APPENDIX A:

SLOPE STABILITY ANALYSIS

Drained - Normalpool

File Information

Title: BoRit Geotechnical Investigation - BOB1
Created By: McCafferty, Conor M NAP
Last Edited By: Fatzinger, Travis T NAP
Revision Number: 27
File Version: 8.0
Tool Version: 8.0.10.6504
Date: 8/21/2013
Time: 6:59:55 PM
File Name: BOB-1 Current.gsz
Directory: I:\IIS\Superfund\Borit Reservoir Investigation 2013\Borit report\Final GeoStudio Runs\Current\
Last Solved Date: 8/21/2013
Last Solved Time: 6:59:58 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

Drained - Normalpool

Kind: SLOPE/W
Parent: BOB1 - SEEP_Drained Normalpool
Method: Spencer
Settings
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6
  - Lambda 10: 0.8
  - Lambda 11: 1
- PWP Conditions Source: Parent Analysis

Slip Surface
- 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: Yes
- Tension Crack
  - Tension Crack Option: (none)

F of S Distribution
- F of S Calculation Option: Constant

Advanced
- Number of Slices: 30
- F of S Tolerance: 0.001
- Minimum Slip Surface Depth: 0.1 ft
- Optimization Maximum Iterations: 2,000
- 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

Bedroack / Retaining wall
Model: Bedrock (Impenetrable)

Clean Silty Sand FILL (Drained)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Sandy Lean Clay FILL (Drained)
Model: Mohr-Coulomb
Unit Weight: 123.6 pcf
Cohesion': 0 psf
Phi': 26 °
Phi-B: 0 °

Clayey Sand FILL (Drained)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33.2 °
Phi-B: 0 °

Clayey SAND (Drained)
Model: Mohr-Coulomb
Unit Weight: 120 pcf

Cohesion': 0 psf
Phi': 29 °
Phi-B: 0 °

Sandy Lean CLAY (Drained)

Model: Mohr-Coulomb
Unit Weight: 119.5 pcf
Cohesion': 0 psf
Phi': 23 °
Phi-B: 0 °

Poorly Graded SAND (Drained)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33 °
Phi-B: 0 °

Silty GRAVEL (Drained)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 38 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0, 189.7132) ft
Left-Zone Right Coordinate: (8, 190.2232) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (15.49667, 187.1136) ft
Right-Zone Right Coordinate: (57.37217, 180.88753) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (-20, 185) ft
Right Coordinate: (129, 191.7632) ft

Points

	X (ft)	Y (ft)
Point 1	-9	185
Point 2	-4	185.2032
Point 3	0	189.7132
Point 4	8	190.2232
Point 5	13	188.4832
Point 6	20	184.6432

Point 7	27	183.7332
Point 8	27.5	183.7332
Point 9	27.5	176.6532
Point 10	41	176.3832
Point 11	52	176.6032
Point 12	60	182.9832
Point 13	76	183.8732
Point 14	85	187.6232
Point 15	93	191.4732
Point 16	103	190.9632
Point 17	116	190.9232
Point 18	123	193.1432
Point 19	127	193.2132
Point 20	129	191.7632
Point 21	129	167.2
Point 22	69.2904	183.5
Point 23	129	183.5
Point 24	53.7514	178
Point 25	129	178
Point 26	-20	176
Point 27	129	176
Point 28	-20	175
Point 29	129	175
Point 30	-20	172
Point 31	129	172
Point 32	-20	169.2
Point 33	129	169.2
Point 34	-20	167.2
Point 35	12.1593	185.5
Point 36	19.1894	181.6765
Point 37	15.8366	183.5
Point 38	27	180.4734
Point 39	27	178
Point 40	-20	178
Point 41	27	176.6532
Point 42	-3.7368	185.5
Point 43	-20	183.5
Point 44	-20	185
Point 45	-2.40641	187

Regions

	Material	Points	Area (ft²)
Region 1	Bedroack / Retaining wall	41,9,8,7,38,39	3.54
Region 2	Clean Silty Sand FILL (Drained)	38,36,37,35,42,45,3,4,5,6,7	109.15
Region 3	Clayey SAND (Drained)	39,40,26,27,25,24,11,10,9,41	259.52
Region 4	Sandy Lean CLAY (Drained)	26,28,29,27	149
Region 5	Poorly Graded SAND (Drained)	30,31,29,28	447

Region 6	Silty GRAVEL (Drained)	32,33,31,30	417.2
Region 7	Bedroack / Retaining wall	34,21,33,32	298
Region 8	Clayey Sand FILL (Drained)	24,12,22,23,25	392.67
Region 9	Sandy Lean Clay FILL (Drained)	22,13,14,15,16,17,18,19,20,23	360.24
Region 10	Clayey Sand FILL (Drained)	40,43,37,36,38,39	236.5
Region 11	Sandy Lean Clay FILL (Drained)	43,44,1,2,42,35,37	60.465

Current Slip Surface

Slip Surface: 126
F of S: 1.323
Volume: 3.3479716 ft³
Weight: 385.01673 lbs
Resisting Moment: 14,037.684 lbs-ft
Activating Moment: 10,610.661 lbs-ft
Resisting Force: 206.09097 lbs
Activating Force: 155.77794 lbs
F of S Rank: 1
Exit: (19.9735, 184.65774) ft
Entry: (8, 190.2232) ft
Radius: 6.8972841 ft
Center: (35.004174, 244.73389) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	8.1503225	190.16974	-338.83704	0.11960466	0.080674364	0
Slice 2	8.4509675	190.06283	-334.73654	0.35881399	0.24202309	0
Slice 3	8.7680183	189.95067	-330.4489	0.55126525	0.3718331	0
Slice 4	9.101475	189.83327	-325.97401	0.69380616	0.46797816	0
Slice 5	9.4349317	189.71586	-321.49949	0.83634707	0.56412322	0
Slice 6	9.84488	189.55934	-315.25841	2.1861034	1.4745454	0
Slice 7	10.33132	189.36371	-307.2585	4.8241189	3.2539093	0
Slice 8	10.83374	189.14496	-298.00089	8.7168932	5.8796187	0
Slice 9	11.1973	188.97628	-290.69053	12.805057	8.6371203	0
Slice 10	11.4594	188.85429	-285.40658	15.565666	10.499174	0
Slice 11	11.77488	188.70577	-278.95931	19.217719	12.962515	0
Slice 12	12.22473	188.48551	-269.2863	24.621044	16.607104	0

Slice 13	12.75842	188.19926	-256.38543	31.753094	21.417732	0
Slice 14	13.067525	188.01981	-248.52574	36.786696	24.81294	0
Slice 15	13.365165	187.83686	-240.67499	37.2052	25.095224	0
Slice 16	13.825395	187.54938	-228.28487	40.126536	27.06569	0
Slice 17	14.25434	187.29185	-217.35773	43.704265	29.478899	0
Slice 18	14.676255	187.05269	-207.43421	44.733175	30.172908	0
Slice 19	15.122425	186.80194	-197.06852	45.257479	30.526555	0
Slice 20	15.53141	186.58086	-188.06748	46.703769	31.50209	0
Slice 21	15.90321	186.38943	-180.42354	45.564199	30.73344	0
Slice 22	16.274145	186.2022	-173.00179	44.826923	30.236141	0
Slice 23	16.644215	186.01915	-165.54284	42.981497	28.991386	0
Slice 24	17.014285	185.8361	-157.9449	41.13607	27.74663	0
Slice 25	17.384355	185.65305	-150.35603	39.290644	26.501874	0
Slice 26	17.785868	185.46808	-142.91237	38.009202	25.63753	0
Slice 27	18.218825	185.28117	-135.62714	33.073926	22.308645	0
Slice 28	18.651782	185.09427	-128.3686	28.138651	18.97976	0
Slice 29	19.052467	184.94364	-122.97011	23.907977	16.126134	0
Slice 30	19.42088	184.82928	-119.44035	14.344786	9.6756803	0
Slice 31	19.789293	184.71492	-115.94882	4.7815953	3.2252268	0

Drained - Highpool

File Information

Title: BoRit Geotechnical Investigation - BOB1
Created By: McCafferty, Conor M NAP
Last Edited By: Fatzinger, Travis T NAP
Revision Number: 27
File Version: 8.0
Tool Version: 8.0.10.6504
Date: 8/21/2013
Time: 6:59:55 PM
File Name: BOB-1 Current.gsz
Directory: I:\IIS\Superfund\Borit Reservoir Investigation 2013\Borit report\Final GeoStudio Runs\Current\
Last Solved Date: 8/21/2013
Last Solved Time: 7:00:02 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

Drained - Highpool

Kind: SLOPE/W
Parent: BOB1 - SEEP_Drained Highpool
Method: Spencer
Settings
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6
  - Lambda 10: 0.8
  - Lambda 11: 1
- PWP Conditions Source: Parent Analysis

Slip Surface
- 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: Yes
- Tension Crack
  - Tension Crack Option: (none)

F of S Distribution
- F of S Calculation Option: Constant

Advanced
- Number of Slices: 30
- F of S Tolerance: 0.001
- Minimum Slip Surface Depth: 0.1 ft
- Optimization Maximum Iterations: 2,000
- 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

Bedroack / Retaining wall
Model: Bedrock (Impenetrable)

Clean Silty Sand FILL (Drained)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Sandy Lean Clay FILL (Drained)
Model: Mohr-Coulomb
Unit Weight: 123.6 pcf
Cohesion': 0 psf
Phi': 26 °
Phi-B: 0 °

Clayey Sand FILL (Drained)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33.2 °
Phi-B: 0 °

Clayey SAND (Drained)
Model: Mohr-Coulomb
Unit Weight: 120 pcf

Cohesion': 0 psf
Phi': 29 °
Phi-B: 0 °

Sandy Lean CLAY (Drained)

Model: Mohr-Coulomb
Unit Weight: 119.5 pcf
Cohesion': 0 psf
Phi': 23 °
Phi-B: 0 °

Poorly Graded SAND (Drained)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33 °
Phi-B: 0 °

Silty GRAVEL (Drained)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 38 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0, 189.7132) ft
Left-Zone Right Coordinate: (12.37918, 188.69924) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (16.57695, 186.52099) ft
Right-Zone Right Coordinate: (57.37217, 180.88753) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (-20, 185) ft
Right Coordinate: (129, 191.7632) ft

Points

	X (ft)	Y (ft)
Point 1	-9	185
Point 2	-4	185.2032
Point 3	0	189.7132
Point 4	8	190.2232
Point 5	13	188.4832
Point 6	20	184.6432

Point 7	27	183.7332
Point 8	27.5	183.7332
Point 9	27.5	176.6532
Point 10	41	176.3832
Point 11	52	176.6032
Point 12	60	182.9832
Point 13	76	183.8732
Point 14	85	187.6232
Point 15	93	191.4732
Point 16	103	190.9632
Point 17	116	190.9232
Point 18	123	193.1432
Point 19	127	193.2132
Point 20	129	191.7632
Point 21	129	167.2
Point 22	69.2904	183.5
Point 23	129	183.5
Point 24	53.7514	178
Point 25	129	178
Point 26	-20	176
Point 27	129	176
Point 28	-20	175
Point 29	129	175
Point 30	-20	172
Point 31	129	172
Point 32	-20	169.2
Point 33	129	169.2
Point 34	-20	167.2
Point 35	12.1593	185.5
Point 36	19.1894	181.6765
Point 37	15.8366	183.5
Point 38	27	180.4734
Point 39	27	178
Point 40	-20	178
Point 41	27	176.6532
Point 42	-3.7368	185.5
Point 43	-20	183.5
Point 44	-20	185
Point 45	-2.40641	187

Regions

	Material	Points	Area (ft²)
Region 1	Bedroack / Retaining wall	41,9,8,7,38,39	3.54
Region 2	Clean Silty Sand FILL (Drained)	38,36,37,35,42,45,3,4,5,6,7	109.15
Region 3	Clayey SAND (Drained)	39,40,26,27,25,24,11,10,9,41	259.52
Region 4	Sandy Lean CLAY (Drained)	26,28,29,27	149
Region 5	Poorly Graded SAND (Drained)	30,31,29,28	447

Region 6	Silty GRAVEL (Drained)	32,33,31,30	417.2
Region 7	Bedroack / Retaining wall	34,21,33,32	298
Region 8	Clayey Sand FILL (Drained)	24,12,22,23,25	392.67
Region 9	Sandy Lean Clay FILL (Drained)	22,13,14,15,16,17,18,19,20,23	360.24
Region 10	Clayey Sand FILL (Drained)	40,43,37,36,38,39	236.5
Region 11	Sandy Lean Clay FILL (Drained)	43,44,1,2,42,35,37	60.465

Current Slip Surface

Slip Surface: 126
F of S: 1.252
Volume: 0.75755386 ft³
Weight: 87.118694 lbs
Resisting Moment: 2,016.0137 lbs-ft
Activating Moment: 1,610.1784 lbs-ft
Resisting Force: 45.542646 lbs
Activating Force: 36.374617 lbs
F of S Rank: 1
Exit: (19.931903, 184.68056) ft
Entry: (12.379182, 188.69924) ft
Radius: 4.7996053 ft
Center: (32.383403, 222.11589) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	12.511996	188.63504	-180.43729	1.6825784	1.1349135	0
Slice 2	12.822405	188.46705	-173.40497	6.6880868	4.5111715	0
Slice 3	13.053515	188.332	-167.8306	10.453782	7.0511647	0
Slice 4	13.25708	188.21014	-163.11697	11.150522	7.5211219	0
Slice 5	13.55718	188.02894	-156.08664	12.549314	8.464619	0
Slice 6	13.814415	187.87596	-150.19969	13.794202	9.3043064	0
Slice 7	13.93568	187.80575	-147.53528	14.4329	9.7351137	0
Slice 8	14.10681	187.71172	-144.06391	14.520545	9.7942313	0
Slice 9	14.42091	187.53929	-137.70144	14.531036	9.8013073	0
Slice 10	14.70526	187.38573	-132.08407	14.561411	9.821796	0
Slice 11	14.94267	187.26155	-127.62004	14.1757	9.5616302	0
Slice 12	15.16289	187.1479	-123.5634	13.524774	9.1225754	0

Slice 13	15.373345	187.04148	-119.80634	12.948715	8.7340185	0
Slice 14	15.574035	186.9423	-116.34809	11.938616	8.0526981	0
Slice 15	15.73626	186.86176	-113.53025	11.09867	7.4861477	0
Slice 16	15.940695	186.7561	-109.74517	10.282225	6.9354482	0
Slice 17	16.199135	186.62515	-105.10158	9.6281356	6.4942594	0
Slice 18	16.45652	186.48876	-100.14394	8.5590397	5.7731452	0
Slice 19	16.708905	186.34271	-94.433677	9.0128447	6.0792405	0
Slice 20	16.930675	186.21094	-89.20734	9.8735949	6.6598238	0
Slice 21	17.172939	186.07848	-84.132839	10.589971	7.1430255	0
Slice 22	17.435698	185.94535	-79.215985	9.5814022	6.4627374	0
Slice 23	17.698456	185.81221	-74.303448	8.5728336	5.7824493	0
Slice 24	17.961214	185.67907	-69.395233	7.5642649	5.1021611	0
Slice 25	18.223973	185.54594	-64.491341	6.5556963	4.421873	0
Slice 26	18.486731	185.4128	-59.591776	5.5471276	3.7415848	0
Slice 27	18.74949	185.27967	-54.696539	4.5385589	3.0612967	0
Slice 28	19.012248	185.14653	-49.805634	3.5299903	2.3810085	0
Slice 29	19.275007	185.0134	-44.919064	2.5214216	1.7007204	0
Slice 30	19.537765	184.88026	-40.03683	1.512853	1.0204322	0
Slice 31	19.800523	184.74712	-35.158937	0.50428433	0.34014407	0

BOB2 - Drained Normalpool

File Information

Title: Borit Resevior Investigation
Created By: McCafferty, Conor M NAP
Last Edited By: McCafferty, Conor M NAP
Revision Number: 96
File Version: 8.0
Tool Version: 8.0.10.6504
Date: 8/21/2013
Time: 11:04:25 AM
File Name: BOB-2 Current.gsz
Directory: I:\IIS\Superfund\Borit Reservoir Investigation 2013\Borit report\Final GeoStudio Runs\Current\
Last Solved Date: 8/21/2013
Last Solved Time: 11:04:30 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

BOB2 - Drained Normalpool

Kind: SLOPE/W
Parent: BOB2 - SEEP_Drained Normalpool
Method: Spencer
Settings
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6
  - Lambda 10: 0.8
  - Lambda 11: 1
- PWP Conditions Source: Parent Analysis

Slip Surface
- 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: Yes
- Tension Crack
  - Tension Crack Option: (none)

F of S Distribution
- F of S Calculation Option: Constant

Advanced
- Number of Slices: 30
- F of S Tolerance: 0.1
- Minimum Slip Surface Depth: 0.1 ft
- Optimization Maximum Iterations: 2,000
- 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

Bedrock
Model: Bedrock (Impenetrable)

Clean Silty Sand FILL (Drained)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Sandy SILT (Drained)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 22 °
Phi-B: 0 °

Poorly Graded SAND (Drained)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33 °
Phi-B: 0 °

Dense Silty SAND (Drained)
Model: Mohr-Coulomb
Unit Weight: 125 pcf

Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Loose Silty SAND (Drained)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 29 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (16.32529, 192.02177) ft
Left-Zone Right Coordinate: (38.5578, 188) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (54.91958, 180.3018) ft
Right-Zone Right Coordinate: (77, 175.82787) ft
Right-Zone Increment: 4
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, 176) ft
Right Coordinate: (187, 176) ft

Points

	X (ft)	Y (ft)
Point 1	0	176
Point 2	16.01	192.01
Point 3	30.01	192.5325
Point 4	47.01	183.6425
Point 5	65.01	176.04
Point 6	78.01	175.81
Point 7	87.2654	174.5
Point 8	101.01	174.16
Point 9	104.01	175
Point 10	126.01	175.43
Point 11	141.01	172.68
Point 12	160.01	171.91
Point 13	181.01	172.8225
Point 14	185.9475	177.1625
Point 15	27.3291	165.90625
Point 16	0	166.125
Point 17	187	165.90625
Point 18	0	171

Point 19	187	171
Point 20	184.7658	176
Point 21	187	176
Point 22	12	188
Point 23	38.5578	188
Point 24	0	159
Point 25	187	158
Point 26	8	184
Point 27	46.2069	184
Point 28	183.0376	174.5
Point 29	35.5578	188
Point 30	43.2069	184
Point 31	62.01	176.04
Point 32	10	186
Point 33	54.613	180.3952

Regions

	Material	Points	Area (ft²)
Region 1	Sandy SILT (Drained)	1,5,6,7,8,9,10,11,12,13,20,21,19,18	701.18
Region 2	Poorly Graded SAND (Drained)	16,18,19,17,15	949.54
Region 3	Bedrock	24,25,17,15,16	1,388
Region 4		20,14,21	1.2986
Region 5	Clean Silty Sand FILL (Drained)	22,2,3,23,27,4,5,31,30,29	122.92
Region 6	Dense Silty SAND (Drained)	26,32,22,29,30	117.53
Region 7	Loose Silty SAND (Drained)	1,26,30,31	388

Current Slip Surface

Slip Surface: 276
F of S: 0.513
Volume: 26.144704 ft³
Weight: 3,006.641 lbs
Resisting Moment: 29,725.052 lbs-ft
Activating Moment: 58,002.426 lbs-ft
Resisting Force: 520.72325 lbs
Activating Force: 1,015.8764 lbs
F of S Rank: 1
Exit: (65.031072, 176.03963) ft
Entry: (38.551183, 188.00351) ft
Radius: 15.554776 ft
Center: (71.602934, 226.09065) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	38.554491	188.0017	-306.23378	0.0035035631	0.0023631831	0

Slice 2	39.039277	187.7374	-293.61334	0.76626448	0.51685192	0
Slice 3	40.002232	187.21239	-268.54888	2.2847792	1.541103	0
Slice 4	40.947402	186.68118	-243.00265	4.7720875	3.2188137	0
Slice 5	41.874785	186.14379	-216.97097	8.3874526	5.6574082	0
Slice 6	42.802168	185.6064	-190.69694	12.002818	8.0960028	0
Slice 7	43.747108	185.01423	-160.83577	17.521274	11.818249	0
Slice 8	44.709605	184.3673	-127.73696	26.769143	18.056015	0
Slice 9	45.672102	183.72037	-94.52298	36.017012	24.293781	0
Slice 10	46.180125	183.3792	-76.955954	41.200273	27.789935	0
Slice 11	46.6023	183.10004	-62.588904	46.985716	31.692266	0
Slice 12	47.00385	182.83402	-49.056894	49.708085	33.528527	0
Slice 13	47.30057	182.61342	-38.184903	55.537665	37.460628	0
Slice 14	47.914604	182.13376	-14.495747	65.834321	44.40581	0
Slice 15	48.291609	181.8265	0.68073646	81.535951	44.818778	0
Slice 16	48.790055	181.57631	11.460256	108.72693	53.9158	0
Slice 17	49.679865	181.1632	28.697942	116.63507	48.744345	0
Slice 18	50.62345	180.71992	47.336714	124.92653	43.008739	0
Slice 19	51.62081	180.24646	64.269619	133.99962	38.651968	0
Slice 20	52.591708	179.78906	80.199997	142.75319	34.673801	0
Slice 21	53.536145	179.34773	95.497464	150.53671	30.508752	0
Slice 22	54.480582	178.9064	110.76235	158.31089	26.356587	0
Slice 23	55.428155	178.47301	121.76541	164.83586	23.874343	0
Slice 24	56.378865	178.04757	132.25705	169.68229	20.745147	0
Slice 25	57.329575	177.62214	142.781	174.53764	17.602995	0
Slice 26	58.23116	177.24765	150.97138	178.04627	15.007856	0
Slice 27	59.08362	176.92409	150.84547	174.89304	13.329785	0

Slice 28	60.09369	176.57423	148.65849	169.05046	11.303455	0
Slice 29	61.302265	176.2166	142.33217	154.86252	6.9456879	0
Slice 30	61.960169	176.04706	137.35951	147.88841	5.8362642	0
Slice 31	62.404734	176.04701	117.89739	126.28103	5.6548368	0
Slice 32	63.227524	176.04693	80.433592	86.153195	3.8579211	0
Slice 33	64.050315	176.04684	42.969792	46.025358	2.0610054	0
Slice 34	64.735855	176.04335	12.124734	12.964365	0.56633829	0
Slice 35	65.020536	176.03976	0.0018235075	0.0063039538	0.0018102178	0

BOB2 - Drained Highpool

File Information

Title: Borit Resevior Investigation
Created By: McCafferty, Conor M NAP
Last Edited By: McCafferty, Conor M NAP
Revision Number: 96
File Version: 8.0
Tool Version: 8.0.10.6504
Date: 8/21/2013
Time: 11:04:25 AM
File Name: BOB-2 Current.gsz
Directory: I:\IIS\Superfund\Borit Reservoir Investigation 2013\Borit report\Final GeoStudio Runs\Current\
Last Solved Date: 8/21/2013
Last Solved Time: 11:04:28 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

BOB2 - Drained Highpool

Kind: SLOPE/W
Parent: BOB2 - SEEP_Drained Highpool
Method: Spencer
Settings
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6
  - Lambda 10: 0.8
  - Lambda 11: 1
- PWP Conditions Source: Parent Analysis

Slip Surface
- 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: Yes
- Tension Crack
  - Tension Crack Option: (none)

F of S Distribution
- F of S Calculation Option: Constant

Advanced
- Number of Slices: 30
- F of S Tolerance: 0.1
- Minimum Slip Surface Depth: 0.1 ft
- Optimization Maximum Iterations: 2,000
- 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

Bedrock
Model: Bedrock (Impenetrable)

Clean Silty Sand FILL (Drained)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Sandy SILT (Drained)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 22 °
Phi-B: 0 °

Poorly Graded SAND (Drained)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33 °
Phi-B: 0 °

Dense Silty SAND (Drained)
Model: Mohr-Coulomb
Unit Weight: 125 pcf

Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Loose Silty SAND (Drained)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 29 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (15.50483, 191.50483) ft
Left-Zone Right Coordinate: (40.47008, 187) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (54.72742, 180.38296) ft
Right-Zone Right Coordinate: (79, 175.66988) ft
Right-Zone Increment: 4
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, 176) ft
Right Coordinate: (187, 176) ft

Points

	X (ft)	Y (ft)
Point 1	0	176
Point 2	16.01	192.01
Point 3	30.01	192.5325
Point 4	47.01	183.6425
Point 5	65.01	176.04
Point 6	78.01	175.81
Point 7	87.2654	174.5
Point 8	101.01	174.16
Point 9	104.01	175
Point 10	126.01	175.43
Point 11	141.01	172.68
Point 12	160.01	171.91
Point 13	181.01	172.8225
Point 14	185.9475	177.1625
Point 15	27.3291	165.90625
Point 16	0	166.125
Point 17	187	165.90625
Point 18	0	171

