2 92	0 30	2 51	1 40	1 10
124 3	0 492	62 8	8 50%	108 0	0 492	0 04170	6 825	2 24	0 4032	0 72	2 96	0 32	2 55	1 44	1 12
126 6	0 521	62 6	9 01%	110 3	0 521	0 04415	6 862	2 27	0 3744	0 72	2 99	0 35	2 62	1 48	1 14
128 9	0 550	62 4	9 51%	112 6	0 550	0 04661	6 900	2 30	0 3456	0 72	3 02	0 37	2 68	1 53	1 15

Report Date: Friday, August 14, 2009

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10906
Point: A

131.3	0.579	62.3	10.01%	115.0	0.579	0.04907	6.939	2.34	0.3312	0.72	3.06	0.39	2.73	1.56	1.17
135.5	0.637	61.9	11.01%	119.2	0.637	0.05399	7.017	2.39	0.2736	0.72	3.11	0.45	2.84	1.64	1.20
139.6	0.695	61.6	12.01%	123.3	0.695	0.05890	7.097	2.44	0.2304	0.72	3.16	0.49	2.93	1.71	1.22
143.7	0.753	61.4	13.01%	127.4	0.753	0.06380	7.178	2.49	0.2016	0.72	3.21	0.52	3.01	1.76	1.25
147.2	0.810	61.1	14.01%	130.9	0.810	0.06868	7.261	2.53	0.1584	0.72	3.25	0.56	3.09	1.83	1.26
151.3	0.868	60.9	15.01%	135.0	0.868	0.07360	7.347	2.57	0.1296	0.72	3.29	0.59	3.16	1.88	1.29
154.6	0.926	60.6	16.01%	138.3	0.926	0.07851	7.435	2.60	0.0864	0.72	3.32	0.63	3.23	1.93	1.30
158.0	0.984	60.4	17.02%	141.7	0.984	0.08343	7.525	2.63	0.0576	0.72	3.35	0.66	3.29	1.98	1.31
161.5	1.042	60.2	18.02%	145.2	1.042	0.08833	7.616	2.66	0.0288	0.72	3.38	0.69	3.35	2.02	1.33
165.0	1.100	59.9	19.01%	148.7	1.100	0.09322	7.710	2.68	-0.0144	0.72	3.40	0.73	3.42	2.08	1.34
168.1	1.158	59.7	20.02%	151.8	1.158	0.09814	7.807	2.70	-0.0432	0.72	3.42	0.76	3.47	2.11	1.35

Report Date: Friday August 14 2009

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10906
Point: B

Material Description: Boring PZ-0901, Shelby Tube - 26' - 28'; Lab # S-10906

Moisture Determination ASTM D2216

	Before Testing	After Testing
Tare No.	4	4
Mass of Container and Wet Specimen (Mcws), grams	1389 93	1393 24
Mass of Container and Over Dry Specimen (Mcs), grams	1142 12	1142 12
Mass of Container (Mc), grams	213 10	213 10
Mass of Water (Mw), grams:	247 81	251 12
Mass of Solid Particles (Ms), grams:	929 02	929.02
Moisture Content (w), %	26 67%	27 03%

Initial Condition of Speciman ASTM D2435

	(1)	(2)	(3)	Average
Diameter Measurents, Inches:	2 854	2 852	2 835	2 847
Height Measurements, Inches:	5 75	5 75	5 76	5 753
Initial Volume of Specimen (Vo), In.3:	36 63			
Dry Mass of Specimen After Testing, (Md), grams:	929 02			
Dry Unit Weight, (γ d) pcf:	96 63			
Specific Gravity of the Solids, (G):	2.70			
Volume of Solids, (Vs), Cu. In.:	20 9972			
Height of Solids,(Hs),In.:	3 2983			
Void Ratio Before Consolidation (Eo):	0 7443			
Intitail Degree of Saturation: (So)	96 76%			

Saturation - ASTM D4767 Section 8 2

Dial Indicator Reading Prior to Saturation (Rb:) In	0
Cell Pressure AfterSaturation, psi:	65.00
Back Presssure After Saturation After, psi:	60 00
Pore Pressure Paramenter B:	1
Dial Indicator Reading After Saturation, (Ra) In.:	0 024
Change in Height during Satureation, (Delta Hs) In.	0 024
Change In Volume of Specimen during Saturation (Delta Vsat), In.3:	0 458

Report Date: Friday, August 14, 2009

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10906
Point: B

Consolidation- ASTM D2435, Section 11 5:

Sample No:	T:	Burette 2:	Burette3:	Rc:
10906	0	23.8	23.8	0.024
10906	0.25	23.7	23.7	
10906	0.5	23.6	23.6	
10906	1	23.6	23.6	
10906	2	23.5	23.5	
10906	4	23.4	23.3	
10906	8	23.2	23.2	
10906	15	23	23	0.028
10906	30	22.8	22.8	0.03
10906	60	22.6	22.5	0.031
10906	120	22.4	22.3	0.031
10906	240	22.3	22.2	0.032
10906	450	22.1	22.1	0.032
10906	1440	22	22	0.032

Specimen Height After Consolidation, (Hc), In.: 5 72

Volume Change During Consolidation (Delta Vc), In.3: 0 22

Cross-Sectional Area of Specimen After Consolidation (Ac), In.2: 6 28

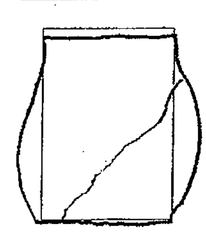
Triaxial Compression Testing
ASTM D 4767

Sample Depth: 0 ft.
Cell Pressure: 70 psi
Back Pressure: 60 psi
Confining Pressure: 10 psi
Strain Rate: 0 006 In/min

Specimen Height After Consolidation, (Hc), In.: 5 72
Correction for Vert Displacement, In.: 0
Load due to Friction and Uplift: 19 1 lbs.
Correction for Filter Paper: 0
Thickness of Membrane (tm), In.: 0 012

$\sigma1-\sigma3=$ Deviator Stress at Failure, ksf: 3 44
$\sigma3$ f= Effective Consolidation Stress at Failure, ksf: 1 44
$\sigma1=$ Total Major Principal Stress at Failure: 4 88
$\sigma'3f=$ $\sigma3-\Delta u=$ Effective Minor Principal Stress at Failure, ksf: 1 02
$\sigma'1f=$ Effective Major Principal Stress at Failure, ksf: 4 46
Axial Strain at Failure: 15 00%

Failure Sketch



Report Date: Friday, August 14, 2009

SPP00003254

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10906
Point: B

Pa: Applied Force	Vertical Displacement Reading In. :	Pore Pressure psi:	Axial Strain (El):	(P) - Force Adj for U and F lbs:	Corrected Vertical Displac In :	Correction for Membrane ksf:	(A) Area In 2:	(σ1−σ3) Deviator Stress ksf:	[Δu] Induced Pore Water Pressure ksf:	σ3 Effective Consolidation Stress ksf	σ1 Total Major Principal Stress ksf	σ3 Effective Minor Principal Stress ksf	σ1' Effective Major Principal Stress ksf	p'	q
19.1	0.000	62.3	0.00%	0.0	0.000	0.00002	6.283	0.00	0.3312	1.44	1.44	1.11	1.11	1.11	0.00
38.3	0.003	63.6	0.05%	19.2	0.003	0.00026	6.286	0.44	0.5184	1.44	1.88	0.92	1.36	1.14	0.22
45.8	0.006	64.3	0.10%	26.7	0.006	0.00048	6.289	0.61	0.6192	1.44	2.05	0.82	1.43	1.13	0.31
51.7	0.009	64.9	0.16%	32.6	0.009	0.00079	6.293	0.75	0.7056	1.44	2.19	0.73	1.48	1.11	0.37
54.5	0.011	65.1	0.20%	35.4	0.011	0.00096	6.295	0.81	0.7344	1.44	2.25	0.71	1.51	1.11	0.40
58.3	0.014	65.5	0.25%	39.2	0.014	0.00123	6.299	0.89	0.7920	1.44	2.33	0.65	1.54	1.10	0.45
61.7	0.018	65.9	0.31%	42.6	0.018	0.00152	6.303	0.97	0.8496	1.44	2.41	0.59	1.56	1.08	0.49
64.0	0.020	66.0	0.35%	44.9	0.020	0.00171	6.305	1.02	0.8640	1.44	2.46	0.58	1.60	1.09	0.51
66.0	0.023	66.3	0.40%	46.9	0.023	0.00193	6.308	1.07	0.9072	1.44	2.51	0.53	1.60	1.07	0.53
69.1	0.026	66.6	0.46%	50.0	0.026	0.00224	6.312	1.14	0.9504	1.44	2.58	0.49	1.63	1.06	0.57
70.5	0.029	66.6	0.50%	51.4	0.029	0.00244	6.315	1.17	0.9504	1.44	2.61	0.49	1.66	1.07	0.58
73.7	0.032	66.9	0.56%	54.6	0.032	0.00273	6.318	1.24	0.9936	1.44	2.68	0.45	1.69	1.07	0.62
75.7	0.035	66.9	0.61%	56.6	0.035	0.00299	6.322	1.29	0.9936	1.44	2.73	0.45	1.73	1.09	0.64
77.6	0.037	67.1	0.65%	58.5	0.037	0.00316	6.324	1.33	1.0224	1.44	2.77	0.42	1.75	1.08	0.66
78.9	0.040	67.1	0.70%	59.8	0.040	0.00342	6.327	1.36	1.0224	1.44	2.80	0.42	1.78	1.10	0.68
81.0	0.043	67.3	0.75%	61.9	0.043	0.00367	6.331	1.40	1.0512	1.44	2.84	0.39	1.79	1.09	0.70
82.7	0.046	67.3	0.80%	63.6	0.046	0.00390	6.334	1.44	1.0512	1.44	2.88	0.39	1.83	1.11	0.72
85.1	0.048	67.5	0.85%	66.0	0.048	0.00413	6.337	1.50	1.0800	1.44	2.94	0.36	1.86	1.11	0.75
86.7	0.052	67.5	0.91%	67.6	0.052	0.00444	6.341	1.53	1.0800	1.44	2.97	0.36	1.89	1.13	0.77
88.9	0.055	67.6	0.96%	69.8	0.055	0.00470	6.344	1.58	1.0944	1.44	3.02	0.35	1.93	1.14	0.79
90.2	0.057	67.6	1.00%	71.1	0.057	0.00490	6.347	1.61	1.0944	1.44	3.05	0.35	1.95	1.15	0.80
105.7	0.086	67.9	1.50%	86.6	0.086	0.00733	6.379	1.95	1.1376	1.44	3.39	0.30	2.25	1.28	0.97
117.4	0.114	67.8	2.00%	98.3	0.114	0.00976	6.411	2.20	1.1232	1.44	3.64	0.32	2.51	1.42	1.10
126.9	0.143	67.7	2.50%	107.8	0.143	0.01220	6.444	2.40	1.1088	1.44	3.84	0.33	2.73	1.53	1.20
134.3	0.172	67.2	3.00%	115.2	0.172	0.01468	6.478	2.55	1.0368	1.44	3.99	0.40	2.95	1.68	1.27
140.4	0.200	66.9	3.50%	121.3	0.200	0.01709	6.511	2.67	0.9936	1.44	4.11	0.45	3.11	1.78	1.33
145.5	0.229	66.8	4.00%	126.4	0.229	0.01953	6.545	2.76	0.9792	1.44	4.20	0.46	3.22	1.84	1.38
150.1	0.257	66.4	4.50%	131.0	0.257	0.02199	6.579	2.85	0.9216	1.44	4.29	0.52	3.36	1.94	1.42
154.0	0.286	66.3	5.00%	134.9	0.286	0.02445	6.614	2.91	0.9072	1.44	4.35	0.53	3.45	1.99	1.46
157.5	0.315	66.1	5.50%	138.4	0.315	0.02688	6.649	2.97	0.8784	1.44	4.41	0.56	3.53	2.05	1.49
160.8	0.343	65.9	6.00%	141.7	0.343	0.02930	6.684	3.02	0.8496	1.44	4.46	0.59	3.61	2.10	1.51
163.9	0.372	65.4	6.50%	144.8	0.372	0.03178	6.720	3.07	0.7776	1.44	4.51	0.66	3.73	2.20	1.54
166.8	0.400	65.2	6.99%	147.7	0.400	0.03419	6.756	3.11	0.7488	1.44	4.55	0.69	3.81	2.25	1.56
169.5	0.429	65.0	7.49%	150.4	0.429	0.03663	6.792	3.15	0.7200	1.44	4.59	0.72	3.87	2.30	1.58
172.1	0.458	64.8	8.00%	153.0	0.458	0.03909	6.829	3.19	0.6912	1.44	4.63	0.75	3.94	2.34	1.59
174.4	0.486	64.6	8.49%	155.3	0.486	0.04152	6.866	3.22	0.6624	1.44	4.66	0.78	3.99	2.39	1.61
176.8	0.515	64.6	8.99%	157.7	0.515	0.04396	6.904	3.25	0.6624	1.44	4.69	0.78	4.02	2.40	1.62
179.2	0.543	64.5	9.49%	160.1	0.543	0.04640	6.942	3.27	0.6480	1.44	4.71	0.79	4.07	2.43	1.64

Report Date: Friday, August 14, 2009

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: **AEP**

Project: **SPORN ASH DISP FACILITY**

Sample No: **10906**

Point: **B**

181 2	0 572	64 3	10 00%	162 1	0 572	0 04886	6 981	3 29	0 6192	1 44	4 73	0 82	4 12	2 47	1 65
185 4	0 629	64 0	11 00%	166 3	0 629	0 05375	7 059	3 34	0 5760	1 44	4 78	0 86	4 20	2 53	1 67
189 0	0 686	63 6	11 99%	169 9	0 686	0 05862	7.139	3 37	0 5184	1 44	4 81	0 92	4 29	2 61	1 68
192 6	0 744	63 5	13 00%	173 5	0 744	0 06352	7 222	3 40	0 5040	1 44	4 84	0 94	4 33	2 63	1 70
196 1	0 801	63 3	13 99%	177 0	0 801	0 06839	7 305	3 42	0 4752	1 44	4 86	0 96	4 39	2 68	1 71
199.5	0 858	62 9	15 00%	180 4	0 858	0 07331	7 392	3 44	0 4176	1 44	4 88	1 02	4 46	2 74	1 72
203 0	0 915	62 7	16 00%	183 9	0 915	0 07818	7 480	3 46	0 3888	1 44	4 90	1 05	4 51	2 78	1 73
206.0	0 972	62.5	16 99%	186 9	0 972	0 08305	7 569	3 47	0 3600	1 44	4 91	1 08	4 55	2 82	1 74
209 4	1 029	62 5	17 99%	190 3	1 029	0 08794	7 662	3 49	0 3600	1 44	4 93	1 08	4 57	2 82	1 74
212 4	1 087	62 3	19 00%	193 3	1 087	0 09284	7 756	3 50	0 3312	1 44	4 94	1 11	4 60	2 86	1 75
215 5	1 144	62 1	20 00%	196 4	1 144	0 09773	7 853	3 50	0 3024	1 44	4 94	1 14	4 64	2 89	1 75

FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP
AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10906
Point: C

Material Description: Boring PZ-0901, Shelby Tube - 26' - 28'; Lab # S-10906

Moisture Determination ASTM D2216

	Before Testing	After Testing
Tare No.	T-29	T-29
Mass of Container and Wet Specimen (Mcws), grams	1460 95	1459 15
Mass of Container and Over Dry Specimen (Mcs), grams	1228 10	1228.10
Mass of Container (Mc), grams	207 93	207 93
Mass of Water (Mw), grams:	232 85	231 05
Mass of Solid Particles (Ms), grams:	1020 17	1020 17
Moisture Content (w), %	22 82%	22 65%

Initial Condition of Speciman ASTM D2435

	(1)	(2)	(3)	Average
Diameter Measurents, Inches:	2 853	2 842	2 843	2 846
Height Measurements, Inches:	5 85	5 842	5 853	5 848
Initial Volume of Specimen (Vo), In 3:	37 20			
Dry Mass of Specimen After Testing, (Md), grams:	1020 17			
Dry Unit Weight, (γ d) pcf:	104.46			
Specific Gravity of the Solids, (G):	2 70			
Volume of Solids, (Vs), Cu. In.:	23 0574			
Height of Solids,(Hs),In.:	3 6245			
Void Ratio Before Consolidation (Eo):	0 6136			
Intitail Degree of Saturation: (So)	100 44%			

Saturation - ASTM D4767 Section 8.2

Dial Indicator Reading Prior to Saturation (Rb:) In.	0
Cell Pressure AfterSaturation, psi:	80.00
Back Presssure After Saturation After, psi:	60 00
Pore Pressure Paramenter B:	1
Dial Indicator Reading After Saturation, (Ra) In.:	-0 008
Change in Height during Satureation, (Delta Hs) In.	-0 008
Change In Volume of Specimen during Saturation (Delta Vsat), In 3:	-0 153

FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP FACILITY
Sample No: 10906
Point: C

Consolidation- ASTM D2435, Section 11 5:

Sample No:	T:	Burette 2:	Burette3:	Rc:
10906	0	23.7	23.6	-0.008
10906	0.25	23.2	23.4	
10906	0.5	23.1	23.3	
10906	1	22.9	23.3	
10906	2	22.7	23.2	
10906	4	22.3	23.1	
10906	8	21.9	22.9	
10906	15	21.3	22.7	0.004
10906	30	20.4	22.4	0.006
10906	60	19.3	22	0.012
10906	120	18	21.5	0.018
10906	240	17	21	0.022
10906	450	16.3	20.7	0.026
10906	1440	15.8	20.5	0.029

Specimen Height After Consolidation, (Hc), In.: 5 82

Volume Change During Consolidation (Delta Vc), In.3: 0 67

Cross-Sectional Area of Specimen After Consolidation (Ac), In.2: 6 30

Triaxial Compression Testing
ASTM D 4767

Sample Depth: 26 ft.

Cell Pressure: 80 psi

Back Pressure: 60 psi

Confining Pressure: 20 psi

Strain Rate: 0 006 In/min.

Specimen Height After Consolidation, (Hc), In : 5 82

Correction for Vert Displacement, In.: 0

Load due to Friction and Uplift: 17 9 lbs.

Correction for Filter Paper: 0

Thickness of Membrane (tm), In.: 0 012

$\sigma 1-\sigma 3=$ Deviator Stress at Failure, ksf: 4 84

$\sigma 3$ f= Effective Consolidation Stress at Failure, ksf: 2 88

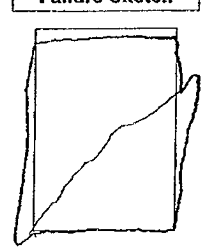
$\sigma 1=$ Total Major Principal Stress at Failure: 7.72

σ '3f= $\sigma 3-\Delta u=$ Effective Minor Principal Stress at Failure,ksf: 1 53

σ '1f= Effective Major Principal Stress at Failure, ksf: 6 36

Axial Strain at Failure: 11 00%

Failure Sketch



Report Date: Friday, August 14, 2009

SPP00003258

FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP

Project: SPORN ASH DISP. FACILITY

Sample No: 10906

Point: C

Pa: Applied Force	Vertical Displacement Reading In :	Pore Pressure psi:	Axial Strain (El):	(P) - Force Adj for U and F lbs:	Corrected Vertical Displac In :	Correction for Membrane ksf:	(A) Area In 2:	(σ1−σ3) Deviator Stress ksf:	[Δu] Induced Pore Water Pressure ksf:	σ3 Effective Consolidation Stress ksf	σ1 Total Major Principal Stress ksf	σ3 Effective Minor Principal Stress ksf	σ1 ' Effective Major Principal Stress ksf	p'	q
17.9	0.000	62.0	0.00%	0.0	0.000	0.00000	6.304	0.00	0.2880	2.88	2.88	2.59	2.59	2.59	0.00
64.6	0.003	65.6	0.05%	46.7	0.003	0.00025	6.307	1.07	0.8064	2.88	3.95	2.07	3.14	2.61	0.53
75.4	0.006	67.9	0.10%	57.5	0.006	0.00047	6.310	1.31	1.1376	2.88	4.19	1.74	3.05	2.40	0.66
86.6	0.009	69.0	0.16%	68.7	0.009	0.00079	6.314	1.57	1.2960	2.88	4.45	1.58	3.15	2.37	0.78
90.4	0.011	69.4	0.20%	72.5	0.011	0.00096	6.316	1.65	1.3536	2.88	4.53	1.53	3.18	2.35	0.83
94.7	0.014	71.0	0.25%	76.8	0.014	0.00121	6.320	1.75	1.5840	2.88	4.63	1.30	3.04	2.17	0.87
100.0	0.018	71.0	0.31%	82.1	0.018	0.00151	6.324	1.87	1.5840	2.88	4.75	1.30	3.16	2.23	0.93
103.4	0.020	71.0	0.35%	85.5	0.020	0.00169	6.326	1.94	1.5840	2.88	4.82	1.30	3.24	2.27	0.97
106.1	0.023	71.1	0.40%	88.2	0.023	0.00195	6.329	2.00	1.5984	2.88	4.88	1.28	3.29	2.28	1.00
109.9	0.027	73.4	0.46%	92.0	0.027	0.00223	6.333	2.09	1.9296	2.88	4.97	0.95	3.04	2.00	1.04
112.2	0.029	72.9	0.50%	94.3	0.029	0.00243	6.336	2.14	1.8576	2.88	5.02	1.02	3.16	2.09	1.07
115.9	0.033	73.0	0.56%	98.0	0.033	0.00275	6.340	2.22	1.8720	2.88	5.10	1.01	3.23	2.12	1.11
118.3	0.036	73.2	0.61%	100.4	0.036	0.00298	6.343	2.28	1.9008	2.88	5.16	0.98	3.26	2.12	1.14
120.1	0.038	73.5	0.65%	102.2	0.038	0.00317	6.345	2.32	1.9440	2.88	5.20	0.94	3.25	2.09	1.16
122.4	0.041	73.7	0.70%	104.5	0.041	0.00340	6.348	2.37	1.9728	2.88	5.25	0.91	3.27	2.09	1.18
124.8	0.044	73.9	0.75%	106.9	0.044	0.00366	6.352	2.42	2.0016	2.88	5.30	0.88	3.30	2.09	1.21
127.3	0.047	74.0	0.80%	109.4	0.047	0.00391	6.355	2.48	2.0160	2.88	5.36	0.86	3.34	2.10	1.24
129.4	0.049	74.0	0.85%	111.5	0.049	0.00414	6.358	2.52	2.0160	2.88	5.40	0.86	3.39	2.12	1.26
131.9	0.053	74.4	0.91%	114.0	0.053	0.00443	6.362	2.58	2.0736	2.88	5.46	0.81	3.38	2.09	1.29
133.9	0.056	74.7	0.96%	116.0	0.056	0.00466	6.365	2.62	2.1168	2.88	5.50	0.76	3.38	2.07	1.31
136.3	0.058	74.7	1.00%	118.4	0.058	0.00488	6.368	2.67	2.1168	2.88	5.55	0.76	3.44	2.10	1.34
152.8	0.087	75.9	1.50%	134.9	0.087	0.00733	6.400	3.03	2.2896	2.88	5.91	0.59	3.62	2.10	1.51
167.3	0.116	76.5	2.00%	149.4	0.116	0.00974	6.433	3.33	2.3760	2.88	6.21	0.50	3.84	2.17	1.67
180.1	0.146	76.5	2.50%	162.2	0.146	0.01221	6.466	3.60	2.3760	2.88	6.48	0.50	4.10	2.30	1.80
191.1	0.174	76.1	3.00%	173.2	0.174	0.01462	6.499	3.82	2.3184	2.88	6.70	0.56	4.38	2.47	1.91
200.1	0.204	76.0	3.50%	182.2	0.204	0.01707	6.533	4.00	2.3040	2.88	6.88	0.58	4.58	2.58	2.00
207.7	0.233	75.5	4.00%	189.8	0.233	0.01952	6.567	4.14	2.2320	2.88	7.02	0.65	4.79	2.72	2.07
214.5	0.262	75.0	4.50%	196.6	0.262	0.02195	6.601	4.27	2.1600	2.88	7.15	0.72	4.99	2.85	2.13
220.7	0.291	74.6	5.00%	202.8	0.291	0.02440	6.636	4.38	2.1024	2.88	7.26	0.78	5.15	2.97	2.19
226.2	0.320	74.1	5.50%	208.3	0.320	0.02683	6.671	4.47	2.0304	2.88	7.35	0.85	5.32	3.08	2.23
230.7	0.349	73.9	6.00%	212.8	0.349	0.02926	6.706	4.54	2.0016	2.88	7.42	0.88	5.42	3.15	2.27
234.8	0.378	73.3	6.50%	216.9	0.378	0.03173	6.743	4.60	1.9152	2.88	7.48	0.96	5.57	3.27	2.30
238.9	0.407	72.9	7.00%	221.0	0.407	0.03416	6.779	4.66	1.8576	2.88	7.54	1.02	5.68	3.35	2.33
242.5	0.437	72.7	7.50%	224.6	0.437	0.03661	6.815	4.71	1.8288	2.88	7.59	1.05	5.76	3.41	2.35
245.5	0.466	71.1	8.00%	227.6	0.466	0.03904	6.852	4.74	1.5984	2.88	7.62	1.28	6.03	3.65	2.37
248.5	0.495	71.0	8.50%	230.6	0.495	0.04149	6.890	4.78	1.5840	2.88	7.66	1.30	6.07	3.69	2.39
250.9	0.524	71.0	9.00%	233.0	0.524	0.04392	6.928	4.80	1.5840	2.88	7.68	1.30	6.10	3.70	2.40
253.3	0.553	71.0	9.50%	235.4	0.553	0.04637	6.966	4.82	1.5840	2.88	7.70	1.30	6.12	3.71	2.41