Point 19	187	171
Point 20	184.7658	176
Point 21	187	176
Point 22	12	188
Point 23	38.5578	188
Point 24	0	159
Point 25	187	158
Point 26	8	184
Point 27	46.2069	184
Point 28	183.0376	174.5
Point 29	35.5578	188
Point 30	43.2069	184
Point 31	62.01	176.04
Point 32	10	186
Point 33	54.613	180.3952

Regions

	Material	Points	Area (ft²)
Region 1	Sandy SILT (Drained)	1,5,6,7,8,9,10,11,12,13,20,21,19,18	701.18
Region 2	Poorly Graded SAND (Drained)	16,18,19,17,15	949.54
Region 3	Bedrock	24,25,17,15,16	1,388
Region 4		20,14,21	1.2986
Region 5	Clean Silty Sand FILL (Drained)	22,2,3,23,27,4,5,31,30,29	122.92
Region 6	Dense Silty SAND (Drained)	26,32,22,29,30	117.53
Region 7	Loose Silty SAND (Drained)	1,26,30,31	388

Current Slip Surface

Slip Surface: 276
F of S: 0.140
Volume: 16.568307 ft³
Weight: 1,905.3553 lbs
Resisting Moment: 4,874.2314 lbs-ft
Activating Moment: 34,856.19 lbs-ft
Resisting Force: 94.447901 lbs
Activating Force: 674.82341 lbs
F of S Rank: 1
Exit: (65.06813, 176.03897) ft
Entry: (40.41971, 187.02634) ft
Radius: 14.210574 ft
Center: (71.049393, 223.09793) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	40.886323	186.77882	-180.45405	0.1125376	0.075907572	0

Slice 2	41.819548	186.28379	-161.06759	0.33761281	0.22772272	0
Slice 3	42.699468	185.822	-142.40051	0.39507733	0.26648303	0
Slice 4	43.526085	185.39346	-124.00964	0.27400107	0.18481606	0
Slice 5	44.352702	184.96492	-105.62234	0.15292481	0.10314909	0
Slice 6	45.126233	184.54453	-87.278304	0.63428585	0.42783121	0
Slice 7	45.846677	184.13229	-68.941834	1.7275712	1.1652615	0
Slice 8	46.60845	183.6964	-49.127691	3.8457516	2.5939922	0
Slice 9	47.17099	183.37452	-34.864409	6.1603663	4.1552195	0
Slice 10	47.88399	182.97047	-19.116668	9.3939262	6.3362832	0
Slice 11	48.74133	182.49643	-0.8782814	13.301931	8.972266	0
Slice 12	49.531175	182.06949	15.346337	27.551438	8.2324448	0
Slice 13	50.500205	181.53984	35.596834	46.535548	7.378256	0
Slice 14	51.418847	181.03229	49.505199	60.632695	7.5055906	0
Slice 15	52.2871	180.54683	63.240664	74.684752	7.7191348	0
Slice 16	53.155353	180.06139	78.523672	89.902742	7.6752796	0
Slice 17	54.1207	179.48457	100.46429	111.31989	7.3221911	0
Slice 18	55.194335	178.92287	118.18348	130.77658	6.9804691	0
Slice 19	56.084507	178.54739	124.4359	134.90152	5.801188	0
Slice 20	56.78002	178.25167	129.46524	138.34211	4.9205272	0
Slice 21	57.475533	177.95594	134.49485	141.78287	4.0398178	0
Slice 22	58.29186	177.60728	140.2057	145.76662	3.0824658	0
Slice 23	59.127792	177.2524	140.60492	146.07957	3.0346482	0
Slice 24	59.862518	176.94423	140.72836	146.07327	2.9627318	0
Slice 25	60.63073	176.6212	140.90635	146.13927	2.9006539	0
Slice 26	61.43243	176.28333	141.1389	146.26413	2.8409599	0
Slice 27	62.3118	176.09433	121.02802	123.47279	1.6490203	0

Slice 28	63.158891	176.06855	84.004089	85.633205	1.0988527	0
Slice 29	63.896033	176.05713	50.557978	51.538464	0.66134604	0
Slice 30	64.637302	176.04565	16.924592	17.252816	0.22138963	0
Slice 31	65.039065	176.03942	-1.0040966	0.0051415966	0.0020773399	0

Drained Normalpool

File Information

Title: BoRit Reservior Investigation - BOB3
Created By: McCafferty, Conor M NAP
Last Edited By: Fatzinger, Travis T NAP
Revision Number: 111
File Version: 8.0
Tool Version: 8.0.10.6504
Date: 8/21/2013
Time: 11:16:38 AM
File Name: BOB-3 Current.gsz
Directory: I:\IIS\Superfund\Borit Reservoir Investigation 2013\Borit report\Final GeoStudio Runs\Current\
Last Solved Date: 8/21/2013
Last Solved Time: 11:16:42 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

Drained Normalpool

Kind: SLOPE/W
Parent: BOB3 - SEEP_Drained Normalpool
Method: Spencer
Settings
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6
  - Lambda 10: 0.8
  - Lambda 11: 1
- PWP Conditions Source: Parent Analysis

Slip Surface
- 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: Yes
- Tension Crack
  - Tension Crack Option: (none)

F of S Distribution
- F of S Calculation Option: Constant

Advanced
- Number of Slices: 30
- F of S Tolerance: 0.001
- Minimum Slip Surface Depth: 0.1 ft
- Optimization Maximum Iterations: 2,000
- 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

Bedrock
Model: Bedrock (Impenetrable)

Silty CLAY with Sand (Fill-Drained)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33 °
Phi-B: 0 °

Clean Silty Sand FILL (Drained)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

SILT with Sand (Drained)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Clayey SAND (Drained)
Model: Mohr-Coulomb
Unit Weight: 125 pcf

Cohesion': 0 psf
Phi': 36 °
Phi-B: 0 °

Silty GRAVEL (Drained)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 38 °
Phi-B: 0 °

Silty Sand FILL (Drained)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33 °
Phi-B: 0 °

SILT with Sand (Drained) (0)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (19.82965, 191.82965) ft
Left-Zone Right Coordinate: (40, 186.63151) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (54, 179.99203) ft
Right-Zone Right Coordinate: (78, 174.89333) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (5, 177) ft
Right Coordinate: (192.0544, 181.6779) ft

Points

	X (ft)	Y (ft)
Point 1	5	172
Point 2	19.83	191.83
Point 3	29.4911	191.92
Point 4	46.2227	183.5
Point 5	64.4911	175.26
Point 6	78.4911	174.88

Point 7	98.6163	172.5709
Point 8	111.4911	172.28
Point 9	115.4911	170.75
Point 10	129.4911	170.75
Point 11	134.4911	173.6
Point 12	149.4911	173.35
Point 13	157.4911	170.04
Point 14	176.4911	167.91
Point 15	181.663	168.7856
Point 16	189.9825	181.6779
Point 17	192.0544	181.6779
Point 18	192.0544	161.7
Point 19	5	161
Point 20	15.5	187.5
Point 21	31.3206	187.5
Point 22	10	182
Point 23	42.2474	182
Point 24	5	177
Point 25	53.1743	176.5
Point 26	5	167
Point 27	192.0544	167.5532
Point 28	5	163
Point 29	192.0544	163
Point 30	55.4963	175.3312
Point 31	186.6411	176.5
Point 32	192.0544	176.5
Point 33	5	140
Point 34	192.0544	140.7
Point 35	13.46074	185.46074

Regions

	Material	Points	Area (ft²)
Region 1	Clean Silty Sand FILL (Drained)	20,2,3,4,5,30,25,23,21	163.69
Region 2	Silty Sand FILL (Drained)	22,35,20,21,23	132.19
Region 3	Silty CLAY with Sand (Fill-Drained)	22,23,25,24	210.37
Region 4	Clayey SAND (Drained)	28,26,27,29	799.96
Region 5	Silty GRAVEL (Drained)	19,28,29,18	308.64
Region 6	Silty CLAY with Sand (Fill-Drained)	31,16,17,32	19.379
Region 7	Bedrock	33,19,18,34	3,928.1
Region 8	SILT with Sand (Drained) (0)	7,8,9,10,11,12,13,14,15,31,32,27,26,1	868.05
Region 9	SILT with Sand (Drained)	24,25,30,5,6,7,1	318.55

Current Slip Surface

Slip Surface: 126
F of S: 1.343
Volume: 3.7871897 ft³

Weight: 435.52681 lbs
Resisting Moment: 55,047.361 lbs-ft
Activating Moment: 40,982.716 lbs-ft
Resisting Force: 234.59847 lbs
Activating Force: 174.65827 lbs
F of S Rank: 1
Exit: (46.374547, 183.43151) ft
Entry: (29.485717, 191.91995) ft
Radius: 10.365273 ft
Center: (133.64666, 373.84309) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	29.488409	191.91821	-724.59427	0.14490392	0.097738929	0
Slice 2	29.665575	191.80337	-718.41869	2.3609126	1.5924556	0
Slice 3	30.129237	191.52771	-703.8061	6.2251433	4.1989122	0
Slice 4	30.70761	191.2026	-686.7473	9.2047317	6.2086699	0
Slice 5	31.285983	190.87748	-669.70267	12.18432	8.2184276	0
Slice 6	31.82173	190.57877	-654.07951	14.847176	10.014547	0
Slice 7	32.31485	190.30646	-639.87611	16.976994	11.451127	0
Slice 8	32.850991	190.01323	-624.84983	19.192382	12.945425	0
Slice 9	33.430154	189.69909	-609.77455	21.208582	14.305369	0
Slice 10	34.009316	189.38494	-594.7038	23.224782	15.665313	0
Slice 11	34.588479	189.0708	-579.63756	25.240982	17.025257	0
Slice 12	35.202423	188.74615	-564.16802	27.198551	18.345654	0
Slice 13	35.85115	188.411	-548.29323	27.9871	18.877537	0
Slice 14	36.499877	188.07585	-532.56732	28.775649	19.40942	0
Slice 15	37.103747	187.76544	-518.09398	29.50305	19.900059	0
Slice 16	37.662762	187.47977	-504.79541	29.899366	20.167377	0
Slice 17	38.221778	187.19411	-491.4968	30.295681	20.434695	0
Slice 18	38.780792	186.90844	-478.19814	30.691996	20.702013	0
Slice 19	39.354951	186.62708	-465.25148	31.0448	20.939982	0

Slice 20	39.944253	186.35002	-452.6355	29.205189	19.699148	0
Slice 21	40.533555	186.07296	-440.01549	27.365578	18.458315	0
Slice 22	41.122857	185.79589	-427.39524	25.525967	17.217482	0
Slice 23	41.712159	185.51883	-414.77475	23.686356	15.976649	0
Slice 24	42.329628	185.22817	-401.52956	21.772099	14.685466	0
Slice 25	42.975262	184.9239	-387.65727	19.826205	13.372944	0
Slice 26	43.607927	184.62989	-374.30072	17.730208	11.959176	0
Slice 27	44.22762	184.34614	-361.46951	15.051015	10.152038	0
Slice 28	44.847313	184.06239	-348.63968	12.371823	8.3448996	0
Slice 29	45.423545	183.81351	-337.59807	8.8807803	5.9901619	0
Slice 30	45.956315	183.5995	-328.34535	3.4608983	2.3344054	0
Slice 31	46.298624	183.46201	-322.37853	0.37547868	0.25326357	0

Drained Highpool

File Information

Title: BoRit Reservior Investigation - BOB3
Created By: McCafferty, Conor M NAP
Last Edited By: Fatzinger, Travis T NAP
Revision Number: 111
File Version: 8.0
Tool Version: 8.0.10.6504
Date: 8/21/2013
Time: 11:16:38 AM
File Name: BOB-3 Current.gsz
Directory: I:\IIS\Superfund\Borit Reservoir Investigation 2013\Borit report\Final GeoStudio Runs\Current\
Last Solved Date: 8/21/2013
Last Solved Time: 11:16:50 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

Drained Highpool

Kind: SLOPE/W
Parent: BOB3 - SEEP_Drained Highpool
Method: Spencer
Settings
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6
  - Lambda 10: 0.8
  - Lambda 11: 1
- PWP Conditions Source: Parent Analysis

Slip Surface
- 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: Yes
- Tension Crack
  - Tension Crack Option: (none)

F of S Distribution
- F of S Calculation Option: Constant

Advanced
- Number of Slices: 30
- F of S Tolerance: 0.001
- Minimum Slip Surface Depth: 0.1 ft
- Optimization Maximum Iterations: 2,000
- 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

Bedrock
Model: Bedrock (Impenetrable)

Silty CLAY with Sand (Fill-Drained)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33 °
Phi-B: 0 °

Clean Silty Sand FILL (Drained)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

SILT with Sand (Drained)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Clayey SAND (Drained)
Model: Mohr-Coulomb
Unit Weight: 125 pcf

Cohesion': 0 psf
Phi': 36 °
Phi-B: 0 °

Silty GRAVEL (Drained)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 38 °
Phi-B: 0 °

Silty Sand FILL (Drained)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33 °
Phi-B: 0 °

SILT with Sand (Drained) (0)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (19.415, 191.415) ft
Left-Zone Right Coordinate: (40, 186.63151) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (55.24025, 179.43261) ft
Right-Zone Right Coordinate: (78, 174.89333) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (5, 177) ft
Right Coordinate: (192.0544, 181.6779) ft

Points

	X (ft)	Y (ft)
Point 1	5	172
Point 2	19.83	191.83
Point 3	29.4911	191.92
Point 4	46.2227	183.5
Point 5	64.4911	175.26
Point 6	78.4911	174.88

Point 7	98.6163	172.5709
Point 8	111.4911	172.28
Point 9	115.4911	170.75
Point 10	129.4911	170.75
Point 11	134.4911	173.6
Point 12	149.4911	173.35
Point 13	157.4911	170.04
Point 14	176.4911	167.91
Point 15	181.663	168.7856
Point 16	189.9825	181.6779
Point 17	192.0544	181.6779
Point 18	192.0544	161.7
Point 19	5	161
Point 20	15.5	187.5
Point 21	31.3206	187.5
Point 22	10	182
Point 23	42.2474	182
Point 24	5	177
Point 25	53.1743	176.5
Point 26	5	167
Point 27	192.0544	167.5532
Point 28	5	163
Point 29	192.0544	163
Point 30	55.4963	175.3312
Point 31	186.6411	176.5
Point 32	192.0544	176.5
Point 33	5	140
Point 34	192.0544	140.7
Point 35	13.46074	185.46074

Regions

	Material	Points	Area (ft²)
Region 1	Clean Silty Sand FILL (Drained)	20,2,3,4,5,30,25,23,21	163.69
Region 2	Silty Sand FILL (Drained)	22,35,20,21,23	132.19
Region 3	Silty CLAY with Sand (Fill-Drained)	22,23,25,24	210.37
Region 4	Clayey SAND (Drained)	28,26,27,29	799.96
Region 5	Silty GRAVEL (Drained)	19,28,29,18	308.64
Region 6	Silty CLAY with Sand (Fill-Drained)	31,16,17,32	19.379
Region 7	Bedrock	33,19,18,34	3,928.1
Region 8	SILT with Sand (Drained) (0)	7,8,9,10,11,12,13,14,15,31,32,27,26,1	868.05
Region 9	SILT with Sand (Drained)	24,25,30,5,6,7,1	318.55

Current Slip Surface

Slip Surface: 126
F of S: 1.172
Volume: 78.6926 ft³

Weight: 9,085.655 lbs
Resisting Moment: 97,740.694 lbs-ft
Activating Moment: 83,417.291 lbs-ft
Resisting Force: 3,601.0219 lbs
Activating Force: 3,073.5213 lbs
F of S Rank: 1
Exit: (66.008279, 175.21882) ft
Entry: (36.241962, 188.5227) ft
Radius: 18.252432 ft
Center: (60.870389, 198.7668) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	36.634119	188.18864	-329.46788	9.8127595	6.6187898	0
Slice 2	37.418433	187.52052	-301.40227	29.438278	19.85637	0
Slice 3	38.188708	186.84751	-272.87038	48.595486	32.778069	0
Slice 4	38.944943	186.16962	-243.87171	69.369896	46.790586	0
Slice 5	39.82169	185.37165	-209.54544	92.957226	62.700441	0
Slice 6	40.81895	184.4536	-169.91659	121.62346	82.036063	0
Slice 7	41.809228	183.55952	-131.56194	152.07106	102.57323	0
Slice 8	42.792525	182.68942	-94.474431	178.47255	120.38126	0
Slice 9	43.775822	181.81932	-57.347224	204.87404	138.18929	0
Slice 10	44.84065	180.89523	-18.116106	236.6888	159.64861	0
Slice 11	45.476285	180.35291	4.8187433	254.97816	162.45542	0
Slice 12	45.88072	180.04605	17.348843	283.07512	172.56467	0
Slice 13	46.553435	179.54724	37.79757	299.9047	170.21436	0
Slice 14	47.339718	179.03657	57.56259	346.99609	187.96031	0
Slice 15	48.250815	178.5057	76.994282	359.02941	183.15575	0
Slice 16	49.161912	177.97483	96.484653	371.06704	178.31589	0
Slice 17	50.25639	177.40098	116.44967	403.72323	186.55763	0
Slice 18	51.618353	176.80061	134.75663	423.87258	187.75409	0
Slice 19	52.692603	176.36682	142.55512	418.37482	172.35127	0

Slice 20	53.10906	176.20436	142.1869	441.12252	186.79571	0
Slice 21	53.596983	176.05004	147.08527	433.48617	178.96315	0
Slice 22	54.442348	175.78265	158.98231	420.10494	163.16753	0
Slice 23	55.337995	175.49936	168.60284	407.30689	161.00792	0
Slice 24	55.884466	175.33865	171.00156	450.77397	188.70888	0
Slice 25	56.40196	175.26046	165.77871	429.34009	164.69143	0
Slice 26	57.289933	175.12628	156.46604	398.29756	151.1131	0
Slice 27	58.348552	174.99816	145.39248	372.37534	141.83463	0
Slice 28	59.577818	174.87611	132.65304	318.68101	116.24318	0
Slice 29	60.613907	174.79694	110.62985	285.6796	109.38323	0
Slice 30	61.45682	174.76067	91.386002	242.38278	94.35326	0
Slice 31	62.299733	174.7244	72.404908	199.02436	79.120611	0
Slice 32	63.397965	174.74313	45.749052	146.71486	63.090443	0
Slice 33	64.28292	174.82724	24.901482	94.696633	43.612851	0
Slice 34	64.870395	174.96057	15.989745	51.081192	21.92757	0
Slice 35	65.628984	175.13274	5.1381474	17.138504	7.4986553	0

Drained - Normalpool

File Information

Title: BoRit Geotechnical Investigation - BOB1
Created By: McCafferty, Conor M NAP
Last Edited By: Fatzinger, Travis T NAP
Revision Number: 30
File Version: 8.0
Tool Version: 8.0.10.6504
Date: 8/21/2013
Time: 7:14:58 PM
File Name: BOB-1 Proposed.gsz
Directory: I:\IIS\Superfund\Borit Reservoir Investigation 2013\Borit report\Final GeoStudio Runs\Proposed\
Last Solved Date: 8/21/2013
Last Solved Time: 7:15:02 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

Drained - Normalpool

Kind: SLOPE/W
Parent: BOB1 - SEEP_Drained Normalpool
Method: Spencer
Settings
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6
  - Lambda 10: 0.8
  - Lambda 11: 1
- PWP Conditions Source: Parent Analysis

Slip Surface
- 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: Yes
- Tension Crack
  - Tension Crack Option: (none)

F of S Distribution
- F of S Calculation Option: Constant

Advanced
- Number of Slices: 30
- F of S Tolerance: 0.001
- Minimum Slip Surface Depth: 0.1 ft
- Optimization Maximum Iterations: 2,000
- 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

Bedroack / Retaining wall
Model: Bedrock (Impenetrable)

Sandy Lean Clay FILL (Undrained)
Model: Mohr-Coulomb
Unit Weight: 123.6 pcf
Cohesion': 0 psf
Phi': 23 °
Phi-B: 0 °

Clayey Sand FILL (Undrained)
Model: Mohr-Coulomb
Unit Weight: 119 pcf
Cohesion': 345.6 psf
Phi': 22 °
Phi-B: 0 °

Clean Silty Sand FILL (Drained)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Sandy Lean Clay FILL (Drained)
Model: Mohr-Coulomb
Unit Weight: 123.6 pcf

Cohesion': 0 psf
Phi': 26 °
Phi-B: 0 °

Clayey Sand FILL (Drained)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33.2 °
Phi-B: 0 °

Clayey SAND (Drained)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 29 °
Phi-B: 0 °

Sandy Lean CLAY (Drained)

Model: Mohr-Coulomb
Unit Weight: 119.5 pcf
Cohesion': 0 psf
Phi': 23 °
Phi-B: 0 °

Poorly Graded SAND (Drained)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33 °
Phi-B: 0 °

Silty GRAVEL (Drained)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 38 °
Phi-B: 0 °

BACKFILL

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-10, 189.65076) ft
Left-Zone Right Coordinate: (8, 190.2232) ft
Left-Zone Increment: 4

Right Projection: Range
Right-Zone Left Coordinate: (15.49667, 187.1136) ft
Right-Zone Right Coordinate: (57.37217, 180.88753) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (-25, 181) ft
Right Coordinate: (129, 191.7632) ft

Points

	X (ft)	Y (ft)
Point 1	0	189.7132
Point 2	8	190.2232
Point 3	13	188.4832
Point 4	20	184.6432
Point 5	27	183.7332
Point 6	27.5	183.7332
Point 7	27.5	176.6532
Point 8	41	176.3832
Point 9	52	176.6032
Point 10	60	182.9832
Point 11	76	183.8732
Point 12	85	187.6232
Point 13	93	191.4732
Point 14	103	190.9632
Point 15	116	190.9232
Point 16	123	193.1432
Point 17	127	193.2132
Point 18	129	191.7632
Point 19	129	167.2
Point 20	69.2904	183.5
Point 21	129	183.5
Point 22	53.7514	178
Point 23	129	178
Point 24	-25	176
Point 25	129	176
Point 26	-25	175
Point 27	129	175
Point 28	-25	172
Point 29	129	172
Point 30	-25	169.2
Point 31	129	169.2
Point 32	-25	167.2
Point 33	12.1593	185.5
Point 34	19.1894	181.6765

Point 35	15.8366	183.5
Point 36	27	180.4734
Point 37	27	178
Point 38	-25	178
Point 39	27	176.6532
Point 40	-3.7368	185.5
Point 41	-2.40641	187
Point 42	-25	181
Point 43	-7	183
Point 44	-12	181
Point 45	-9.93877	189.68607

Regions

	Material	Points	Area (ft²)
Region 1	Bedroack / Retaining wall	39,7,6,5,36,37	3.54
Region 2	Clean Silty Sand FILL (Drained)	36,34,35,33,40,41,1,2,3,4,5	109.15
Region 3	Clayey SAND (Drained)	37,38,24,25,23,22,9,8,7,39	269.52
Region 4	Sandy Lean CLAY (Drained)	24,26,27,25	154
Region 5	Poorly Graded SAND (Drained)	28,29,27,26	462
Region 6	Silty GRAVEL (Drained)	30,31,29,28	431.2
Region 7	Bedroack / Retaining wall	32,19,31,30	308
Region 8	Clayey Sand FILL (Drained)	22,10,20,21,23	392.67
Region 9	Sandy Lean Clay FILL (Drained)	20,11,12,13,14,15,16,17,18,21	360.24
Region 10	Sandy Lean Clay FILL (Undrained)	43,40,33,35	43.626
Region 11	Clayey Sand FILL (Undrained)	43,44,42,38,37,36,34,35	218.29
Region 12	BACKFILL	1,45,42,44,43,40,41	111.58

Current Slip Surface

Slip Surface: 126
F of S: 1.323
Volume: 3.3479716 ft³
Weight: 385.01673 lbs
Resisting Moment: 14,037.684 lbs-ft
Activating Moment: 10,610.661 lbs-ft
Resisting Force: 206.09097 lbs
Activating Force: 155.77794 lbs
F of S Rank: 1
Exit: (19.9735, 184.65774) ft
Entry: (8, 190.2232) ft
Radius: 6.8972841 ft
Center: (35.004174, 244.73389) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	8.1503225	190.16974	-743.79017	0.11960466	0.080674364	0