Report Date: Friday August 14, 2009

FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

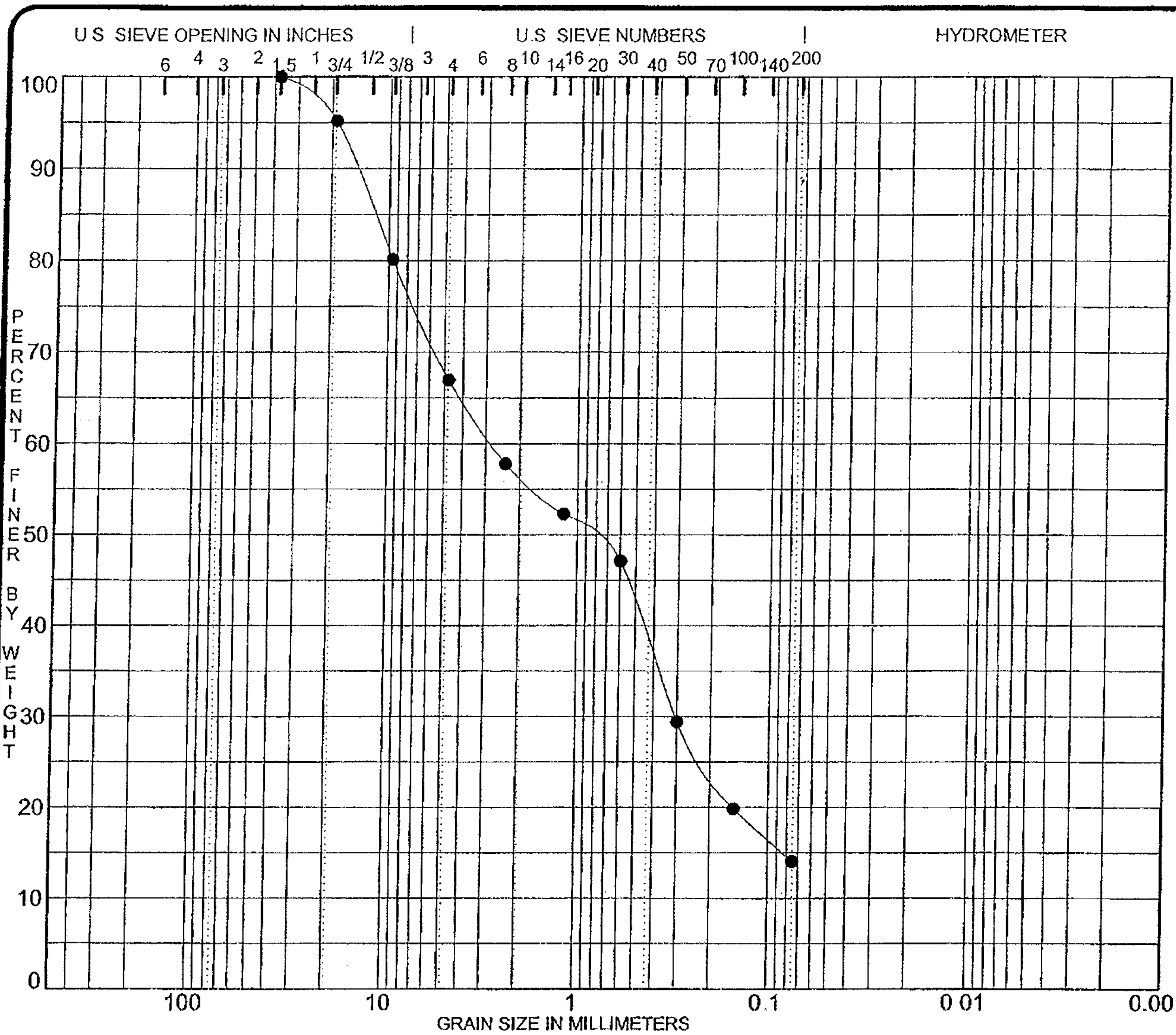
Company: AEP

Project: SPORN ASH DISP. FACILITY

Sample No: 10906

Point: C

255.5	0.582	70.5	10.00%	237.6	0.582	0.04878	7.004	4.84	1.5120	2.88	7.72	1.37	6.20	3.79	2.42
258.4	0.640	69.4	11.00%	240.5	0.640	0.05366	7.083	4.84	1.3536	2.88	7.72	1.53	6.36	3.94	2.42
260.4	0.699	68.6	12.00%	242.5	0.699	0.05858	7.164	4.82	1.2384	2.88	7.70	1.64	6.46	4.05	2.41
261.6	0.756	67.6	13.00%	243.7	0.756	0.06342	7.246	4.78	1.0944	2.88	7.66	1.79	6.57	4.18	2.39
261.4	0.815	66.9	14.00%	243.5	0.815	0.06830	7.330	4.72	0.9936	2.88	7.60	1.89	6.60	4.24	2.36
262.5	0.873	66.1	15.00%	244.6	0.873	0.07320	7.417	4.68	0.8784	2.88	7.56	2.00	6.68	4.34	2.34
263.7	0.931	65.6	16.00%	245.8	0.931	0.07806	7.505	4.64	0.8064	2.88	7.52	2.07	6.71	4.39	2.32
267.4	0.990	65.0	17.01%	249.5	0.990	0.08298	7.596	4.65	0.7200	2.88	7.53	2.16	6.81	4.48	2.32
269.3	1.047	64.6	18.00%	251.4	1.047	0.08782	7.688	4.62	0.6624	2.88	7.50	2.22	6.84	4.53	2.31
271.6	1.106	64.2	19.00%	253.7	1.106	0.09270	7.783	4.60	0.6048	2.88	7.48	2.28	6.88	4.58	2.30
274.8	1.164	64.0	20.00%	256.9	1.164	0.09760	7.880	4.60	0.5760	2.88	7.48	2.30	6.90	4.60	2.30



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	PZ-0902	8.5			NP	NP	NP		
			SILTY SAND with GRAVEL SM						
			Sand & Gravel Mixture - Samples 4,5,6 Combined						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	PZ-0902	8.5	37.500	2.790	0.307		33.0	52.9	14.0	

PROJECT **SPORN PLANT - FLY ASH POND DIKES - FLY ASH POND DIKES**

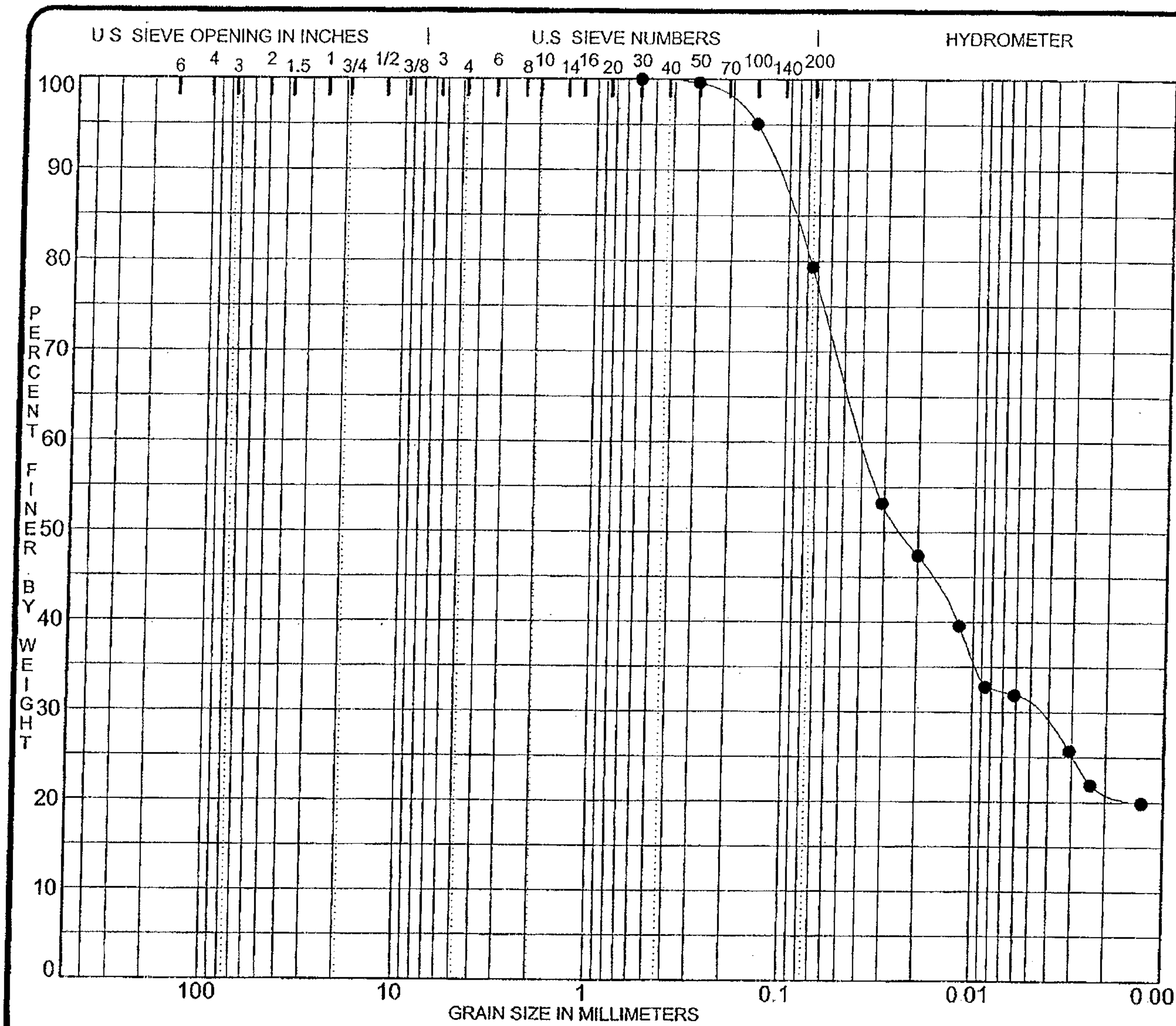
JOB NO

DATE 8/14/09

GRADATION CURVES

American Electric Power Service Corp.
Groveport, OH 43125

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.
●	PZ-0902	31.0			29.5	17.4	12.2	
			LEAN CLAY with SAND CL					
			Shelby Tube Sample - 31' - 33'					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	PZ-0902	31.0	0.600	0.039	0.005		0.0	20.6	79.4	21.3

PROJECT **SPORN PLANT - FLY ASH POND DIKES - FLY ASH POND DIKES**

JOB NO.

DATE 8/14/09

GRADATION CURVES

American Electric Power Service Corp
Groveport, OH 43125

AEP

SPP00003262

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

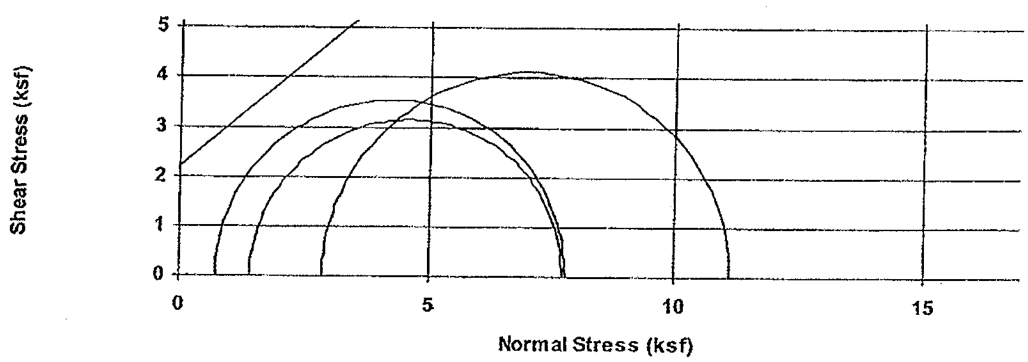
Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10918

Material Description: Boring PZ-0902, Shelby Tube - 31' - 33'; Lab # S-10918

Point Designation	Initial Conditions			Final Conditions			
	Water Content, %	Dry Density, pcf	Degree of Saturation	Water Content, %	Confining Stress, (ksf)	Deviator Stress	Induced Pore Pressure (ksf)
A	16 2%	117 4	100 5%	16 62%	0 72	7 09	-1 15
B	17 2%	114 3	98 1%	17 6%	1 44	6 30	-0 42
C	17 3%	114 5	98 8%	17 4%	2 88	8 24	0 60

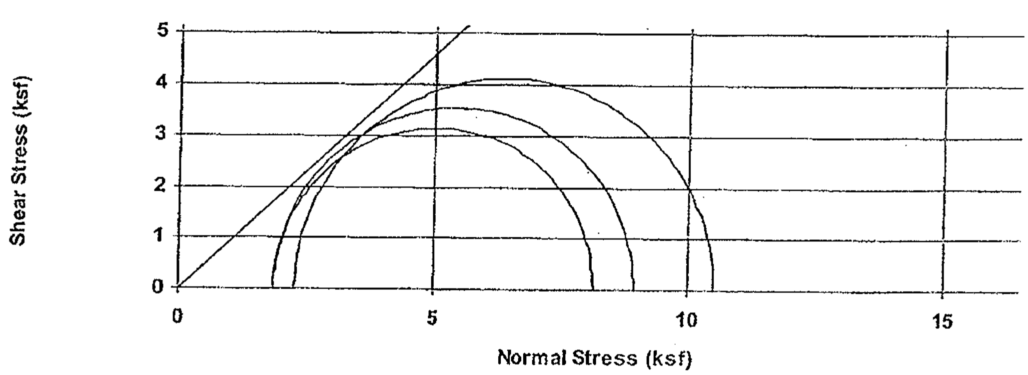
Point Designation	Axial Strain, %	q, (ksf)	Effective Stresses, (ksf)			Total Stresses, (ksf)		
			Major, (ksf)	Minor, (ksf)	p', (ksf)	Major, (ksf)	Minor, (ksf)	p, (ksf)
A	15 0%	3 54	8 96	1 87	5 42	7 81	0 72	4 26
B	15 0%	3 15	8 16	1 86	5 01	7 74	1 44	4 59
C	15 0%	4 12	10 52	2 28	6 40	11 12	2 88	7 00

Total Stress Envelope



ϕ: 40.0 °
c : 2 20 ksf

Effective Stress Envelope



ϕ ': 42 7 °
c' : 0.00 ksf

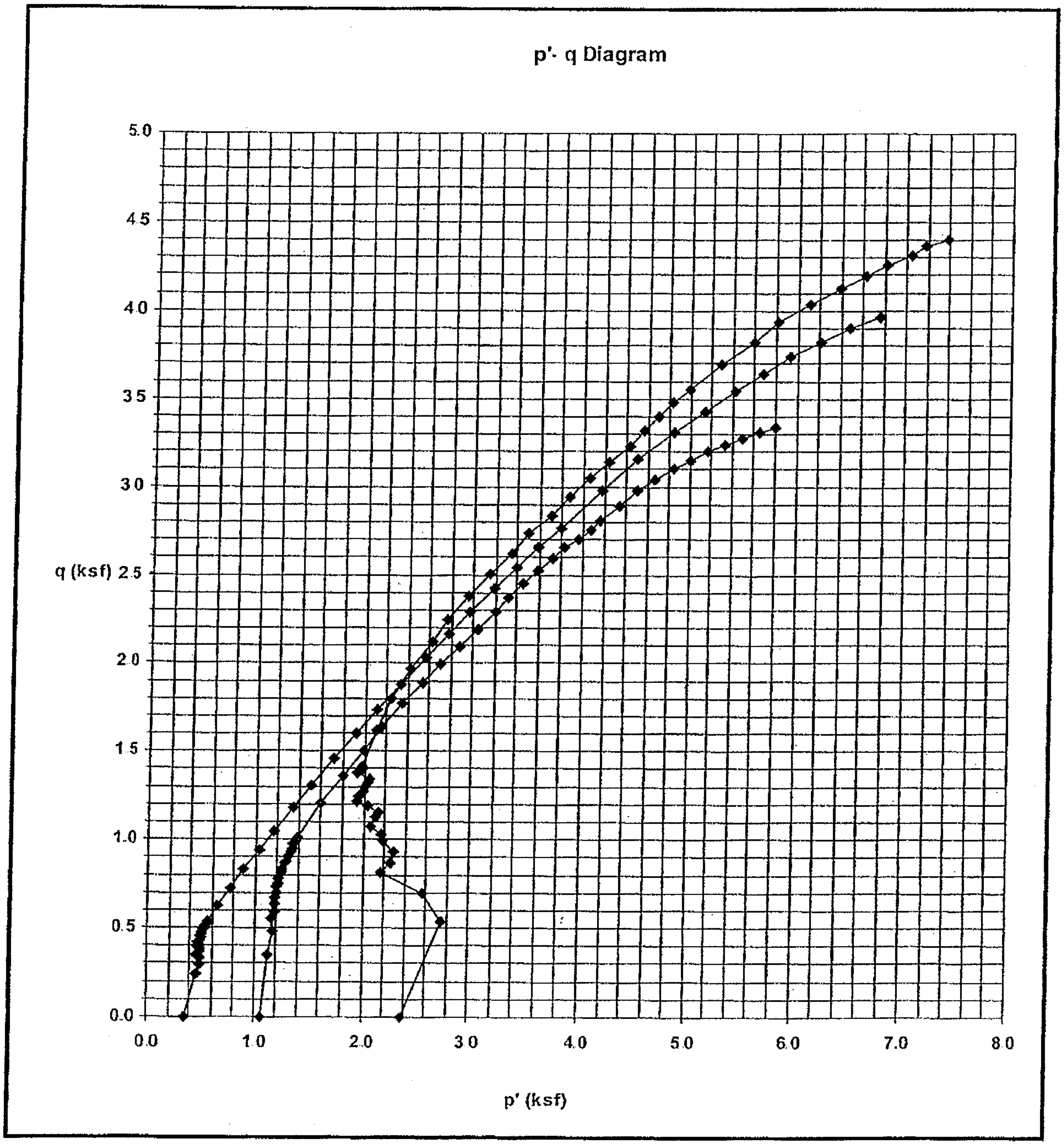
Report Date: Friday, August 14, 2009

FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10918



Report Date: Friday, August 14, 2009

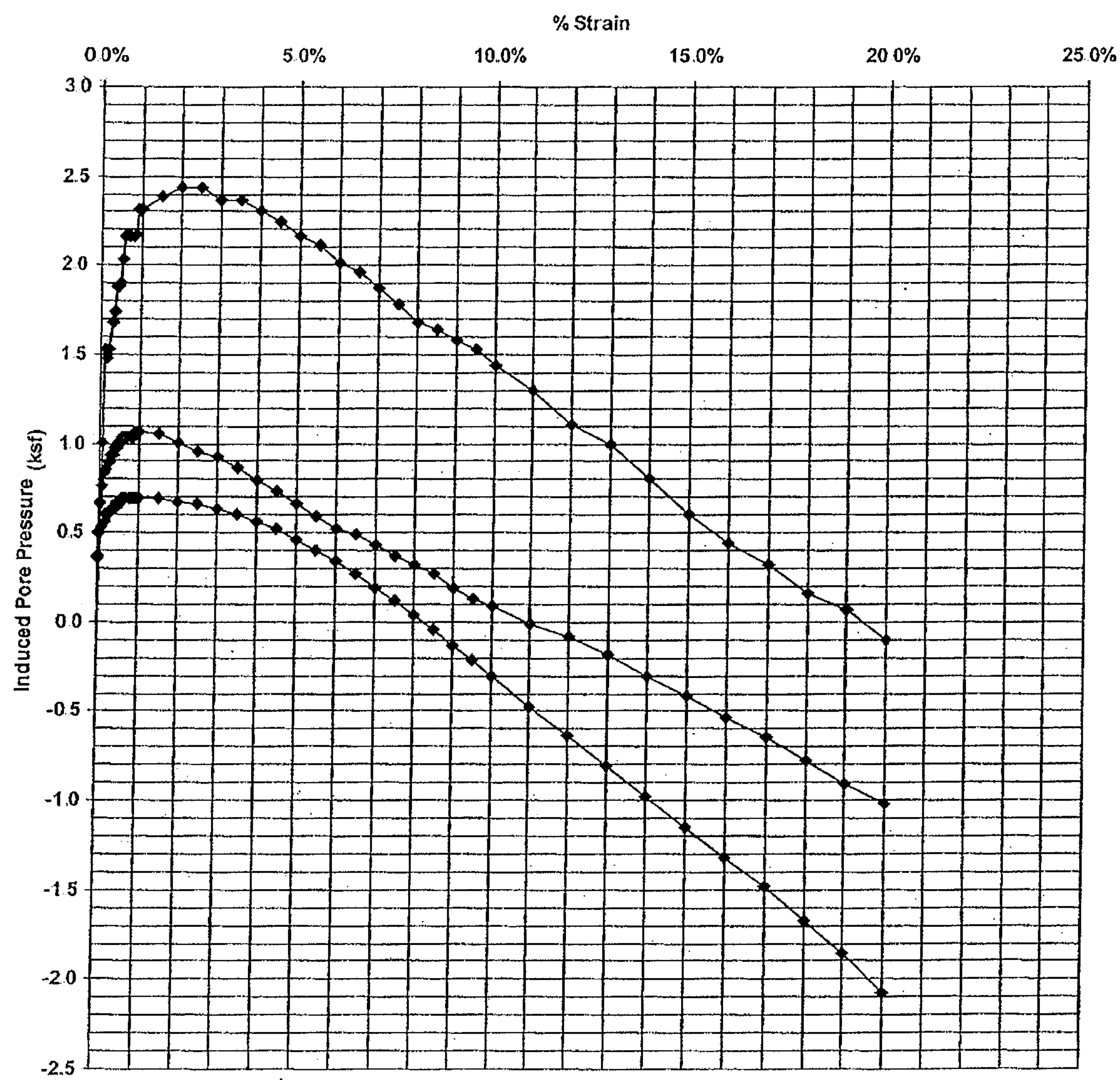
FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10918