Slice 2	8.4509675	190.06283	-737.32109	0.35881399	0.24202309	0
Slice 3	8.7680183	189.95067	-730.53583	0.55126525	0.3718331	0
Slice 4	9.101475	189.83327	-723.43438	0.69380616	0.46797816	0
Slice 5	9.4349317	189.71586	-716.33296	0.83634707	0.56412322	0
Slice 6	9.84488	189.55934	-706.84356	2.1861034	1.4745454	0
Slice 7	10.33132	189.36371	-694.9669	4.8241189	3.2539093	0
Slice 8	10.83374	189.14496	-681.66243	8.7168932	5.8796187	0
Slice 9	11.1973	188.97628	-671.38994	12.805057	8.6371203	0
Slice 10	11.4594	188.85429	-663.96041	15.565666	10.499174	0
Slice 11	11.77488	188.70577	-654.91542	19.217719	12.962515	0
Slice 12	12.22473	188.48551	-641.49205	24.621044	16.607104	0
Slice 13	12.75842	188.19926	-624.02143	31.753094	21.417732	0
Slice 14	13.067525	188.01981	-613.10064	36.786696	24.81294	0
Slice 15	13.365165	187.83686	-601.98944	37.2052	25.095224	0
Slice 16	13.825395	187.54938	-584.52386	40.126536	27.06569	0
Slice 17	14.25434	187.29185	-568.89292	43.704265	29.478899	0
Slice 18	14.676255	187.05269	-554.39643	44.733175	30.172908	0
Slice 19	15.122425	186.80194	-539.20085	45.257479	30.526555	0
Slice 20	15.53141	186.58086	-525.81486	46.703769	31.50209	0
Slice 21	15.90321	186.38943	-514.238	45.564199	30.73344	0
Slice 22	16.274145	186.2022	-502.9195	44.826923	30.236141	0
Slice 23	16.644215	186.01915	-491.88099	42.981497	28.991386	0
Slice 24	17.014285	185.8361	-480.85516	41.13607	27.74663	0
Slice 25	17.384355	185.65305	-469.82996	39.290644	26.501874	0
Slice 26	17.785868	185.46808	-458.71299	38.009202	25.63753	0
Slice 27	18.218825	185.28117	-447.50519	33.073926	22.308645	0

Slice 28	18.651782	185.09427	-436.29923	28.138651	18.97976	0
Slice 29	19.052467	184.94364	-427.31569	23.907977	16.126134	0
Slice 30	19.42088	184.82928	-420.55516	14.344786	9.6756803	0
Slice 31	19.789293	184.71492	-413.79729	4.7815953	3.2252268	0

Drained - Highpool

File Information

Title: BoRit Geotechnical Investigation - BOB1
Created By: McCafferty, Conor M NAP
Last Edited By: Fatzinger, Travis T NAP
Revision Number: 30
File Version: 8.0
Tool Version: 8.0.10.6504
Date: 8/21/2013
Time: 7:14:58 PM
File Name: BOB-1 Proposed.gsz
Directory: I:\IIS\Superfund\Borit Reservoir Investigation 2013\Borit report\Final GeoStudio Runs\Proposed\
Last Solved Date: 8/21/2013
Last Solved Time: 7:15:04 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

Drained - Highpool

Kind: SLOPE/W
Parent: BOB1 - SEEP_Drained Highpool
Method: Spencer
Settings
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6
  - Lambda 10: 0.8
  - Lambda 11: 1
- PWP Conditions Source: Parent Analysis

Slip Surface
- 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: Yes
- Tension Crack
  - Tension Crack Option: (none)

F of S Distribution
- F of S Calculation Option: Constant

Advanced
- Number of Slices: 30
- F of S Tolerance: 0.001
- Minimum Slip Surface Depth: 0.1 ft
- Optimization Maximum Iterations: 2,000
- 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

Bedroack / Retaining wall
Model: Bedrock (Impenetrable)

Sandy Lean Clay FILL (Undrained)
Model: Mohr-Coulomb
Unit Weight: 123.6 pcf
Cohesion': 0 psf
Phi': 23 °
Phi-B: 0 °

Clayey Sand FILL (Undrained)
Model: Mohr-Coulomb
Unit Weight: 119 pcf
Cohesion': 345.6 psf
Phi': 22 °
Phi-B: 0 °

Clean Silty Sand FILL (Drained)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Sandy Lean Clay FILL (Drained)
Model: Mohr-Coulomb
Unit Weight: 123.6 pcf

Cohesion': 0 psf
Phi': 26 °
Phi-B: 0 °

Clayey Sand FILL (Drained)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33.2 °
Phi-B: 0 °

Clayey SAND (Drained)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 29 °
Phi-B: 0 °

Sandy Lean CLAY (Drained)

Model: Mohr-Coulomb
Unit Weight: 119.5 pcf
Cohesion': 0 psf
Phi': 23 °
Phi-B: 0 °

Poorly Graded SAND (Drained)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33 °
Phi-B: 0 °

Silty GRAVEL (Drained)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 38 °
Phi-B: 0 °

BACKFILL

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-10, 189.65076) ft
Left-Zone Right Coordinate: (12.37918, 188.69924) ft
Left-Zone Increment: 4

Right Projection: Range
Right-Zone Left Coordinate: (16.57695, 186.52099) ft
Right-Zone Right Coordinate: (57.37217, 180.88753) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (-25, 181) ft
Right Coordinate: (129, 191.7632) ft

Points

	X (ft)	Y (ft)
Point 1	0	189.7132
Point 2	8	190.2232
Point 3	13	188.4832
Point 4	20	184.6432
Point 5	27	183.7332
Point 6	27.5	183.7332
Point 7	27.5	176.6532
Point 8	41	176.3832
Point 9	52	176.6032
Point 10	60	182.9832
Point 11	76	183.8732
Point 12	85	187.6232
Point 13	93	191.4732
Point 14	103	190.9632
Point 15	116	190.9232
Point 16	123	193.1432
Point 17	127	193.2132
Point 18	129	191.7632
Point 19	129	167.2
Point 20	69.2904	183.5
Point 21	129	183.5
Point 22	53.7514	178
Point 23	129	178
Point 24	-25	176
Point 25	129	176
Point 26	-25	175
Point 27	129	175
Point 28	-25	172
Point 29	129	172
Point 30	-25	169.2
Point 31	129	169.2
Point 32	-25	167.2
Point 33	12.1593	185.5
Point 34	19.1894	181.6765

Point 35	15.8366	183.5
Point 36	27	180.4734
Point 37	27	178
Point 38	-25	178
Point 39	27	176.6532
Point 40	-3.7368	185.5
Point 41	-2.40641	187
Point 42	-25	181
Point 43	-7	183
Point 44	-12	181
Point 45	-9.93877	189.68607

Regions

	Material	Points	Area (ft²)
Region 1	Bedroack / Retaining wall	39,7,6,5,36,37	3.54
Region 2	Clean Silty Sand FILL (Drained)	36,34,35,33,40,41,1,2,3,4,5	109.15
Region 3	Clayey SAND (Drained)	37,38,24,25,23,22,9,8,7,39	269.52
Region 4	Sandy Lean CLAY (Drained)	24,26,27,25	154
Region 5	Poorly Graded SAND (Drained)	28,29,27,26	462
Region 6	Silty GRAVEL (Drained)	30,31,29,28	431.2
Region 7	Bedroack / Retaining wall	32,19,31,30	308
Region 8	Clayey Sand FILL (Drained)	22,10,20,21,23	392.67
Region 9	Sandy Lean Clay FILL (Drained)	20,11,12,13,14,15,16,17,18,21	360.24
Region 10	Sandy Lean Clay FILL (Undrained)	43,40,33,35	43.626
Region 11	Clayey Sand FILL (Undrained)	43,44,42,38,37,36,34,35	218.29
Region 12	BACKFILL	1,45,42,44,43,40,41	111.58

Current Slip Surface

Slip Surface: 126
F of S: 1.252
Volume: 0.75755386 ft³
Weight: 87.118694 lbs
Resisting Moment: 2,016.0137 lbs-ft
Activating Moment: 1,610.1784 lbs-ft
Resisting Force: 45.542647 lbs
Activating Force: 36.374617 lbs
F of S Rank: 1
Exit: (19.931903, 184.68056) ft
Entry: (12.379182, 188.69924) ft
Radius: 4.7996053 ft
Center: (32.383403, 222.11589) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	12.511996	188.63504	-629.3453	1.6825784	1.1349135	0

Slice 2	12.822405	188.46705	-619.13476	6.6880868	4.5111715	0
Slice 3	13.053515	188.332	-610.94092	10.453782	7.0511647	0
Slice 4	13.25708	188.21014	-603.585	11.150522	7.5211219	0
Slice 5	13.55718	188.02894	-592.64623	12.549314	8.464619	0
Slice 6	13.814415	187.87596	-583.41408	13.794202	9.3043064	0
Slice 7	13.93568	187.80575	-579.18048	14.4329	9.7351137	0
Slice 8	14.10681	187.71172	-573.51916	14.520545	9.7942313	0
Slice 9	14.42091	187.53929	-563.13787	14.531036	9.8013073	0
Slice 10	14.70526	187.38573	-553.89629	14.561411	9.821796	0
Slice 11	14.94267	187.26155	-546.43031	14.1757	9.5616302	0
Slice 12	15.16289	187.1479	-539.60017	13.524774	9.1225754	0
Slice 13	15.373345	187.04148	-533.20817	12.948715	8.7340185	0
Slice 14	15.574035	186.9423	-527.25425	11.938616	8.0526981	0
Slice 15	15.73626	186.86176	-522.41928	11.09867	7.4861477	0
Slice 16	15.940695	186.7561	-516.06811	10.282225	6.9354482	0
Slice 17	16.199135	186.62515	-508.20111	9.6281356	6.4942594	0
Slice 18	16.45652	186.48876	-499.99621	8.5590397	5.7731452	0
Slice 19	16.708905	186.34271	-491.22527	9.0128447	6.0792405	0
Slice 20	16.930675	186.21094	-483.309	9.8735949	6.6598238	0
Slice 21	17.172939	186.07848	-475.37164	10.589971	7.1430255	0
Slice 22	17.435698	185.94535	-467.4136	9.5814022	6.4627374	0
Slice 23	17.698456	185.81221	-459.45585	8.5728336	5.7824493	0
Slice 24	17.961214	185.67907	-451.49841	7.5642649	5.1021611	0
Slice 25	18.223973	185.54594	-443.54127	6.5556963	4.421873	0
Slice 26	18.486731	185.4128	-435.58444	5.5471276	3.7415848	0
Slice 27	18.74949	185.27967	-427.6279	4.5385589	3.0612967	0

Slice 28	19.012248	185.14653	-419.67166	3.5299903	2.3810085	0
Slice 29	19.275007	185.0134	-411.71573	2.5214216	1.7007204	0
Slice 30	19.537765	184.88026	-403.7601	1.512853	1.0204322	0
Slice 31	19.800523	184.74712	-395.80477	0.50428433	0.34014407	0

BOB2 - Drained Normalpool

File Information

Title: Borit Resevior Investigation
Created By: McCafferty, Conor M NAP
Last Edited By: Fatzinger, Travis T NAP
Revision Number: 95
File Version: 8.0
Tool Version: 8.0.10.6504
Date: 8/21/2013
Time: 2:25:17 PM
File Name: BOB-2 Proposed.gsz
Directory: I:\IIS\Superfund\Borit Reservoir Investigation 2013\Borit Report\Final GeoStudio Runs\Proposed\
Last Solved Date: 8/21/2013
Last Solved Time: 2:25:26 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

BOB2 - Drained Normalpool

Kind: SLOPE/W
Parent: BOB2 - SEEP_Drained Normalpool
Method: Spencer
Settings
Lambda
Lambda 1: -1
Lambda 2: -0.8
Lambda 3: -0.6
Lambda 4: -0.4
Lambda 5: -0.2
Lambda 6: 0
Lambda 7: 0.2
Lambda 8: 0.4
Lambda 9: 0.6
Lambda 10: 0.8
Lambda 11: 1
PWP Conditions Source: Parent Analysis

Slip Surface
- 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: Yes
- Tension Crack
  - Tension Crack Option: (none)

F of S Distribution
- F of S Calculation Option: Constant

Advanced
- Number of Slices: 30
- F of S Tolerance: 0.1
- Minimum Slip Surface Depth: 0.1 ft
- Optimization Maximum Iterations: 2,000
- 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

Bedrock
Model: Bedrock (Impenetrable)

Clean Silty Sand FILL (Drained)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Sandy SILT (Drained)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 22 °
Phi-B: 0 °

Poorly Graded SAND (Drained)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33 °
Phi-B: 0 °

Dense Silty SAND (Drained)
Model: Mohr-Coulomb
Unit Weight: 125 pcf

Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Loose Silty SAND (Drained)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 29 °
Phi-B: 0 °

BACKFILL

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (16.32529, 192.02177) ft
Left-Zone Right Coordinate: (38.5578, 188) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (54.91958, 180.3018) ft
Right-Zone Right Coordinate: (77, 175.82787) ft
Right-Zone Increment: 4
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-62, 176) ft
Right Coordinate: (187, 176) ft

Points

	X (ft)	Y (ft)
Point 1	0	176
Point 2	16.01	192.01
Point 3	30.01	192.5325
Point 4	47.01	183.6425
Point 5	65.01	176.04
Point 6	78.01	175.81
Point 7	87.2654	174.5
Point 8	101.01	174.16
Point 9	104.01	175
Point 10	126.01	175.43
Point 11	141.01	172.68
Point 12	160.01	171.91

Point 13	181.01	172.8225
Point 14	185.9475	177.1625
Point 15	27.3291	165.90625
Point 16	-62	166.125
Point 17	187	165.90625
Point 18	0	171
Point 19	-62	171
Point 20	187	171
Point 21	184.7658	176
Point 22	187	176
Point 23	12	188
Point 24	38.5578	188
Point 25	-62	159
Point 26	187	158
Point 27	8	184
Point 28	46.2069	184
Point 29	183.0376	174.5
Point 30	35.5578	188
Point 31	43.2069	184
Point 32	62.01	176.04
Point 33	10	186
Point 34	-14	188
Point 35	54.613	180.3952
Point 36	-14	192
Point 37	-62	176
Point 38	-26	187.88359
Point 39	-31.83033	186
Point 40	-50	180

Regions

	Material	Points	Area (ft²)
Region 1	Sandy SILT (Drained)	37,1,5,6,7,8,9,10,11,12,13,21,22,20,18,19	1,011.2
Region 2	Poorly Graded SAND (Drained)	16,19,18,20,17,15	1,258.6
Region 3	Bedrock	25,26,17,15,16	1,853.9
Region 4		21,14,22	1.2986
Region 5	Clean Silty Sand FILL (Drained)	23,2,3,24,28,4,5,32,31,30	122.92
Region 6	Dense Silty SAND (Drained)	27,33,23,30,31	117.53
Region 7	Loose Silty SAND (Drained)	1,27,31,32	388
Region 8	BACKFILL	2,36,38,39,40,37,1,27,33,23	734.43

Current Slip Surface

Slip Surface: 276
F of S: 1.309
Volume: 73.388759 ft³
Weight: 8,529.7345 lbs
Resisting Moment: 322,869.82 lbs-ft

Activating Moment: 246,720.88 lbs-ft
Resisting Force: 4,154.1199 lbs
Activating Force: 3,174.3312 lbs
F of S Rank: 1
Exit: (65.009239, 176.04032) ft
Entry: (29.581714, 192.51652) ft
Radius: 21.468725 ft
Center: (73.454374, 245.21557) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	29.795857	192.27592	-1,014.5553	15.064642	10.161229	0
Slice 2	30.38967	191.60875	-972.92387	43.779573	29.529695	0
Slice 3	31.296008	190.71143	-916.93085	79.420743	53.569967	0
Slice 4	32.349342	189.76995	-858.18129	106.12001	71.578854	0
Slice 5	33.696334	188.6496	-788.27017	143.70978	96.933471	0
Slice 6	35.037229	187.58777	-722.01033	172.52787	116.37152	0
Slice 7	35.966445	186.85194	-676.09308	194.03079	130.87542	0
Slice 8	36.920767	186.12752	-630.88712	220.21854	148.53928	0
Slice 9	38.012122	185.32589	-580.86224	239.05345	161.24359	0
Slice 10	38.65889	184.85082	-551.21594	250.27286	168.81118	0
Slice 11	39.304015	184.39699	-522.89456	266.88493	180.01616	0
Slice 12	40.437099	183.72148	-480.73866	315.06117	174.64126	0
Slice 13	41.597869	183.13832	-444.34534	308.14412	170.80708	0
Slice 14	42.688245	182.63653	-413.03011	318.14222	176.34911	0
Slice 15	43.81832	182.16905	-383.85448	303.6445	168.3129	0
Slice 16	44.87403	181.75612	-358.08293	302.71825	167.79947	0
Slice 17	45.76261	181.43611	-338.11062	287.8275	159.54539	0
Slice 18	46.60845	181.13149	-319.09892	276.86819	153.47054	0
Slice 19	47.326295	180.87297	-302.96341	271.32832	150.39974	0
Slice 20	48.200805	180.57089	-284.10891	269.51208	149.39299	0

Slice 21	49.317235	180.19456	-260.61946	259.52303	143.85597	0
Slice 22	50.433665	179.81823	-237.13004	249.53399	138.31895	0
Slice 23	51.567073	179.44526	-213.84859	241.63823	133.94226	0
Slice 24	52.71746	179.07567	-190.77681	229.27348	127.08836	0
Slice 25	53.867847	178.70608	-167.70503	216.90873	120.23447	0
Slice 26	54.951925	178.36007	-146.10337	205.7971	114.0752	0
Slice 27	56.026308	178.02358	-125.0934	194.40928	107.76282	0
Slice 28	57.157303	177.67303	-103.20497	180.75997	100.19689	0
Slice 29	58.348904	177.32199	-81.282458	168.62825	93.472167	0
Slice 30	59.626999	176.96321	-58.841916	148.69402	82.422444	0
Slice 31	60.804022	176.69432	-42.021756	142.04044	95.807484	0
Slice 32	61.854085	176.5226	-31.274436	107.63722	72.602225	0
Slice 33	62.904148	176.35088	-20.173844	73.234012	49.396965	0
Slice 34	64.21921	176.15267	-7.3219292	28.667125	19.33622	0

BOB2 - Drained Highpool

File Information

Title: Borit Resevior Investigation
Created By: McCafferty, Conor M NAP
Last Edited By: Fatzinger, Travis T NAP
Revision Number: 95
File Version: 8.0
Tool Version: 8.0.10.6504
Date: 8/21/2013
Time: 2:25:17 PM
File Name: BOB-2 Proposed.gsz
Directory: I:\IIS\Superfund\Borit Reservoir Investigation 2013\Borit Report\Final GeoStudio Runs\Proposed\
Last Solved Date: 8/21/2013
Last Solved Time: 2:25:22 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

BOB2 - Drained Highpool

Kind: SLOPE/W
Parent: BOB2 - SEEP_Drained Highpool
Method: Spencer
Settings
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6
  - Lambda 10: 0.8
  - Lambda 11: 1
- PWP Conditions Source: Parent Analysis

Slip Surface
- 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: Yes
- Tension Crack
  - Tension Crack Option: (none)

F of S Distribution
- F of S Calculation Option: Constant

Advanced
- Number of Slices: 30
- F of S Tolerance: 0.1
- Minimum Slip Surface Depth: 0.1 ft
- Optimization Maximum Iterations: 2,000
- 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

Bedrock
Model: Bedrock (Impenetrable)

Clean Silty Sand FILL (Drained)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Sandy SILT (Drained)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 22 °
Phi-B: 0 °

Poorly Graded SAND (Drained)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33 °
Phi-B: 0 °

Dense Silty SAND (Drained)
Model: Mohr-Coulomb
Unit Weight: 125 pcf

Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Loose Silty SAND (Drained)

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 29 °
Phi-B: 0 °

BACKFILL

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (15, 192.00966) ft
Left-Zone Right Coordinate: (40.47008, 187) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (54.72742, 180.38296) ft
Right-Zone Right Coordinate: (79, 175.66988) ft
Right-Zone Increment: 4
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (-62, 176) ft
Right Coordinate: (187, 176) ft

Points

	X (ft)	Y (ft)
Point 1	0	176
Point 2	16.01	192.01
Point 3	30.01	192.5325
Point 4	47.01	183.6425
Point 5	65.01	176.04
Point 6	78.01	175.81
Point 7	87.2654	174.5
Point 8	101.01	174.16
Point 9	104.01	175
Point 10	126.01	175.43
Point 11	141.01	172.68
Point 12	160.01	171.91

Point 13	181.01	172.8225
Point 14	185.9475	177.1625
Point 15	27.3291	165.90625
Point 16	-62	166.125
Point 17	187	165.90625
Point 18	0	171
Point 19	-62	171
Point 20	187	171
Point 21	184.7658	176
Point 22	187	176
Point 23	12	188
Point 24	38.5578	188
Point 25	-62	159
Point 26	187	158
Point 27	8	184
Point 28	46.2069	184
Point 29	183.0376	174.5
Point 30	35.5578	188
Point 31	43.2069	184
Point 32	62.01	176.04
Point 33	10	186
Point 34	-14	188
Point 35	54.613	180.3952
Point 36	-14	192
Point 37	-62	176
Point 38	-26	187.88359
Point 39	-31.83033	186
Point 40	-50	180

Regions

	Material	Points	Area (ft²)
Region 1	Sandy SILT (Drained)	37,1,5,6,7,8,9,10,11,12,13,21,22,20,18,19	1,011.2
Region 2	Poorly Graded SAND (Drained)	16,19,18,20,17,15	1,258.6
Region 3	Bedrock	25,26,17,15,16	1,853.9
Region 4		21,14,22	1.2986
Region 5	Clean Silty Sand FILL (Drained)	23,2,3,24,28,4,5,32,31,30	122.92
Region 6	Dense Silty SAND (Drained)	27,33,23,30,31	117.53
Region 7	Loose Silty SAND (Drained)	1,27,31,32	388
Region 8	BACKFILL	2,36,38,39,40,37,1,27,33,23	734.43

Current Slip Surface

Slip Surface: 276
F of S: 1.308
Volume: 64.392048 ft³
Weight: 7,470.4102 lbs
Resisting Moment: 285,623.82 lbs-ft

Activating Moment: 218,345.33 lbs-ft
Resisting Force: 3,654.8736 lbs
Activating Force: 2,793.9538 lbs
F of S Rank: 1
Exit: (64.878978, 176.09534) ft
Entry: (29.718172, 192.52161) ft
Radius: 21.302513 ft
Center: (74.042059, 245.72173) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	29.864086	192.37313	-1,032.8021	9.8940449	6.6736175	0
Slice 2	30.49972	191.72631	-992.4488	35.128535	23.694496	0
Slice 3	31.556708	190.74396	-931.16295	69.094261	46.604667	0
Slice 4	32.691243	189.7759	-870.77071	95.240751	64.240698	0
Slice 5	34.129232	188.64594	-800.28416	130.98616	88.351279	0
Slice 6	35.278877	187.79308	-747.08931	151.08791	101.91008	0
Slice 7	36.110638	187.17605	-708.60674	166.82394	112.52417	0
Slice 8	37.216313	186.35581	-657.44985	186.44482	125.75862	0
Slice 9	38.163475	185.67571	-615.03338	209.71948	141.45757	0
Slice 10	39.035735	185.07851	-577.78712	221.77581	149.58967	0
Slice 11	39.991605	184.42406	-536.96904	235.24114	158.67215	0
Slice 12	40.540923	184.04842	-513.53969	244.0595	164.62021	0
Slice 13	40.652943	183.97243	-508.79998	247.59364	137.2434	0
Slice 14	41.32191	183.64608	-488.44117	281.23719	155.89232	0
Slice 15	42.57857	183.04849	-451.16339	270.27448	149.81559	0
Slice 16	43.6534	182.53738	-419.28059	262.80507	145.67523	0
Slice 17	44.62665	182.12743	-393.71069	274.56884	152.196	0
Slice 18	45.68015	181.7322	-369.05948	258.73111	143.41699	0
Slice 19	46.449225	181.44367	-351.06369	249.08689	138.07112	0
Slice 20	46.850775	181.29816	-341.9884	252.43055	139.92454	0

Slice 21	47.592658	181.04378	-326.12571	245.88909	136.29855	0
Slice 22	48.757973	180.64421	-301.20933	236.20977	130.93322	0
Slice 23	49.817073	180.28259	-278.65966	227.87563	126.31353	0
Slice 24	50.769957	179.95894	-258.47762	219.61641	121.73537	0
Slice 25	52.027855	179.52603	-231.48971	208.02724	115.31138	0
Slice 26	53.482885	179.02838	-200.46569	197.6062	109.53491	0
Slice 27	54.830035	178.57523	-172.22091	185.4319	102.78658	0
Slice 28	56.084897	178.16231	-146.49379	175.48633	97.273659	0
Slice 29	57.24747	177.78962	-123.27353	162.8808	90.286304	0
Slice 30	58.410043	177.41692	-100.06579	150.27528	83.298949	0
Slice 31	59.401675	177.10174	-80.503181	140.03349	77.62183	0
Slice 32	60.369727	176.87629	-66.524163	141.44216	95.403939	0
Slice 33	61.48514	176.68306	-54.526078	106.46233	71.809748	0
Slice 34	62.600553	176.48982	-43.249361	71.482504	48.215558	0
Slice 35	64.018619	176.24427	-29.256252	27.00035	18.211966	0

Drained Normalpool

File Information

Title: BoRit Reservior Investigation - BOB3
Created By: McCafferty, Conor M NAP
Last Edited By: Fatzinger, Travis T NAP
Revision Number: 108
File Version: 8.0
Tool Version: 8.0.10.6504
Date: 8/21/2013
Time: 2:22:52 PM
File Name: BOB-3 Proposed.gsz
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Last Solved Date: 8/21/2013
Last Solved Time: 2:22:58 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

Drained Normalpool

Kind: SLOPE/W
Parent: BOB3 - SEEP_Drained Normalpool
Method: Spencer
Settings
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6
  - Lambda 10: 0.8
  - Lambda 11: 1
- PWP Conditions Source: Parent Analysis

Slip Surface
- 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: Yes
- Tension Crack
  - Tension Crack Option: (none)

F of S Distribution
- F of S Calculation Option: Constant

Advanced
- Number of Slices: 30
- F of S Tolerance: 0.001
- Minimum Slip Surface Depth: 0.1 ft
- Optimization Maximum Iterations: 2,000
- 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

Bedrock
Model: Bedrock (Impenetrable)

Silty CLAY with Sand (Fill-Drained)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33 °
Phi-B: 0 °

Clean Silty Sand FILL (Drained)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

SILT with Sand (Drained)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Clayey SAND (Drained)
Model: Mohr-Coulomb
Unit Weight: 125 pcf

Cohesion': 0 psf
Phi': 36 °
Phi-B: 0 °

Silty GRAVEL (Drained)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 38 °
Phi-B: 0 °

Silty Sand FILL (Drained)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33 °
Phi-B: 0 °

Red Clay BACKFILL

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

SILT with Sand (Drained) (0)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (19.8293, 191.83) ft
Left-Zone Right Coordinate: (40, 186.63151) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (54, 179.99203) ft
Right-Zone Right Coordinate: (78, 174.89333) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (-61, 172) ft
Right Coordinate: (192.0544, 181.6779) ft

Points

	X (ft)	Y (ft)
Point 1	0	172
Point 2	19.83	191.83
Point 3	29.4911	191.92
Point 4	46.2227	183.5
Point 5	64.4911	175.26
Point 6	78.4911	174.88
Point 7	98.6163	172.5709
Point 8	111.4911	172.28
Point 9	115.4911	170.75
Point 10	129.4911	170.75
Point 11	134.4911	173.6
Point 12	149.4911	173.35
Point 13	157.4911	170.04
Point 14	176.4911	167.91
Point 15	181.663	168.7856
Point 16	189.9825	181.6779
Point 17	192.0544	181.6779
Point 18	192.0544	161.7
Point 19	-61	161
Point 20	15.5	187.5
Point 21	31.3206	187.5
Point 22	10	182
Point 23	42.2474	182
Point 24	4.5	176.5
Point 25	53.1743	176.5
Point 26	-61	167
Point 27	192.0544	167.5532
Point 28	-61	163
Point 29	192.0544	163
Point 30	55.4963	175.3312
Point 31	186.6411	176.5
Point 32	192.0544	176.5
Point 33	-61	140
Point 34	192.0544	140.7
Point 35	13.46074	185.46074
Point 36	-10.17	191.83
Point 37	-61	172
Point 38	-48.22088	177.28826
Point 39	-29.04962	184.78921
Point 40	-23.06834	187.04924

Regions

	Material	Points	Area (ft²)
Region 1	Clean Silty Sand FILL (Drained)	20,2,3,4,5,30,25,23,21	163.69
Region 2	Silty Sand FILL (Drained)	22,35,20,21,23	132.19
Region 3	Silty CLAY with Sand (Fill-Drained)	24,22,23,25	222.53

Region 4	Clayey SAND (Drained)	28,26,27,29	1,082.2
Region 5	Silty GRAVEL (Drained)	19,28,29,18	417.54
Region 6	Silty CLAY with Sand (Fill-Drained)	31,16,17,32	19.379
Region 7	Bedrock	33,19,18,34	5,314.1
Region 8	Red Clay BACKFILL	2,36,40,39,38,37,1,24,22,35,20	913.56
Region 9	SILT with Sand (Drained) (0)	7,8,9,10,11,12,13,14,15,31,32,27,26,37,1	1,181.2
Region 10	SILT with Sand (Drained)	24,25,30,5,6,7,1	317.45

Current Slip Surface

Slip Surface: 126
F of S: 1.343
Volume: 3.7872387 ft³
Weight: 435.53245 lbs
Resisting Moment: 55,048.289 lbs-ft
Activating Moment: 40,983.411 lbs-ft
Resisting Force: 234.6015 lbs
Activating Force: 174.66054 lbs
F of S Rank: 1
Exit: (46.374321, 183.43161) ft
Entry: (29.485612, 191.91995) ft
Radius: 10.365152 ft
Center: (133.64698, 373.84386) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	29.488356	191.91817	-1,178.1494	0.14772571	0.099642247	0
Slice 2	29.665525	191.80334	-1,171.0388	2.3650892	1.5952728	0
Slice 3	30.129138	191.52774	-1,153.9839	6.227504	4.2005045	0
Slice 4	30.707515	191.20263	-1,133.8753	9.2063971	6.2097933	0
Slice 5	31.285892	190.87751	-1,113.7675	12.18529	8.219082	0
Slice 6	31.821642	190.5788	-1,095.2945	14.847598	10.014831	0
Slice 7	32.314768	190.3065	-1,078.4564	16.977203	11.451268	0
Slice 8	32.850911	190.01327	-1,060.3387	19.192405	12.94544	0
Slice 9	33.430074	189.69913	-1,040.9806	21.208605	14.305384	0
Slice 10	34.009236	189.38498	-1,021.6229	23.224804	15.665328	0
Slice 11	34.588399	189.07084	-1,002.2654	25.241004	17.025272	0
Slice 12	35.202347	188.74619	-982.26588	27.198577	18.345672	0

Slice 13	35.85108	188.41104	-961.62422	27.987124	18.877554	0
Slice 14	36.499813	188.07588	-940.98528	28.775671	19.409435	0
Slice 15	37.103689	187.76547	-921.87251	29.503066	19.900069	0
Slice 16	37.662706	187.4798	-904.28449	29.899267	20.167311	0
Slice 17	38.221724	187.19414	-886.69647	30.295469	20.434552	0
Slice 18	38.780741	186.90847	-869.10844	30.69167	20.701793	0
Slice 19	39.354902	186.62711	-851.79309	31.044343	20.939674	0
Slice 20	39.944206	186.35004	-834.74091	29.204829	19.698906	0
Slice 21	40.53351	186.07298	-817.68703	27.365314	18.458137	0
Slice 22	41.122814	185.79592	-800.63316	25.5258	17.217369	0
Slice 23	41.712118	185.51885	-783.57929	23.686285	15.976601	0
Slice 24	42.329585	185.22819	-765.68804	21.772162	14.685509	0
Slice 25	42.975215	184.92392	-746.95648	19.826512	13.373151	0
Slice 26	43.60788	184.62991	-728.84856	17.730615	11.959451	0
Slice 27	44.22758	184.34616	-711.37514	15.051091	10.152089	0
Slice 28	44.84728	184.06241	-693.90184	12.371568	8.3447278	0
Slice 29	45.423522	183.81353	-678.58602	8.8801642	5.9897464	0
Slice 30	45.956308	183.59952	-665.42774	3.4599758	2.3337832	0
Slice 31	46.298511	183.46206	-656.97331	0.37494081	0.25290077	0

Drained Highpool

File Information

Title: BoRit Reservior Investigation - BOB3
Created By: McCafferty, Conor M NAP
Last Edited By: Fatzinger, Travis T NAP
Revision Number: 108
File Version: 8.0
Tool Version: 8.0.10.6504
Date: 8/21/2013
Time: 2:22:52 PM
File Name: BOB-3 Proposed.gsz
Directory: I:\IIS\Superfund\Borit Reservoir Investigation 2013\Borit Report\Final GeoStudio Runs\Proposed\
Last Solved Date: 8/21/2013
Last Solved Time: 2:23:02 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

Drained Highpool

Kind: SLOPE/W
Parent: BOB3 - SEEP_Drained Highpool
Method: Spencer
Settings
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6
  - Lambda 10: 0.8
  - Lambda 11: 1
- PWP Conditions Source: Parent Analysis

Slip Surface
- 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: Yes
- Tension Crack
  - Tension Crack Option: (none)

F of S Distribution
- F of S Calculation Option: Constant

Advanced
- Number of Slices: 30
- F of S Tolerance: 0.001
- Minimum Slip Surface Depth: 0.1 ft
- Optimization Maximum Iterations: 2,000
- 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

Bedrock
Model: Bedrock (Impenetrable)

Silty CLAY with Sand (Fill-Drained)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33 °
Phi-B: 0 °

Clean Silty Sand FILL (Drained)
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

SILT with Sand (Drained)
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °

Clayey SAND (Drained)
Model: Mohr-Coulomb
Unit Weight: 125 pcf

Cohesion': 0 psf
Phi': 36 °
Phi-B: 0 °

Silty GRAVEL (Drained)

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 38 °
Phi-B: 0 °

Silty Sand FILL (Drained)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 33 °
Phi-B: 0 °

Red Clay BACKFILL

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

SILT with Sand (Drained) (0)

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 22 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (19, 191.83) ft
Left-Zone Right Coordinate: (40, 186.63151) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (55.24025, 179.43261) ft
Right-Zone Right Coordinate: (78, 174.89333) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (-61, 172) ft
Right Coordinate: (192.0544, 181.6779) ft

Points

	X (ft)	Y (ft)
Point 1	0	172
Point 2	19.83	191.83
Point 3	29.4911	191.92
Point 4	46.2227	183.5
Point 5	64.4911	175.26
Point 6	78.4911	174.88
Point 7	98.6163	172.5709
Point 8	111.4911	172.28
Point 9	115.4911	170.75
Point 10	129.4911	170.75
Point 11	134.4911	173.6
Point 12	149.4911	173.35
Point 13	157.4911	170.04
Point 14	176.4911	167.91
Point 15	181.663	168.7856
Point 16	189.9825	181.6779
Point 17	192.0544	181.6779
Point 18	192.0544	161.7
Point 19	-61	161
Point 20	15.5	187.5
Point 21	31.3206	187.5
Point 22	10	182
Point 23	42.2474	182
Point 24	4.5	176.5
Point 25	53.1743	176.5
Point 26	-61	167
Point 27	192.0544	167.5532
Point 28	-61	163
Point 29	192.0544	163
Point 30	55.4963	175.3312
Point 31	186.6411	176.5
Point 32	192.0544	176.5
Point 33	-61	140
Point 34	192.0544	140.7
Point 35	13.46074	185.46074
Point 36	-10.17	191.83
Point 37	-61	172
Point 38	-48.22088	177.28826
Point 39	-29.04962	184.78921
Point 40	-23.06834	187.04924

Regions

	Material	Points	Area (ft²)
Region 1	Clean Silty Sand FILL (Drained)	20,2,3,4,5,30,25,23,21	163.69
Region 2	Silty Sand FILL (Drained)	22,35,20,21,23	132.19
Region 3	Silty CLAY with Sand (Fill-Drained)	24,22,23,25	222.53

Region 4	Clayey SAND (Drained)	28,26,27,29	1,082.2
Region 5	Silty GRAVEL (Drained)	19,28,29,18	417.54
Region 6	Silty CLAY with Sand (Fill-Drained)	31,16,17,32	19.379
Region 7	Bedrock	33,19,18,34	5,314.1
Region 8	Red Clay BACKFILL	2,36,40,39,38,37,1,24,22,35,20	913.56
Region 9	SILT with Sand (Drained) (0)	7,8,9,10,11,12,13,14,15,31,32,27,26,37,1	1,181.2
Region 10	SILT with Sand (Drained)	24,25,30,5,6,7,1	317.45

Current Slip Surface

Slip Surface: 126
F of S: 1.345
Volume: 4.7521522 ft³
Weight: 546.4975 lbs
Resisting Moment: 73,701.056 lbs-ft
Activating Moment: 54,793.65 lbs-ft
Resisting Force: 294.53364 lbs
Activating Force: 218.97331 lbs
F of S Rank: 1
Exit: (46.397313, 183.42124) ft
Entry: (29.47675, 191.91987) ft
Radius: 10.399725 ft
Center: (139.90578, 386.2468) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	29.483925	191.91522	-1,064.5459	0.38650907	0.26070366	0
Slice 2	29.785435	191.71989	-1,052.3806	4.2612998	2.874283	0
Slice 3	30.358043	191.37543	-1,030.9289	9.5486044	6.440615	0
Slice 4	30.914588	191.06785	-1,011.7774	11.973723	8.076378	0
Slice 5	31.471133	190.76027	-992.62608	14.398841	9.712141	0
Slice 6	32.027678	190.4527	-973.47506	16.82396	11.347904	0
Slice 7	32.584223	190.14512	-954.32442	19.249078	12.983667	0
Slice 8	33.140768	189.83754	-935.16405	21.674196	14.61943	0
Slice 9	33.725343	189.51713	-915.20068	24.153096	16.291469	0
Slice 10	34.33795	189.18389	-894.4382	26.368545	17.785808	0
Slice 11	34.950557	188.85065	-873.6759	28.583993	19.280147	0
Slice 12	35.505667	188.55023	-854.95877	30.605904	20.643943	0

Slice 13	36.00328	188.28264	-838.28674	32.138695	21.677823	0
Slice 14	36.500893	188.01504	-821.58323	33.671485	22.711704	0
Slice 15	37.06863	187.71737	-802.99789	35.417999	23.889742	0
Slice 16	37.70649	187.38963	-782.53459	36.031505	24.303557	0
Slice 17	38.34435	187.06189	-762.07127	36.645012	24.717372	0
Slice 18	38.954493	186.7505	-742.62884	37.260147	25.132286	0
Slice 19	39.536918	186.45547	-724.19616	37.437303	25.25178	0
Slice 20	40.119343	186.16043	-705.71809	37.614459	25.371273	0
Slice 21	40.701768	185.8654	-687.24002	37.791615	25.490766	0
Slice 22	41.204635	185.62048	-671.89836	38.509482	25.974974	0
Slice 23	41.627945	185.42567	-659.69316	36.776586	24.80612	0
Slice 24	42.117962	185.204	-645.80483	34.813804	23.482207	0
Slice 25	42.674685	184.95549	-630.23342	31.766991	21.427106	0
Slice 26	43.231408	184.70698	-614.61444	28.720177	19.372004	0
Slice 27	43.818847	184.45241	-598.59475	25.307033	17.069809	0
Slice 28	44.437	184.1918	-582.19112	20.343782	13.722054	0
Slice 29	45.055153	183.93118	-565.78795	15.38053	10.374299	0
Slice 30	45.578848	183.722	-552.61731	10.53241	7.1042003	0
Slice 31	46.008083	183.56427	-542.67916	4.5153694	3.0456551	0
Slice 32	46.310006	183.45332	-535.67732	0.75342452	0.50819126	0

APPENDIX B:

GEOTECHNICAL REPORT

Submitted to:

United States Army Corps of Engineers
Philadelphia District

BoRit Asbestos Site

Geotechnical Investigation Report for the BoRit Reservoir
Ambler, Pennsylvania

Submitted by:

Gannett Fleming

*Excellence Delivered **As Promised***

JUNE 2013

Gannett Fleming

Excellence Delivered As Promised

TABLE OF CONTENTS

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3.0	GEOPHYSICAL INVESTIGATION	1
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FIGURES:

Figure 1 - Site Location Map
Figure 2 - Geology Map

APPENDICES:

Appendix A Geophysical Investigation Report
Appendix B Test Boring Location Plan
Appendix C Typed Boring Logs
Appendix D Drillers Boring Logs
Appendix E Laboratory Test Results

1.0 INTRODUCTION

This report presents the results of the subsurface investigation performed along the reservoir berm at the BoRit Asbestos Site located in Upper Dublin and Whitpain Townships, and the Borough of Ambler, Montgomery County, Pennsylvania. The first phase of the investigation included a geophysical survey to profile the reservoir berm, to identify the locations of suspected buried pipes, and to determine potential seepage patterns within the berm. The second phase of the work included geotechnical test borings to determine the type, depth, and characteristics of the subsurface materials, depth to rock, and approximate depth to groundwater. Laboratory testing was performed to classify and evaluate the strength characteristics of the soils encountered. A Site Location Map is attached as Figure 1.

2.0 GEOLOGIC CONDITIONS

According to ***The Geology of Pennsylvania*** (Ed. Shultz, 1999), the project area is described as being located in the Gettysburg-Newark Lowland Section of the Piedmont physiographic province of southeastern Pennsylvania. Based on the subsurface investigation, geologic maps of the region, and historical data, the underlying bedrock is Triassic-age sandstone and dolomite of the Stockton Formation. According to ***Engineering Characteristics of the Rocks of Pennsylvania*** (Geyer and Wilshusen, 1982), the Stockton Formation is described as a light gray to purplish-red arkosic sandstone. The formation is typically slightly resistant to weathering and is considered moderately easy to excavate. A Geology Map is attached as Figure 2.

3.0 GEOPHYSICAL INVESTIGATION

A geophysical investigation was performed between July 5 and 7, 2011, by Quantum Geophysics of Phoenixville, Pennsylvania, a division of Gannett Fleming, Inc. The geophysical investigation was performed in advance of any test boring activity in order to identify areas of potential asbestos-containing material or other anomalies for further investigation. The geophysical investigation included a multi-channel analysis of surface waves (MASW) survey, a self-potential (SP) survey, an EM61 metal detector survey, and a ground penetrating radar (GPR) survey. A brief summary of the geophysical methods used is presented below. Further details regarding the geophysical survey and findings are available in Quantum Geophysics' "Geophysical Investigation Report for the BoRit Reservoir," dated June 11, 2013, which is included as Appendix A.

MASW is a surface wave (seismic) method that determines the vertical distribution of shear wave velocities (V_s) based upon the dispersion of surface waves (Rayleigh Wave). Shear wave velocities are related to material stiffness and density, and based on the relative velocities observed, can be used to determine areas of competent rock (highest V_s values), weathered rock and/or very dense soils (moderate V_s values), and soils of varying densities (lower V_s values). The MASW investigation at the site consisted of two (2) MASW lines, used to generate two-dimensional V_s profiles, covering a total length of approximately 1,970 linear feet along the existing berm.

Self-potential surveys (potential field method) identify areas of possible seepage or migrating groundwater based upon differences in voltage between a source electrode location and an electrode moved about the ground surface. Due to the ionic property of water, moving water creates a small electrical current which is different than that of areas where there is no moving water. The SP survey was performed over a 10-foot x 10-foot grid pattern across the southwest portion of the reservoir berm that parallels the Wissahickon Creek. The survey grid extended from toe to the top edge of the berm (closest to the reservoir), excluding the repair area at the western corner due to rip rap surface cover.

The EM61 (time domain) and GPR (frequency domain) are both electromagnetic geophysical methods used to measure contrasting electrical properties in subsurface materials. The EM61 detects and measures the strength of small eddy currents in metallic subsurface objects induced by a magnetic field produced by the instrument. GPR incorporates an antenna that transmits a high-frequency electromagnetic wave pulse into the subsurface and records the received portion of the signal pulse that is reflected back to the unit from materials with differing dielectric properties. The EM61 and GPR surveys were performed over three (3) areas where former intake and discharge pipes were suspected along the south end of the reservoir. In addition, GPR was performed in an area north of the reservoir near Maple Avenue where a 24-inch vitrified clay pipe is suspected to feed into the reservoir.

The geophysical investigation revealed various anomalies within the limits of the site. The MASW data collected along the crest of the berm adjacent to Rose Valley and Wissahickon Creeks (noted as Section A – A' in the "Geophysical Investigation Report") revealed areas of low shear wave velocities (V_s) within the berm fill that is suggestive of soils with asbestos-containing materials (ACM), and profiled the top of bedrock surface at depths ranging from 16 to 30 feet below the crest of the berm, becoming progressively deeper from north to south approaching Wissahickon Creek. The MASW data collected along the gravel access road east of the reservoir (noted as Section B – B' in the "Geophysical Investigation Report") display an irregular pattern of shear wave velocities between geophysical survey Stations 250 and 620 that may be indicative of previous quarry excavations that have since been backfilled.

4.0 TEST BORING INVESTIGATION

4.1 Test Boring Data

Utilizing historical site information and the results of the geophysical investigation, test boring locations were selected to target areas of interest along the berm, particularly areas with the potential for ACM fill and areas of potential seepage to determine the type nature, and characteristics of subsurface materials and approximate depth to groundwater. A total of three (3) test borings, identified as BOB-1 through BOB-3, were drilled along the top of the berm at the locations shown on the "Test Boring Location Plan," included in Appendix B. Additionally, three (3) offset borings, identified as BOB-1A through BOB-3A, were drilled adjacent to the primary borings to collect undisturbed soil samples. The locations of the test borings shown on the plan were determined in the field by measuring from survey stakes established during the geophysical investigation. Test boring ground surface elevations are based on the topographic survey data provided by USACE.

Test boring operations were performed from May 21 through 24, 2013, by L.G. Hetager Drilling, Inc. (Hetager) of Punxsutawney, Pennsylvania. A Gannett Fleming geologist provided full-time inspection of the drilling operations. Test Borings were advanced to refusal on bedrock, ranging from 20.5 to 28.8 feet below existing grade. Continuous Standard Penetration Testing (SPT) split-spoon sampling was performed at each location using a safety hammer. Offset borings were advanced adjacent to the primary borings to collect undisturbed samples in fine-grained strata of interest. In general, offset borings were drilled adjacent (2- to 3-foot offset) to the original test boring locations, and the borings were advanced without SPT sampling. One undisturbed Shelby tube sample was collected in each offset boring. All test borings were back filled with Portland cement grout on May 24, 2013. Spoils generated from drilling activities were contained in drum liner bags and disposed of at the on-site spoils stock pile as directed by the on-site EPA representative. All drilling equipment and tools were decontaminated with a steam cleaner prior to demobilizing from the site.

Field personnel wore Level C personal protective equipment, as defined by OSHA's HAZWOPER standards, during all intrusive work activities performed onsite. Personal air monitoring was performed during the first full day of drilling activities to monitor airborne asbestos fibers. The test results from the personal air monitoring were well below the OSHA personal exposure limit (PEL) of 0.1 fibers/cc for an eight-hour time-weighted average (TWA).

Hetager advanced the test borings through the overburden soils using 3¼-inch inside diameter hollow stem augers with a track-mounted drill rig. Soil sampling was performed in accordance with ASTM D1586. Gannett Fleming's inspector visually classified the soil samples in the field in, and the samples were named and assigned classification symbols in accordance with ASTM D2487, the Unified Soil Classification System. Undisturbed sampling was performed in accordance with ASTM D1587, and collected in seamless brass thin-wall sample tubes. All sampling equipment was cleaned with Liqui-Nox® Critical Cleaning Liquid Detergent and water prior to reuse.

The subsurface investigation results indicate that the overburden soils at the site generally consist of two or three strata and decomposed rock. Each test boring encountered 8.5 to 16 feet of fill soils underlain by 3 to 19 feet of alluvial clay, sand and gravel, over very dense residual soils and decomposed rock. Typed boring logs are included in Appendix C. Copies of the driller's handwritten boring logs are included in Appendix D.

In general, the fill soils consist of very loose to medium dense silty sand and clayey sand, containing rock fragments, concrete fragments, wood, gravel, and varying amounts of ACM, which was visually identifiable the white coloration and fibrous texture of the asbestos. Specifically, test boring BOB-1 only encountered trace amounts of possible ACM, and test borings BOB-2 and BOB-3 encountered 12 ft and 5.5 ft of ACM, respectively. Test boring BOB-1 encountered approximately 2 ft of medium stiff sandy lean clay within the fill soils, and BOB-2 and -2A encountered wood at depths of 3.5 to 4 ft below the ground surface, possibly from a buried tree, stump, or a large tree root.

The underlying alluvial soils generally consist of very soft to medium stiff cohesive lean clay and silty clay containing varying amounts of sand, gravel and organic matter, overlying medium dense to

very dense sand and gravel with varying amounts of silt and clay. Below the alluvial soils, the residual soils and decomposed rock consist of dense to very dense poorly graded sand with gravel, and silty gravel with sand, containing sandstone fragments. Auger refusal on bedrock was encountered at depths of 20.5 to 28.8 feet below the ground surface. No rock coring was performed.

4.2 Groundwater

Groundwater observations were recorded during drilling and subsequent water level readings were taken upon completion of drilling, and at the start of each day while on-site prior to grouting the borings. A one-inch diameter PVC pipe was installed upon completion of drilling at each location to facilitate monitoring groundwater levels and for tremie grouting the boring at the completion of the investigation. The measured groundwater levels are listed below in Table 5.2.