Induced Pore Pressure Vrs % Strain



Report Date: Friday, August 14 2009

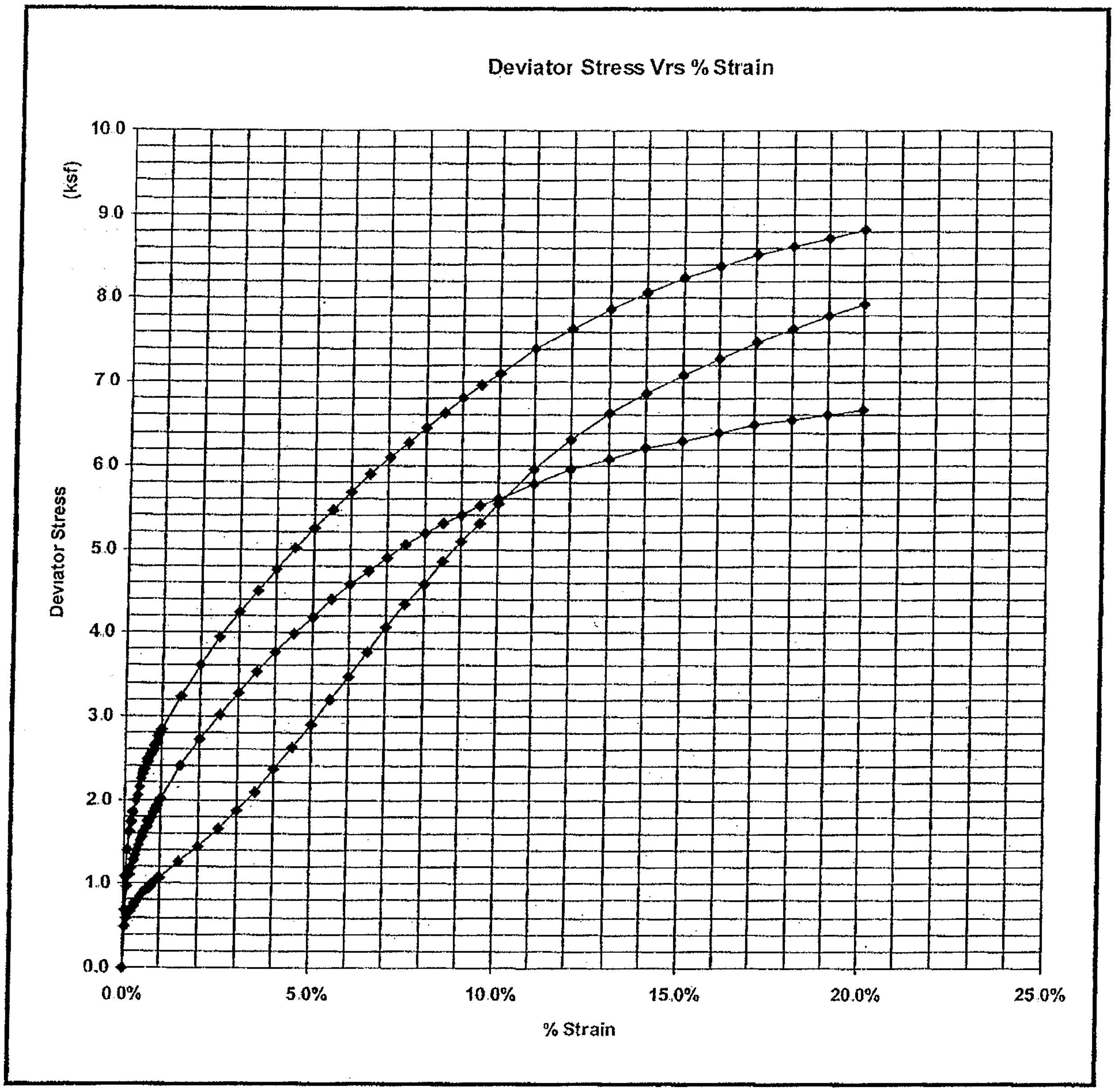
FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP

Project: SPORN ASH DISP. FACILITY

Sample No: 10918



Report Date: Friday, August 14, 2009

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10918
Point: A

Material Description: Boring PZ-0902, Shelby Tube - 31' - 33'; Lab # S-10918

Moisture Determination ASTM D2216

	Before Testing	After Testing
Tare No	#28	#28
Mass of Container and Wet Specimen (Mcws), grams	1493 00	1497 17
Mass of Container and Over Dry Specimen (Mcs), grams	1313 92	1313 92
Mass of Container (Mc), grams	211 24	211 24
Mass of Water (Mw), grams:	179 08	183.25
Mass of Solid Particles (Ms), grams:	1102 68	1102 68
Moisture Content (w), %	16 24%	16 62%

Initial Condition of Speciman ASTM D2435

	(1)	(2)	(3)	Average
Diameter Measurents, Inches:	2 813	2 803	2 824	2 813
Height Measurements, Inches:	5.763	5.753	5 757	5.758

Initial Volume of Specimen (Vo), In 3:	35 79
Dry Mass of Specimen After Testing, (Md), grams:	1102 68
Dry Unit Weight, (γ d) pcf:	117 37
Specific Gravity of the Solids, (G):	2.70
Volume of Solids, (Vs), Cu. In :	24 9222
Height of Solids,(Hs),In :	4 0092
Void Ratio Before Consolidation (Eo):	0 4361
Intitail Degree of Saturation: (So)	100 54%

Saturation - ASTM D4767 Section 8 2

Dial Indicator Reading Prior to Saturation (Rb:) In.	0
Cell Pressure AfterSaturation, psi:	73.00
Back Presssure After Saturation After, psi:	70 00
Pore Pressure Paramenter B:	1
Dial Indicator Reading After Saturation, (Ra) In.:	0 003
Change in Height during Satureation, (Delta Hs) In.	0 003
Change In Volume of Specimen during Saturation (Delta Vsat), In 3:	0 056

Report Date: Friday, August 14, 2009

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10918
Point: A

Consolidation- ASTM D2435, Section 11 5:

Sample No:	T:	Burette 2:	Burette3:	Rc:
10918	0	23.7	24.1	0 003
10918	0.25	23.6	24	
10918	0.5	23.6	24	
10918	1	23.5	24	
10918	2	23.5	23.9	
10918	4	23.4	23.8	
10918	8	23.3	23.8	
10918	15	23.2	23.7	0.005
10918	30	23	23.6	0.005
10918	60	23	23.5	0.006
10918	180	22.9	23.4	0.007
10918	240	22.8	23.3	0.008
10918	454	22.8	23.3	0.009
10918	1440	22.9	23.1	0.01

Specimen Height After Consolidation, (Hc), In.: 5 75

Volume Change During Consolidation (Delta Vc), In 3: 0 11

Cross-Sectional Area of Specimen After Consolidation (Ac), In.2: 6 20

Triaxial Compression Testing
ASTM D 4767

Sample Depth: 31 ft

Cell Pressure: 75 psi

Back Pressure: 70 psi

Confining Pressure: 5 psi

Strain Rate: 0.006 in /min.

Specimen Height After Consolidation, (Hc), In : 5 75

Correction for Vert Displacement, In.: 0

Load due to Friction and Uplift: 15 3 lbs.

Correction for Filter Paper: 0

Thickness of Membrane (tm), In : 0 012

σ1−σ3= Deviator Stress at Failure, ksf: 7 09

σ3 f= Effective Consolidation Stress at Failure, ksf: 0 72

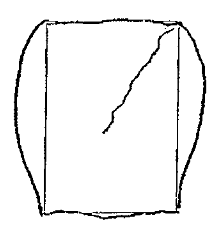
σ1= Total Major Principal Stress at Failure: 7 81

σ '3f= σ3−Δ υ= Effective Minor Principal Stress at Failure,ksf: 1 87

σ '1f= Effective Major Principal Stress at Failure, ksf: 8 96

Axial Strain at Failure: 15 00%

Failure Sketch



Report Date: Friday, August 14, 2009

SPP00003268

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP

Project: SPORN ASH DISP. FACILITY

Sample No: 10918

Point: A

Pa: Applied Force	Vertical Displacement Reading In:	Pore Pressure psi:	Axial Strain (Ef):	(P) - Force Adj for U and F lbs:	Corrected Vertical Displac In:	Correction for Membrane ksf:	(A) Area In 2:	(σ1−σ3) Deviator Stress ksf:	[Δu] Induced Pore Water Pressure ksf:	σ3 Effective Consolidation Stress ksf	σ1 Total Major Principal Stress ksf	σ3 Effective Minor Principal Stress ksf	σ1' Effective Major Principal Stress ksf	p'	q
15.3	0.001	72.5	0.01%	0.0	0.001	0.00005	6.199	0.00	0.3600	0.72	0.72	0.36	0.36	0.36	0.00
36.2	0.003	73.5	0.05%	20.9	0.003	0.00024	6.201	0.49	0.5040	0.72	1.21	0.22	0.70	0.46	0.24
41.0	0.006	73.7	0.10%	25.7	0.006	0.00048	6.204	0.60	0.5328	0.72	1.32	0.19	0.78	0.49	0.30
44.2	0.009	73.9	0.16%	28.9	0.009	0.00079	6.208	0.67	0.5616	0.72	1.39	0.16	0.83	0.49	0.33
45.4	0.012	74.2	0.20%	30.1	0.012	0.00099	6.211	0.70	0.6048	0.72	1.42	0.12	0.81	0.46	0.35
47.1	0.014	74.2	0.25%	31.8	0.014	0.00123	6.214	0.74	0.6048	0.72	1.46	0.12	0.85	0.48	0.37
48.5	0.018	74.3	0.31%	33.2	0.018	0.00152	6.218	0.77	0.6192	0.72	1.49	0.10	0.87	0.48	0.38
49.3	0.020	74.4	0.35%	34.0	0.020	0.00171	6.220	0.79	0.6336	0.72	1.51	0.09	0.87	0.48	0.39
50.5	0.023	74.4	0.40%	35.2	0.023	0.00195	6.223	0.81	0.6336	0.72	1.53	0.09	0.90	0.49	0.41
51.8	0.026	74.6	0.46%	36.5	0.026	0.00224	6.227	0.84	0.6624	0.72	1.56	0.06	0.90	0.48	0.42
52.9	0.029	74.6	0.50%	37.6	0.029	0.00245	6.229	0.87	0.6624	0.72	1.59	0.06	0.92	0.49	0.43
54.1	0.032	74.6	0.56%	38.8	0.032	0.00274	6.233	0.89	0.6624	0.72	1.61	0.06	0.95	0.50	0.45
55.1	0.035	74.8	0.61%	39.8	0.035	0.00298	6.236	0.92	0.6912	0.72	1.64	0.03	0.94	0.49	0.46
55.9	0.037	74.8	0.65%	40.6	0.037	0.00320	6.239	0.93	0.6912	0.72	1.65	0.03	0.96	0.50	0.47
56.9	0.040	74.8	0.70%	41.6	0.040	0.00344	6.242	0.96	0.6912	0.72	1.68	0.03	0.99	0.51	0.48
57.8	0.043	74.8	0.75%	42.5	0.043	0.00370	6.245	0.98	0.6912	0.72	1.70	0.03	1.01	0.52	0.49
58.8	0.046	74.8	0.80%	43.5	0.046	0.00396	6.248	1.00	0.6912	0.72	1.72	0.03	1.03	0.53	0.50
59.6	0.049	74.8	0.85%	44.3	0.049	0.00418	6.251	1.02	0.6912	0.72	1.74	0.03	1.05	0.54	0.51
60.7	0.053	74.8	0.92%	45.4	0.053	0.00450	6.256	1.04	0.6912	0.72	1.76	0.03	1.07	0.55	0.52
61.5	0.055	74.8	0.96%	46.2	0.055	0.00473	6.258	1.06	0.6912	0.72	1.78	0.03	1.09	0.56	0.53
62.2	0.057	74.8	1.00%	46.9	0.057	0.00491	6.261	1.07	0.6912	0.72	1.79	0.03	1.10	0.57	0.54
70.4	0.086	74.8	1.50%	55.1	0.086	0.00740	6.293	1.25	0.6912	0.72	1.97	0.03	1.28	0.66	0.63
79.3	0.115	74.7	2.00%	64.0	0.115	0.00985	6.325	1.45	0.6768	0.72	2.17	0.04	1.49	0.77	0.72
89.3	0.144	74.6	2.50%	74.0	0.144	0.01231	6.357	1.66	0.6624	0.72	2.38	0.06	1.72	0.89	0.83
99.4	0.173	74.4	3.00%	84.1	0.173	0.01478	6.390	1.88	0.6336	0.72	2.60	0.09	1.97	1.03	0.94
109.4	0.201	74.2	3.50%	94.1	0.201	0.01721	6.423	2.09	0.6048	0.72	2.81	0.12	2.21	1.16	1.05
121.9	0.230	73.9	4.00%	106.6	0.230	0.01969	6.457	2.36	0.5616	0.72	3.08	0.16	2.52	1.34	1.18
134.4	0.259	73.6	4.50%	119.1	0.259	0.02214	6.490	2.62	0.5184	0.72	3.34	0.20	2.82	1.51	1.31
148.2	0.288	73.2	5.01%	132.9	0.288	0.02464	6.525	2.91	0.4608	0.72	3.63	0.26	3.17	1.71	1.45
162.0	0.316	72.8	5.50%	146.7	0.316	0.02705	6.559	3.19	0.4032	0.72	3.91	0.32	3.51	1.91	1.60
175.8	0.345	72.4	6.00%	160.5	0.345	0.02952	6.594	3.48	0.3456	0.72	4.20	0.37	3.85	2.11	1.74
190.0	0.374	71.9	6.50%	174.7	0.374	0.03199	6.629	3.76	0.2736	0.72	4.48	0.45	4.21	2.33	1.88
204.9	0.402	71.3	7.00%	189.6	0.402	0.03445	6.665	4.06	0.1872	0.72	4.78	0.53	4.59	2.56	2.03
218.5	0.431	70.8	7.50%	203.2	0.431	0.03690	6.701	4.33	0.1152	0.72	5.05	0.60	4.93	2.77	2.16
231.6	0.460	70.3	8.00%	216.3	0.460	0.03937	6.737	4.58	0.0432	0.72	5.30	0.68	5.26	2.97	2.29
245.2	0.489	69.7	8.50%	229.9	0.489	0.04183	6.774	4.85	-0.0432	0.72	5.57	0.76	5.61	3.19	2.42
257.8	0.517	69.1	9.00%	242.5	0.517	0.04430	6.811	5.08	-0.1296	0.72	5.80	0.85	5.93	3.39	2.54
270.3	0.546	68.5	9.50%	255.0	0.546	0.04675	6.849	5.31	-0.2160	0.72	6.03	0.94	6.25	3.59	2.66

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP

Project: SPORN ASH DISP. FACILITY

Sample No: 10918

Point: A

282 4	0 575	67 9	10 00%	267.1	0 575	0 04921	6 887	5 54	-0 3024	0 72	6 26	1 02	6 56	3 79	2 77
306 0	0 632	66 7	11 00%	290 7	0 632	0 05414	6 965	5 96	-0 4752	0 72	6 68	1 20	7 15	4 17	2 98
326 7	0 690	65 6	12 00%	311 4	0 690	0 05906	7 044	6 31	-0 6336	0 72	7 03	1 35	7 66	4 51	3 15
346 2	0 747	64 4	13 00%	330 9	0 747	0 06399	7 125	6 62	-0 8064	0 72	7 34	1 53	8 15	4 84	3 31
362 1	0 805	63 2	14 00%	346 8	0 805	0 06890	7 207	6 86	-0 9792	0 72	7 58	1 70	8 56	5 13	3 43
378 0	0 862	62 0	15.00%	362 7	0 862	0 07383	7.292	7 09	-1 1520	0 72	7 81	1 87	8 96	5 42	3 54
392 6	0 920	60 8	16 00%	377 3	0 920	0 07875	7 379	7 28	-1 3248	0 72	8 00	2 04	9 33	5 69	3 64
407 1	0 977	59 7	17 01%	391 8	0 977	0 08368	7 468	7 47	-1 4832	0 72	8 19	2 20	9 67	5 94	3 74
421 0	1 035	58 4	18 00%	405 7	1 035	0 08859	7 559	7 64	-1 6704	0 72	8 36	2 39	10 03	6.21	3 82
434 8	1 092	57 1	19 01%	419 5	1 092	0 09353	7 653	7 80	-1 8576	0 72	8 52	2.58	10 38	6 48	3 90
447.2	1 150	55 6	20 01%	431 9	1 150	0 09846	7 749	7 93	-2 0736	0 72	8 65	2 79	10 72	6 76	3 96

Report Date: Friday August 14, 2009

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10918
Point: B

Material Description: Boring PZ-0902, Shelby Tube - 31' - 33'; Lab # S-10918

Moisture Determination ASTM D2216

	Before Testing	After Testing
Tare No.	#900	#900
Mass of Container and Wet Specimen (Mcws), grams	1499 01	1502 94
Mass of Container and Over Dry Specimen (Mcs), grams	1310 23	1310 23
Mass of Container (Mc), grams	215.43	215 43
Mass of Water (Mw), grams:	188 78	192 71
Mass of Solid Particles (Ms), grams:	1094 8	1094 8
Moisture Content (w), %	17 24%	17 60%

Initial Condition of Speciman ASTM D2435

	(1)	(2)	(3)	Average
Diameter Measurents, Inches:	2 849	2 839	2.834	2 841
Height Measurements, Inches:	5 756	5 766	5.751	5 758
Initial Volume of Specimen (Vo), In.3:	36 49			
Dry Mass of Specimen After Testing, (Md), grams:	1094 8			
Dry Unit Weight, (γ d) pcf:	114 30			
Specific Gravity of the Solids, (G):	2 70			
Volume of Solids, (Vs), Cu. In.:	24 7441			
Height of Solids,(Hs),In.:	3 9043			
Void Ratio Before Consolidation (Eo):	0.4747			
Intitail Degree of Saturation: (So)	98 07%			

Saturation - ASTM D4767 Section 8.2

Dial Indicator Reading Prior to Saturation (Rb:) In.	0
Cell Pressure AfterSaturation, psi:	75 00
Back Presssure After Saturation After, psi:	70.00
Pore Pressure Paramenter B:	0.99
Dial Indicator Reading After Saturation, (Ra) In.:	0.003
Change in Height during Satureation, (Delta Hs) In.	0 003
Change In Volume of Specimen during Saturation (Delta Vsat), In.3:	0 057

Report Date: Friday, August 14, 2009

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP

Project: SPORN ASH DISP. FACILITY

Sample No: 10918

Point: B

Consolidation- ASTM D2435, Section 11.5:

Sample No:	T:	Burette 2:	Burette3:	Rc:
10918	0	24.1	23.9	0.003
10918	0.25	24	23.8	
10918	0.5	24	23.8	
10918	1	24	23.8	
10918	2	23.9	23.7	
10918	4	23.9	23.7	
10918	8	23.8	23.5	
10918	15	23.7	23.4	0.005
10918	30	23.6	23.2	0.006
10918	60	23.5	23.1	0.006
10918	180	23.4	23	0.007
10918	240	23.4	22.9	0.007
10918	452	23.3	22.9	0.008
10918	1440	23.3	22.9	0.008

Specimen Height After Consolidation, (Hc), In.: 5 75

Volume Change During Consolidation (Delta Vc), In.3: 0 11

Cross-Sectional Area of Specimen After Consolidation (Ac), In.2: 6 32

Triaxial Compression Testing ASTM D 4767

Sample Depth: 31 ft.

Cell Pressure: 80 psi

Back Pressure: 70 psi

Confining Pressure: 10 psi

Strain Rate: 0 006 In/min

Specimen Height After Consolidation, (Hc), In.: 5 75

Correction for Vert Displacement, In.: 0

Load due to Friction and Uplift: 18 6 lbs.

Correction for Filter Paper: 0

Thickness of Membrane (tm), In.: 0 012

$\sigma 1 - \sigma 3 =$ Deviator Stress at Failure, ksf: 6 30

$\sigma 3$ f= Effective Consolidation Stress at Failure, ksf: 1 44

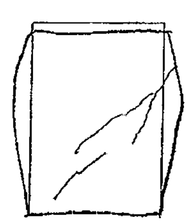
$\sigma 1 =$ Total Major Principal Stress at Failure: 7.74

$\sigma '3f = \sigma 3 - \Delta \upsilon =$ Effective Minor Principal Stress at Failure,ksf: 1 86

$\sigma '1f =$ Effective Major Principal Stress at Failure, ksf: 8 16

Axial Strain at Failure: 15 00%

Failure Sketch



Report Date: Friday, August 14, 2009

SPP00003272

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP

Project: SPORN ASH DISP. FACILITY

Sample No: 10918

Point: B

Pa: Applied Force	Vertical Displacement Reading In :	Pore Pressure psi:	Axial Strain (El):	(P) - Force Adj for U and F lbs:	Corrected Vertical Displac In. :	Correction for Membrane ksf:	(A) Area In 2:	(σ1−σ3) Deviator Stress ksf:	[Δu] Induced Pore Water Pressure ksf:	σ3 Effective Consolidation Stress ksf	σ1 Total Major Principal Stress ksf	σ3 Effective Minor Principal Stress ksf	σ1 ' Effective Major Principal Stress ksf	p'	q
18.6	0.000	72.6	0.00%	0.0	0.000	0.00000	6.317	0.00	0.3744	1.44	1.44	1.07	1.07	1.07	0.00
49.0	0.003	74.6	0.05%	30.4	0.003	0.00022	6.320	0.69	0.6624	1.44	2.13	0.78	1.47	1.12	0.35
61.0	0.006	75.3	0.10%	42.4	0.006	0.00047	6.324	0.97	0.7632	1.44	2.41	0.68	1.64	1.16	0.48
67.3	0.009	75.8	0.16%	48.7	0.009	0.00076	6.327	1.11	0.8352	1.44	2.55	0.60	1.71	1.16	0.55
70.9	0.011	75.9	0.20%	52.3	0.011	0.00097	6.330	1.19	0.8496	1.44	2.63	0.59	1.78	1.18	0.59
74.7	0.015	76.2	0.25%	56.1	0.015	0.00124	6.334	1.27	0.8928	1.44	2.71	0.55	1.82	1.18	0.64
77.9	0.018	76.5	0.31%	59.3	0.018	0.00149	6.337	1.35	0.9360	1.44	2.79	0.50	1.85	1.18	0.67
80.1	0.020	76.5	0.35%	61.5	0.020	0.00171	6.340	1.40	0.9360	1.44	2.84	0.50	1.90	1.20	0.70
83.0	0.023	76.8	0.40%	64.4	0.023	0.00193	6.343	1.46	0.9792	1.44	2.90	0.46	1.92	1.19	0.73
85.3	0.026	76.8	0.46%	66.7	0.026	0.00222	6.346	1.51	0.9792	1.44	2.95	0.46	1.97	1.22	0.76
87.4	0.029	77.0	0.50%	68.8	0.029	0.00244	6.349	1.56	1.0080	1.44	3.00	0.43	1.99	1.21	0.78
90.3	0.032	77.0	0.56%	71.7	0.032	0.00271	6.353	1.62	1.0080	1.44	3.06	0.43	2.05	1.24	0.81
92.4	0.035	77.2	0.61%	73.8	0.035	0.00297	6.356	1.67	1.0368	1.44	3.11	0.40	2.07	1.24	0.83
95.1	0.038	77.2	0.65%	76.5	0.038	0.00319	6.359	1.73	1.0368	1.44	3.17	0.40	2.13	1.27	0.86
96.2	0.040	77.2	0.70%	77.6	0.040	0.00339	6.362	1.75	1.0368	1.44	3.19	0.40	2.16	1.28	0.88
98.3	0.043	77.2	0.75%	79.7	0.043	0.00365	6.365	1.80	1.0368	1.44	3.24	0.40	2.20	1.30	0.90
100.9	0.046	77.2	0.80%	82.3	0.046	0.00390	6.368	1.86	1.0368	1.44	3.30	0.40	2.26	1.33	0.93
102.6	0.049	77.2	0.85%	84.0	0.049	0.00414	6.372	1.89	1.0368	1.44	3.33	0.40	2.30	1.35	0.95
104.8	0.052	77.4	0.91%	86.2	0.052	0.00443	6.375	1.94	1.0656	1.44	3.38	0.37	2.32	1.35	0.97
106.7	0.055	77.4	0.96%	88.1	0.055	0.00468	6.379	1.98	1.0656	1.44	3.42	0.37	2.36	1.37	0.99
108.3	0.058	77.4	1.00%	89.7	0.058	0.00488	6.381	2.02	1.0656	1.44	3.46	0.37	2.39	1.38	1.01
126.1	0.086	77.3	1.50%	107.5	0.086	0.00729	6.413	2.41	1.0512	1.44	3.85	0.39	2.80	1.59	1.20
141.1	0.115	77.0	2.00%	122.5	0.115	0.00975	6.446	2.73	1.0080	1.44	4.17	0.43	3.16	1.80	1.36
154.6	0.144	76.6	2.50%	136.0	0.144	0.01221	6.480	3.01	0.9504	1.44	4.45	0.49	3.50	1.99	1.51
167.2	0.172	76.4	3.00%	148.6	0.172	0.01462	6.513	3.27	0.9216	1.44	4.71	0.52	3.79	2.15	1.64
180.0	0.201	76.0	3.50%	161.4	0.201	0.01706	6.547	3.53	0.8640	1.44	4.97	0.58	4.11	2.34	1.77
191.8	0.230	75.5	4.00%	173.2	0.230	0.01950	6.581	3.77	0.7920	1.44	5.21	0.65	4.42	2.53	1.89
202.7	0.259	75.1	4.50%	184.1	0.259	0.02194	6.615	3.99	0.7344	1.44	5.43	0.71	4.69	2.70	1.99
213.2	0.287	74.6	5.00%	194.6	0.287	0.02436	6.650	4.19	0.6624	1.44	5.63	0.78	4.97	2.87	2.09
223.6	0.316	74.1	5.50%	205.0	0.316	0.02681	6.685	4.39	0.5904	1.44	5.83	0.85	5.24	3.04	2.19
233.4	0.345	73.6	6.00%	214.8	0.345	0.02923	6.720	4.57	0.5184	1.44	6.01	0.92	5.49	3.21	2.29
242.5	0.374	73.4	6.50%	223.9	0.374	0.03167	6.756	4.74	0.4896	1.44	6.18	0.95	5.69	3.32	2.37
251.2	0.402	73.0	7.00%	232.6	0.402	0.03411	6.793	4.90	0.4320	1.44	6.34	1.01	5.90	3.46	2.45
259.6	0.431	72.6	7.50%	241.0	0.431	0.03655	6.830	5.04	0.3744	1.44	6.48	1.07	6.11	3.59	2.52
267.5	0.460	72.2	8.00%	248.9	0.460	0.03900	6.867	5.18	0.3168	1.44	6.62	1.12	6.30	3.71	2.59
275.0	0.489	71.9	8.50%	256.4	0.489	0.04145	6.905	5.31	0.2736	1.44	6.75	1.17	6.47	3.82	2.65
281.4	0.518	71.3	9.01%	262.8	0.518	0.04390	6.943	5.41	0.1872	1.44	6.85	1.25	6.66	3.96	2.70
288.3	0.546	70.9	9.50%	269.7	0.546	0.04632	6.981	5.52	0.1296	1.44	6.96	1.31	6.83	4.07	2.76