Table 4.2 – Groundwater Level Readings

Boring	Date & Time of Reading	Groundwater Depth (ft)	Groundwater Elevation (ft)	Remarks
BOB-1	5/21/13, 10:10	12.0	178.0	Observed at time of drilling – may be perched (sample was wet)
	5/22/13, 07:25	17.2	172.8	
	5/23/13, 07:30	16.2	173.8	
BOB-1A	5/22/13, 16:55	Not Encountered	Not Encountered	Total depth of boring = 6.5 ft
BOB-2	5/21/13, 13:30	16.0	176.0	At time of drilling
	5/22/13, 07:20	16.9	175.1	
	5/23/13, 07:33	17.6	174.4	
BOB-2A	5/22/13, 16:25	16.5	175.5	Water in top of Shelby tube
BOB-3	5/22/13, 14:10	22.6	169.4	One hour after drilling
	5/23/13, 07:35	21.8	170.2	
BOB-3A	5/22/13, 14:00	Not Encountered	Not Encountered	Total depth of boring = 11.0 ft

The groundwater data recorded on the boring logs, and noted above, indicates groundwater levels at the times shown on the logs and may not be representative of the daily or seasonal variability in the groundwater table at the site. Fluctuations in the water table should be expected with variations in precipitation, surface runoff, pumping, evaporation and evapotranspiration occurring throughout the year.

4.3 Laboratory Soil Test Results

Selected soil samples obtained from the borings were tested by GeoStructures Inc, King of Prussia, Pennsylvania. The following tests were performed:

- Sieve analysis (ASTM D422) 11 samples
- Atterberg limits (ASTM D4318) 11 samples
- Water content (D2216) 11 samples
- Organic content by ignition (ASTM D2974) 1 sample

- Triaxial CU w/pore pressure (ASTM D4767) 2 samples
- Unconfined compression (ASTM D2166) 1 sample

Strength testing was performed on all three of the undisturbed samples collected during the drilling operations. The sample from BOB-1A was tested for unconfined compressive (UC) strength. The samples from BOB-2A and -3A were tested for consolidated undrained triaxial compressive strength, with pore pressure measurements (CU w/PP). Initially, the samples from BOB-2A and -3A were also scheduled for UC testing in addition to the CU w/PP testing; however, once the samples were extruded from the Shelby tubes, it was determined there was not a sufficient amount of high-quality sample available to also run the UC testing. As a result, only CU w/PP testing was performed on these samples.

In addition to the classification and strength testing, an alluvial composite sample from BOB-3, between 14 to 18 feet, was tested for organic content, with a resulting value of 6.9%. On the typed boring logs, lab-classified soil samples are indicated by capitalized USCS symbols shown in the soil descriptions, and the listing of water content, liquid limit, plastic limit and fines content in the remarks column. A summary of laboratory soil strength test results are presented in the table below. Detailed results of the laboratory tests are included in Appendix E, Laboratory Test Results.

Table 4.3 - Summary of Laboratory Soil Strength Test Results

Boring No.	Sample No. & Depth	Test Performed & ASTM No.	Total Stress Parameters*		Effective Stress Parameters*	
			(°)	**c** (psi)	**’** (°)	**c’** (psi)
BOB-1A	U-1, 4.5’-6.5’	UC (D2166)	-	5.2	-	-
BOB-2A	U-1, 16.5-18.5’	CU w/PP (D4767)	8.9	5.2	22.0	0.0
BOB-3A	U-1, 9.0-11.0’	CU w/PP (D4767)	22.0	2.4	33.2	0.0

**Note: Strength parameters as interpreted by GeoStructures Inc. soil laboratory.*

Disturbed soil samples not tested in the laboratory will be delivered to the USACE Fort Mifflin Engineer Office, Philadelphia, PA. The lab tested soils were containerized at the laboratory upon completion of testing, and were returned to the BoRit site, where they were disposed of in the USEPA-designated soil stockpile.

5.0 SUMMARY OF FINDINGS

Based on the geophysical survey results and test boring investigation, the existing berm around the BoRit Reservoir is composed of highly variable fill soils, including asbestos-containing materials at some locations, underlain by soft alluvial clays and medium to very dense sand and gravel deposits. The information collected from the test borings correlated reasonably well with the top of rock profile and areas of potential ACM as indicated in the MASW survey data.

Test Borings BOB-2 and BOB-3 encountered considerable amounts of asbestos containing material within the fill stratum. In addition, BOB-2 and BOB-2A encountered a 6-inch piece of wood at approximately 3.5 to 4.0 ft below the ground surface suggestive of a buried tree, stump or large tree root.

During the drilling of BOB-2, it was noted that the soil cuttings were not exiting the bore hole while drilling from 8 to 18 feet, and soil sample recovery was very low in this region. This may be a result of the very soft nature of the soil and ACM present in this stratum.

Each test boring encountered areas where wet soil seams/lenses were noted within samples collected above the apparent groundwater table, as indicated by groundwater level readings taken during and after the drilling. It may be that the actual groundwater table at the location of the borings is higher than observed in the field at the time of the test boring work, but that the groundwater levels did not have sufficient time to stabilize in the boreholes prior to being grouted.

6.0 REFERENCES

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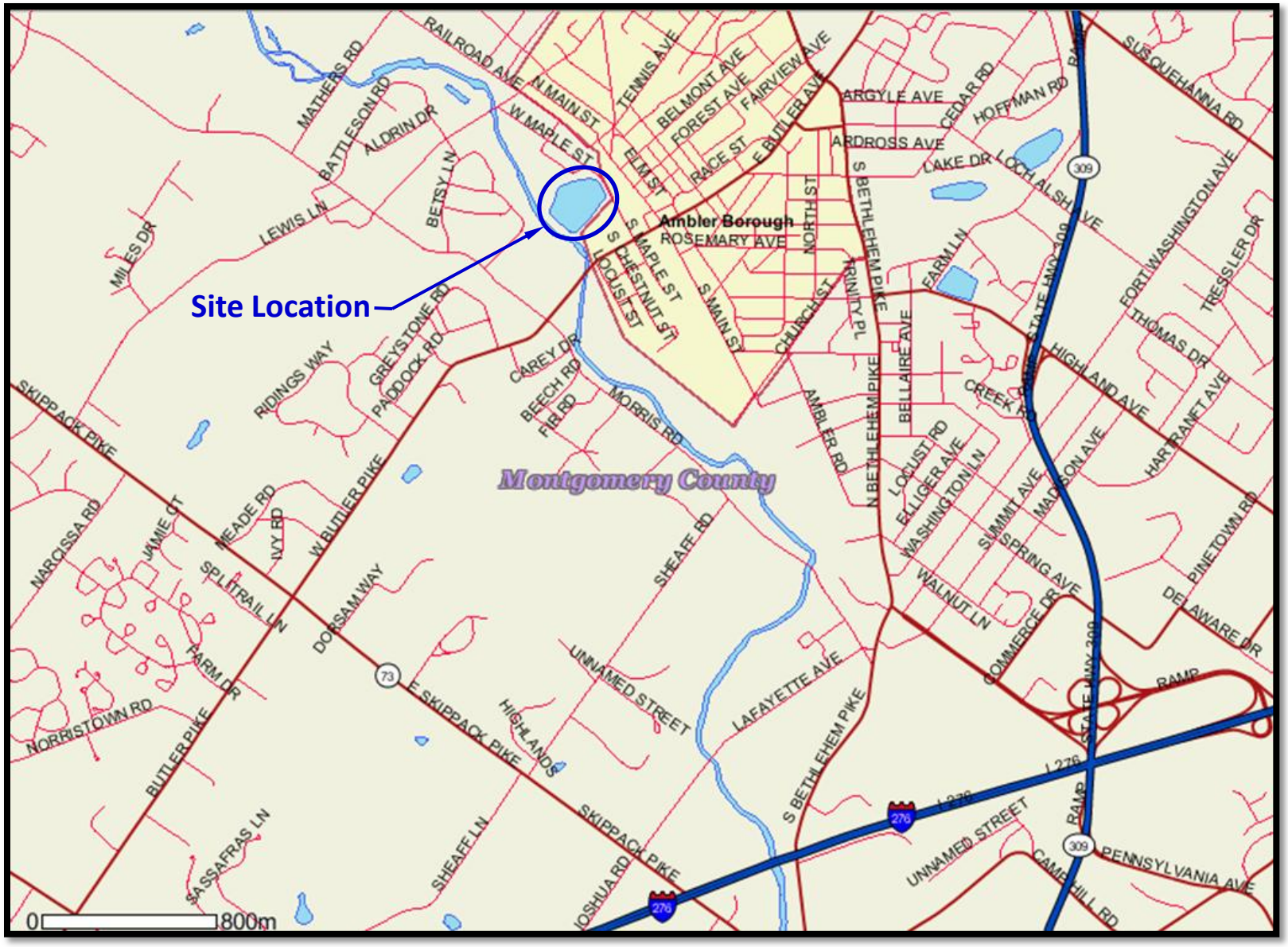
FIGURES



Reference: U.S Department of Agriculture Natural Resources Conservation Service, PennState Cooperative Extension Geospatial Technology Program. Basemap created by SoilMap; http://soilmap.psu.edu.

Figure 1. Site Location Map

Figure 2. Geology Map

Reference: U.S Department of Agriculture Natural Resources Conservation Service, PennState Cooperative Extension Geospatial Technology Program. Basemap created by SoilMap; http://soilmap.psu.edu.

APPENDIX A
Geophysical Investigation Report

QUANTUMGEOPHYSICS

June 11, 2013

Mr. Travis Fatzinger
Attention: CENAP-EC-EG
U.S. Army Engineer District, Philadelphia
The Wanamaker Building
100 Penn Square East
Philadelphia, PA 19107-3390

Re: Final Report
Geophysical Investigation for the BoRit Reservoir
BoRit Superfund Site
Ambler, Pennsylvania

Dear Mr. Fatzinger:

This report presents the findings of Quantum Geophysics' geophysical investigation at the BoRit Superfund Site in Ambler, PA. The investigation included a multi-channel analysis of surface wave (MASW) survey to delineate subsurface stratigraphy and to identify potentially less dense/stiff materials along the perimeter of the reservoir (excluding the northern portion that flanks Maple Street and a private residence), a self-potential (SP) survey to identify potential seepage along the berm that faces the Wissahickon Creek, and an EM61 metal detector survey and a ground penetrating radar (GPR) survey of 3 suspected buried pipes and 1 known pipe. The scope of work is graphically shown in Figure 1.

It is our understanding that in March 2011, a temporary higher pool elevation in the reservoir caused minor surface sloughing on part of the berm that faces the Wissahickon Creek. At the time of the geophysical investigation, water was observed seeping out of the berm in the repaired area. The 3 suspected buried pipes are located along the southern portion of the reservoir. The known pipe is a 24" vitrified clay pipe located at the north end of the reservoir.

The surveys were carried-out April 25-30, 2013 by Quantum's staff geophysicists Greg Fournier and Andrew Bachman. In support of the geophysical investigation, the Corps of Engineers provided an electronic file of a basemap (BoRit Reservoir (1).dwg) for the purpose of plotting the geophysical data and findings. The investigation included a Leica Model G-14 GPS receiver surveying on the Leica Smartnet satellite network referencing PA NAD83 South to locate and geo-reference the geophysical data and findings onto the basemap. The Corps also provided the boring logs from 3 monitoring wells (MW-03, MW-04, and MW-05) as reference. The borings are shown in Figure 1

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and the logs are included in Appendix A.

As part of the overall investigation of the reservoir and subsequent to the geophysical investigation, Gannett Fleming, Inc. drilled 3 geotechnical borings along the berm. Those borings have been incorporated into the analysis of the MASW data. They are shown in the report drawings as BOB-1, BOB-2, and B0B-3, and the logs are included in Appendix B.

Lastly, this final report incorporates comments on the draft report provided by the Corps of Engineers on May 29, 2013.

This report continues with a brief description of our technical approach followed by a detail discussion of the geophysical findings.

TECHNICAL APPROACH

A. MASW Survey

A.1. Brief Description of the MASW Method

MASW is a seismic method that determines the vertical distribution of shear wave velocities (V_s) based upon the dispersion of surface waves (Rayleigh Wave). Seismic surveys generate 2 types of seismic waves - body waves (Compressional Wave and Shear Wave) and surface waves (Rayleigh Wave and Love Wave). Body waves penetrate through the earth; surface waves travel along the free-air boundary where the air is non-bounding (air has no resistance to shear wave forces). The different types of waves also differ in how they displace particles along the direction of propagation. For example, compressional waves, also known as P-waves, displace particles in the direction of wave propagation; whereas shear waves displace particles perpendicular to the direction of wave propagation.

The penetration depth of the Rayleigh Wave depends on the wavelength which, in turn, depends on frequency. When the velocity of materials changes with depth, each frequency component of the surface wave is affected by the different velocities and, therefore, propagates with different phase velocity. This phenomenon is known as dispersion.

By recording fundamental-mode Rayleigh Waves propagating from the source to the receiver, the dispersive properties directly beneath the seismic spread can be measured and represented by a curve (dispersion curve). This curve is used to estimate the vertical variation of V_s through a process known as inversion.

A.2. Brief Description of the MASW Field Work, Data Processing, and Analysis

The MASW survey was conducted along 2 lines designated A-A’ and B-B’. A-A’ is located along

the berm, starting 65 ft. from a chain-link fence that separates the reservoir from the adjacent property. A-A' was set-back from the fence to avoid interference from a sluice box. B-B' is located on the compacted gravel and dirt road along the eastern perimeter of the reservoir.

The MASW survey included a Geometrics Stratavisor 24-channel seismograph (serial number 83038) and a Geometrics Geode 24-channel seismograph (serial number 3700) configured into a 48-channel recording system, 4.5 Hz vertical geophones, and Pro-Seismic spread cables. Seismic waves were generated by striking the ground surface with a 12 lbs sledge hammer. Along B-B', the geophones were mounted onto a landstreamer (kevlar strip with adjustable plates) tethered to a vehicle to avoid poor earth coupling that generally results from difficulties implanting spiked geophones into a "compacted surface".

Data were acquired with geophones spaced 3 ft. apart and a shot offset (distance between shot and 1st in-line geophone) of 15 ft. 0.7 second shot records were acquired at a sampling rate of 62.5 *u*sec every 5 ft of traverse. Each shot record was collected by stacking 3 hammer & plate shots (striking the plate 3 times) to increase the signal-to-noise ratio.

The data were processed using the Kansas Geological (KGS) software program Surfseis. Surfseis converts the raw data (SEG-2) into KGS processing format, combines all shot records into a single file, assigns field geometry (geophone spacing and shot offset), recompiles the data into a roll-along data set, identifies the range of surface wave velocities for each shot record, conducts dispersion curve analysis for all shot records, applies an inversion process to the dispersion curves to determine 1-D V_s, and constructs 2-D V_s profiles by interpolating the 1-D V_s profiles using a Bilinear algorithm.

The V_s profiles were contoured between 200 and 2000 fps, and constructed at a horizontal scale of 1 inch = 100 feet and a vertical scale of 1 inch = 20 feet for a vertical exaggeration (VE) of 5:1.

B. SP Survey

B.1. Brief Description of the SP Method

Because of the ionic property of water, flowing water creates a small electrical current which is different than that at a location where there is no moving water. This represents a voltage difference which is the premise of the SP method.

The SP method locates seepage by making voltage measurements between a base station (located outside of the seepage) and an electrode that occupies discreet locations across the area of concern, generally in a grid pattern. The electrode that is moved about the site is known as the "roving electrode". The potential difference is known as a SP anomaly.

B.2. Brief Description of the SP Field Work, Data Processing, and Analysis

The SP survey was conducted using a pair of Tinker & Rasor copper-copper sulfate porous pot electrodes, a spool of 20 gauge wire, and a Fluke Model 116 multi-meter.
To guide the SP survey, a 10 ft x 10 ft grid was constructed over the area of investigation using fiberglass tape measures and fluorescent paint. The grid extends from the reservoir side of the crest to the bottom of the berm, but excludes the repair at the northwest end of the berm because the porous pot electrodes cannot be coupled with rip rap.

Prior to data acquisition, a simple resistance test was conducted on the wire to check for open breaks. Next, the polarization amongst the electrodes were checked in a bath of copper sulfate solution and entered into a data sheet. A base station was selected about 200 ft southeast of the survey area, and then measurements were made every 10 ft and entered onto the data sheets. Polarization checks were made periodically during the day and at the end of the day to monitor diurnal drift.

In the office, the data were entered into an Excel spreadsheet, a linear progression was applied to the periodic bath measurements and then accordingly applied to the station readings to correct for diurnal changes. The data were then entered into the surface application program Surfer for Windows, gridded using the Kriging Method with an octant search, contoured at an interval of 10 mV, exported as a raster image, and then superimposed onto the base map using GPS data.

C. EM61 Metal Detector and GPR Surveys

C.1. Brief Description of the EM61 and GPR Methods

The Geonics Limited EM61 (serial number 950805) is a time-domain metal detector that incorporates 2 1 meter x 1 meter square coils mounted on BMX bicycle wheels and interfaced with a battery and electronics back pack. The coils are momentarily energized which creates a magnetic field to flow into the earth. The magnetic field, in turn, induces small eddy currents which are detected by the coils. Upon current shut-off, that portion of the induced current associated with non-metallic materials (e.g., clay soils) dissipate instantaneously whereas the current associated with metal (both ferrous and non-ferrous) deteriorate over a short-period of time. Upon current turn-off, the instrument waits a brief moment before making a reading so that the measurement is not influenced by conductive soils.

The EM61 is a simple instrument. When over metal, there is a high response. The larger or closer the metal is to the instrument, the higher the reading. The source of an anomaly is located beneath the coils. Therefore, the shape and size of an EM61 anomaly observed in a contour map constructed from closely-spaced data mimics the shape and size of the source causing the anomaly.

GPR incorporates an antenna that is slowly pulled along the ground surface and rapidly transmits a high-frequency electromagnetic wave (signal) into the earth. When that signal encounters a boundary between materials with contrasting electrical properties, part of that wave energy is reflected back to the surface where it is detected by the antenna, relayed back to a control unit where it is recorded and displayed as a graphic image. The process works much like a depth or fish finder on a boat.

The depth of GPR penetration depends largely on 2 factors, antenna frequency and site soils. Lower frequencies penetrate deeper but have lower resolution than higher frequency antenna. GPR signals penetrate deeper into materials that are electrically resistive. These materials include rock, dry sands and gravels, concrete and asphalt. Lower penetration depths can be expected in electrically conductive materials because these material tend to hold onto moisture and it is the moisture which absorbs and attenuated GPR signals. Fine-grained soils (silts and clays) are generally conductive.

C.2. Brief Description of the EM61 and GPR Field Work, Data Processing, and Analysis

EM61 and GPR were conducted on the 3 suspected buried pipes located at the south end of the reservoir. Only GPR was performed on the 24" vitrified clay pipe at the north end of the reservoir.

The GPR survey included a Geophysical Survey Systems, Inc. (GSI) SIR20 subsurface radar system (serial number 0416) and a 400 MHz antenna. Tests were conducted onsite using both a 400 MHz antenna and a 200 MHz antenna. We chose to use the 400 MHz antenna for collecting all GPR data because it provided much better subsurface resolution than the 200 MHz antenna, and the 200 MHz antenna did not penetrate that much more into the earth than the 400 MHz antenna. GPR data were acquired at 8-bits/sample, 512 samples/scan, and 32 scans/second, with a recording period of 60 nanoseconds (nsec). The antenna was hand-towed along the ground surface at a slow, steady rate of approximately 2 feet per second.

The 3 pipes at the south end of the reservoir were each straddled by survey grids that ranged from 15 ft x 110 ft to 35 ft x 120 ft. The EM61 was operated in the “wheel-mode” whereby data were automatically acquired every 0.86 ft of traverse along lines spaced 5 ft apart for 100% coverage, where accessible. The data were then gridded and contoured at an interval of 5 millivolts (mV) using Surfer for Windows, and superimposed as raster images onto the basemap using GPS coordinates acquired on each grid.

GPR data were collected every 5 ft along lines oriented perpendicular to the trend of the suspected pipes, except over the non-metallic pipe near Maple Street where GPR traverses were run where site conditions permitted (along the road, in a grass median, and in the yard of the private residence). Additional GPR traverses were conducted across linear anomalies observed in the EM61 data to corroborate the cause of the anomalies. GPR data were reviewed using the GSSI software program Radan. The travel-time scale was converted to depth using the an average soil velocity of 1-foot/10 nanoseconds (2-way travel-time).

FINDINGS

MASW Survey of the Reservoir Perimeter

The location of the MASW lines are shown in Figure 2, and the respective V_s profiles are shown in Figures 3 and 4. As stated earlier, A-A' was conducted along the berm; B-B' was conducted along the dirt road.

A layer of relatively low V_s was observed along line A-A' between stations 350 and 875 at depths of about 6 ft to 18 ft below crest of berm. Velocities ranged from approximately 270 to 400 fps, and the layer is nominally 4 ft thick. The low V_s layer is observed within the embankment fill, as well as below the apparent bottom of the berm which we estimated based upon topo. The up-station portion of the low V_s layer coincides with the repair at the base of the berm which is located at sta. 750.

The low V_s layer correlates with a silty Sand (sm) layer with asbestos containing materials reported in boring BOB-2. The materials are mainly very loose. From 8 ft to 16 ft, N values ranged from 2 to 4. Also, very little spoon recovery is reported from 8 ft to 18 ft, attesting to the "looseness" of the materials.

According to borings (BOB-1, BOB-2, and BOB-3), the embankment fill is underlain by alluvial, residual, and decomposed rock to depths of 20.5 ft to 28.8 ft. For the most part, these materials correlate with shear wave velocities of approximately 700 to 1200 fps, except at the vicinity of boring BOB-3 where clay soils with N values as low as 3 and 4 correlate with V_s of approximately 350-400 fps.

Top of rock (TOR) reported in borings match-up with a V_s of 1200 fps. Higher velocities observed below TOR indicate more competent rock. Tracing the 1200 fps contour along the A-A' V_s profile, we note that TOR is shallowest along that portion of the berm that faces Rose Valley Creek, and becomes progressively deeper approaching and along that portion that faces Wissahickon Creek.

Along the dirt road, we note an irregular pattern of shear wave velocities on B-B' between stations 250 and 620, in the approximate depth range of 3-30 ft bgs. V_s is as low as approximately 270 fps and as high as 700 fps. Also, TOR within this station interval is noticeably deeper than TOR observed down-station and up-station (about 40-45 ft bgs vs. nominally 20 ft bgs), and that the change in TOR at either end of this interval is near-vertical, which suggests excavated sidewalls. We suspect that the interval between stations 250 and 620 may be a buried quarry excavation backfilled with bulk asbestos containing material (BACS) debris mixed with soil, as reported in MW-04 which is located on B-B' at approximately station 490. MW-04 reports rock at 18 ft bgs but it is of variable density to at least 29 ft bgs which suggests that it may be rock fill.

Potential Seepage

The fully annotated SP contour map is shown in Figure 5.

The SP data is characterized by a large, low SP anomaly. It is largely amorphous-shaped in the vicinity of the repair but tapers into a narrow linear anomaly that trends SE along slope. It is characterized by nominal measurements of-50 to -70 mV. At the SE end of the anomaly, there is an abrupt decrease in SP with measurements as low as -150 mV. This abrupt change and the relatively low values may be caused by the corrosion of a buried metal pipe or sheet pile. Corroding metal creates a “corrosion potential” and on other similar projects, we have noted the corrosion potential as a low SP anomaly.

We are puzzled that a low SP anomaly is associated with the apparent seepage at the repair. We were expecting a high SP anomaly. It is well documented in the literature, and it has also been our experience, that water flowing into an area (e.g., water moving through an earthen embankment, water leaking from a broken pipe) creates a high SP anomaly. There is no typical SP value representative of seepage since it is partly dependent on flow rate, but we have observed seepage anomalies of over 100 mV at other project sites. Water leaving an area, such as through the bottom of a reservoir, creates a low SP anomaly. Because of this “disparity”, we conducted a root-cause analysis by first examining whether proper field procedures were followed in acquiring the data (e.g., red or positive lead of the voltmeter to the roving electrode and black or negative lead to the base station electrode). We concluded that proper procedures were followed in the field.

We then examined the data processing procedure and concluded that the correct procedures were also followed. Our attention then turned to whether the SP results may have been because of where the base station was located. To see if this was the case, we re-ran the SP survey using a different base station location. The results of the re-run were very similar to those of the initial survey, thereby ruling-out the base station location as the cause of the disparity.

Through the process of elimination, we conclude that the low SP anomaly indicates seepage in the area of the repair but that the polarity of the anomaly is reversed because it is influenced by a corroding potential metal pipe or sheet pile at the southeastern end of the survey area. Though the seepage area and the suspected corroding metal pipe or sheet pile are about 350-400 ft apart, they appear to be “electrically connected” as indicated by a linear trend of low SP measurements observed along the berm.

Suspected Buried Pipes

The EM61 contour maps over the 3 suspected pipes in the southeastern portion of the reservoir, and the location of the GPR lines over these pipes, are shown in Figure 6. Representative GPR profiles are shown in Figures 7 and 8.

Of the 3 possible pipes investigated along the southern portion of the reservoir, the western-most possible pipe identified on the basemap as “possible discharge pipe to investigate (shown in 1988 NUS Report for USEPA)” may be located about 20 ft further west where a potential buried pipe is indicated by a vaguely-defined linear EM61 anomaly and a hyperbolic-shaped GPR anomaly. We marked the hyperbolic-shaped GPR anomaly in the field with a wooden stake labeled “GPR 1a”, and the ends of the linear EM61 anomaly with wooden stakes labeled “GPR 3a” and GPR 3b”.

The geophysical data does not support the presence of the other 2 possible pipes, the C.I. (cast iron) pipe extending-out from a concrete sump pump or the 12" cast iron pipe identified as the possible former intake from reservoir. We do not see any indication of a pipe in the data where the 2 possible pipes are shown on the basemap. The pipes are either buried deeper than the max. depth of exploration of the EM61, which is 10-15 ft bgs, or they are not present where we have EM61 coverage.

About 75 ft east of the C.I. pipe that reportedly extends out from the sump pump, we do observe a linear high EM61 anomaly indicating a potential buried pipe. It trends north-northeast to south-southwest. It is also observed in the GPR data as a small, parabolic-shaped anomaly at a depth of approximately 2 ft bgs. The GPR anomaly is flanked by a pair of opposed dipping reflectors indicative of trench sidewalls (Figure 8). This potential buried pipe is marked in the field with wooden stakes labeled “GPR-2b” and “GPR 2a”. Opposed dipping reflectors are not unique to trench sidewalls. They have also been observed as a result of soil piping/raveling associated with sinkhole activity but we can exclude this from further consideration because the site is not underlain by carbonate geology.

Three GPR lines were conducted across the 24" vitrified clay pipe located at the north end of the reservoir, near Maple Street (Figure 9). The pipe is not readily apparent in the GPR data (Figure 10). The max. depth of investigation with GPR was about 3-4 ft bgs. Some possible explanations why the vitrified clay pipe is not obvious in the GPR data include: 1) insufficient contrast in electrical properties between the pipe and the surrounding materials, 2) it is filled in-place (e.g., grouted) which can make it difficult to see, and 3) pipe is located deeper than what the GPR can penetrate. There are no other geophysical methods capable of detecting a 24" diameter vitrified clay pipe buried 6 ft to 8 ft bgs, baring the influence of site conditions.

Other Observed Features

Several linear EM61 anomalies were identified along the edge of the berm that faces the reservoir (Figure 6). Where observed on the same contour map, they appear “staggered”. We suspect that they may be caused by sheet piles. However, we are not able to corroborate this with the GPR. We do not clearly see indications of sheet piles in the GPR data but then this may be because the sheets are too thin to be observed (resolved) with a 400 MHz antenna.

The boring logs for the 2 monitoring wells located on the east side of the reservoir report asbestos

waste 2-14 ft bgs (MW-04) and 2-18+ ft bgs (MW-05). The wells are shown in Figure 1. MW-04 is located in about the middle of the berm; MW-05 is located at the south end of the reservoir. These two wells are located approximately 330 ft apart. Given that the asbestos waste is reported at about the same depth interval in both wells, it is reasonable to assume that the waste is a layer that is potentially continuous along the east side of the berm, and that sheet piles were installed to contain and prevent the waste from entering the reservoir.

Quantum appreciates this opportunity to be of service. Please call if you have any questions or if we can be of further assistance.

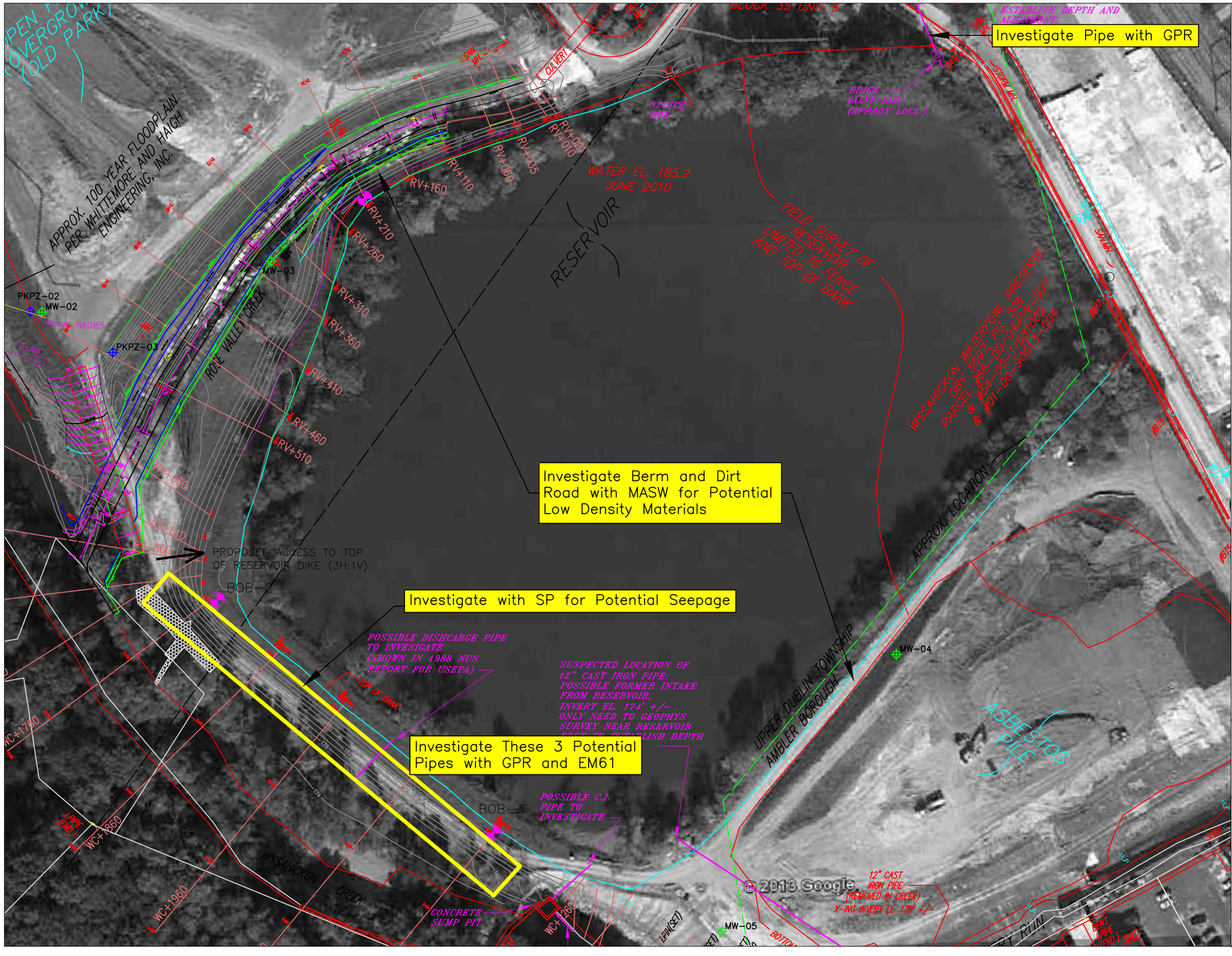
Sincerely,

***Quantum** Geophysics*
A Division of Gannett Fleming, Inc.

Richard K. Lee

Richard K. Lee, P.G., R.GP.
President and Principal Geophysicist

RKL/jas



LEGEND:

PROPOSED EXPLORATORY BORING — BOB-2

EXISTING MONITORING WELL — MW-04

EXISTING PIEZOMETER — PKPZ-03

LUDGATE SURVEY X-SECTION — RV+210

NOTES:

1. THE TOPOGRAPHY DEPICTED ON THIS MAP REPRESENTS THE RESULTS OF SURVEYING PERFORMED BY LUDGATE ENGINEERING IN JUNE 2010 AND CAN ONLY BE CONSIDERED INDICATIVE OF THE GENERAL CONDITIONS EXISTING AT THAT TIME.

2. THE CONTRACTOR IS URGED AND EXPECTED TO INSPECT THE SITE WHERE SERVICES ARE TO BE PERFORMED AND TO SATISFY HIMSELF REGARDING ALL GENERAL AND LOCAL CONDITIONS THAT MAY AFFECT THE COST OF CONTRACT PERFORMANCE.

3. GRAVEL ACCESS ROADS SURROUND THE RESERVOIR, BUT GAINING ACCESS ONTO THE RESERVOIR DIKE MUST BE DONE BY DRIVING UP THE 3H:1V DIKE SLOPE AT THE LOCATION INDICATED. ACCESS IS ALSO LIMITED BY VEGETATION ON SOME AREAS OF THE DIKE. AS SUCH, USE OF AN ALL TERRAIN VEHICLE DRILL RIG IS REQUIRED.

4. THE CONTRACTOR SHALL LAY OUT THE PROPOSED BORINGS USING GPS AND IN COORDINATION WITH THE USACE. BORING LOCATIONS SHALL BE FIELD-ADJUSTED AS NECESSARY AND APPROVED PENDING THE RESULTS OF THE GEOPHYSICAL SURVEY. UPON COMPLETION OF THE BORINGS, THE BORING LOCATIONS SHALL BE SURVEYED (X,Y,Z COORDINATES) AS SPECIFIED IN THE SCOPE OF WORK.

5. CONTOUR INTERVAL = 2 FEET.

0 100 200 300

Scale (ft)

Basemap: BORIT-RESERVOIR_Negative Rotation.dwg provided by the Phila. COE.

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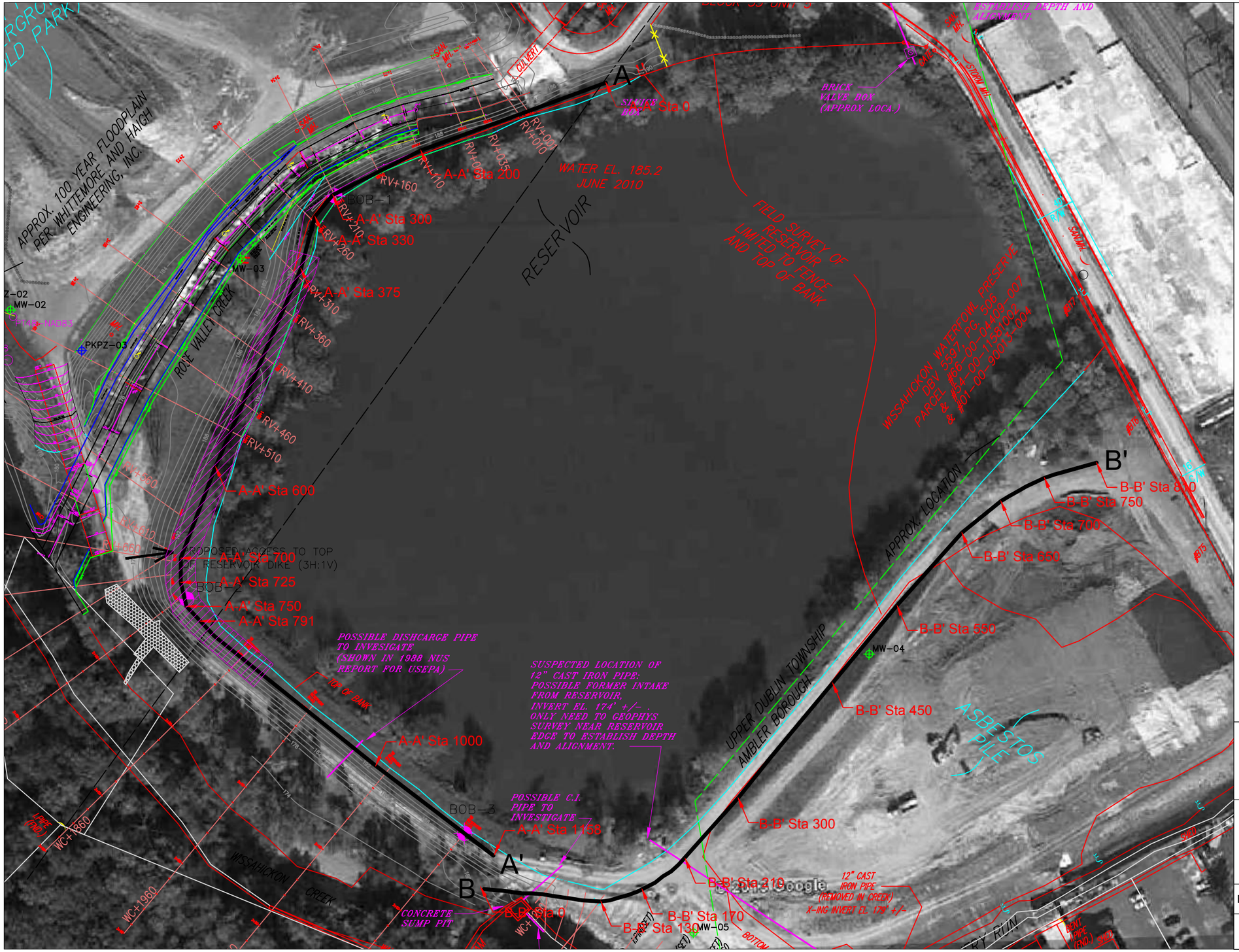
Sitemap
Geophysical Investigation for the BoRit Reservoir
BoRit Superfund Site
Ambler, Pennsylvania

For:	Philadelphia Army Corps of Engineers		Figure
Date: 5-14-13	Project No.: 054414.0005.3000	File: C:\Phila COE\BoRit\Fig 1.dwg	1



LEGEND

A-A' Sta 0
A — A'

MASW Line and Stationing Based Upon GPS.

Low Vs (250-400 fps) Materials. Contains Asbestos According to Boring BOB-2.

Fence.

0 100 200 300

Scale (ft)

Basemap: BORIT-RESERVOIR_Negative Rotation.dwg provided by the Phila. COE.

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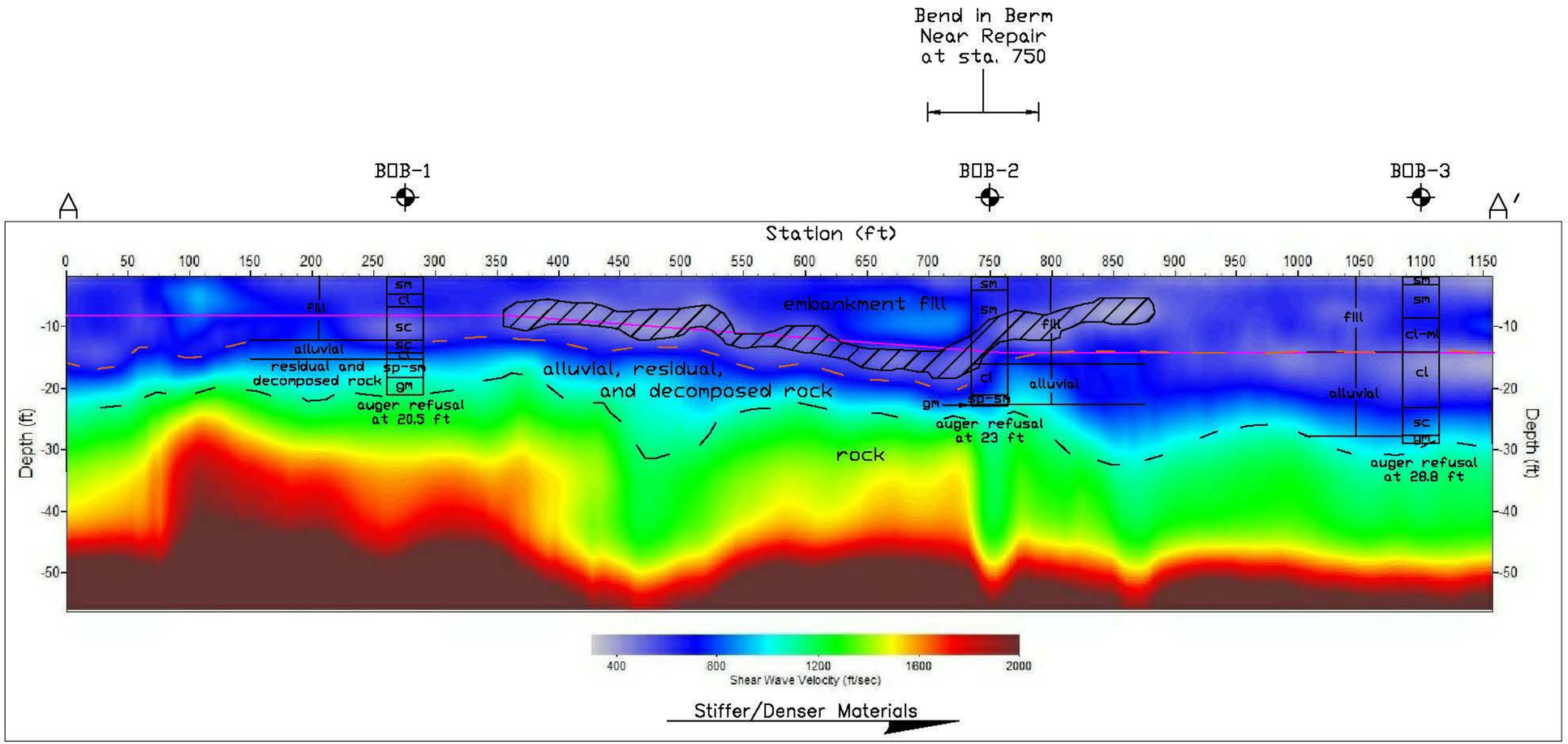
MASW Survey
Geophysical Investigation for the BoRit Reservoir
BoRit Superfund Site
Ambler, Pennsylvania

For:	Philadelphia Army Corps of Engineers		Figure 2
Date: 5-14-13	Project No.: 054414.0005.3000	File: C:\Phila COE\BoRit\Fig 2.dwg	



LEGEND

- Approximate Bottom of Berm, Based Upon Topo.
- Base of Embankment Fill.
- Top of Rock (TOR)
- Low Vs (270–400 fps) Layer, Contains Asbestos According to Boring BOB–2.

sc = clayey Sand
sm = silty Sand
gm = silty Gravel with sand
cl = Clay
sp–sm = Sand with silt and gravel
cl–ml = silty Clay with sand

Note: Layer descriptions (e.g., alluvial, residual, and decomposed rock) based upon boring logs.

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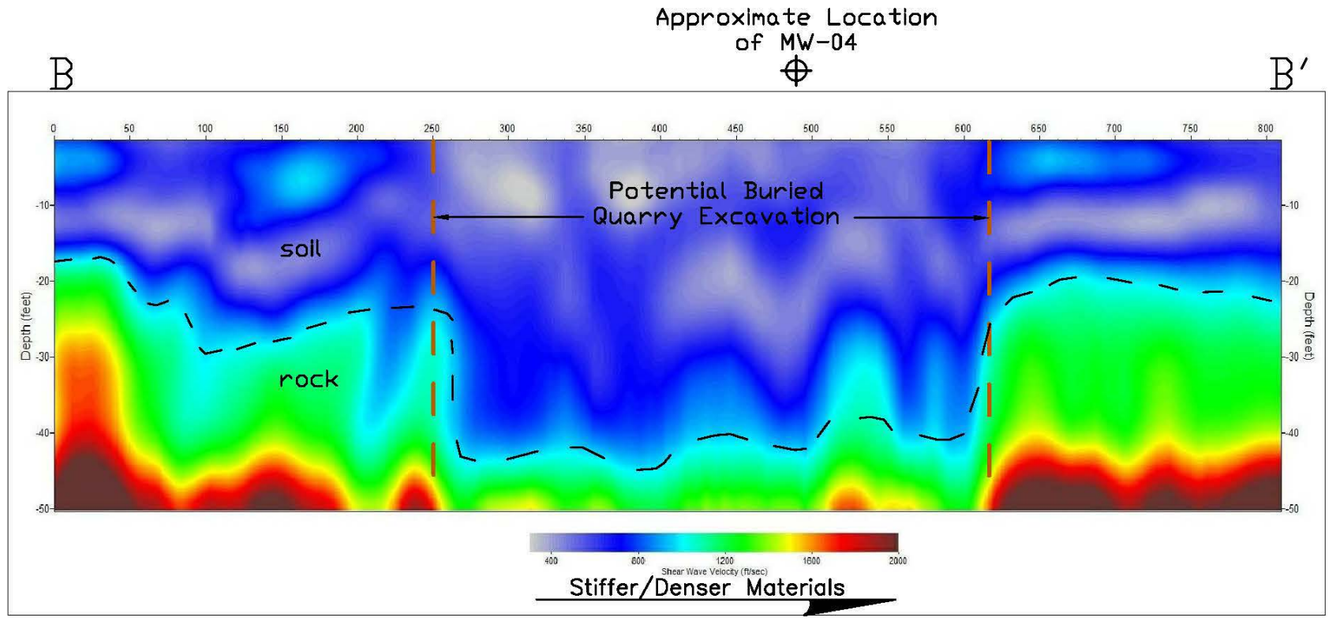
V_s Profile A-A'
Geophysical Investigation for the BoRit Reservoir
BoRit Superfund Site
Ambler, Pennsylvania

For:	Philadelphia Army Corps of Engineers		Figure
Date: 5-14-13	Project No.: 054414.0005.3000	File: C:\Phila COE\BoRit\Fig 3.dwg	3



Note: MW-04 reports BACS (bulk asbestos containing waste) debris mixed with soil 2-18 ft bgs. Apparent weathered rock of variable density 18-29 ft bgs.

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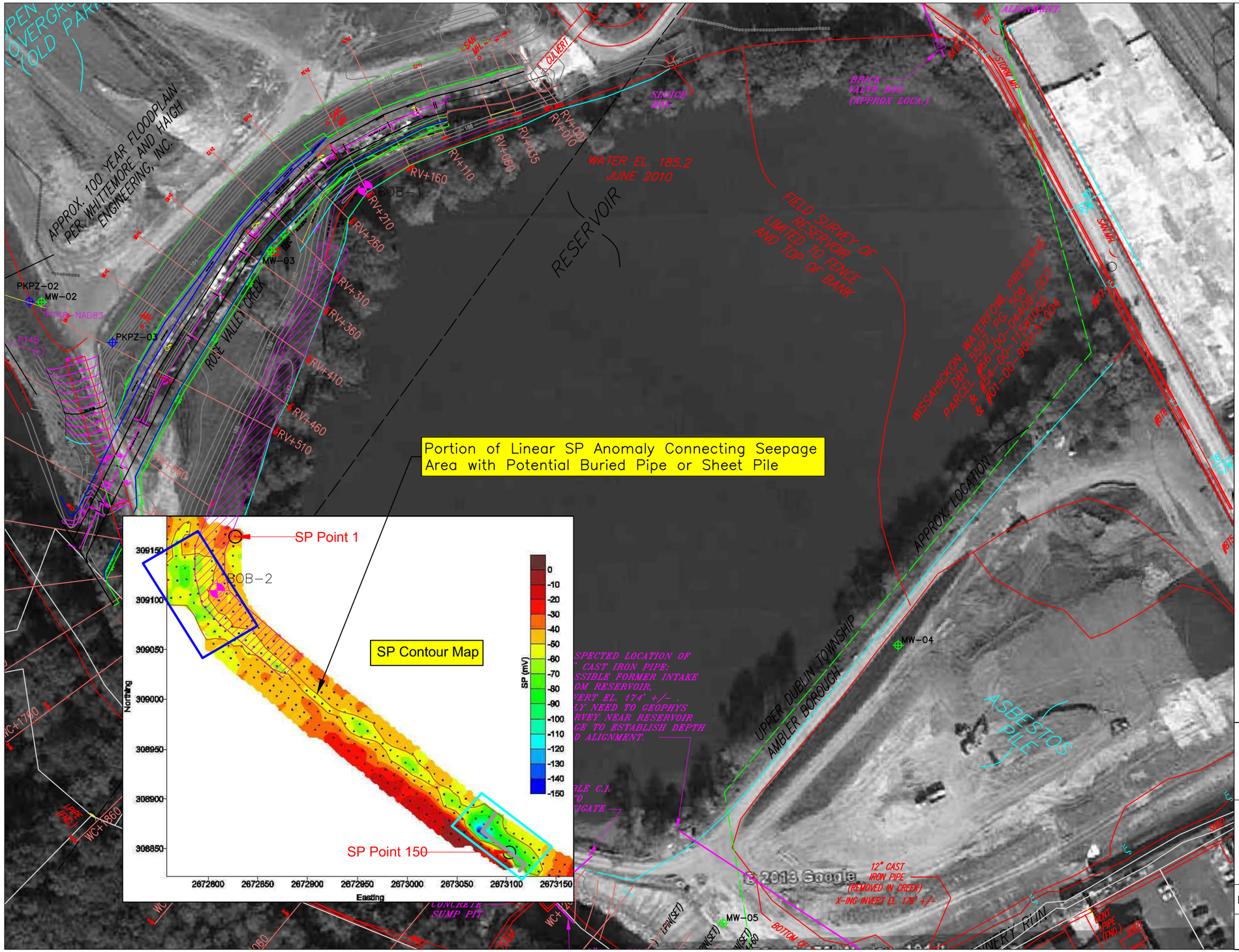
V_s Profile B-B'
Geophysical Investigation for the BoRit Reservoir
BoRit Superfund Site
Ambler, Pennsylvania

For:	Philadelphia Army Corps of Engineers	Figure
Date: 5-14-13	Project No.: 054414.0005.3000	File: C:\Phila COE\BoRit\Fig 4.dwg	4



LEGEND

SP Point 1	Point Located with GPS and Used to Geo-Reference the SP Contour Map.
	SP Measurement Station.
	Linear SP Anomaly.
	Portion of Linear SP Anomaly Caused by Seepage.
	Portion of Linear SP Anomaly Caused by Corrosion of Potential Buried Pipe or Sheet Pile.
	Potential Buried Pipe, or Sheet Pile.
	Low Vs (250-400 fps) Materials. Contains Asbestos According to Boring BOB-2.