Report Date: Friday, August 14, 2009

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: **AEP**

Project: **SPORN ASH DISP. FACILITY**

Sample No: **10918**

Point: **B**

294.5	0.575	70.6	10.00%	275.9	0.575	0.04873	7.019	5.61	0.0864	1.44	7.05	1.35	6.97	4.16	2.81
306.4	0.633	69.9	11.01%	287.8	0.633	0.05365	7.099	5.78	-0.0144	1.44	7.22	1.45	7.24	4.35	2.89
318.1	0.690	69.4	12.00%	299.5	0.690	0.05848	7.179	5.95	-0.0864	1.44	7.39	1.53	7.48	4.50	2.97
328.6	0.748	68.7	13.00%	310.0	0.748	0.06338	7.262	6.08	-0.1872	1.44	7.52	1.63	7.71	4.67	3.04
338.6	0.805	67.9	14.00%	320.0	0.805	0.06824	7.346	6.20	-0.3024	1.44	7.64	1.74	7.95	4.84	3.10
347.6	0.863	67.1	15.00%	329.0	0.863	0.07313	7.433	6.30	-0.4176	1.44	7.74	1.86	8.16	5.01	3.15
356.8	0.920	66.3	16.00%	338.2	0.920	0.07799	7.521	6.40	-0.5328	1.44	7.84	1.97	8.37	5.17	3.20
365.6	0.978	65.5	17.00%	347.0	0.978	0.08288	7.612	6.48	-0.6480	1.44	7.92	2.09	8.57	5.33	3.24
373.3	1.035	64.6	18.00%	354.7	1.035	0.08776	7.705	6.54	-0.7776	1.44	7.98	2.22	8.76	5.49	3.27
381.9	1.092	63.7	19.00%	363.3	1.092	0.09261	7.799	6.62	-0.9072	1.44	8.06	2.35	8.96	5.65	3.31
389.9	1.150	62.9	20.00%	371.3	1.150	0.09747	7.897	6.67	-1.0224	1.44	8.11	2.46	9.14	5.80	3.34

Report Date: Friday, August 14, 2009

FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP

Project: SPORN ASH DISP. FACILITY

Sample No: 10918

Point: C

Material Description: Boring PZ-0902, Shelby Tube - 31' - 33'; Lab # S-10918

Moisture Determination ASTM D2216

	Before Testing	After Testing
Tare No.	R-3	R-3
Mass of Container and Wet Specimen (Mcws), grams	1515.47	1516 93
Mass of Container and Over Dry Specimen (Mcs), grams	1324 08	1324 08
Mass of Container (Mc), grams	216 28	216 28
Mass of Water (Mw), grams:	191 39	192 85
Mass of Solid Particles (Ms), grams:	1107 8	1107 8
Moisture Content (w), %	17 28%	17 41%

Initial Condition of Speciman ASTM D2435

	(1)	(2)	(3)	Average
Diameter Measurents, Inches:	2 843	2 848	2 837	2 843
Height Measurements, Inches:	5 801	5 809	5 811	5 807

Initial Volume of Specimen (Vo), In.3:	36 85
Dry Mass of Specimen After Testing, (Md), grams:	1107.8
Dry Unit Weight, (γ d) pcf:	114 51
Specific Gravity of the Solids, (G):	2 70
Volume of Solids, (Vs), Cu. In.:	25 0379
Height of Solids,(Hs),In.:	3 9451
Void Ratio Before Consolidation (Eo):	0 4720
Intitail Degree of Saturation: (So)	98 84%

Saturation - ASTM D4767 Section 8.2

Dial Indicator Reading Prior to Saturation (Rb:) In.	0
Cell Pressure AfterSaturation, psi:	90 00
Back Presssure After Saturation After, psi:	70 00
Pore Pressure Paramenter B:	1
Dial Indicator Reading After Saturation, (Ra) In.:	-0 004
Change in Height during Satureation, (Delta Hs) In.	-0 004
Change In Volume of Specimen during Saturation (Delta Vsat), In 3:	-0 076

Report Date: Friday, August 14, 2009

FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10918
Point: C

Consolidation- ASTM D2435, Section 11.5:

Sample No:	T:	Burette 2:	Burette3:	Rc:
10918	0	23.8	23.7	-0.004
10918	0.25	23.5	23.5	
10918	0.5	23.5	23.5	
10918	1	23.5	23.4	
10918	2	23.4	23.3	
10918	4	23.2	23.1	
10918	8	23.1	22.8	
10918	15	22.9	22.4	0.005
10918	30	22.5	22	0.008
10918	60	22	21.4	0.011
10918	180	21.2	20.6	0.015
10918	240	21.1	20.4	0.016
10918	450	20.8	20.1	0.018
10918	1440	20.7	20.4	0.02

Specimen Height After Consolidation, (Hc), In: 5.79

Volume Change During Consolidation (Delta Vc), In.3: 0.39

Cross-Sectional Area of Specimen After Consolidation (Ac), In.2: 6.31

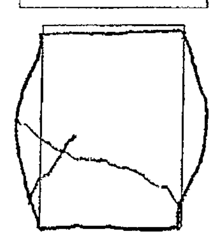
Triaxial Compression Testing ASTM D 4767

Sample Depth: 31 ft.
Cell Pressure: 90 psi
Back Pressure: 70 psi
Confining Pressure: 20 psi
Strain Rate: 0.006 In/min.

Specimen Height After Consolidation, (Hc), In: 5.79
Correction for Vert Displacement, In: 0
Load due to Friction and Uplift: 20 lbs.
Correction for Filter Paper: 0
Thickness of Membrane (tm), In.: 0.012

	$\sigma1-\sigma3=$	Deviator Stress at Failure, ksf:	8.24
	$\sigma3$ f=	Effective Consolidation Stress at Failure, ksf:	2.88
	$\sigma1=$	Total Major Principal Stress at Failure:	11.12
σ '3f=	$\sigma3-\Delta$ υ=	Effective Minor Principal Stress at Failure,ksf:	2.28
	σ '1f=	Effective Major Principal Stress at Failure, ksf:	10.52
		Axial Strain at Failure:	15.01%

Failure Sketch



Report Date: Friday, August 14, 2009

FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION

AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP
AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP

Project: SPORN ASH DISP. FACILITY

Sample No: 10918

Point: C

Pa: Applied Force	Vertical Displacement Reading In :	Pore Pressure psi:	Axial Strain (E1):	(P) - Force Adj for U and F lbs:	Corrected Vertical Displac In :	Correction for Membrane ksf:	(A) Area In 2:	(σ1-σ3) Deviator Stress ksf:	[Δu] Induced Pore Water Pressure ksf:	σ3 Effective Consolidation Stress ksf	σ1 Total Major Principal Stress ksf	σ3 Effective Minor Principal Stress ksf	σ1 ' Effective Major Principal Stress ksf	p'	q
20 0	0 000	73 5	0 00%	0 0	0 000	0 00000	6 314	0 00	0 5040	2 88	2 88	2 38	2 38	2 38	0 00
67 4	0 003	74 7	0 05%	47 4	0 003	0 00025	6 317	1 08	0 6768	2.88	3 96	2 20	3 28	2 74	0 54
81 2	0 006	77 0	0 10%	61 2	0 006	0 00049	6 321	1 39	1 0080	2 88	4 27	1 87	3 27	2 57	0 70
91 2	0 009	80 6	0 16%	71 2	0 009	0 00076	6 324	1 62	1 5264	2 88	4 50	1 35	2 97	2 16	0 81
96.0	0 011	80 3	0 20%	76 0	0 011	0 00096	6 327	1 73	1.4832	2 88	4 61	1 40	3 13	2 26	0 86
101 8	0 014	80 6	0 25%	81 8	0 014	0 00120	6 330	1 86	1 5264	2 88	4 74	1 35	3 21	2 28	0 93
107 7	0.018	81 7	0 31%	87 7	0 018	0 00150	6 334	1.99	1 6848	2 88	4 87	1 20	3 19	2 19	1 00
110 5	0 020	82 1	0 35%	90 5	0 020	0 00170	6 336	2 06	1 7424	2 88	4 94	1 14	3 19	2 17	1 03
114 8	0 023	83 1	0 40%	94 8	0 023	0 00194	6 339	2 15	1 8864	2 88	5 03	0 99	3 15	2 07	1 08
119.0	0 027	83 1	0 46%	99 0	0 027	0 00224	6 343	2 25	1 8864	2 88	5 13	0 99	3 24	2 12	1 12
122.2	0 029	83 2	0 50%	102 2	0 029	0 00244	6 346	2 32	1 9008	2 88	5 20	0 98	3 30	2 14	1 16
124 7	0 032	84 1	0 56%	104 7	0 032	0 00271	6 350	2 37	2 0304	2 88	5 25	0 85	3 22	2 04	1.19
127 8	0 035	85 0	0 61%	107 8	0 035	0 00297	6 353	2 44	2 1600	2 88	5 32	0 72	3 16	1 94	1 22
129 6	0 038	85 1	0 65%	109 6	0 038	0 00317	6 356	2 48	2 1744	2 88	5 36	0 71	3 19	1 95	1 24
132 2	0 041	85 0	0 70%	112 2	0 041	0 00342	6 359	2 54	2 1600	2 88	5 42	0 72	3 26	1 99	1 27
134 4	0 043	85 0	0 75%	114 4	0 043	0 00366	6 362	2 59	2 1600	2 88	5 47	0 72	3 31	2 01	1 29
137 1	0 046	85 0	0 80%	117 1	0 046	0 00391	6 365	2 65	2 1600	2 88	5 53	0 72	3 37	2 04	1 32
139 0	0 049	85 1	0 85%	119 0	0 049	0 00413	6 368	2 69	2 1744	2 88	5 57	0 71	3 39	2 05	1 34
142.1	0 053	86 1	0 91%	122 1	0 053	0.00445	6 372	2 75	2 3184	2 88	5 63	0 56	3 32	1 94	1 38
143 8	0 055	86 0	0 96%	123 8	0 055	0 00467	6 375	2 79	2 3040	2 88	5 67	0 58	3 37	1 97	1 40
145 6	0 058	86 1	1 00%	125 6	0 058	0 00487	6 378	2 83	2 3184	2 88	5 71	0 56	3 39	1.98	1 42
164.2	0 087	86 6	1 50%	144 2	0 087	0 00730	6 410	3 23	2 3904	2 88	6 11	0 49	3 72	2 11	1 62
181 7	0 116	86 9	2 00%	161 7	0 116	0.00976	6 443	3 60	2 4336	2 88	6 48	0 45	4 05	2 25	1 80
197 6	0 145	86 9	2 50%	177 6	0 145	0 01218	6 476	3 94	2 4336	2 88	6 82	0 45	4 38	2 41	1 97
212 0	0 174	86 4	3 00%	192 0	0.174	0.01464	6 510	4 23	2 3616	2 88	7 11	0 52	4 75	2 63	2 12
224 9	0 203	86 4	3 50%	204 9	0 203	0 01707	6 543	4 49	2 3616	2 88	7 37	0 52	5 01	2 76	2.25
238 2	0 231	86 0	4 00%	218 2	0 231	0 01950	6 577	4 76	2 3040	2 88	7 64	0 58	5 33	2 95	2 38
251 3	0 260	85 6	4 50%	231 3	0 260	0 02194	6 612	5 02	2 2464	2 88	7 90	0 63	5 65	3 14	2 51
263 4	0 290	85 0	5 01%	243 4	0 290	0 02442	6 647	5 25	2 1600	2 88	8 13	0 72	5 97	3 34	2 62
275 0	0 318	84 7	5 50%	255 0	0 318	0 02682	6 682	5 47	2 1168	2 88	8 35	0 76	6 23	3 50	2 73
286 3	0 347	84 0	6 00%	266 3	0 347	0 02927	6 717	5 68	2 0160	2 88	8 56	0 86	6 54	3 70	2 84
297 9	0 376	83 6	6 50%	277 9	0 376	0 03169	6 753	5 89	1 9584	2 88	8 77	0 92	6 82	3 87	2 95
309 3	0 406	83 0	7 01%	289 3	0 406	0 03417	6 790	6 10	1 8720	2 88	8 98	1 01	7 11	4 06	3 05
319 5	0 434	82 4	7 51%	299 5	0 434	0 03660	6 827	6 28	1 7856	2 88	9 16	1 09	7 38	4 23	3 14
329 7	0 463	81 7	8 01%	309 7	0 463	0 03904	6 864	6 46	1 6848	2 88	9 34	1 20	7 65	4 42	3 23
340 0	0 492	81 4	8 51%	320 0	0 492	0 04147	6 901	6 64	1 6416	2 88	9 52	1 24	7 87	4 56	3 32
350 1	0 521	81 0	9 00%	330 1	0 521	0 04389	6 939	6 81	1 5840	2 88	9 69	1 30	8 10	4 70	3 40
359 3	0 550	80 6	9 50%	339 3	0 550	0 04632	6 977	6 96	1 5264	2 88	9 84	1 35	8 31	4 83	3 48

Report Date: Friday, August 14, 2009

FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

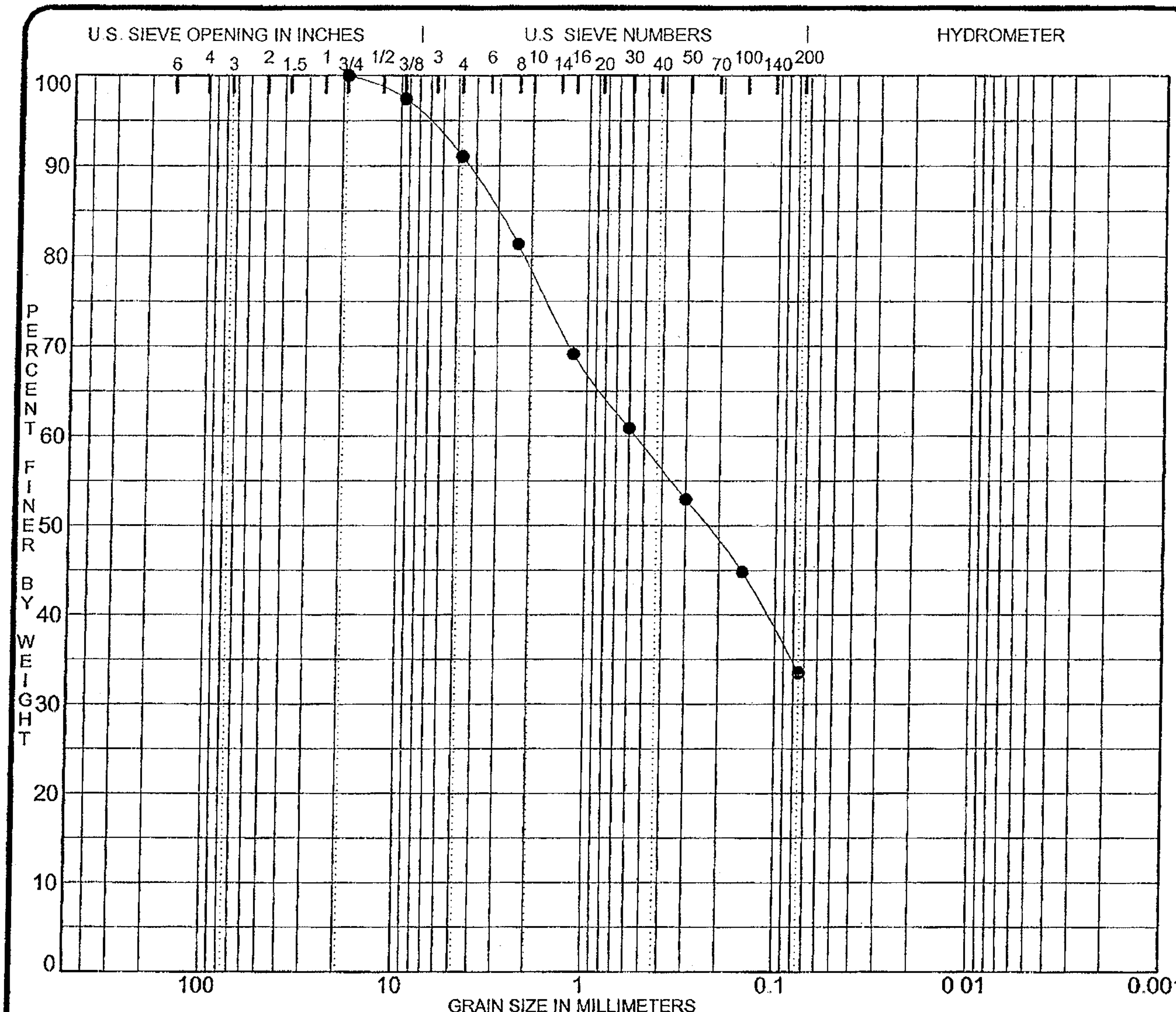
Company: AEP

Project: SPORN ASH DISP. FACILITY

Sample No: 10918

Point: C

368 6	0 579	80 0	10 01%	348 6	0 579	0 04878	7 016	7 11	1 4400	2 88	9 99	1 44	8 55	4 99	3 55
386 9	0 637	79 0	11 00%	366 9	0 637	0 05365	7 095	7 39	1 2960	2 88	10 27	1 58	8 98	5 28	3 70
403 5	0 695	77 7	12 00%	383 5	0 695	0 05852	7 175	7 64	1 1088	2 88	10 52	1 77	9 41	5 59	3 82
419 6	0 753	76 9	13 01%	399 6	0 753	0 06342	7 258	7 86	0 9936	2 88	10 74	1 89	9 75	5 82	3 93
434 5	0 810	75 6	14 00%	414 5	0 810	0 06828	7 342	8 06	0 8064	2 88	10 94	2 07	10 13	6 10	4 03
448.9	0 869	74 2	15 01%	428 9	0 869	0 07318	7 429	8 24	0 6048	2 88	11 12	2 28	10 52	6 40	4 12
461 8	0 926	73 1	16 01%	441 8	0 926	0 07805	7 518	8 38	0 4464	2 88	11 26	2 43	10 82	6 63	4 19
474 4	0 984	72 2	17 01%	454 4	0 984	0 08293	7 608	8 52	0 3168	2 88	11 40	2 56	11 08	6 82	4 26
486 1	1 042	71 1	18 01%	466 1	1 042	0 08779	7 701	8 63	0 1584	2 88	11 51	2 72	11 35	7 04	4 31
497 3	1 100	70 5	19 01%	477 3	1 100	0 09269	7 796	8 72	0 0720	2 88	11 60	2 81	11 53	7 17	4 36
508 3	1 158	69 3	20 01%	488 3	1 158	0 09756	7 894	8 81	-0 1008	2 88	11 69	2 98	11 79	7 39	4 41



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	PZ-0903	23.5			NP	NP	NP		
			SILTY SAND SM						
			Ash Mixture - Samples10,11,12,13 Combined						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%< 002
●	PZ-0903	23.5	19.000	0.556			8.9	57.5	33.5	

PROJECT **SPORN PLANT - FLY ASH POND DIKES - FLY ASH POND DIKES**

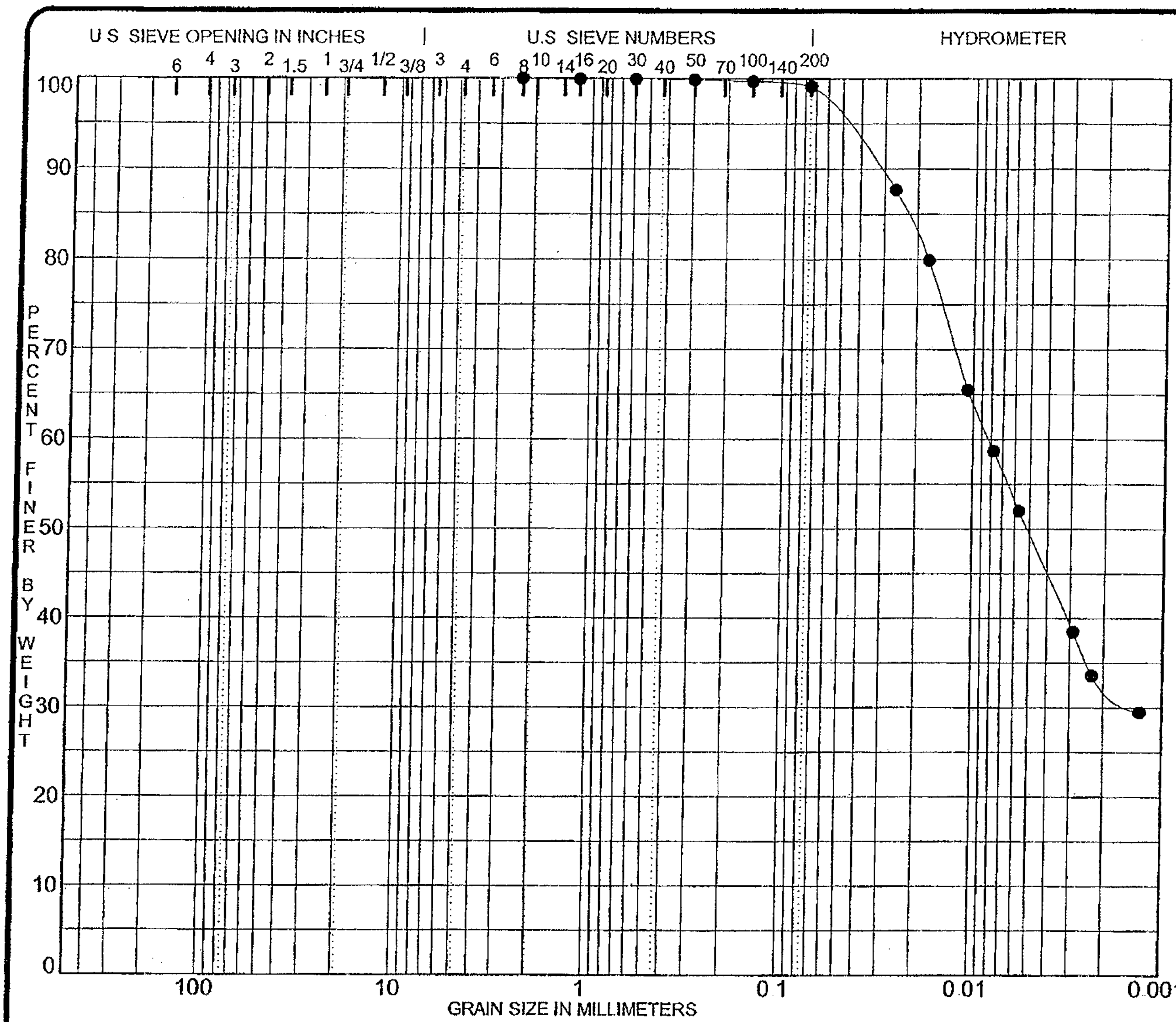
JOB NO

DATE 8/14/09

GRADATION CURVES

American Electric Power Service Corp.
Groveport, OH 43125

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	PZ-0903	46.0			45.6	24.7	20.9		
			LEAN CLAY CL						
			Shelby Tube Sample - 46' - 48'						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	PZ-0903	46.0	2.360	0.008	0.001		0.0	0.9	99.1	32.6

PROJECT SPORN PLANT - FLY ASH POND DIKES - FLY ASH POND DIKES

JOB NO

DATE 8/14/09

GRADATION CURVES

American Electric Power Service Corp.
Groveport, OH 43125

AEP

JOB NO ____________ DATE: Jul 31, 09

PROJECT SPORN PLANT - FLY ASH POND DIKES

LOCATION: FLY ASH POND DIKES

SOURCE OF MATERIAL PZ-0903 DEPTH 46.0 ft.

DESCRIPTION OF MATERIAL

ASTM DESCRIPTION

MAX DRY DENSITY, pcf		OPTIMUM MOISTURE, %	
SPECIFIC GRAVITY	2 70		
SAMPLE HGT., mm	146 740	SAMPLE DIA., mm	71.480
CHAMBER PRESSURE, psi	70 0	BACK PRESSURE, psi	60.0
B-PARAMETER	1 00	EFFECTIVE PRESSURE, psi	10 0
INITIAL HEAD, mm	2369.2		

	BEFORE	AFTER
WATER CONTENT, %	35 4	34.3
WET DENSITY, pcf	117.0	
DRY DENSITY, pcf	86.5	
SATURATION, %	100 51	
VOID RATIO	0.9497	

PERMEABILITY COEFFICIENT K, cm/sec 1.08E-07

FLEXIBLE-MEMBRANE PERMEABILITY TEST

American Electric Power Service Corp.

Groveport, Ohio

AEP

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

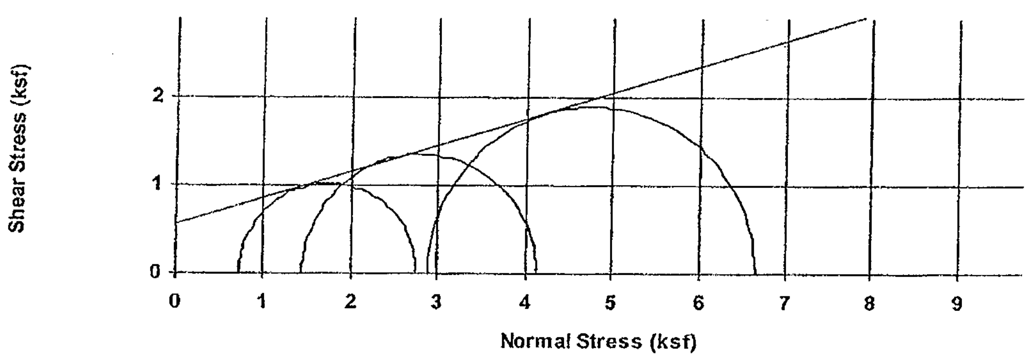
Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10922

Material Description: Boring PZ-0903, Shelby Tube - 46' - 48'; Lab # S-10922

Point Designation	Initial Conditions			Final Conditions			
	Water Content, %	Dry Density, pcf	Degree of Saturation	Water Content, %	Confining Stress, (ksf)	Deviator Stress	Induced Pore Pressure (ksf)
A	29 5%	93 1	98 3%	28 43%	0 72	2 03	0 30
B	35 4%	86 4	100 5%	34 3%	1 44	2 69	0 81
C	30 3%	92 3	99 0%	27 3%	2 88	3 77	1 92

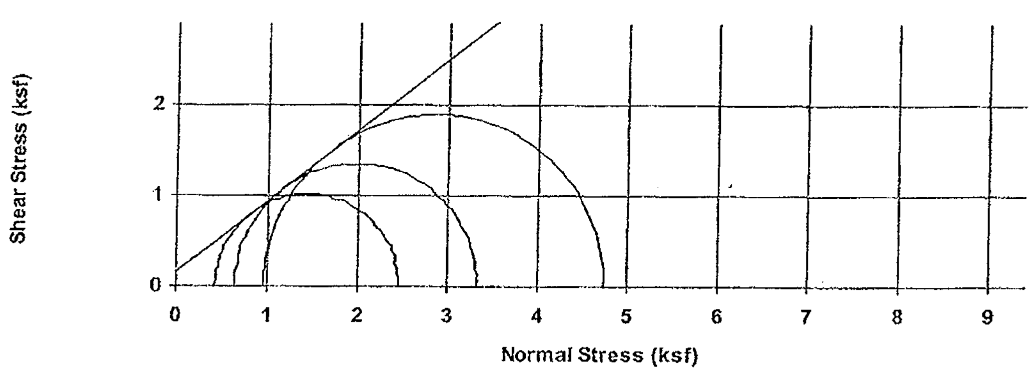
Point Designation	Axial Strain, %	q, (ksf)	Effective Stresses, (ksf)			Total Stresses, (ksf)		
			Major, (ksf)	Minor, (ksf)	p', (ksf)	Major, (ksf)	Minor, (ksf)	p, (ksf)
A	15 0%	1 01	2 45	0 42	1 43	2 75	0 72	1 73
B	13 0%	1 35	3 33	0 63	1 98	4 13	1 44	2 79
C	15 0%	1 89	4 74	0 96	2 85	6 65	2 88	4 77

Total Stress Envelope



φ: 16.6 °
c: 0.55 ksf

Effective Stress Envelope



φ ': 37.9 °
c': 0.17 ksf

Report Date: Friday, August 14, 2009

SPP00003282

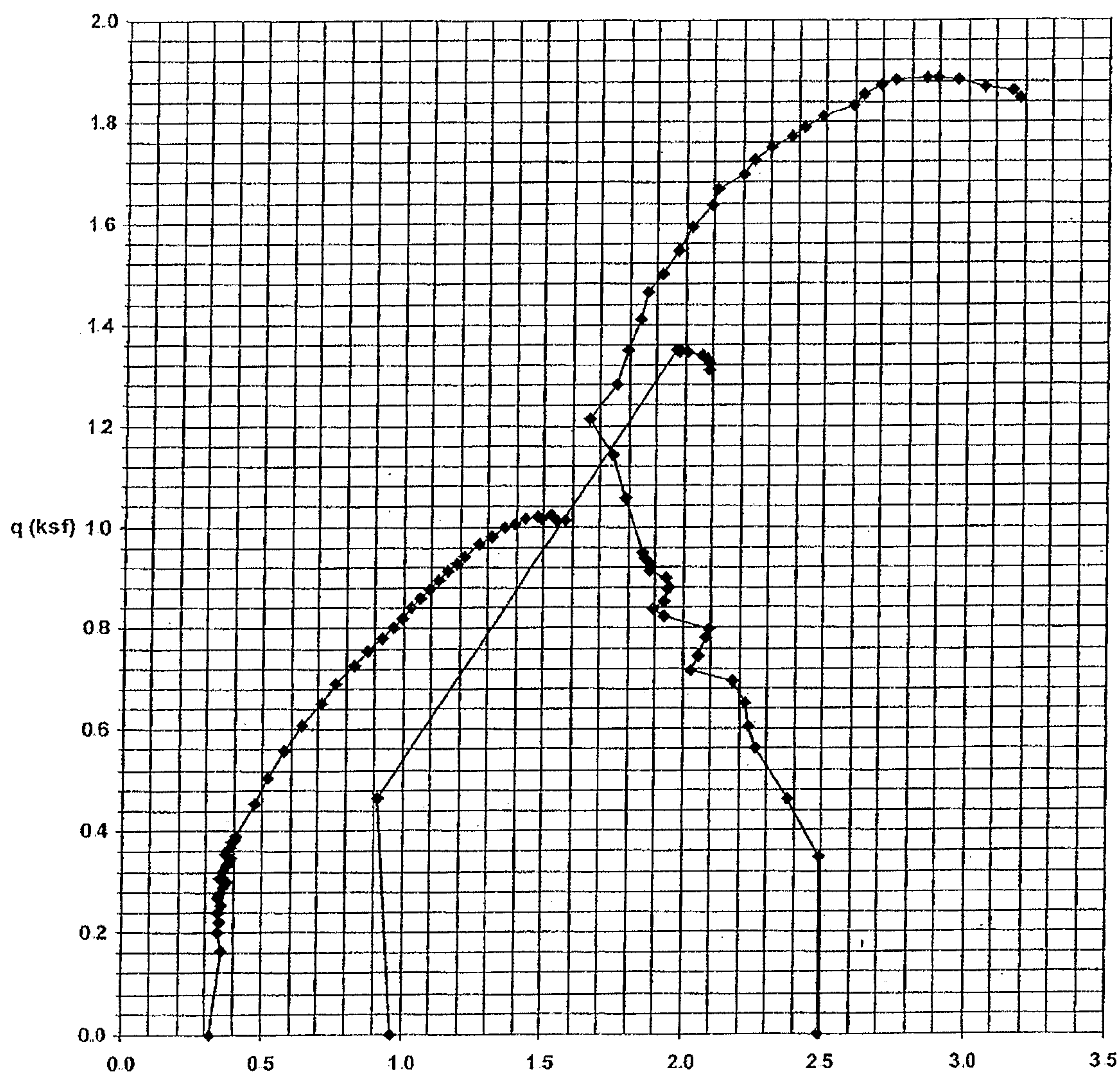
FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10922

p'- q Diagram



Report Date: Friday, August 14, 2009

FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

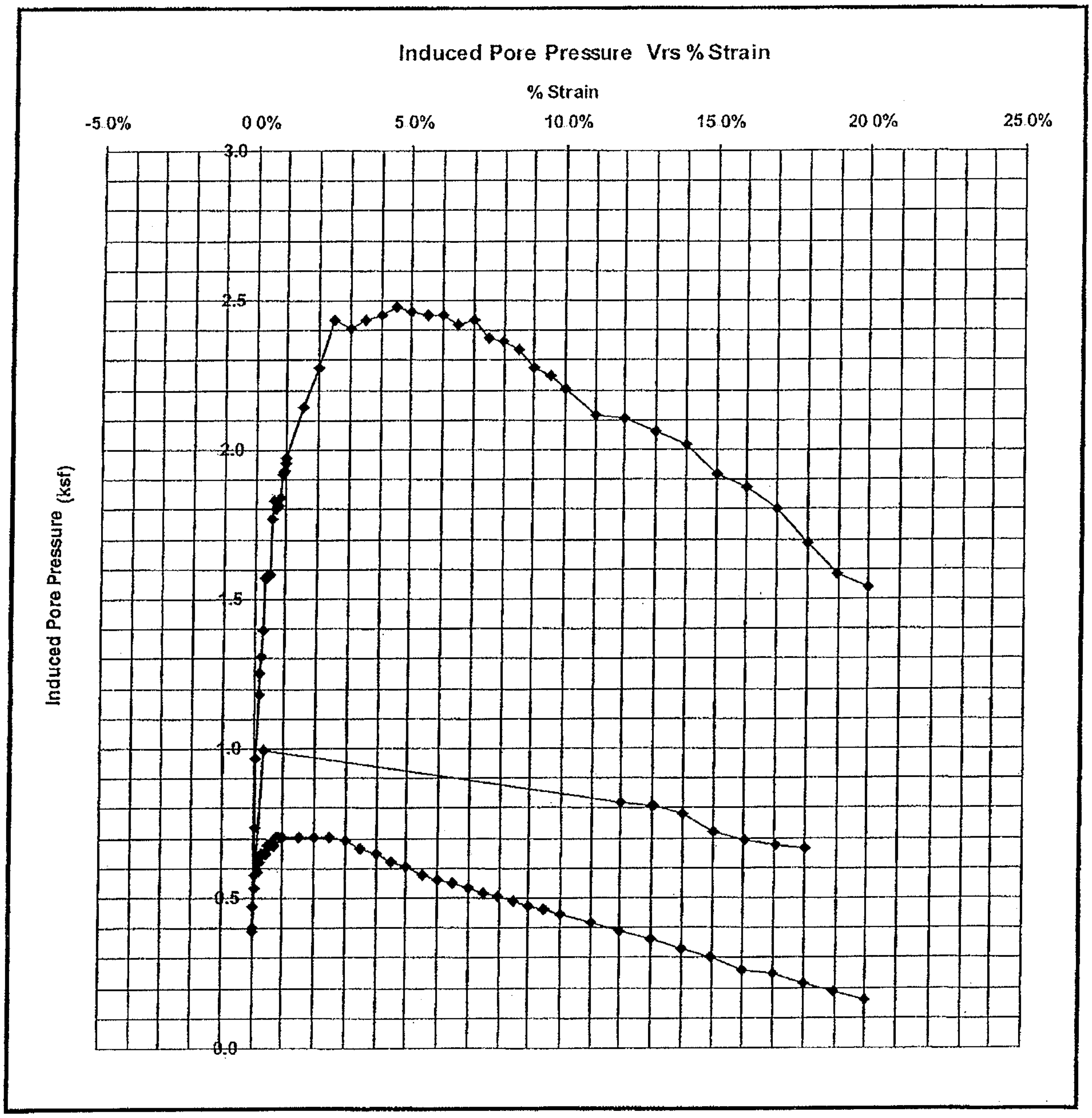
AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP

Project: SPORN ASH DISP. FACILITY

Sample No: 10922



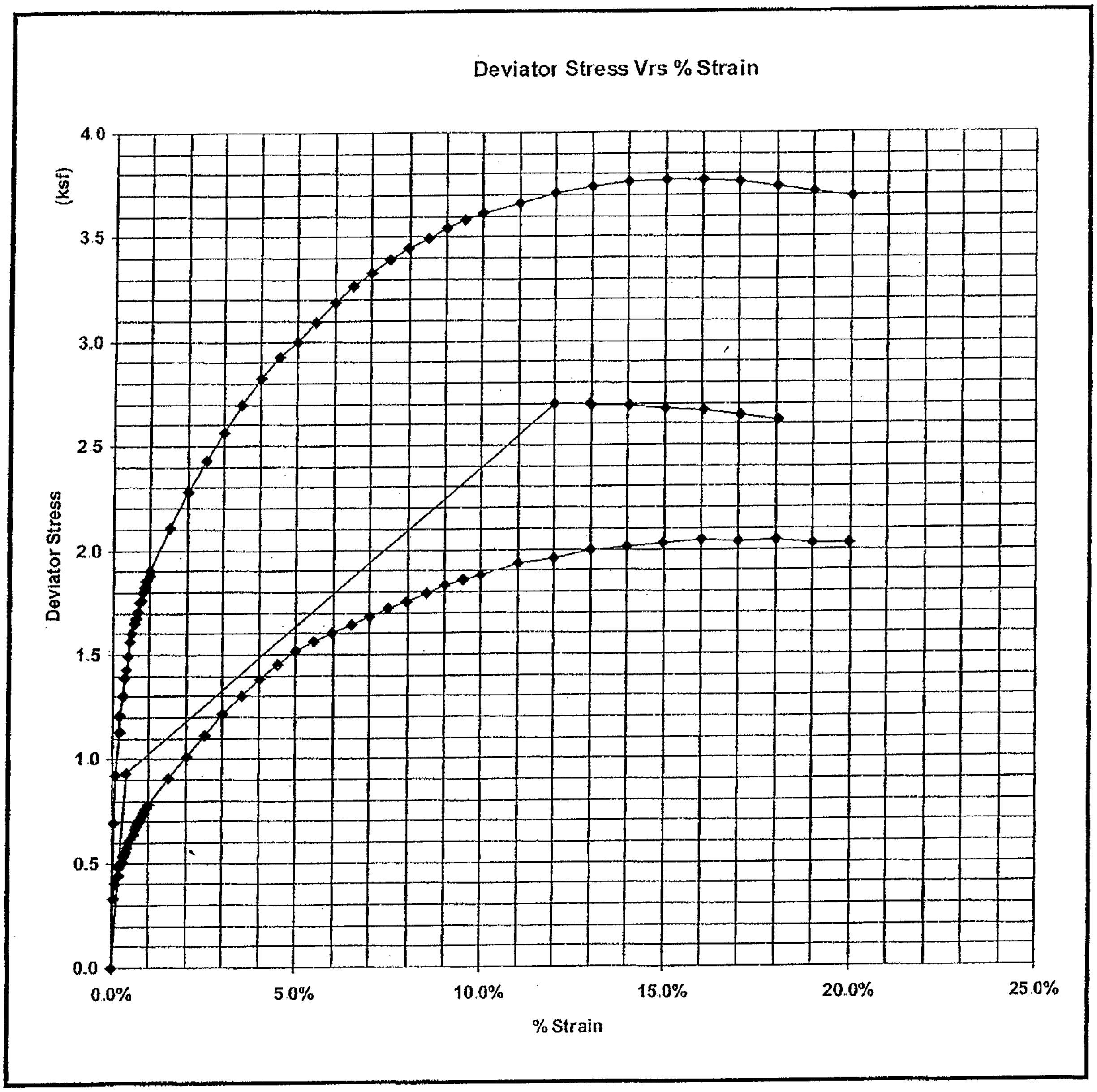
Report Date: Friday, August 14, 2009

FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10922



Report Date: Friday, August 14 2009

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10922
Point: A

Material Description: Boring PZ-0903, Shelby Tube - 46' - 48'; Lab # S-10922

Moisture Determination ASTM D2216

	Before Testing	After Testing
Tare No.	TV	TV
Mass of Container and Wet Specimen (Mcws), grams	1333.67	1324.63
Mass of Container and Over Dry Specimen (Mcs), grams	1077.83	1077.83
Mass of Container (Mc), grams	209.64	209.64
Mass of Water (Mw), grams:	255.84	246.8
Mass of Solid Particles (Ms), grams:	868.19	868.19
Moisture Content (w), %	29.47%	28.43%

Initial Condition of Speciman ASTM D2435

	(1)	(2)	(3)	Average
Diameter Measurents, Inches:	2.829	2.84	2.817	2.829
Height Measurements, Inches:	5.66	5.637	5.655	5.651
Initial Volume of Specimen (Vo), In.3:	35.51			
Dry Mass of Specimen After Testing, (Md), grams:	868.19			
Dry Unit Weight, (γd) pcf:	93.14			
Specific Gravity of the Solids, (G):	2.70			
Volume of Solids, (Vs), Cu. In.:	19.6224			
Height of Solids,(Hs),In.:	3.1225			
Void Ratio Before Consolidation (Eo):	0.8097			
Intitail Degree of Saturation: (So)	98.27%			

Saturation - ASTM D4767 Section 8.2

Dial Indicator Reading Prior to Saturation (Rb:) In.	0
Cell Pressure AfterSaturation, psi:	63.00
Back Presssure After Saturation After, psi:	60.00
Pore Pressure Paramenter B:	1
Dial Indicator Reading After Saturation, (Ra) In.:	0.021
Change in Height during Satureation, (Delta Hs) In	0.021
Change In Volume of Specimen during Saturation (Delta Vsat), In.3:	0.396

Report Date: Friday, August 14, 2009

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP
AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10922
Point: A

Consolidation- ASTM D2435, Section 11.5:

Sample No:	T:	Burette 2:	Burette3:	Rc:
10922	0	24.1	24	0.021
10922	0.25	23.9	23.8	
10922	0.5	23.9	23.7	
10922	1	23.8	23.7	
10922	2	23.8	23.6	
10922	4	23.6	23.4	
10922	8	23.4	23.2	
10922	15	23.2	22.9	0.027
10922	30	23	22.5	0.028
10922	60	22.6	22.1	0.03
10922	120	22.3	21.6	0.032
10922	240	22.1	21.3	0.034
10922	360	22	21.2	0.036
10922	1440	21.8	21	0.037

Specimen Height After Consolidation, (Hc), In.: 5.61

Volume Change During Consolidation (Delta Vc), In.3: 0.32

Cross-Sectional Area of Specimen After Consolidation (Ac), In.2: 6.20

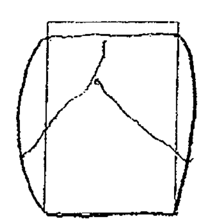
Triaxial Compression Testing
ASTM D 4767

Sample Depth: 0 ft.
Cell Pressure: 65 psi
Back Pressure: 60 psi
Confining Pressure: 5 psi
Strain Rate: 0.006 in./min.

Specimen Height After Consolidation, (Hc), In.: 5.61
Correction for Vert Displacement, In.: 0
Load due to Friction and Uplift: 17.4 lbs.
Correction for Filter Paper: 0
Thickness of Membrane (tm), In.: 0.012

$\sigma_1-\sigma_3=$ Deviator Stress at Failure, ksf: 2.03
σ_3 f= Effective Consolidation Stress at Failure, ksf: 0.72
$\sigma_1=$ Total Major Principal Stress at Failure: 2.75
$\sigma'_{3f}=$ $\sigma_3-\Delta u=$ Effective Minor Principal Stress at Failure,ksf: 0.42
$\sigma'_{1f}=$ Effective Major Principal Stress at Failure, ksf: 2.45
Axial Strain at Failure: 14.99%