0 100 200 300

Scale (ft)

Basemap: BORIT-RESERVOIR_Negative Rotation.dwg provided by the Phila. COE.

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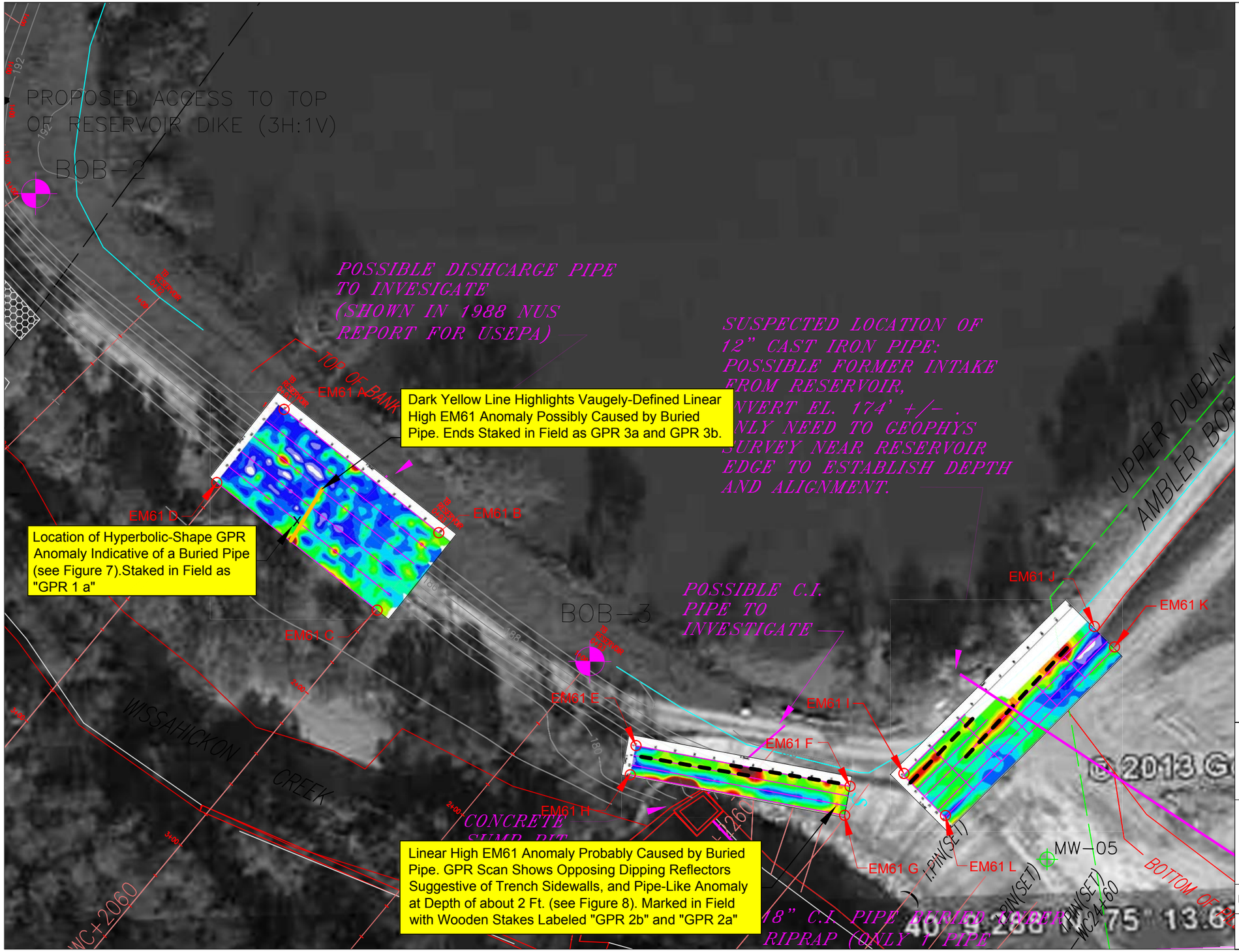
SP Contour Map
Geophysical Investigation for the BoRit Reservoir
BoRit Superfund Site
Ambler, Pennsylvania

For:	Philadelphia Army Corps of Engineers		Figure
Date:	Project No.:	File:	5
5-14-13	054414.0005.3000	C:\Phila COE\BoRit\Fig 5.dwg	



LEGEND

EM61 A — Point Located with GPS and Used to Geo-Reference the EM61 Contour Maps.

GPR Line.

Linear High EM61 Anomaly Potentially Caused by Sheet Pile.

EM61 (mV)

-10 0 10 20 30 40 50 60 70

0 50 100 150

Scale (ft)

Basemap: BORIT-RESERVOIR_Negative Rotation.dwg provided by the Phila. COE.

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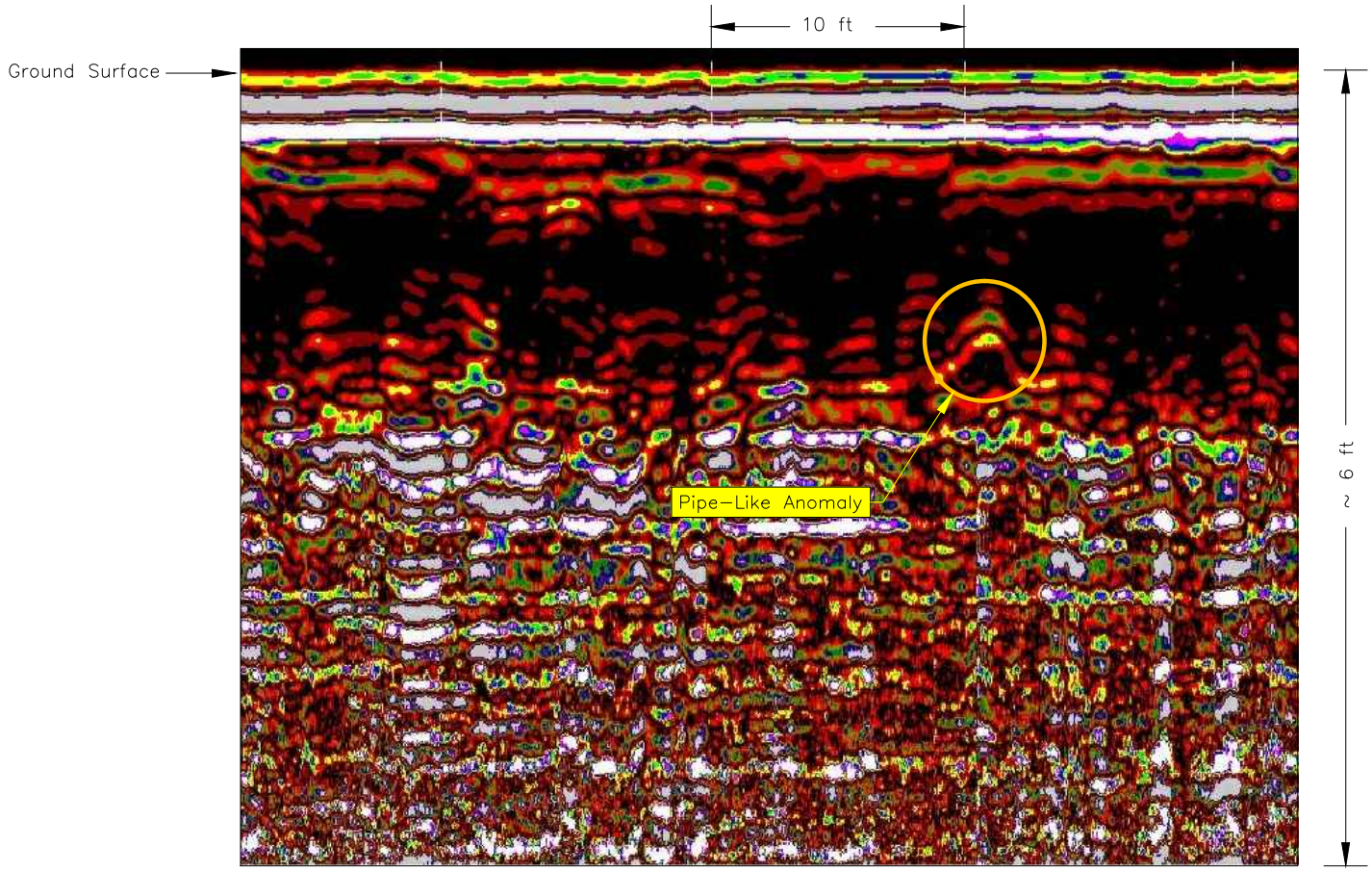
EM61 Contour Maps and GPR Survey Lines
Geophysical Investigation for the BoRit Reservoir
BoRit Superfund Site
Ambler, Pennsylvania

For:	Philadelphia Army Corps of Engineers		Figure
Date:	Project No.:	File:	6
5-14-13	054414.0005.3000	C:\Phila COE\BoRit\Fig 6.dwg	



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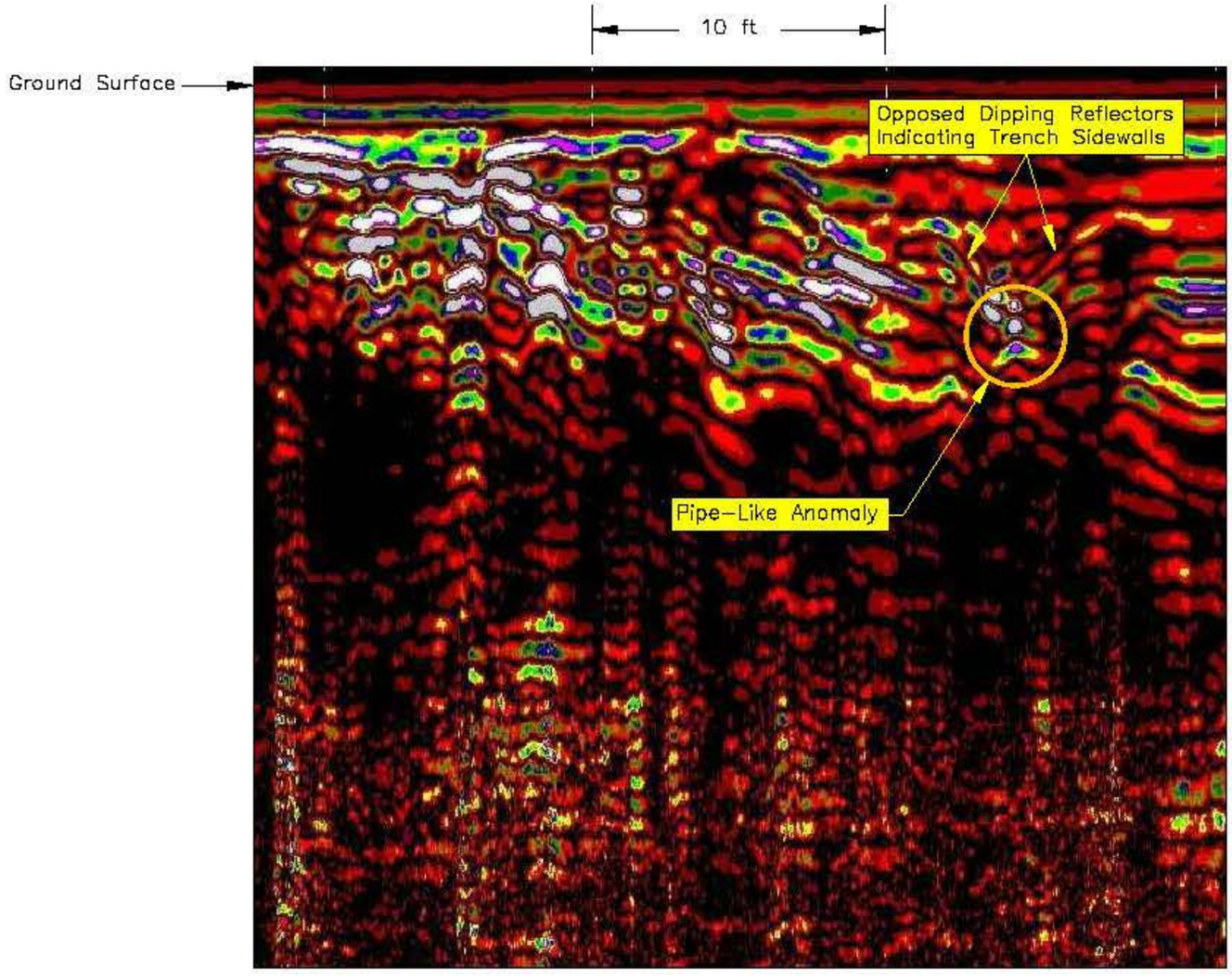
GPR Profile
Geophysical Investigation for the BoRit Reservoir
BoRit Superfund Site
Ambler, Pennsylvania

For:	Philadelphia Army Corps of Engineers	Figure 7
Date: 5-14-13	Project No.: 054414.0005.3000	File: C:\Phila COE\BoRit\Fig 7.dwg



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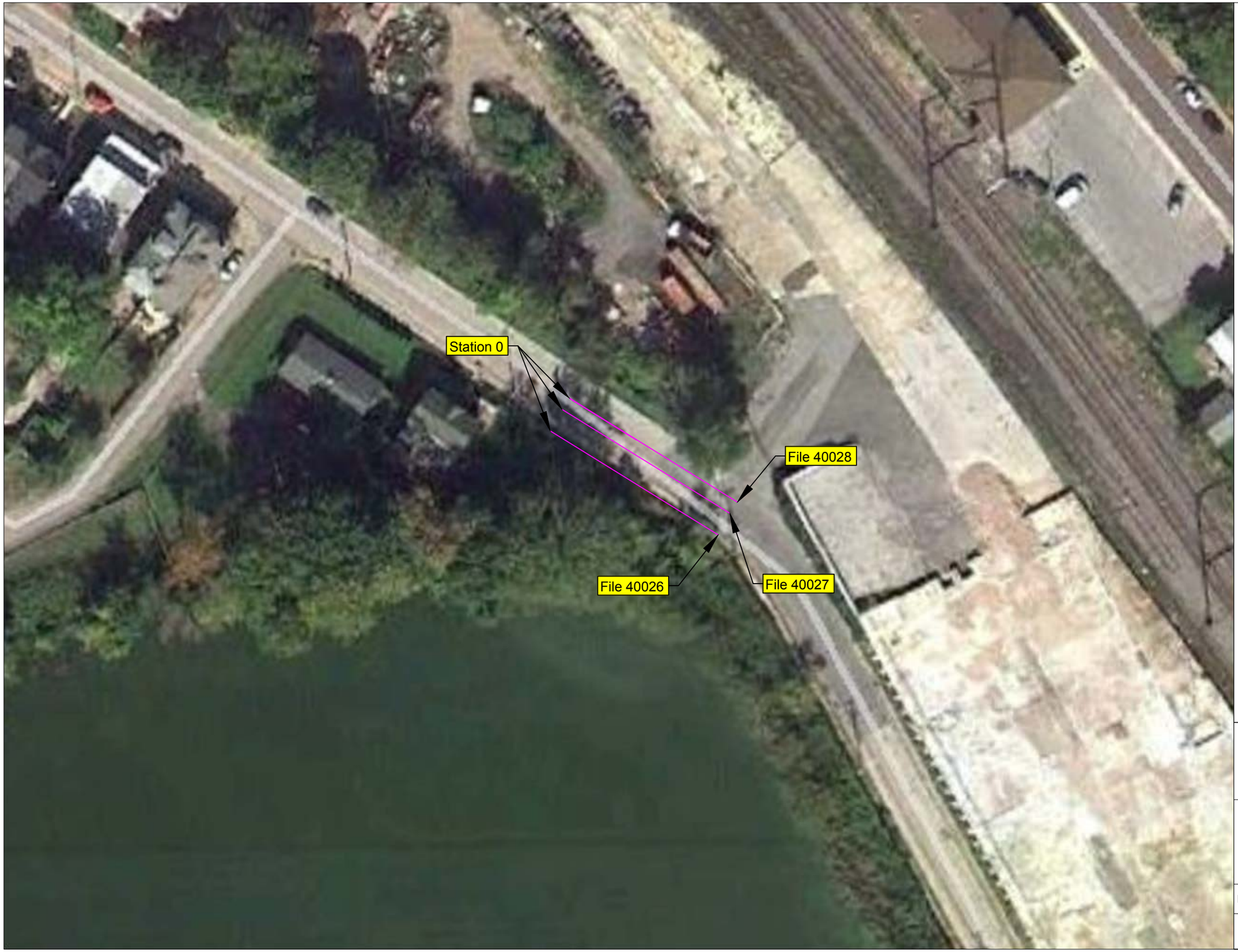
GPR Profile
Geophysical Investigation for the BoRit Reservoir
BoRit Superfund Site
Ambler, Pennsylvania

For:	Philadelphia Army Corps of Engineers		Figure 8
Date: 5-14-13	Project No.: 054414.0005.3000	File: C:\Phila COE\BoRit\Fig 8.dwg	



LEGEND

GPR Line.

0 50 100 150

Scale (ft)

Basemap: BORIT-RESERVOIR_Negative Rotation.dwg provided by the Phila. COE.

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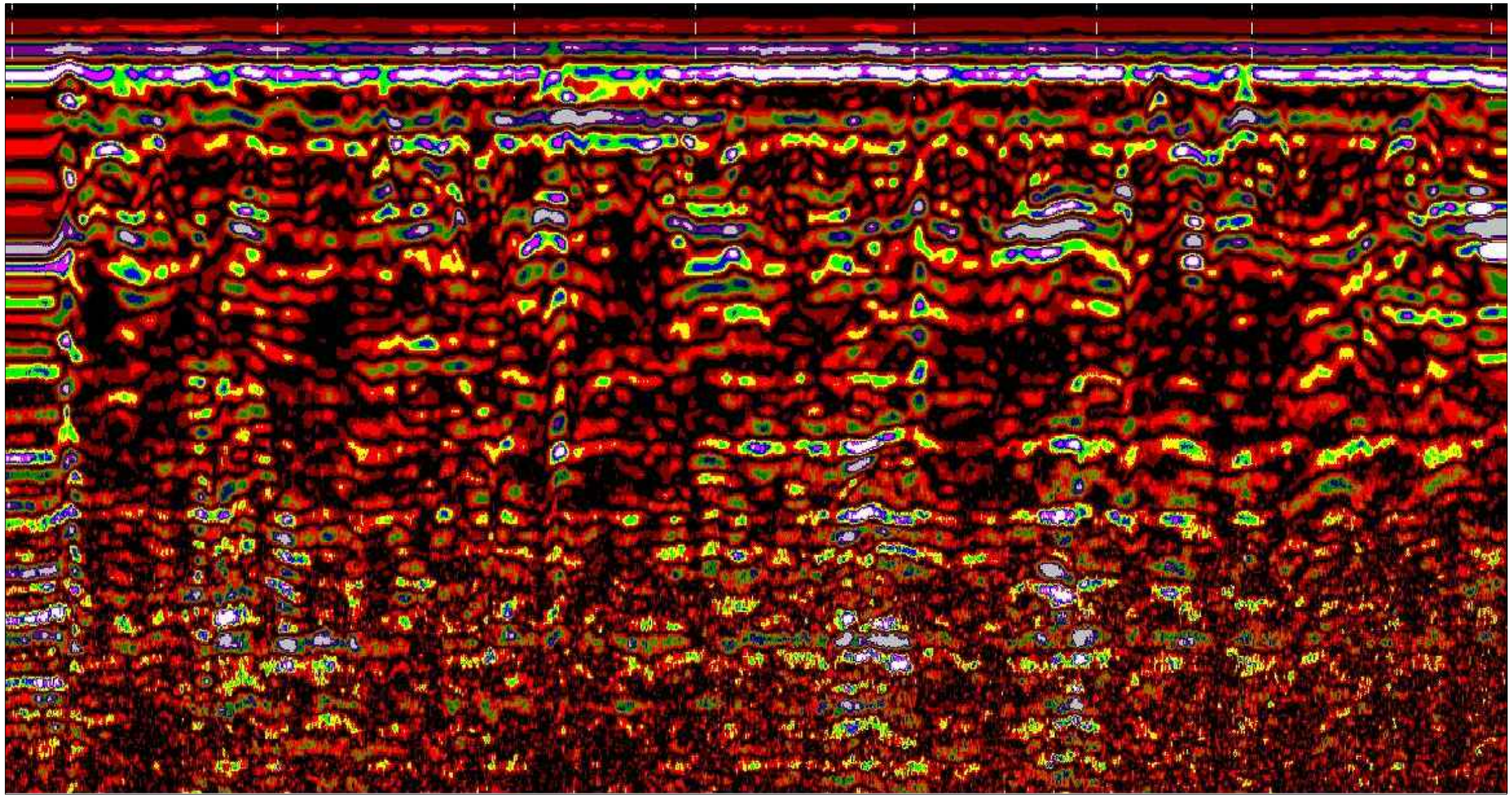
GPR Survey Lines In Area of Maple Street
Geophysical Investigation for the BoRit Reservoir
BoRit Superfund Site
Ambler, Pennsylvania

For:	Philadelphia Army Corps of Engineers		Figure 9
Date: 5-14-13	Project No.: 054414.0005.3000	File: C:\Phila COE\BoRit\Fig 9.dwg	

10 ft

Ground Surface



~ 9 ft

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GPR Profile in Area of Maple Street
Geophysical Investigation for the BoRit Reservoir
BoRit Superfund Site
Ambler, Pennsylvania

For:	Philadelphia Army Corps of Engineers		Figure
Date: 5-14-13	Project No.: 054414.0005.3000	File: C:\Phila COE\BoRit\Fig 10.dwg	10

Appendix A

Logs for MW-03, MW-04 and MW-05

PROJECT: Borit Asbestos
LOCATION: Ambler, Pennsylvania

HSA/AIR HAMMER NO: USEPA

MW-03

STARTED: 10/22/10 COMPLETED: 10/28/10
DRILLING COMPANY: Uni-Tech
DRILLING EQUIPMENT: CME-85/Reichdrill T-650-W
DRILLING METHOD: HSA/Air Rotary, 6 In. Dia. Borehole
SAMPLING METHOD: Split Spoon
SURFACE COMPLETION: Steel Stickup

NORTHING: 309452.96 FT EASTING: 2672863.64 FT
G.S. ELEVATION: 181.7 FT M.P. ELEV: 183.27
WATER: 48 FT TOTAL DEPTH: 53.0 FT
LOGGED BY: S. Moller
HORIZONTAL DATUM: NAD83, COORD. SYS.: State Plane PA South

DEPTH (feet)	GRAPHIC LOG	USCS	DESCRIPTION (Sampler Length: 2 Feet)	SAMPLE INTERVAL (feet)	RECOV. (feet)	BLOW COUNTS	PID (ppm)	ELEV. (ft)	ANALYTICAL SAMPLE	SAMPLE ID	Asbestos (MFL)	Other Detections
1–2			FILL: Silty clay with trace gravel, dark grayish-brown, slightly moist, medium dense.	0 to 2	0.83	10 10 9 8	0	180				
3–4		SM	Native. Fine medium silty sand with clay, trace rootlets, dark brown, slightly moist, loose.	2 to 4	1.67	7 4 6 5	0					
5		SP	Fine medium, trace clay sand, dark brown to black, slightly moist to wet, loose.	4 to 6	1.5	1 2 3 1	0					
6–7		SC	Fine clay, sand with gravel, black and silty clay, dark gray, wet, soft/loose.	6 to 8	1.17	1 1 1 4	0	175				
8–9				8 to 10	2	NR NR NR NR	0					
10		CL	Reddish clay with fine sand and sub-rounded gravel, stiff, slightly moist.	10 to 12	1.33	3 4 15 13	0					
11–13		SC	Mixed reddish sandy clay and fine medium tan sand, slightly moist, very dense, layer of dark reddish brown rock at 12.4 feet.	12 to 14	0.92	23 50/5	0	170				
14–16			Reddish brown fine grained bedrock. HSA refusal at 14.4 feet. Overdrill with 10 inch air hammer to 24 feet, install 6-inch steel casing.	14 to 16	0.42	50/5	0					
17–23								165				
22								160				
24–29			Drilling below casing with 6-inch air hammer.					155				

Abbreviations

AAPW - Apparent asbestos process waste
ACM - Asbestos containing material
BACM - Bulk ACM debris
BACS - Bulk ACM debris mixed with soil
NM - Not measured
NR - Not recorded
WOH - Weight of hammer
WOR - Weight of rod

Consistency vs Blowcount/Foot

Granular (Sand):				Fine Grained (Clay):			
V. Loose:	0-4	Dense:	30-50	V. Soft:	<2	Stiff:	8-15
Loose:	4-10	V. Dense:	>50	Soft:	2-4	V. Stiff:	15-30
M. Dense:	10-30			M. Stiff:	4-8	Hard:	>30

Camp, Dresser & McKee Inc
14420 Albemarle Point Place Suite 210
Chantilly, VA 20151
Telephone: 703-968-0900
Fax: 703-968-0915

HSA/Air Hammer LOG
Draft

PROJECT NO. 3330.029

BORIT LOGS WITH WATER DATA BORIT_ASBESTOS.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 02/24/11 REV.