Failure Sketch



Report Date: Friday August 14, 2009

SPP00003287

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP

Project: SPORN ASH DISP. FACILITY

Sample No: 10922

Point: A

Pa: Applied Force	Vertical Displacement Reading In :	Pore Pressure psi:	Axial Strain (E1):	(P) - Force Adj for U and F lbs:	Corrected Vertical Displac In :	Correction for Membrane ksf:	(A) Area In 2:	(σ1−σ3) Deviator Stress ksf:	[Δυ] Induced Pore Water Pressure ksf:	σ3 Effective Consolidation Stress ksf	σ1 Total Major Principal Stress ksf	σ3 Effective Minor Principal Stress ksf	σ1 ' Effective Major Principal Stress ksf	p'	q
17.4	0.000	62.8	0.00%	0.0	0.000	-0.00002	6.197	0.00	0.4032	0.72	0.72	0.32	0.32	0.32	0.00
31.6	0.003	63.7	0.05%	14.2	0.003	0.00025	6.201	0.33	0.5328	0.72	1.05	0.19	0.52	0.35	0.16
34.7	0.005	64.0	0.10%	17.3	0.005	0.00047	6.203	0.40	0.5760	0.72	1.12	0.14	0.55	0.34	0.20
36.6	0.009	64.1	0.16%	19.2	0.009	0.00077	6.207	0.44	0.5904	0.72	1.16	0.13	0.57	0.35	0.22
38.1	0.011	64.3	0.20%	20.7	0.011	0.00098	6.210	0.48	0.6192	0.72	1.20	0.10	0.58	0.34	0.24
39.3	0.014	64.3	0.25%	21.9	0.014	0.00124	6.213	0.51	0.6192	0.72	1.23	0.10	0.61	0.35	0.25
40.6	0.017	64.5	0.31%	23.2	0.017	0.00153	6.217	0.54	0.6480	0.72	1.26	0.07	0.61	0.34	0.27
41.3	0.019	64.5	0.35%	23.9	0.019	0.00170	6.219	0.55	0.6480	0.72	1.27	0.07	0.62	0.35	0.28
42.4	0.022	64.5	0.40%	25.0	0.022	0.00196	6.222	0.58	0.6480	0.72	1.30	0.07	0.65	0.36	0.29
43.5	0.026	64.5	0.46%	26.1	0.026	0.00224	6.226	0.60	0.6480	0.72	1.32	0.07	0.67	0.37	0.30
44.2	0.028	64.7	0.50%	26.8	0.028	0.00244	6.228	0.62	0.6768	0.72	1.34	0.04	0.66	0.35	0.31
45.3	0.031	64.7	0.56%	27.9	0.031	0.00275	6.232	0.64	0.6768	0.72	1.36	0.04	0.69	0.36	0.32
46.2	0.034	64.7	0.61%	28.8	0.034	0.00302	6.236	0.66	0.6768	0.72	1.38	0.04	0.71	0.37	0.33
46.8	0.036	64.7	0.65%	29.4	0.036	0.00319	6.238	0.68	0.6768	0.72	1.40	0.04	0.72	0.38	0.34
47.5	0.039	64.7	0.69%	30.1	0.039	0.00342	6.241	0.69	0.6768	0.72	1.41	0.04	0.73	0.39	0.35
48.2	0.042	64.9	0.74%	30.8	0.042	0.00366	6.244	0.71	0.7056	0.72	1.43	0.01	0.72	0.37	0.35
49.0	0.045	64.9	0.80%	31.6	0.045	0.00393	6.247	0.72	0.7056	0.72	1.44	0.01	0.74	0.38	0.36
49.7	0.048	64.9	0.85%	32.3	0.048	0.00419	6.251	0.74	0.7056	0.72	1.46	0.01	0.75	0.38	0.37
50.5	0.051	64.9	0.91%	33.1	0.051	0.00447	6.254	0.76	0.7056	0.72	1.48	0.01	0.77	0.39	0.38
50.9	0.054	64.9	0.95%	33.5	0.054	0.00470	6.257	0.77	0.7056	0.72	1.49	0.01	0.78	0.40	0.38
51.6	0.056	64.9	1.00%	34.2	0.056	0.00491	6.260	0.78	0.7056	0.72	1.50	0.01	0.80	0.41	0.39
57.4	0.084	64.9	1.50%	40.0	0.084	0.00738	6.292	0.91	0.7056	0.72	1.63	0.01	0.92	0.47	0.45
62.1	0.112	64.9	2.00%	44.7	0.112	0.00982	6.324	1.01	0.7056	0.72	1.73	0.01	1.02	0.52	0.50
67.2	0.140	64.9	2.49%	49.8	0.140	0.01227	6.356	1.12	0.7056	0.72	1.84	0.01	1.13	0.57	0.56
72.0	0.168	64.8	3.00%	54.6	0.168	0.01475	6.389	1.22	0.6912	0.72	1.94	0.03	1.24	0.64	0.61
76.2	0.196	64.6	3.50%	58.8	0.196	0.01722	6.422	1.30	0.6624	0.72	2.02	0.06	1.36	0.71	0.65
80.1	0.224	64.5	4.00%	62.7	0.224	0.01967	6.456	1.38	0.6480	0.72	2.10	0.07	1.45	0.76	0.69
83.7	0.253	64.3	4.50%	66.3	0.253	0.02214	6.490	1.45	0.6192	0.72	2.17	0.10	1.55	0.83	0.72
87.0	0.280	64.2	4.99%	69.6	0.280	0.02458	6.523	1.51	0.6048	0.72	2.23	0.12	1.63	0.87	0.76
89.8	0.308	64.0	5.49%	72.4	0.308	0.02704	6.558	1.56	0.5760	0.72	2.28	0.14	1.71	0.93	0.78
92.1	0.336	63.9	5.99%	74.7	0.336	0.02949	6.593	1.60	0.5616	0.72	2.32	0.16	1.76	0.96	0.80
94.4	0.365	63.8	6.49%	77.0	0.365	0.03196	6.628	1.64	0.5472	0.72	2.36	0.17	1.81	0.99	0.82
96.9	0.393	63.7	7.00%	79.5	0.393	0.03443	6.664	1.68	0.5328	0.72	2.40	0.19	1.87	1.03	0.84
99.1	0.421	63.6	7.49%	81.7	0.421	0.03687	6.699	1.72	0.5184	0.72	2.44	0.20	1.92	1.06	0.86
101.3	0.449	63.5	7.99%	83.9	0.449	0.03933	6.736	1.75	0.5040	0.72	2.47	0.22	1.97	1.09	0.88
103.5	0.477	63.4	8.49%	86.1	0.477	0.04178	6.773	1.79	0.4896	0.72	2.51	0.23	2.02	1.12	0.89
105.9	0.505	63.3	8.99%	88.5	0.505	0.04425	6.810	1.83	0.4752	0.72	2.55	0.24	2.07	1.16	0.91
107.8	0.533	63.2	9.49%	90.4	0.533	0.04671	6.847	1.85	0.4608	0.72	2.57	0.26	2.11	1.19	0.93

Report Date: Friday, August 14, 2009

SPP00003288

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP

Project: SPORN ASH DISP. FACILITY

Sample No: 10922

Point: A

109 6	0 561	63 1	9 99%	92 2	0 561	0 04918	6 886	1 88	0 4464	0 72	2 60	0 27	2 15	1 21	0 94
113 3	0 617	62 9	10 99%	95 9	0 617	0 05411	6 963	1 93	0 4176	0 72	2 65	0 30	2 23	1 27	0 96
116 1	0 673	62 7	11 99%	98 7	0 673	0 05900	7 042	1 96	0 3888	0 72	2 68	0 33	2 29	1 31	0 98
119.2	0 729	62 5	12 99%	101 8	0 729	0 06394	7 123	1 99	0 3600	0 72	2 71	0 36	2 35	1 36	1 00
121.6	0 785	62 3	13 99%	104 2	0 785	0 06885	7 206	2 01	0 3312	0 72	2 73	0 39	2 40	1 40	1 01
123 9	0 841	62 1	14 99%	106 5	0 841	0 07376	7 290	2 03	0 3024	0 72	2 75	0 42	2 45	1 43	1 01
126 0	0 897	61 8	15 99%	108 6	0 897	0 07867	7 377	2 04	0 2592	0 72	2 76	0 46	2 50	1 48	1 02
127 2	0 954	61 7	16 99%	109 8	0 954	0 08361	7 466	2 03	0 2448	0 72	2 75	0 48	2 51	1 49	1 02
129 3	1 010	61 5	17 98%	111 9	1 010	0 08851	7 557	2 04	0 2160	0 72	2 76	0 50	2 55	1 53	1 02
130 0	1 066	61 3	18 99%	112 6	1 066	0 09343	7 650	2 03	0 1872	0 72	2 75	0 53	2 56	1 55	1 01
131 6	1 122	61 1	19 98%	114 2	1 122	0 09834	7 745	2 02	0 1584	0 72	2 74	0 56	2 59	1.57	1 01

Report Date: Friday August 14, 2009

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10922
Point: B

Material Description: Boring PZ-0903 Shelby Tube - 46' - 48'; Lab # S-10922

Moisture Determination ASTM D2216

	Before Testing	After Testing
Tare No.	Q	Q
Mass of Container and Wet Specimen (Mcws), grams	1309 98	1301 68
Mass of Container and Over Dry Specimen (Mcs), grams	1021 69	1021.69
Mass of Container (Mc), grams	206 24	206 24
Mass of Water (Mw), grams:	288 29	279 99
Mass of Solid Particles (Ms), grams:	815.45	815.45
Moisture Content (w), %	35 35%	34 34%

Initial Condition of Speciman ASTM D2435

	(1)	(2)	(3)	Average
Diameter Measurents, Inches:	2 826	2 812	2 805	2 814
Height Measurements, Inches:	5 775	5 776	5 779	5 777

Initial Volume of Specimen (Vo), In.3:	35 94
Dry Mass of Specimen After Testing, (Md), grams:	815.45
Dry Unit Weight, (γ d) pcf:	86 45
Specific Gravity of the Solids, (G):	2.70
Volume of Solids, (Vs), Cu. In.:	18.4304
Height of Solids,(Hs),In.:	2 9627
Void Ratio Before Consolidation (Eo):	0 9498
Intitail Degree of Saturation: (So)	100.50%

Saturation - ASTM D4767 Section 8 2

Dial Indicator Reading Prior to Saturation (Rb:) In.	0
Cell Pressure AfterSaturation, psi:	65 00
Back Presssure After Saturation After, psi:	60 00
Pore Pressure Paramenter B:	1
Dial Indicator Reading After Saturation, (Ra) In.:	0 03
Change in Height during Satureation, (Delta Hs) In.	0 03
Change In Volume of Specimen during Saturation (Delta Vsat), In 3:	0 560

Report Date: Friday, August 14 2009

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10922
Point: B

Consolidation- ASTM D2435, Section 11.5:

Sample No:	T:	Burette 2:	Burette3:	Rc:
10922	0	23.9	23.7	0.03
10922	0.25	23.8	23.5	
10922	0.5	23.7	23.5	
10922	1	23.7	23.5	
10922	2	23.7	23.4	
10922	4	23.6	23.3	
10922	8	23.5	23.2	
10922	15	23.4	23.1	0.036
10922	30	23.1	22.9	0.036
10922	60	22.8	22.5	0.039
10922	120	22.5	22.2	0.042
10922	240	22.1	21.8	0.042
10922	360	21.9	21.6	0.046
10922	1440	21.6	21.3	0.048

Specimen Height After Consolidation, (Hc), In.: 5.73

Volume Change During Consolidation (Delta Vc), In 3: 0.29

Cross-Sectional Area of Specimen After Consolidation (Ac), In.2: 6.13

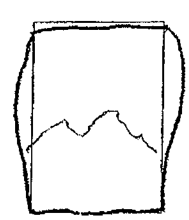
Triaxial Compression Testing
ASTM D 4767

Sample Depth: 46 ft.
Cell Pressure: 70 psi
Back Pressure: 60 psi
Confining Pressure: 10 psi
Strain Rate: 0.006 in/min.

Specimen Height After Consolidation, (Hc), In.: 5.73
Correction for Vert Displacement, In.: 0
Load due to Friction and Uplift: 17.9 lbs.
Correction for Filter Paper: 0
Thickness of Membrane (tm), In.: 0.012

$\sigma 1-\sigma 3=$	Deviator Stress at Failure, ksf:	2.69
$\sigma 3$ f=	Effective Consolidation Stress at Failure, ksf:	1.44
$\sigma 1=$	Total Major Principal Stress at Failure:	4.13
σ '3f= $\sigma 3-\Delta \upsilon=$	Effective Minor Principal Stress at Failure,ksf:	0.63
σ '1f=	Effective Major Principal Stress at Failure, ksf:	3.33
	Axial Strain at Failure:	13.02%

Failure Sketch



Report Date: Friday August 14, 2009

CIVIL LABORATORY
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP

Project: SPORN ASH DISP. FACILITY

Sample No: 10922

Point: B

Pa: Applied Force	Vertical Displacement Reading In :	Pore Pressure psi:	Axial Strain (El):	(P) - Force Adj for U and F lbs:	Corrected Vertical Displac In :	Correction for Membrane ksf:	(A) Area In 2:	$(\sigma1-\sigma3)$ Deviator Stress ksf:	[Δu] Induced Pore Water Pressure ksf:	$\sigma3$ Effective Consolidation Stress ksf	$\sigma1$ Total Major Principal Stress ksf	$\sigma3$ Effective Minor Principal Stress ksf	$\sigma1'$ Effective Major Principal Stress ksf	p'	q
17.9	0.000	63.3	0.00%	0.0	0.000	0.00000	6.125	0.00	0.4752	1.44	1.44	0.96	0.96	0.96	0.00
57.6	0.020	66.9	0.35%	39.7	0.020	0.00173	6.147	0.93	0.9936	1.44	2.37	0.45	1.37	0.91	0.46
151.0	0.686	65.7	11.97%	133.1	0.686	0.05928	6.958	2.70	0.8208	1.44	4.14	0.62	3.31	1.97	1.35
152.8	0.744	65.6	12.99%	134.9	0.744	0.06429	7.039	2.70	0.8064	1.44	4.14	0.63	3.33	1.98	1.35
152.8	0.746	65.6	13.02%	134.9	0.746	0.06446	7.042	2.69	0.8064	1.44	4.13	0.63	3.33	1.98	1.35
154.4	0.803	65.4	14.02%	136.5	0.803	0.06942	7.124	2.69	0.7776	1.44	4.13	0.66	3.35	2.01	1.34
155.5	0.861	65.0	15.03%	137.6	0.861	0.07438	7.208	2.67	0.7200	1.44	4.11	0.72	3.39	2.06	1.34
156.8	0.918	64.8	16.03%	138.9	0.918	0.07934	7.294	2.66	0.6912	1.44	4.10	0.75	3.41	2.08	1.33
157.8	0.976	64.7	17.03%	139.9	0.976	0.08432	7.383	2.64	0.6768	1.44	4.08	0.76	3.41	2.09	1.32
158.6	1.033	64.6	18.03%	140.7	1.033	0.08926	7.472	2.62	0.6624	1.44	4.06	0.78	3.40	2.09	1.31

Report Date: Friday, August 14, 2009

FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10922
Point: C

Material Description: Boring PZ-0903, Shelby Tube - 46' - 48'; Lab # S-10922

Moisture Determination ASTM D2216

	Before Testing	After Testing
Tare No.	Y	Y
Mass of Container and Wet Specimen (Mcws), grams	1361 13	1334.81
Mass of Container and Over Dry Specimen (Mcs), grams	1093 60	1093 60
Mass of Container (Mc), grams	210 21	210 21
Mass of Water (Mw), grams:	267 53	241 21
Mass of Solid Particles (Ms), grams:	883 39	883 39
Moisture Content (w), %	30 28%	27 31%

Initial Condition of Speciman ASTM D2435

	(1)	(2)	(3)	Average
Diameter Measurents, Inches:	2 807	2 825	2.827	2 820
Height Measurements, Inches:	5 841	5 841	5 835	5 839
Initial Volume of Specimen (Vo), In.3:	36 46			
Dry Mass of Specimen After Testing, (Md), grams:	883 39			
Dry Unit Weight, (γd) pcf:	92 30			
Specific Gravity of the Solids, (G):	2 70			
Volume of Solids, (Vs), Cu. In.:	19 9659			
Height of Solids,(Hs),In.:	3 1974			
Void Ratio Before Consolidation (Eo):	0 8261			
Intitail Degree of Saturation: (So)	98 98%			

Saturation - ASTM D4767 Section 8.2

Dial Indicator Reading Prior to Saturation (Rb:) In.	0
Cell Pressure AfterSaturation, psi:	65.00
Back Presssure After Saturation After, psi:	60 00
Pore Pressure Paramenter B:	1
Dial Indicator Reading After Saturation, (Ra) In.:	0 031
Change in Height during Satureation, (Delta Hs) In.	0 031
Change In Volume of Specimen during Saturation (Delta Vsat), In.3:	0 581

Report Date: Friday, August 14 2009

FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AEP AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Comprésion Test - ASTM D 4767

Company: AEP
Project: SPORN ASH DISP. FACILITY
Sample No: 10922
Point: C

Consolidation- ASTM D2435, Section 11 5:

Sample No:	T:	Burette 2:	Burette3:	Rc:
10922	0	23.4	23.8	0.031
10922	0.25	23.1	23.5	
10922	0.5	23	23.5	
10922	1	22.9	23.4	
10922	2	22.8	23.3	
10922	4	22.5	23.1	
10922	8	22.2	22.7	
10922	15	21.8	22.3	0.046
10922	30	21.1	21.6	0.051
10922	60	19.9	20.5	0.058
10922	120	18.2	19.1	0.068
10922	240	16.2	17.4	0.08
10922	360	15	16.4	0.086
10922	1440	13.1	14.7	0.098

Specimen Height After Consolidation, (Hc), In.: 5 74

Volume Change During Consolidation (Delta Vc), In 3: 1 18

Cross-Sectional Area of Specimen After Consolidation (Ac), In 2: 6 04

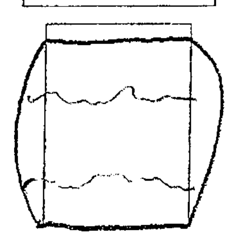
Triaxial Compression Testing ASTM D 4767

Sample Depth: 46 ft.
Cell Pressure: 80 psi
Back Pressure: 60 psi
Confining Pressure: 20 psi
Strain Rate: 0 006 In/min

Specimen Height After Consolidation, (Hc), In.: 5 74
Correction for Vert Displacement, In.: 0
Load due to Friction and Uplift: 22.5 lbs.
Correction for Filter Paper: 0
Thickness of Membrane (tm), In.: 0 012

	σ1-σ3=	Deviator Stress at Failure, ksf:	3 77
	σ3 f=	Effective Consolidation Stress at Failure, ksf:	2 88
	σ1=	Total Major Principal Stress at Failure:	6 65
σ '3f=	σ3-Δ u=	Effective Minor Principal Stress at Failure,ksf:	0 96
	σ '1f=	Effective Major Principal Stress at Failure, ksf:	4 74
		Axial Strain at Failure:	15 00%

Failure Sketch



Report Date: Friday, August 14, 2009

SPP00003294

FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

AMERICAN ELECTRIC POWER

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: AEP

Project: SPORN ASH DISP. FACILITY

Sample No: 10922

Point: C

Pa: Applied Force	Vertical Displacement Reading In :	Pore Pressure psi:	Axial Strain (El):	(P) - Force Adj for U and F lbs:	Corrected Vertical Displac In :	Correction for Membrane ksf:	(A) Area In 2:	(σ1−σ3) Deviator Stress ksf:	[Δu] Induced Pore Water Pressure ksf:	σ3 Effective Consolidation Stress ksf	σ1 Total Major Principal Stress ksf	σ3 Effective Minor Principal Stress ksf	σ1' Effective Major Principal Stress ksf	p'	q
22.5	0.000	62.7	0.00%	0.0	0.000	0.00002	6.044	0.00	0.3888	2.88	2.88	2.49	2.49	2.49	0.00
51.7	0.003	65.1	0.05%	29.2	0.003	0.00024	6.046	0.70	0.7344	2.88	3.58	2.15	2.84	2.49	0.35
61.2	0.006	66.7	0.10%	38.7	0.006	0.00049	6.049	0.92	0.9648	2.88	3.80	1.92	2.84	2.38	0.46
69.8	0.009	68.2	0.16%	47.3	0.009	0.00080	6.053	1.12	1.1808	2.88	4.00	1.70	2.82	2.26	0.56
73.4	0.011	68.7	0.20%	50.9	0.011	0.00099	6.056	1.21	1.2528	2.88	4.09	1.63	2.84	2.23	0.60
77.2	0.014	69.1	0.25%	54.7	0.014	0.00123	6.059	1.30	1.3104	2.88	4.18	1.57	2.87	2.22	0.65
81.0	0.018	69.7	0.31%	58.5	0.018	0.00155	6.062	1.39	1.3968	2.88	4.27	1.48	2.87	2.18	0.69
82.8	0.020	70.9	0.35%	60.3	0.020	0.00174	6.065	1.43	1.5696	2.88	4.31	1.31	2.74	2.03	0.72
85.3	0.023	70.9	0.40%	62.8	0.023	0.00198	6.068	1.49	1.5696	2.88	4.37	1.31	2.80	2.05	0.74
88.5	0.026	71.0	0.46%	66.0	0.026	0.00229	6.071	1.56	1.5840	2.88	4.44	1.30	2.86	2.08	0.78
90.0	0.029	71.0	0.50%	67.5	0.029	0.00250	6.074	1.60	1.5840	2.88	4.48	1.30	2.89	2.09	0.80
92.1	0.032	72.3	0.56%	69.6	0.032	0.00280	6.078	1.65	1.7712	2.88	4.53	1.11	2.76	1.93	0.82
93.4	0.035	72.7	0.61%	70.9	0.035	0.00302	6.080	1.68	1.8288	2.88	4.56	1.05	2.73	1.89	0.84
94.7	0.037	72.5	0.65%	72.2	0.037	0.00325	6.083	1.71	1.8000	2.88	4.59	1.08	2.79	1.93	0.85
96.7	0.040	72.6	0.70%	74.2	0.040	0.00349	6.086	1.75	1.8144	2.88	4.63	1.07	2.82	1.94	0.88
97.2	0.043	72.6	0.75%	74.7	0.043	0.00372	6.089	1.76	1.8144	2.88	4.64	1.07	2.83	1.95	0.88
98.8	0.046	72.8	0.80%	76.3	0.046	0.00399	6.092	1.80	1.8432	2.88	4.68	1.04	2.84	1.94	0.90
99.9	0.049	73.3	0.85%	77.4	0.049	0.00422	6.095	1.82	1.9152	2.88	4.70	0.96	2.79	1.88	0.91
101.1	0.052	73.4	0.91%	78.6	0.052	0.00451	6.099	1.85	1.9296	2.88	4.73	0.95	2.80	1.88	0.93
102.3	0.055	73.6	0.96%	79.8	0.055	0.00481	6.102	1.88	1.9584	2.88	4.76	0.92	2.80	1.86	0.94
103.2	0.057	73.7	1.00%	80.7	0.057	0.00498	6.105	1.90	1.9728	2.88	4.78	0.91	2.81	1.86	0.95
112.7	0.086	74.9	1.50%	90.2	0.086	0.00748	6.136	2.11	2.1456	2.88	4.99	0.73	2.84	1.79	1.05
120.7	0.115	75.8	2.00%	98.2	0.115	0.00997	6.167	2.28	2.2752	2.88	5.16	0.60	2.89	1.75	1.14
127.6	0.143	76.9	2.50%	105.1	0.143	0.01245	6.198	2.43	2.4336	2.88	5.31	0.45	2.88	1.66	1.21
134.1	0.172	76.7	3.00%	111.6	0.172	0.01493	6.230	2.56	2.4048	2.88	5.44	0.48	3.04	1.76	1.28
140.6	0.201	76.9	3.50%	118.1	0.201	0.01743	6.263	2.70	2.4336	2.88	5.58	0.45	3.14	1.80	1.35
146.7	0.229	77.0	4.00%	124.2	0.229	0.01991	6.295	2.82	2.4480	2.88	5.70	0.43	3.25	1.84	1.41
152.0	0.258	77.2	4.50%	129.5	0.258	0.02241	6.328	2.92	2.4768	2.88	5.80	0.40	3.33	1.87	1.46
156.2	0.287	77.1	5.00%	133.7	0.287	0.02490	6.361	3.00	2.4624	2.88	5.88	0.42	3.42	1.92	1.50
161.1	0.316	77.0	5.50%	138.6	0.316	0.02741	6.395	3.09	2.4480	2.88	5.97	0.43	3.53	1.98	1.55
166.0	0.344	77.0	6.00%	143.5	0.344	0.02990	6.429	3.18	2.4480	2.88	6.06	0.43	3.62	2.02	1.59
170.7	0.373	76.8	6.50%	148.2	0.373	0.03240	6.464	3.27	2.4192	2.88	6.15	0.46	3.73	2.10	1.63
174.4	0.402	76.9	7.00%	151.9	0.402	0.03486	6.498	3.33	2.4336	2.88	6.21	0.45	3.78	2.11	1.67
178.1	0.430	76.5	7.50%	155.6	0.430	0.03736	6.533	3.39	2.3760	2.88	6.27	0.50	3.90	2.20	1.70
181.6	0.459	76.4	8.00%	159.1	0.459	0.03984	6.569	3.45	2.3616	2.88	6.33	0.52	3.97	2.24	1.72
184.9	0.488	76.2	8.50%	162.4	0.488	0.04236	6.605	3.50	2.3328	2.88	6.38	0.55	4.05	2.30	1.75
188.0	0.517	75.8	9.00%	165.5	0.517	0.04484	6.641	3.54	2.2752	2.88	6.42	0.60	4.15	2.38	1.77
190.7	0.545	75.6	9.50%	168.2	0.545	0.04733	6.678	3.58	2.2464	2.88	6.46	0.63	4.21	2.42	1.79

Report Date: Friday, August 14, 2009

FOSSIL AND HYDRO GENERATION
CIVIL AND MINING ENGINEERING DIVISION
CIVIL LABORATORY SECTION
AMERICAN ELECTRIC POWER SERVICE CORPORATION
4001 BIXBY ROAD
GROVEPORT, OHIO 43125
(614) 836-4200

Test Report for Consolidated-Undrained Triaxial Compresion Test - ASTM D 4767

Company: **AEP**

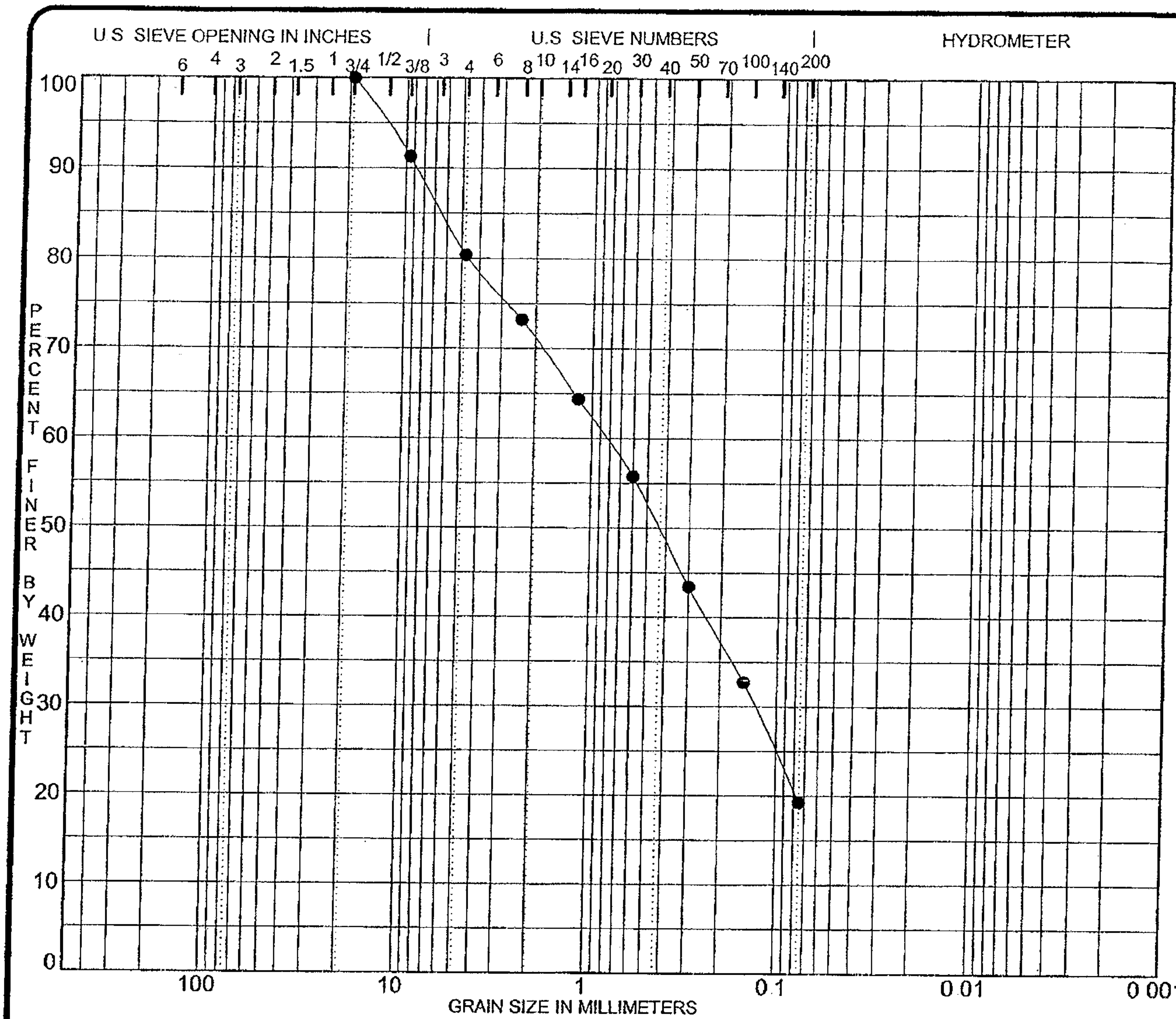
Project: **SPORN ASH DISP. FACILITY**

Sample No: **10922**

Point: **C**

193 5	0 574	75 3	10 00%	171 0	0 574	0 04983	6 715	3 62	2 2032	2 88	6 50	0 68	4 29	2 49	1 81
197 7	0 632	74 7	11 00%	175 2	0 632	0 05483	6 791	3 66	2 1168	2 88	6 54	0 76	4 42	2 59	1 83
202 2	0 689	74 6	11 99%	179 7	0 689	0 05977	6 867	3 71	2 1024	2 88	6 59	0 78	4 49	2 63	1 85
206 2	0 746	74 3	13 00%	183 7	0 746	0 06477	6 946	3 74	2 0592	2 88	6 62	0 82	4 56	2 69	1 87
209.6	0 803	74 0	13 99%	187 1	0 803	0 06974	7 027	3 76	2 0160	2 88	6 64	0 86	4 63	2 75	1 88
212 5	0 861	73 3	15 00%	190 0	0 861	0 07476	7 110	3 77	1 9152	2 88	6 65	0 96	4 74	2 85	1 89
215 0	0 919	73 0	16 00%	192 5	0 919	0 07974	7 195	3 77	1 8720	2 88	6 65	1 01	4 78	2 89	1 89
217 0	0 976	72 5	16 99%	194.5	0 976	0 08469	7 281	3 76	1 8000	2 88	6 64	1 08	4 84	2 96	1 88
218 3	1 033	71 7	18 00%	195 8	1 033	0 08969	7 370	3 74	1 6848	2 88	6 62	1 20	4 93	3 06	1 87
220 1	1.090	71 0	18 99%	197 6	1 090	0.09465	7 461	3 72	1 5840	2 88	6 60	1 30	5 02	3 16	1 86
221 5	1 148	70 7	20 00%	199 0	1 148	0 09965	7 554	3 69	1 5408	2 88	6 57	1 34	5 03	3 19	1 85

Report Date: Friday, August 14 2009



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	PZ-0905	11.0			NP	NP	NP		
			SILTY SAND with GRAVEL SM						
			Ash Mixture - Samples 5,6,7,8 Combined						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%< 002
●	PZ-0905	11.0	19.000	0.836	0.130		19.6	61.2	19.2	

PROJECT **SPORN PLANT - FLY ASH POND DIKES - FLY ASH POND DIKES**

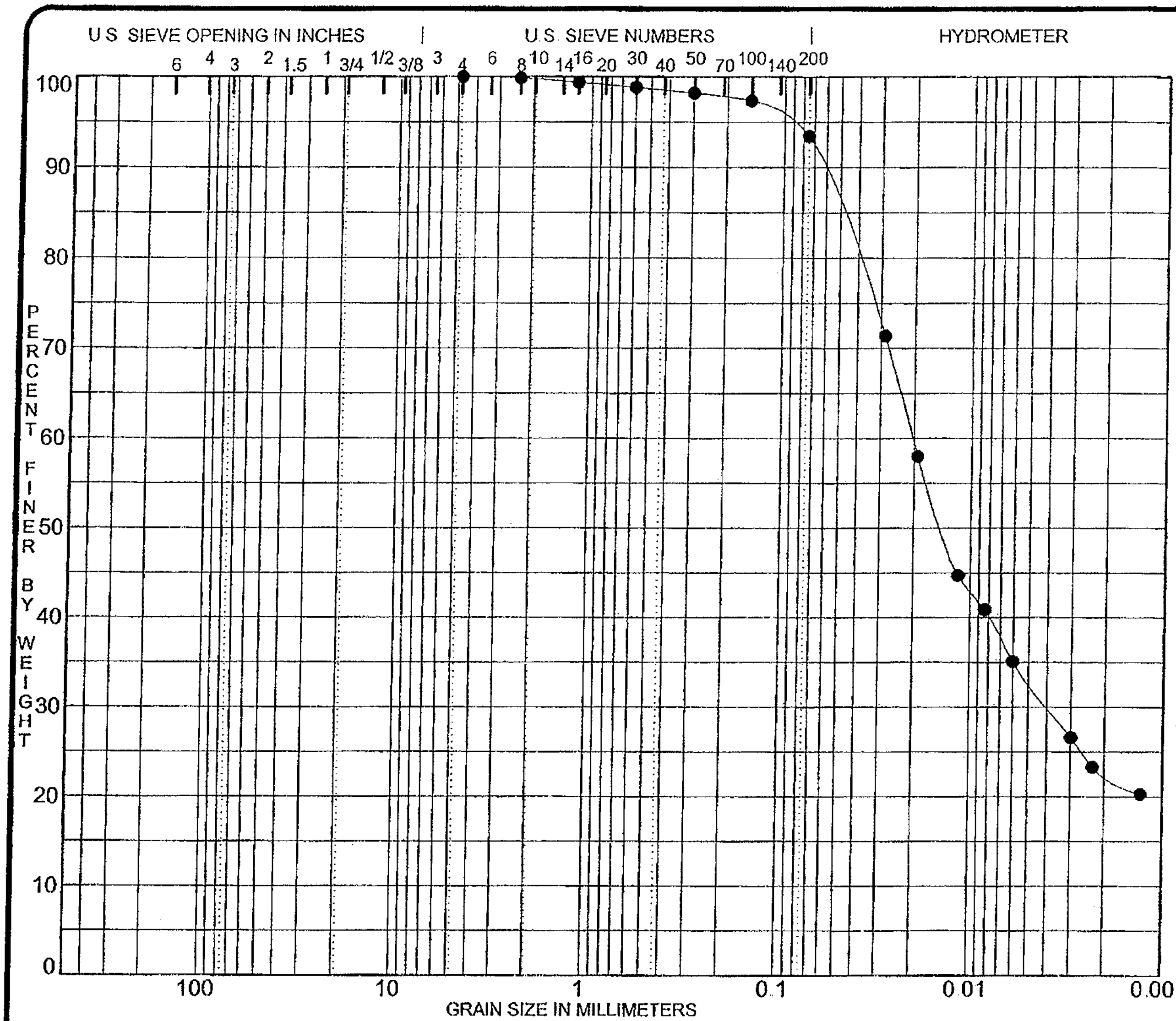
JOB NO.

DATE 8/14/09

GRADATION CURVES

American Electric Power Service Corp.
Groveport, OH 43125

SPP00003297



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	PZ-0905	38.0		25.3	31.2	19.1	12.0		
			LEAN CLAY CL						
			Shelby Tube Sample - 38' - 40'						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%< 002
●	PZ-0905	38.0	4.750	0.020	0.004		0.0	6.5	93.5	22.6

PROJECT **SPORN PLANT - FLY ASH POND DIKES - FLY ASH POND DIKES**

JOB NO

DATE 8/14/09

GRADATION CURVES

American Electric Power Service Corp.
Groveport, OH 43125

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D C 20460

OFFICE OF
ENFORCEMENT AND
COMPLIANCE ASSURANCE

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

NOV 13 2009

Alan R. Wood, PE
Manager
Water & Ecological Resource Services Section
Environmental Services Division
American Electric Power
1 Riverside Plaza
Columbus, OH 43215-2373

Re: Request for Information Pursuant to Section 308 of the Clean Water Act (33 U.S.C. § 1318)

Dear Mr Wood:

Enclosed is an Information Request issued pursuant to Section 308(a) of the Clean Water Act, 33 U S C. § 1318(a). Section 308 of the Clean Water Act authorizes the Administrator of the United States Environmental Protection Agency ("EPA") to require those subject to the Act to furnish information, conduct monitoring, provide entry to the Administrator or authorized representatives, and make reports as may be necessary to carry out the objectives of the Act This authority has been re-delegated to the undersigned Director of the Water Enforcement Division in the Office of Enforcement and Compliance Assurance. The enclosures, which are hereby made part of this letter, provide details of the information the American Electric Power ("AEP") Philip Sporn Generating Plant ("Facility") must provide to EPA and contain instructions on how this information is to be submitted to EPA.

Section 308(a) of the Clean Water Act, 33 U.S C. § 1318(a) authorizes EPA to require any person to provide information required to carry out the objectives of the Clean Water Act. Accordingly, you are requested to respond to the enclosed Information Request (Enclosure 1). Please read the instructions in the enclosure carefully before preparing your response Answer each request as clearly and completely as possible. To the extent that AEP has any of the requested data currently on file, that data may be submitted in the requested format as part of your response Your response to this request must be accompanied by a certificate that is signed and dated by you or the person who is authorized by you to respond to the request The certification must state that the response is complete and contains all information and documentation available to you pursuant to the request A Statement of Certification is enclosed with this letter (Enclosure 2).

Please submit your written responses in accordance with the deadlines set forth in the request to:

Ginny Phillips
U.S. Environmental Protection Agency
Water Enforcement Division
1200 Pennsylvania Avenue, NW
Mail Code 2243A; Room 4118A
Washington, DC 20460
(For deliveries by courier use the Zip Code 20004)

You are entitled to assert a business confidentiality claim pursuant to the regulations set forth in 40 C.F.R. Part 2, Subpart B. If EPA determines the information you have designated meets the criteria in 40 C.F.R. § 2.208, the information will be disclosed only to the extent and by means of the procedures specified in Subpart B. Unless a confidentiality claim is asserted at the time the requested information is submitted, EPA may make the information available to the public without further notice to you.

Compliance with the provisions of this Information Request is mandatory. If you do not respond fully and truthfully to this Information Request or adequately justify your failure to do so, you may be subject to civil penalties or criminal fines under Section 309 of the Clean Water Act, 33 U.S.C. § 1319.

We appreciate your cooperation and prompt attention to this matter. Please contact Ginny Phillips of my staff at 202-564-6139 (phillips.ginny@epa.gov) within 72 hours of receipt this Information Request to inform us of your intention to comply with this request. If you or your staff would like an opportunity to confer, have any questions, or would like to schedule a meeting relating to this Information Request, please contact Ginny Phillips. Thank you for your cooperation in this matter.

Sincerely,

Mark Pollins, Director
Water Enforcement Division

Enclosures

cc: Michael Zeto, West Virginia Department of Environmental Protection
Brian Long, West Virginia Department of Environmental Protection
Rick Rogers, EPA Region 3

Enclosure 1

INFORMATION REQUEST

I. STATUTORY AUTHORITY

1. This information is requested pursuant to Section 308 of the Clean Water Act, 33 U.S.C. § 1318

II. INSTRUCTIONS

1. Respond to Each Request Completely. Provide a separate report for each of the three reports requested. Within each report, indicate the subpart of the request being addressed.

2. Provide the Best Information Available. If any request or subpart of the request cannot be responded to in full, respond to the extent possible along with an explanation of why the request cannot be responded to in full.

3. Source(s) of Response. Include with each report, the name, position, and title of each person(s) who participated in developing the report.

4. Source(s) of Data. Any existing field and laboratory data relied upon by you to develop the reports required by this Information Request must be identified in the report and include an explanation of how the data are representative of the conditions at the site.

5. Indicate Objections to Requests. While you may indicate that you object to certain requests contained in this Information Request, you must provide responsive information notwithstanding those objections. To object without providing responsive information may subject you to the penalties discussed in the cover letter.

6. Claims of Privilege. If you claim that an entire document submitted in response to this Information Request is privileged communication, identify the document and provide the basis for the privilege. If you claim that any particular section of a document is privileged communication, identify that section and provide the basis for the privilege. Regardless of the assertion of a privilege, you must respond to the Information Request in full.

7. New Information. If you become aware of any information not previously known or not available to you as of the date of submission of your response to this Information Request, you must supplement your response to EPA within five (5) business days. Moreover, should you find, at any time after the submission of your response, that any portion of the submitted information is false or misrepresents the truth, you must notify EPA of this fact immediately and provide a corrected response within two (2) business days

8. Submission of Response by U.S. Mail. Submit a paper copy and an electronic pdf file on CD of your response to:

> Ginny Phillips
> U.S. Environmental Protection Agency
> Water Enforcement Division
> 1200 Pennsylvania Avenue, NW
> Mail Code 2243A; Rm. 4118A
> Washington, DC 20460
> 202-564-6139
> *(For deliveries by courier use the Zip Code 20004)*

9. Submission of Response by E-mail. Submit an electronic .pdf file of your response to phillips.ginny@epa.gov.

10. Retention of Records. All records and documents that were created and/or relied upon in responding to any part of this request must be maintained until EPA informs you that maintenance is no longer required.

11. Inclusion of Statement of Certification. The Statement of Certification found in Enclosure 2 must be submitted along with each submission made pursuant to this Information Request This statement must be signed by you or a person authorized by you to respond to the Information Request.

III. DEFINITIONS

Unless otherwise defined herein, terms used in this request shall have the meaning given to those terms in the Act, 33 U.S.C. § 1251 et seq., the regulations promulgated thereunder at 40 CFR § 122, and in AEP's NPDES Permit, No. WV0001058.

1. The terms "and" and "or" shall be construed either disjunctively or conjunctively as necessary to bring within the scope of this Information Request any information which might otherwise be construed to be outside its scope

2. The term "any," as in "any documents," for example, shall mean "any and all"

3. The term "describe" means to detail, depict, or give an account of the requested information, or to report the content of any oral and/or written correspondence, communication, or conversation, or to report the contents of any document, including the title, the author, the position or title of the author, the addressee, the position or title of the addressee, indicated or blind copies, date, subject matter, number of pages, attachment or appendices, and all persons to whom the document was distributed, shown, or explained

4. "State" shall mean the State of West Virginia.

5. "Person" means an individual, trust, firm, joint stock company, corporation (including a government corporation), partnership, association, State, municipality, commission, political subdivision of a State, or an interstate body.

6. "Facility" is defined as:

AEP Philip Sporn, State Route 62, New Haven, WV 25265

7. "Permit" is defined as AEP Philip Sporn, National Pollutant Discharge Elimination System Permit Number WV0001058 Expiration Date: June 30, 2013.

IV. SUPPLEMENTAL REPORTS TO BE SUBMITTED

AEP shall develop supplemental reports for the requests below to ensure that the coal combustion waste impoundments at the Facility are structurally sound and will continue in safe and reliable operation. AEP shall develop and submit a supplemental report for the following requests in accordance with this section:

1. Site-specific study of the potential for liquefaction of foundation ash under design earthquake loading conditions for the raised eastern dike at the Fly Ash Pond;
2. Site-specific assessment of the effect of railway-induced ground vibrations on the embankments at both the Fly Ash Pond and the Bottom Ash Pond; and
3. Analysis of slope stability under design earthquake loading conditions for the upper sections of the eastern dike of the Fly Ash Pond.

1. Report on Earthquake-Induced Liquefaction for Eastern Dike of Fly Ash Pond: Within ninety (90) days of receipt of this request, AEP shall perform a study and submit an engineering report to EPA addressing the potential for earthquake-induced liquefaction of sluiced ash deposits upon which the raised eastern dike of the Fly Ash Pond was constructed at the Facility. The study shall be based on the specific site characteristics, subsurface conditions, material properties and parameters existing at the raised Fly Ash Pond dike, as determined by field exploration and laboratory tests. Existing field and laboratory data may be used to the extent that the data are representative of the conditions at the ash pond dike. Additional test borings and laboratory tests shall be performed if needed to adequately and accurately characterize the subsurface profiles and evaluate the densities, strengths, moisture contents, classification and index properties of the soil and ash layers that comprise the subsurface profiles. The Experimental Investigation approach used in The Ohio State University Research Project # 60005876 reported in "*Draft Final Report of Evaluation of Liquefaction Potential of Impounded Fly Ash*," dated October 17, 2005 and adapted from The Indian Institute of Technology (Madras, India) "*Liquefaction Analysis of Pond Ash*" contained in the Proceedings of the 15th International Conference on Solid Waste Technology & Management held on December 12-15, 1999 in Philadelphia, Pennsylvania, may be used in this study to evaluate the liquefaction potential of foundation ash supporting the raised dike of the Fly Ash

SPP00003225

Pond at the Facility. However, the cyclic triaxial testing shall be on representative samples of Philip Sporn fly ash remolded to relative densities that bracket the in-situ relative densities of the fly ash. Alternatively, semi-empirical procedures may be used to evaluate liquefaction potential of the foundation ash, such as those presented in the paper "*Semi-Empirical Procedures for Evaluating Liquefaction Potential During Earthquakes*," by I. M. Idriss and R.W. Boulanger, Proceedings of The Joint11th International Conference on Soil Dynamics & Earthquake Engineering (ICSDEE) & 3rd International Conference on Earthquake Geotechnical Engineering (ICEGE) (pp. 32-56), January 7-9, 2004. The design earthquake ground acceleration shall be at least 0.06g. At a minimum, the report shall include the following:

(a) description of background information and approach of the study;
(b) description of the methodology and procedures used in the analysis;
(c) description of any additional field testing performed and the results obtained;
(d) description of any additional laboratory testing performed and the results obtained;
(e) description of the site(s) including site map(s) depicting planimetric and topographic features and the location of critical section(s) selected for analysis;
(f) description of the subsurface conditions at the critical sections and illustration of the analysis profiles;
(g) discussion of the design soil and ash properties and parameters and the basis of selection of these values or the source of the values;
(h) presentation of analysis results, including appropriate charts and graphs illustrating the results, and discussion of the results;
(i) conclusions regarding liquefaction potential under design earthquake loading conditions at the Philip Sporn Fly Ash Pond dike;
(j) recommendations for remedial action to eliminate or minimize liquefaction potential should the foundation ash be found susceptible to liquefaction under design earthquake loading;
(k) list of references;
(l) tables as needed to facilitate presentation of data;
(m) figures as needed for illustration purposes;
(n) an appendix containing summary descriptions of field and laboratory test procedures that may be used to develop additional soil and ash data as needed for the study;
(o) an appendix containing all test boring logs and other field data considered in the study, including existing data and additional data that may be obtained to fully characterize the analysis profiles;
(p) an appendix containing all laboratory test data considered in the study, including existing data and additional data developed for the study;
(q) an appendix containing calculations, including analysis calculations, *e.g.*, program SHAKE runs, and calculations for calculated values used in the analysis, *e.g.*, calculation of shear modulus values (G_{max}); and

(r) certification of the study and report by a professional engineer registered in the state of West Virginia

2 <u>Report on Railway-Induced Ground Vibration for Fly Ash Pond Dike and Bottom Ash Pond Dike</u>: Within ninety (90) days of receipt of this request, AEP shall perform assessment and submit a report to EPA addressing the effect of railway-induced ground vibrations on the slope stability at the Fly Ash Pond dike and the Bottom Ash Pond dike located at the Facility. In addition, the study shall evaluate the potential for liquefaction of foundation ash under the raised eastern dike of the Fly Ash Pond due to railway-induced ground vibrations The study shall be based on the specific site characteristics, railway loading conditions, subsurface conditions, material properties and parameters existing at the Fly Ash Pond dike and at the Bottom Ash Pond dike, as determined by field measurement, field exploration and laboratory tests. Existing field and laboratory data may be used to the extent that the data are representative of the conditions at the ash pond dikes. The study shall also examine the cause of apparently shallow sloughing of the dike slopes and determine whether the root cause of the sloughing is railway-induced ground vibration or some other cause, such as saturation of the thick topsoil layer on the relatively steep slopes and consequential loss of its nominal cohesive strength, leading to failure due to insufficient frictional shearing resistance, or a combination of causes In light of the results of this examination, the study shall review plans for repairs of the sloughing and determine whether modifications to the plans ought to be made to ensure long-term success of the repair. At a minimum, the report shall include the following:

(a) a description of the site including a site map depicting the location of the railway superstructure, embankments and other planimetric and topographic features;

(b) description, procedures and summary of field measurements of railway-induced ground vibrations generated by loaded railway traffic under dynamic conditions at various speeds and stopping conditions;

(c) description, procedures and summary of field exploration and laboratory tests of in-situ subsurface conditions, including, but not limited to:
   (i) soil test & instrumentation location map;
   (ii) cross-sectional geometry of embankment sections depicting phreatic surface; and
   (iii) soil test boring logs and laboratory analyses of soil testing.

(d) description, procedures and summary of slope stability analysis including, but not limited to:
   (i) soil strength parameters modeled and basis of values used;
   (ii) loading conditions modeled from measured railway-induced ground vibrations generated by railway traffic;
   (iii) factors of safety against shallow slope failures and global slope instability.

(e) evaluation of the potential liquefaction of fly ash under the raised eastern dike of the Fly Ash Pond from instantaneous, as well as long term exposure, to railway induced ground vibrations from the west side of the Fly Ash Pond;

(f) evaluation of the potential liquefaction of fly ash under the raised eastern dike of the Fly Ash Pond from train collision and derailment on the west side of the Fly Ash Pond;
(g) determination of the root cause of apparently shallow sloughing of the dike slopes;
(h) evaluation of the plans for sloughing repairs in consideration of the determination of the root cause and description of potential changes, if any, that may need to be made to the plans to ensure long-term success of the repair;
(i) conclusions regarding railway vibrations and their effect on slope stability and liquefaction potential at the Philip Sporn Fly Ash Pond dikes and on slope stability at the Bottom Ash Pond dike;
(j) conclusions regarding train wreck and its effect on liquefaction potential at the raised eastern dike of the Philip Sporn Fly Ash Pond;
(k) recommendations for remedial action to enhance slope stability to acceptable safety margins and/or eliminate or minimize liquefaction potential, as may be required, depending on the results of the assessment;
(l) list of references;
(m) tables as needed to facilitate presentation of data;
(n) figures as needed for illustration purposes;
(o) an appendix containing summary descriptions of field and laboratory test procedures that may be used to develop vibration data and additional soil and ash data as needed for the assessment;
(p) an appendix containing the vibration monitoring data and all test boring logs and other field data considered in the study, including existing data and additional data that may be obtained;
(q) an appendix containing all laboratory test data considered in the assessment, including existing data and additional data developed for the assessment;
(r) an appendix containing all calculations, including slope stability analyses and liquefaction analyses; and
(s) certification of the assessment and report by a professional engineer registered in the state of West Virginia.