PROJECT: Borit Asbestos
LOCATION: Ambler, Pennsylvania

HSA/AIR HAMMER NO: **MW-03**

DEPTH (feet)	GRAPHIC LOG	USCS	DESCRIPTION (Sampler Length: 2 Feet)	SAMPLE INTERVAL (feet)	RECOV. (feet)	BLOW COUNTS	PID (ppm)	ELEV. (ft)	ANALYTICAL SAMPLE	SAMPLE ID	Asbestos (MFL)	Other Detections
31–66			Drilling below casing with 6-inch air hammer. *(continued)*					150, 145, 140, 135, 130, 125, 120				
48			Drilling below casing with 6-inch air hammer. Water-bearing fracture encountered at 48 feet.									
53			End of Boring at 53 feet bgs. Well Screen installed 43 - 53 feet. See well construction diagram.									

BORIT LOGS WITH WATER DATA BORIT_ASBESTOS.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 02/24/11 REV.

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Draft

PROJECT NO. 3330.029

PROJECT: Borit Asbestos
LOCATION: Ambler, Pennsylvania

HSA/AIR HAMMER NO: USEPA

MW-04

STARTED: 10/27/10 COMPLETED: 11/2/10
DRILLING COMPANY: Uni-Tech
DRILLING EQUIPMENT: CME-85/Reichdrill T-650-W
DRILLING METHOD: HSA/Air Rotary, 6 In. Dia. Borehole
SAMPLING METHOD: Split Spoon
SURFACE COMPLETION: Steel Flush-mount

NORTHING: 309044.44 FT EASTING: 2673481.37 FT
G.S. ELEVATION: 195.79 FT M.P. ELEV: 195.44
WATER: 95 FT TOTAL DEPTH: 100.0 FT
LOGGED BY: S. Moller
HORIZONTAL DATUM: NAD83, COORD. SYS.: State Plane PA South

DEPTH (feet)	GRAPHIC LOG	USCS	DESCRIPTION (Sampler Length: 2 Feet)	SAMPLE INTERVAL (feet)	RECOV. (feet)	BLOW COUNTS	PID (ppm)	ELEV. (ft)	ANALYTICAL SAMPLE	SAMPLE ID	Asbestos (MFL)	Other Detections
1–2			FILL: Road gravel over dark gray wet clay, firm.	0 to 2	0.83	16 18 19 5	0	195				
3–4			BACS: 4-inch red clay over grayish-white fibrous silty material, slightly moist, soft.	2 to 4	1.17	12 8 8 6	0					
5–6				4 to 6	1.5	1 2 1 2	0	190				
7–8			BACS: 4-inch red clay over grayish-white fibrous silty material, slightly moist, soft. Layers of green, red gray, brown fill, very soft.	6 to 8	1.5	1 1 1 WOH	0					
9–10			BACS: 4-inch red clay over grayish-white fibrous silty material, slightly moist, soft. Wet in area near shoe.	8 to 10	2	WOH WOH WOH WOH	0					
11–12			BACS: White, very soft, spongy, vermiculite-like material with colored laminae. Black mucky material from 12 to 13 feet, then back to white.	10 to 12	2	WOH WOH WOH WOH	0	185				
13–14				12 to 14	2	WOH WOH WOH WOH	0					
15–16		SM	Native, dark brown silty sand, moist, very soft.	14 to 16	0.33	2 WOH WOH WOH	0					
17–18		ML	Fine silt with sand and clay, very dark brown, very soft, wet.	16 to 18	2	WOH WOH WOH WOH	0	180				
19–20			Reddish brown to green slightly cemented sand apparent weathered sandstone, dense.	18 to 20	1.5	17 22 50/6	0					
21–22			Same as above, becomes softer.	20 to 22	1.5	7 10 12 12	0	175				
23–24			Same as above, becomes denser, greenish. PID malfunctions due to rain.	22 to 24	0.83	22 25 28 40	0					
25–26				24 to 26	0.67	21 50/5	NM					
27–28			No Recovery	26 to 28	0	50/6	NM	170				
29			Same as above, becomes denser, greenish. PID malfunctions due to rain.	28 to 30	1.5	25 30 50/2	NM					

Abbreviations

AAPW - Apparent asbestos process waste
ACM - Asbestos containing material
BACM - Bulk ACM debris
BACS - Bulk ACM debris mixed with soil
NM - Not measured
NR - Not recorded
WOH - Weight of hammer
WOR - Weight of rod

Consistency vs Blowcount/Foot

Granular (Sand):

V. Loose:	0-4	Dense:	30-50
Loose:	4-10	V. Dense:	>50
M. Dense:	10-30		

Fine Grained (Clay):

V. Soft:	<2	Stiff:	8-15
Soft:	2-4	V. Stiff:	15-30
M. Stiff:	4-8	Hard:	>30

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HSA/Air Hammer LOG
Draft

PROJECT NO. 3330.029

BORIT LOGS WITH WATER DATA BORIT_ASBESTOS.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 02/24/11 REV.

PROJECT: Borit Asbestos
LOCATION: Ambler, Pennsylvania

HSA/AIR HAMMER NO: **MW-04**

DEPTH (feet)	GRAPHIC LOG	USCS	DESCRIPTION (Sampler Length: 2 Feet)	SAMPLE INTERVAL (feet)	RECOV. (feet)	BLOW COUNTS	PID (ppm)	ELEV. (ft)	ANALYTICAL SAMPLE	SAMPLE ID	Asbestos (MFL)	Other Detections
31			Black, very fine grained, very dense rock in shoe.	30 to 32	0.25	50/4	NM	165				
32												
33			Greenish sandstone bedrock, very dense. HSA refusal at 32.1 feet.	32 to 34	0.17	50/2	NM					
34												
35			Overdrill with 10-inch air hammer to 44 feet, install 6-inch steel casings. Sandstone bedrock.									
36								160				
37												
38												
39												
40												
41								155				
42												
43												
44			Darker reddish brown bedrock cuttings.									
45												
46								150				
47												
48												
49												
50												
51								145				
52												
53												
54												
55												
56								140				
57												
58												
59												
60			Return to gray-brown apparent sandstone cuttings.									
61								135				
62												
63												
64												
65												
66								130				

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HSA/Air Hammer LOG
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PROJECT NO. 3330.029

PROJECT: Borit Asbestos
LOCATION: Ambler, Pennsylvania

HSA/AIR HAMMER NO: **MW-04**

DEPTH (feet)	GRAPHIC LOG	USCS	DESCRIPTION (Sampler Length: 2 Feet)	SAMPLE INTERVAL (feet)	RECOV. (feet)	BLOW COUNTS	PID (ppm)	ELEV. (ft)	ANALYTICAL SAMPLE	SAMPLE ID	Asbestos (MFL)	Other Detections
67–102			Return to gray-brown apparent sandstone cuttings. *(continued)*					125, 120, 115, 110, 105, 100, 95				
82			Sandstone bedrock cuttings.									
95			Sandstone bedrock cuttings. Estimated depth of initial water-bearing fracture at 95 feet.									
100			End of boring at 100 feet bgs. Well screen installed 80 - 100 feet. See well construction diagram.									

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HSA/Air Hammer LOG
Draft

PROJECT NO. 3330.029

PROJECT: Borit Asbestos
LOCATION: Ambler, Pennsylvania

HSA/AIR HAMMER NO: USEPA

MW-05

STARTED: 10/27/10 COMPLETED: 10/29/10
DRILLING COMPANY: Uni-Tech
DRILLING EQUIPMENT: CME-85/Reichdrill T-650-W
DRILLING METHOD: HSA/Air Rotary, 6 In. Dia. Borehole
SAMPLING METHOD: Split Spoon
SURFACE COMPLETION: Steel Stickup

NORTHING: 308764.39 FT
G.S. ELEVATION: 190.99 FT
WATER: 58 FT
LOGGED BY: S. Moller
EASTING: 2673296.79 FT
M.P. ELEV: 192.81
TOTAL DEPTH: 64.0 FT
HORIZONTAL DATUM: NAD83, COORD. SYS.: State Plane PA South

DEPTH (feet)	GRAPHIC LOG	USCS	DESCRIPTION (Sampler Length: 2 Feet)	SAMPLE INTERVAL (feet)	RECOV. (feet)	BLOW COUNTS	PID (ppm)	ELEV. (ft)	ANALYTICAL SAMPLE	SAMPLE ID	Asbestos (MFL)	Other Detections
1–2			FILL: Dark grayish-brown silty sand with clay, wet, medium dense with gravel.	0 to 2	0.67	7 14 14 7	0	190				
3–6			BACS: 6-inch gray silty material with bulk ACM over layers of dark gray, red, and white material, fibrous, slightly moist, loose/soft.	2 to 4	0.83	4 7 12 6	0					
				4 to 6	0.83	5 3 1 2	0					
				6 to 8	0.67	2 4 3 2	0	185				
8–10				8 to 10	0.5	2 1 3 1	0					
11–12				10 to 12	0.5	1 1 1 1	0	180				
12–14			BACM: Bulk ACM with wire reinforcing observed.	12 to 14	0.5	3 2 2 2	0					
15–16				14 to 16	0.33	1 2 1 1	0					
16–18				16 to 18	0.5	2 5 4 4	0	175				
19–20		ML	Native, 3-inch silt with red-brown organics, 4-inch sand with silt and gravel over fine silt with clay and trace organics, wet, very soft, dark gray.	18 to 20	2	4 3 3 WOH	0					
20–22				20 to 22	1	2 3 1 1	0	170				
22		GWS	6-inch sand and gravel.	22 to 24	2	WOH 2 3 8	0					
23		ML	12-inch silt with clay.									
24		GWS										
24		GWS	6-inch sand and gravel, loose/soft, wet, dark gray to dark grayish brown.	24 to 26	1	8 11 7 8	0					
25		SP	8-inch sand and gravel, same as above.									
26–27			4-inch weathered rock and sand, red, medium dense.	26 to 28	2	10 16 25 50	0	165				
28–29			Same as above. HSA refusal at 29 feet.	28 to 30	0.5	21 50/5	0					

BORIT LOGS WITH WATER DATA BORIT_ASBESTOS.GPJ STANDARD_ENVIRONMENTAL_PROJECT.GDT 02/24/11 REV.

Abbreviations

AAPW - Apparent asbestos process waste
ACM - Asbestos containing material
BACM - Bulk ACM debris
BACS - Bulk ACM debris mixed with soil
NM - Not measured
NR - Not recorded
WOH - Weight of hammer
WOR - Weight of rod

Consistency vs Blowcount/Foot

Granular (Sand):

V. Loose:	0-4	Dense:	30-50
Loose:	4-10	V. Dense:	>50
M. Dense:	10-30		

Fine Grained (Clay):

V. Soft:	<2	Stiff:	8-15
Soft:	2-4	V. Stiff:	15-30
M. Stiff:	4-8	Hard:	>30

Camp, Dresser & McKee Inc
14420 Albemarle Point Place Suite 210
Chantilly, VA 20151
Telephone: 703-968-0900
Fax: 703-968-0915

HSA/Air Hammer LOG
Draft

PROJECT NO. 3330.029

PROJECT: Borit Asbestos
LOCATION: Ambler, Pennsylvania

HSA/AIR HAMMER NO:

MW-05

DEPTH (feet)	GRAPHIC LOG	USCS	DESCRIPTION (Sampler Length: 2 Feet)	SAMPLE INTERVAL (feet)	RECOV. (feet)	BLOW COUNTS	PID (ppm)	ELEV. (ft)	ANALYTICAL SAMPLE	SAMPLE ID	Asbestos (MFL)	Other Detections
31			Overdrill with 10-inch air hammer to 39 feet, install 6-inch steel casing.					160				
32												
33												
34												
35												
36								155				
37												
38												
39			Drilling below casing with 6-inch air hammer.									
40												
41								150				
42												
43												
44												
45												
46								145				
47												
48												
49												
50												
51								140				
52												
53												
54												
55												
56								135				
57												
58			Drilling below casing with 6-inch air hammer. Water-bearing fracture encountered at 58 to 59 feet.									
59												
60												
61								130				
62												
63												
64			End of boring at 64 feet bgs. Well screen installed at 54 - 64 feet. See well construction diagram.									
65												
66								125				

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14420 Albemarle Point Place Suite 210
Chantilly, VA 20151
Telephone: 703-968-0900
Fax: 703-968-0915

HSA/Air Hammer LOG
Draft

PROJECT NO. 3330.029

Appendix B

Logs for BOB-1, BOB-2, and BOB-3

Gannett Fleming

Hole No. BOB-1

DRILLING LOG

DIVISION: North Atlantic

INSTALLATION: Philadelphia District

SHEET 1 OF 2 SHEETS

1. PROJECT: BoRit Reservoir
2. LOCATION (Coordinates or Station): STA. 2+75.0
3. DRILLING AGENCY: L.G. Hetager Drilling, Inc.
4. HOLE NO. *(As shown on drawing title and file number)*: BOB-1
5. NAME OF DRILLER: Jim Hopkins
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 20.8
8. DEPTH DRILLED INTO ROCK: 0.0
9. TOTAL DEPTH OF HOLE: 20.8
10. SIZE AND TYPE OF BIT: 3-1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*: NAVD 88
12. MANUFACTURER'S DESIGNATION OF DRILL: HH-250 Track Rig
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 12; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: 0
15. ELEVATION GROUND WATER: 173.8 ft
16. DATE HOLE: STARTED 5/21/13; COMPLETED 5/21/13
17. ELEVATION TOP OF HOLE: 190.0 ft
18. TOTAL CORE RECOVERY FOR BORING: %
19. GEOLOGIST: J. Krupansky

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g	Blows/0.5 FT
189.9	0.1		1" Topsoil	60	S-1 0.0 1.5		4
			Sandy SILT (ML), contains rock fragments, brown and red-brown, moist, medium dense, heterogeneous (Fill)				8
							11
				33	S-2 1.5 3.0		5
			S-2: some black and white soil particles				5
							6
				67	S-3 3.0 4.5	S-3: Wc= 18.6%, LL= 26, PL= 22, Fines= 55.3%	8
							6
185.5	4.5						5
			Sandy LEAN CLAY (cl), contains roots, brown, moist, medium stiff, homogeneous (Fill)	73	S-4 4.5 6.0	PP = 0.3 TSF	3
							3
							4
183.5	6.5			45	S-5 6.0 8.0		2
			SANDY SILT (ML), brown, moist to wet, very loose to medium dense, varies homogeneous to lensed, (Fill)				4
							7
							11
				20	S-6 8.0 10.0	wet soil seams S-6 & S-7: Wc= 20.7%, LL= 27, PL= 22, Fines= 57.4%	4
			S-6: contains concrete fragments				4
							3
							3
				75	S-7 10.0 12.0		2
							2
							2
178.0	12.0						3
			Silty SAND (SM), trace gravel, brown, wet, loose, homogeneous (Alluvial)	75	S-8 12.0 14.0	S-8: perched water - sample & spoon wet S-8: Wc= 18.9%, LL= 24, PL= 21, Fines= 36.6%	3
							3
							4
176.0	14.0						3

0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE 190.0 ft

Hole No. BOB-1

PROJECT: BoRit Reservoir

INSTALLATION: Philadelphia District

SHEET 2 OF 2 SHEETS

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g	Blows/ 0.5 FT
175.0	15.0		Sandy LEAN CLAY (cl), brown and gray, moist to wet, medium stiff, stratified (Alluvial)	85	S-9 14.0 16.0		3 9
			Silty SAND with Gravel (SM), brown and gray, moist to wet, dense to very dense, homogeneous (Residual)				36 31
			15 - 16 ft: auger grinding (possible boulder)	75	S-10 16.0 18.0	S-10: Wc= 11.3%, LL= NP, PL= NP, Fines= 12.2%	22 18 19 23
172.0	18.0		Silty GRAVEL with Sand (gm), brown and gray, moist to wet, very dense, stratified (Decomposed Rock)	60	S-11 18.0 20.0	18 - 20.8 ft: choppy drill action	53 39 40 20
169.2	20.8			62	S-12 20.0 20.8		45 50/0.3'
			Bottom of borehole at 20.8 feet.			Auger Refusal at 20.5 ft Spoon Refusal at 20.8 ft Boring tremie grouted 5/23/13. WATER LEVEL READINGS: 5/21/13 10:10: 12.0 ft - At time of Drilling 5/22/13 07:25: 17.2 ft 5/23/13 07:30: 16.2 ft Abbreviations: PP= Pocket Penetrometer Wc= Water Content LL= Liquid Limit PL= Plastic Limit NP= Non-plastic	

14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0

Gannett Fleming

Hole No. BOB-1A

DRILLING LOG

DIVISION: North Atlantic

INSTALLATION: Philadelphia District

SHEET 1 OF 1 SHEETS

1. PROJECT: BoRit Reservoir
2. LOCATION (Coordinates or Station): STA. 2+77.0
3. DRILLING AGENCY: L.G. Hetager Drilling, Inc.
4. HOLE NO. *(As shown on drawing title and file number)*: BOB-1A
5. NAME OF DRILLER: Jim Hopkins
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN:
8. DEPTH DRILLED INTO ROCK:
9. TOTAL DEPTH OF HOLE: 6.5
10. SIZE AND TYPE OF BIT: 3-1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*: NAVD 88
12. MANUFACTURER'S DESIGNATION OF DRILL: HH-250 Track Rig
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 0; UNDISTURBED 1
14. TOTAL NUMBER CORE BOXES: 0
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED 5/22/13; COMPLETED 5/22/13
17. ELEVATION TOP OF HOLE: 190.0 ft
18. TOTAL CORE RECOVERY FOR BORING: %
19. GEOLOGIST: J. Krupansky

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g	Blows/ 0.5 FT
190.0	0.0		0 - 4.5 ft: Unsampled			Offset boring 2.0' southwest from BOB-1 to obtain undisturbed sample	
185.5	4.5		Sandy SILT (ML), contains roots, brown, moist, medium stiff, homogeneous (Fill)	80	U-1 4.5 6.5	Pushed Shelby Tube Hydraulic Down Pressure = 250 psi PP = 1.8 TSF TV = 0.9 TSF U-1: Wc= 20.5%, LL= 30, PL= 23, Fines= 59.1%	
183.5	6.5		Bottom of borehole at 6.5 feet.			Boring tremie grouted 5/23/13. Water not encountered in boring during or after drilling. Abbreviations: PP= Pocket Penetrometer TV= Torvane Wc= Water Content LL= Liquid Limit PL= Plastic Limit	

0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0

Gannett Fleming

Hole No. BOB-2

DRILLING LOG

DIVISION: North Atlantic

INSTALLATION: Philadelphia District

SHEET 1 OF 2 SHEETS

1. PROJECT: BoRit Reservoir
2. LOCATION (Coordinates or Station): STA. 7+50.0
3. DRILLING AGENCY: L.G. Hetager Drilling, Inc.
4. HOLE NO. *(As shown on drawing title and file number)*: BOB-2
5. NAME OF DRILLER: Jim Hopkins
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 23.0
8. DEPTH DRILLED INTO ROCK: 0.0
9. TOTAL DEPTH OF HOLE: 23.0
10. SIZE AND TYPE OF BIT: 3-1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*: NAVD 88
12. MANUFACTURER'S DESIGNATION OF DRILL: HH-250 Track Rig
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 12; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: 0
15. ELEVATION GROUND WATER: 174.4 ft
16. DATE HOLE: STARTED 5/21/13; COMPLETED 5/21/13
17. ELEVATION TOP OF HOLE: 192.0 ft
18. TOTAL CORE RECOVERY FOR BORING: %
19. GEOLOGIST: J. Krupansky

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g	Blows/0.5 FT	
								0.0
191.9	0.1		1" Topsoil	50	S-1 0.0 2.0	S-1 & S-2: Wc= 15.9%, LL= 37%, PL= 26%, Fines= 46.9%	4	
			Silty SAND with Gravel (SM), contains rock fragments, brown, moist, medium dense, homogeneous (Fill)				4	
							7	
							9	2.0
				77	S-2 2.0 3.3		7	
							8	
							50/0.3'	
			S-2: large piece of wood (tree or root) encountered at 3.5 ft (in spoon and auger)			Auger through wood obstruction		
188.0	4.0							4.0
			Silty SAND (sm) with asbestos-containing material, gray, tan, red-brown, and white, moist, very loose to medium dense, heterogeneous (Fill)	100	S-3 4.0 6.0		4	
							23	
							14	
							8	6.0
				60	S-4 6.0 8.0		4	
							6	
							8	
							12	8.0
			8.0 - 18.0 ft: Cuttings not exiting hole (very little recovery in spoon samples)	15	S-5 8.0 10.0	8.0 - 18.0 ft: Auger cuttings not exiting hole (very little recovery in spoon samples)	2	
							2	
							1	
							1	10.0
				10	S-6 10.0 12.0		3	
							1	
							1	
							1	12.0
				50	S-7 12.0 14.0	wet soil seams	2	
							1	
							3	
							6	14.0

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE 192.0 ft

Hole No. BOB-2

PROJECT: BoRit Reservoir

INSTALLATION: Philadelphia District

SHEET 2 OF 2 SHEETS

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g	Blows/ 0.5 FT
			Silty SAND (sm) with asbestos-containing material, gray, tan, red-brown, and white, moist, very loose to medium dense, heterogeneous (Fill) *(continued)*	20	S-8 14.0 16.0		3 2 1 1
176.0	16.0						
			Sandy LEAN CLAY (cl), contains organic matter, brown, wet, very soft to soft, homogeneous (Alluvial)	30	S-9 16.0 18.0	PP = <0.25 tsf	2 2 2 2
				100	S-10 18.0 20.0	PP = <0.25 tsf	1 1 1 WOH
171.0	21.0			100	S-11 20.0 22.0		4 7 12 10
			Poorly-graded SAND with Silt and Gravel (sp-sm), brown and gray, wet, medium dense, homogeneous (Alluvial)	100	S-12 22.0 22.8		19 50/0.3'
169.5	22.5						
169.0	23.0		Silty GRAVEL with Sand (gm), gray, wet, very dense, homogeneous (Residual/Decomposed Rock)			Auger Refusal at 23.0 ft	
			Bottom of borehole at 23.0 feet.			Boring tremie grouted 5/23/13. WATER LEVEL READINGS: 5/21/13 13:30: 16.0 ft - At time of Drilling 5/22/13 07:20: 16.9 ft 5/23/13 07:33: 17.6 ft Abbreviations: PP= Pocket Penetrometer Wc= Water Content LL= Liquid Limit PL= Plastic Limit	

14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0

Gannett Fleming

Hole No. BOB-2A

DRILLING LOG	DIVISION: North Atlantic	INSTALLATION: Philadelphia District	SHEET 1 OF 2 SHEETS

1. PROJECT: BoRit Reservoir
2. LOCATION (Coordinates or Station): STA. 7+50.0
3. DRILLING AGENCY: L.G. Hetager Drilling, Inc.
4. HOLE NO. *(As shown on drawing title and file number)*: BOB-2A
5. NAME OF DRILLER: Jim Hopkins
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN:
8. DEPTH DRILLED INTO ROCK:
9. TOTAL DEPTH OF HOLE: 18.5
10. SIZE AND TYPE OF BIT: 3-1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*: NAVD 88
12. MANUFACTURER'S DESIGNATION OF DRILL: HH-250 Track