3. Report on Analysis of Seismic Slope Stability of Fly Ash Pond Eastern Dike Upper Section: Within ninety (90) days of receipt of this request, AEP shall submit a report to EPA of the "Seismic Slope Stability Analysis" to characterize the seismic stability of the Upper Section of the Fly Ash Pond eastern dike, which was constructed over sluiced fly ash deposits, at the Facility. The analysis shall be based on the specific site characteristics, subsurface conditions, material properties and parameters existing at the raised Fly Ash Pond dike, as determined by field exploration and laboratory tests. The analysis shall be based on a design earthquake ground acceleration of at least 0.06g. Pseudo-static design methodologies may be used. Existing field and laboratory data may be used to the extent that the data are representative of the conditions at the ash pond dike. A report of the analysis shall be prepared and at a minimum the report shall include:

(a) a description of the geotechnical properties used for each soil and ash layer used in the analysis including total and effective shear strength parameters;
(b) a description of the data collection and modeling methodologies utilized by AEP in the evaluation of seismic slope stability;
(c) an analysis of embankment internal stresses, including static pore pressures under expected seepage conditions;
(d) an analysis of embankment internal stresses, including static pore pressures during normal and maximum waste placement conditions;
(e) analyses of embankment stability shall consider both slope and base sliding conditions;
(f) analyses of slope stability shall include evaluation of critical full height and partial height potential failure planes;
(g) computed minimum safety factors during the design earthquake event for both slope and base sliding conditions;
(h) conclusions regarding seismic slope stability under design earthquake loading conditions of upper section of the Fly Ash Pond eastern dike at the Facility;
(i) recommendations for remedial action to enhance seismic stability of the upper section of the Fly Ash Pond eastern dike to acceptable safety margins, as may be required, depending on the results of the assessment;
(j) list of references;
(k) tables as needed to facilitate presentation of data;
(l) figures as needed for illustration purposes;
(m) an appendix containing summary descriptions of field and laboratory test procedures that may be used to develop additional soil and ash data as needed for the analysis;
(n) an appendix containing all test boring logs and other field data considered in the analysis, including existing data and additional data that may be obtained;
(o) an appendix containing all laboratory test data considered in the analysis, including existing data and additional data developed for the analysis;
(p) an appendix containing all stability analysis calculations; and
(q) certification of the analysis by a professional engineer registered in the state of West Virginia.

Enclosure 2

STATEMENT OF CERTIFICATION

I certify that the information contained in or accompanying this submission is true, accurate, and complete.

As to the identified portion(s) of this submission for which I cannot personally verify its truth and accuracy, I certify as the company official having supervisory responsibility for the person(s) who, acting under my direct instructions, made the verification, that this information is true, accurate, and complete I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment.

By ______________________________
(Signature)

____
~~(Title)~~

____
(Date)

TABLE OF CONTENTS

APPENDICES

Geo/Environmental Associates, Inc.

3502 Overlook Circle • Knoxville, TN 37909 • 865-584-0344 • Fax 865-584-0778 • www.geoe.com

January 18, 2010

American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43215-2373

Attn.: Mr. Pedro J. Amaya, P.E.

RE: Analysis of Seismic Slope Stability of
Fly Ash Pond Eastern Dike Upper Section
Sporn Fly Ash Pond
Philip Sporn Power Plant
New Haven, West Virginia
NPDES No. WV0001058
GA File No. 09-387

Dear Mr. Amaya:

At the request of American Electric Power (AEP), Geo/Environmental Associates, Inc. (GA) has prepared a supplemental report regarding the seismic (pseudo-static) slope stability of the Sporn Fly Ash Pond - Eastern Dike. Specifically, this report is in response to the United States Environmental Protection Agency's (USEPA) request for information, Items 3a through 3q, issued in a letter dated November 13, 2009. Provided herein is the supplemental report addressing each of the USEPA's requests for Items 3a through 3q. A copy of the letter in which the USEPA requests information is provided in Appendix I. Additionally, laboratory and field testing data, seepage analyses, slope stability analyses, site drawings, and references are provided in Appendices II through VI.

BACKGROUND

The Sporn Fly Ash Pond is maintained and operated by American Electric Power to support temporary disposal of fly ash generated at the Philip Sporn Power Plant. The Fly Ash Pond (i.e., the Eastern Dike) is located at approximate coordinates N 38° 58' 29", W 81° 55' 47", near the town of New Haven, West Virginia. The fly ash pond is bounded by the Mountaineer Power Plant on its north side, the Ohio River on its east side, the Philip Sporn Bottom Ash Pond and coal yard on its south side, and West Virginia State Route 62 on its west side.

Fly ash generated at the Philip Sporn Power Plant is temporarily disposed in the Fly Ash Pond; where after, it is excavated and hauled for dry disposal into AEP's Little Broad Run Landfill. AEP maintains an operating pool level of approximately 605 feet, NGVD in the Fly Ash Pond. A plan view drawing of the Fly Ash Pond is provided in Appendix V.

The Eastern Dike of the Fly Ash Pond was constructed with earthfill and ash materials. Specifically, the Eastern Dike consists of an original soil dike constructed in the 1950's, lower dike extensions constructed in 1965 and 1968, and an upper dike constructed in 1972. The lower dike is founded primarily on residual clay and silt materials. The upper dike is constructed/founded primarily on fly ash that was hydraulically placed in the pond prior to 1972. AEP implemented modifications to the Eastern Dike between 1996 and 2002 to address seepage observed on the exterior face of the dike and to improve the overall stability conditions of the slopes. In general, for the improvements, the company installed drainage collection provisions and regraded/buttressed the exterior slopes. Additionally, AEP began implementing modifications to the ash disposal operations by removing the fly ash from the pond for haulage and placement into the Little Broad Run Landfill. As shown on the plan view and profile drawings provided in Appendix V, the as-built crest elevation of the upper dike of the Eastern Dike is approximately 620 feet, NGVD. The as-built elevation of the crest of the lower dike/current haulroad ranges from about elevation 599 feet, NGVD to about 603 feet, NGVD.

In order to provide additional information for the USEPA pursuant to their November 13, 2009 letter, AEP has requested that GA conduct seismic (pseudo-static) slope stability analyses of the Philip Sporn Fly Ash Pond – Eastern Dike. Correspondingly, we have conducted detailed slope stability analyses on three critical sections (i.e., Section K-K, Section L-L, and Section M-M) located through the Eastern Dike of the facility. Provided herein are itemized responses to each of the USEPA's requests regarding the Eastern Dike seismic slope stability assessment.

RESPONSES TO USEPA REQUEST FOR INFORMATION – ITEMS 3a TO 3q

Provided herein are USEPA Information Request Items 3a through 3q and corresponding responses prepared by GA. For completeness, the November 13, 2009 letter containing the information requests is provided in Appendix I. Background information, data, and analyses supporting the responses provided herein are included in Appendices II through VI.

Information Request Item 3a

Provide a description of the geotechnical properties used for each soil and ash layer used in the analyses including total and effective shear strength parameters.

Response to Item 3a

Geotechnical properties for the soil materials used in the seismic slope stability analyses of the three critical sections (i.e., Section K-K, Section L-L, and Section M-M) were developed based on: (1) field testing, laboratory testing, and analysis data included in the "*Philip Sporn Electric Generating Plant Unit 5 Ash Facility – Engineering Report*," prepared/compiled by the Geotechnical Engineering Section of American Electric Power Service Corporation, dated July 1998; (2) field testing, laboratory testing, and analysis data included in the "*Philip Sporn Power Plant – Stability Analysis*," prepared/compiled by the Geotechnical Engineering Section of American Electric Power Service Corporation, dated March 2009; and (3) geotechnical subsurface exploration and laboratory testing conducted by GA in December 2009. The background, laboratory, and field data supporting the analyses herein are included in Appendix II. A detailed summary of the material parameters used in the steady-state seepage analyses provided herein is included in Appendix III. A detailed summary of the material parameters used in the slope stability analyses is included in Appendix IV.

Tables 1, 2, and 3 summarize the parameters used in the seepage and slope stability analyses conducted for Section K-K, Section L-L, and Section M-M, respectively. The material layers for each of the respective sections are shown on the slope stability analysis output provided in Appendix IV and on drawing sheet 2 in Appendix V. Strength models used in the slope stability analyses were based on the Mohr-Coulomb criterion. It should be noted that the slope stability analyses were conducted using effective stress conditions. Therefore, the material strength parameters presented in the tables are effective strength parameters. Where available, material total stress parameters are included in the laboratory data provided in Appendix II.

TABLE 1
SOIL MATERIAL PARAMETERS USED FOR SECTION K-K ANALYSES

Soil Layer Number	Material Type	Location	Unit Weight (pcf)		Permeability (ft/sec)	Effective Strength Parameters	
			Moist	Saturated		c' (psf)	φ'
1	Silty Clay	1972 Embankment Extension	125	130	$4.92x10^{-8}$	0	34
2	Gravelly Silty Sand	1972 Embankment Extension	108	115	$1.77x10^{-5}$	0	33
3	Sand & Gravel	1972 Embankment Extension	114	120	$1.6x10^{-4}$	0	36
4	Bottom Ash (68)	1968 Embankment Extension	100	105	$9.5x10^{-6}$	0	31
5	Gravelly Silty Sand	1968 Embankment Extension	110	115	$1.77x10^{-5}$	0	35
6	Silty Clay	1965 Embankment Extension	120	128	$1.2x10^{-8}$	0	34
7	Bottom Ash (65)	1965 Embankment Extension	65	90	$9.5x10^{-6}$	0	29
8	Fly Ash (1)	Fly Ash Pond	80	90	$2.2x10^{-6}$	0	27
9	Sandy Silt	1972 Embankment Extension	100	105	$1.3x10^{-6}$	0	31
10	Clay Foundation	Upper Foundation Soil	120	125	$3.6x10^{-9}$	0	33
11	Clay Foundation	Upper Foundation Soil	125	130	$1.6x10^{-8}$	0	39
12	Silty Clay Foundation	Mid-Level Foundation Soil	120	125	$3.6x10^{-9}$	0	37
13	Silty Clay	Original Dike	125	130	$1.2x10^{-8}$	0	33
14	Foundation Soil	Lower Foundation Soil	125	130	$3.6x10^{-9}$	0	32

Notes:

(1) We conservatively applied an effective friction angle of 27° to the fly ash material based on previous testing and analyses. It should be noted that an effective friction angle of 33° was measured for the fly ash material during updated triaxial testing conducted in December 2009.

TABLE 2 SOIL MATERIAL PARAMETERS USED FOR SECTION L-L ANALYSES							
Soil Layer Number	Material Type	Location	Unit Weight (pcf)		Permeability (cm/sec)	Effective Strength Parameters	
			Moist	Saturated		c' (psf)	φ'
1	Sandy Silty Clay	1972 Embankment Extension	125	130	2.0×10^{-7}	0	34
2	Road Fill	1972 Embankment Extension	108	115	2.1×10^{-4}	0	33
3	Gravelly Silty Sand	1972 Embankment Extension	114	120	2.1×10^{-4}	0	36
4	Gravelly Silty Sand	1972 Embankment Extension	100	105	2.1×10^{-4}	0	31
5	Bottom Ash	1968 Embankment Extension	110	115	9.5×10^{-6}	0	35
6	Silty Sand & Gravel	1968 Embankment Extension	120	128	6.6×10^{-5}	0	34
7	Silty Sandy Clay	1965 Embankment Extension	65	90	1.2×10^{-8}	0	29
8	Silty Clay	1965 Embankment Extension	80	90	1.2×10^{-8}	0	33
9	Fly Ash (1)	Fly Ash Pond	100	105	2.2×10^{-6}	0	27
10	Clay Foundation	Upper Foundation Soil	120	125	1.6×10^{-8}	0	33
11	Clay Foundation	Upper Foundation Soil	125	130	3.6×10^{-9}	0	39
12	Silty Clay Foundation	Lower Foundation Soil	120	125	3.6×10^{-9}	0	37

Notes:

(1) We conservatively applied an effective friction angle of 27° to the fly ash material based on previous testing and analyses. It should be noted that an effective friction angle of 33° was measured for the fly ash material during updated triaxial testing conducted in December 2009.

TABLE 3
SOIL MATERIAL PARAMETERS USED FOR SECTION M-M ANALYSES

Soil Layer Number	Material Type	Location	Unit Weight (pcf)		Permeability (cm/sec)	Effective Strength Parameters	
			Moist	Saturated		c' (psf)	ϕ'
1	Sandy Silty Clay	1972 Embankment Extension	125	130	2.0×10^{-7}	0	34
2	Gravelly Silty Sand	1972 Embankment Extension	125	125	2.1×10^{-4}	0	35
3	Bottom Ash	1995 Embankment Modifications	65	90	9.5×10^{-6}	0	36
4	Silty Sand w/ Gravel	1968 Embankment Extension	115	120	6.6×10^{-5}	0	32
5	Sandy Silt	1965 Embankment Extension	125	130	1.3×10^{-6}	0	34
6	Silty Clay	Original Soil Dike	125	130	1.2×10^{-8}	0	33
7	Fly Ash (1)	Fly Ash Pond	110	110	2.2×10^{-6}	0	27
8	Brown Clay	Upper Foundation Soil	120	125	1.6×10^{-8}	0	37
9	Silty Clay	Lower Foundation Soil	122	126	1.2×10^{-8}	170	31.2
10	Sandstone	Foundation	Modeled as Impenetrable				
11	Bottom Ash 2	1972 Embankment Extension	65	90	9.5×10^{-6}	0	32

Notes:

(1) We conservatively applied an effective friction angle of 27° to the fly ash material based on previous testing and analyses. It should be noted that an effective friction angle of 33° was measured for the fly ash material during updated triaxial testing conducted in December 2009.

Information Request Item 3b

Provide a description of the data collection and modeling methodologies in the evaluation of the seismic slope stability.

Response to Item 3b

As described in Response 3a, data used in the analyses was collected from: (1) field testing, laboratory testing, and analysis data included in the "*Philip Sporn Electric Generating Plant Unit 5 Ash Facility – Engineering Report*," prepared/compiled by the Geotechnical Engineering Section of American Electric Power Service Corporation, dated July 1998; (2) field testing, laboratory testing, and analysis data included in the "*Philip Sporn Power Plant – Stability Analysis*," prepared/compiled by the Geotechnical Engineering Section of American Electric Power Service Corporation, dated March 2009; and (3) geotechnical subsurface exploration and laboratory testing conducted by GA in December 2009. Additionally, AEP provided GA with historical piezometer data, updated through December 2009, to use in our evaluation. The site data is compiled and summarized in Appendix II.

The modeling methodology consisted of the following steps:

(1) *Developing an appropriate geological cross-section for each of the critical analysis locations.* For this item, GA used as-built topographic mapping (dated May 2007) to update the detailed geological profiles for Sections K-K, L-L, and M-M that were provided in AEP's 1998 Engineering Report. The updated geological cross-sections are provided on drawing sheet 2 in Appendix V.

(2) *Conducting steady-state seepage analyses for each critical section to approximate an appropriate phreatic level to use in the slope stability analyses.* GA used the finite element computer program, *SEEP/W* to develop the phreatic levels used in the slope stability analyses. *SEEP/W* is developed by GEO-SLOPE International, Ltd. of Calgary, Alberta, Canada. Specifically, steady-state seepage conditions were modeled at each of the critical sections based on a Fly Ash Pond operating pool level of 605 feet, NGVD and an Ohio River pool level of 540 feet, NGVD. It should be noted that the modeled seepage phreatic levels are approximately equal to or higher than the actual piezometric levels measured in the field. Therefore, we believe that the seepage models provided herein and applied in the stability analyses lend to a generally conservative analysis approach. Table 4 provides a comparison of the approximated seepage levels and the measured piezometric levels at Sections K-K, L-L, and M-M. A detailed discussion regarding the seepage analyses and the *SEEP/W* output are provided in Appendix III.

TABLE 4
COMPARISON OF SEEPAGE ANALYSIS PHREATIC LEVELS AND PIEZOMETRIC LEVELS FOR CRITICAL SECTIONS K-K, L-L, AND M-M

Section	Piezometer	Piezometric Level (ft, NGVD)	Modeled Phreatic Level From Seepage Analysis (ft, NGVD)	Difference Between Modeled Phreatic Level and Piezometric Level (ft)
K-K	B-108	556.1 (12/8/10)	585	+ 28.9
	GA-1D	593.5 (1/8/10)	593	-0.5
L-L	B-110	574.1 (12/8/09)	587	+12.9
	PZ-0902	576.4 (12/8/09)	587	+10.6
M-M	PZ-0901	582.4 (12/8/09)	591	+8.6

(3) *Conducting seismic (pseudo-static) slope stability analyses on the upper dike at each critical section.* The computer program *SLOPE/W* was used to analyze each critical section. *SLOPE/W* is developed by GEO-SLOPE International, Ltd. of Calgary, Alberta, Canada. Specifically, the Morgenstern-Price Limit Equilibrium Method was applied in each of the slope stability analyses. Phreatic levels developed with *SEEP/W* were applied in the slope stability analyses. At the request of the USEPA, both circular-type (slope) and block-type (i.e., base sliding) slip surfaces were modeled in the analyses. Moreover, at the recommendation of the USEPA, a horizontal earthquake acceleration of 0.06 *g* was applied in each of the pseudo-static analyses. A detailed discussion regarding the slope stability analyses and the corresponding *SLOPE/W* output are provided in Appendix IV.

(4) *Evaluating the analysis results.* GA evaluated the slope stability analysis results and the corresponding safety factors developed for each of the critical sections along the Eastern Dike. The safety factors for each of the seismic slope stability analyses are tabulated in Appendix IV. As shown therein, the Eastern Dike – Upper Dike has seismic slope stability safety factors in excess of 1.2 for each of the modeled conditions at each of the critical sections.

Information Request Item 3c

Provide an analysis of embankment internal stresses, including static pore water pressures, under expected seepage conditions.

Response to Item 3c

Embankment internal stresses including static pore water pressures for the modeled seepage conditions are shown on the *SEEP/W* graphical output provided in Appendix III.

<u>Information Request Item 3d</u>

Provide an analysis of embankment internal stresses, including static pore water pressures, during normal and maximum waste placement conditions.

<u>Response to Item 3d</u>

AEP maintains the operating pool level in the Fly Ash Pond at approximately elevation 605 feet, NGVD. After hydraulic placement into the pond, the fly ash is excavated and hauled to the Little Broad Run Landfill for placement. It should be noted that AEP typically leaves a minimum 25-foot wide fly ash buffer against the upstream face of the embankment so that the operating pool does not come into direct contact with the upper dike. By dredging/removing the fly ash for placement into the landfill, AEP is able to maintain the fly ash level in the pond approximately at or below elevation 605 feet, NGVD. Therefore, both the normal operating and maximum waste conditions for the Fly Ash Pond are based on a pool level of 605 feet, NGVD. Correspondingly, GA used a pool level of 605 feet, NGVD in the seepage models on critical Eastern Dike Sections K-K, L-L, and M-M. Embankment internal stresses including static pore water pressures are shown on the *SEEP/W* graphical output provided in Appendix III.

<u>Information Request Item 3e</u>

Provide analyses of the embankment slope stability considering both slope and base sliding conditions.

<u>Response to Item 3e</u>

At the request of the USEPA, both circular-type (slope) and block-type (i.e., base sliding) slip surfaces were modeled in the slope stability analyses for critical Eastern Dike Sections K-K, L-L, and M-M. The results of the *SLOPE/W* slope stability analyses are provided in Appendix IV.

<u>Information Request Item 3f</u>

Provide slope stability analyses for the critical full height and partial height potential failure planes.

<u>Response to Item 3f</u>

We have conducted slope stability analyses on the full height (i.e., labeled as Global) and partial height (i.e., labeled as Upper Dike) potential failure planes. The results of the *SLOPE/W* slope stability analyses are provided in Appendix IV.

<u>Information Request Item 3g</u>

Provide computed minimum safety factors during the design earthquake event for both slope and base sliding conditions.

Response to Item 3g

Slope stability safety factors computed using *SLOPE/W* are summarized in Table 5. Graphical output showing the critical slip surfaces and associated safety factors for each of the slope stability analyses are provided in Appendix IV.

TABLE 5
SUMMARY OF *SLOPE/W* SLOPE STABILITY SAFETY FACTORS

Critical Section	Direction	Condition	Safety Factor
K-K	Upstream	Circular-Type Slip	1.93
		Block-Type Slip	2.01
	Downstream	Global Circular-Type Slip	1.33
		Global Block-Type Slip	1.51
		Upper Dike Circular-Type Slip	2.26
		Upper Dike Block-Type Slip	2.43
L-L	Upstream	Circular-Type Slip	1.90
		Block-Type Slip	1.96
	Downstream	Global Circular-Type Slip	1.71
		Global Block-Type Slip	1.71
		Upper Dike Circular-Type Slip	2.27
		Upper Dike Block-Type Slip	2.51
M-M	Upstream	Circular-Type Slip	1.70
		Block-Type Slip	1.80
	Downstream	Global Circular-Type Slip	1.35
		Global Block-Type Slip	1.50
		Upper Dike Circular-Type Slip	1.81
		Upper Dike Block-Type Slip	1.90

Information Request Item 3h

Provide conclusions regarding the seismic slope stability under the design earthquake loading conditions of the upper section of the Fly Ash Pond eastern dike at the facility.

Response to Item 3h

Based on current engineering standard of practice and the West Virginia Department of Environmental Protection - Dam Safety Rule §47-34-7.4.b.1.D.1(d), the minimum recommended factor of safety for an embankment regarding seismic (pseudo-static) slope stability is 1.2. As shown in Table 5 and in the results in Appendix IV, the seismic slope stability safety factors are in excess of 1.2 for the conservatively modeled conditions applied to the critical sections (i.e., Section K-K, Section L-L, and Section M-M) along the Fly Ash Pond - Eastern Dike. Therefore, we conclude that the upper dike of the Sporn Fly Ash Pond - Eastern Dike, in its as-built condition, meets and/or exceeds requirements for seismic slope stability.

Information Request Item 3i

Provide recommendations for remedial action to enhance seismic stability of the upper section of the Fly Ash Pond eastern dike to acceptable safety margins, as may be required, depending on the results of the assessment.

Response to Item 3i

Based on the results of our assessment, no remedial measures are proposed.

Information Request Item 3j

Provide a list of references.

Response to Item 3j

A list of references is included in Appendix VI.

Information Request Item 3k

Provide tables as needed to facilitate presentation of the data.

Response to Item 3k

Tables are provided herein and in the appendices, as appropriate to facilitate the presentation of the data.

Information Request Item 3l

Provide figures as needed for illustration purposes.

Response to Item 3l

For illustration purposes, appropriate figures (i.e., graphical *SEEP/W* seepage output, graphical *SLOPE/W* slope stability output, AutoCAD as-built drawings, etc.) are provided in the appendices.

Information Request Item 3m

Provide an appendix containing summary descriptions of field and laboratory test procedures that may be used to develop additional soil and ash data as needed for the analysis.

<u>Response to Item 3m</u>

No specific summary descriptions are provided herein. The field and the laboratory test procedures were conducted in general accordance with current ASTM standards. If needed, copies of the pertinent ASTM standards used in the field and laboratory testing program will be provided.

<u>Information Request for Item 3n</u>

Provide an appendix containing all test boring logs and other field data considered in the analysis, including existing data and additional data that may be obtained.

<u>Response to Item 3n</u>

The test borings and field data considered in the analyses are provided in Appendix II.

<u>Information Request for Item 3o</u>

Provide an appendix containing all laboratory test data considered in the analysis, including existing data and additional data developed for the analyses.

<u>Response to Item 3o</u>

The laboratory test data used in the analyses is provided in Appendix II.

<u>Information Request for Item 3p</u>

Provide an appendix containing all stability analysis calculations.

<u>Response to Item 3p</u>

The *SLOPE/*W stability analysis data and results are provided in Appendix IV.

<u>Information Request for Item 3q</u>

Provide certification of the analysis by a professional engineer registered in the state of West Virginia.

<u>Response to Item 3q</u>

A certification of the analyses presented herein is provided at the front of this document.

Geo/Environmental Associates, Inc. appreciates this opportunity to be of continuing service to American Electric Power. If you have questions regarding this response letter, feel free to contact me at (865) 584-0344 or email me at rogerc@geoe.com.

Respectfully Submitted,
Geo/Environmental Associates, Inc.

Roger W Cecil

Roger W. Cecil, P.E.
Senior Geotechnical Engineer
West Virginia Registered P.E. No. 14,367

ROGER W. CECIL
REGISTERED
14367
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER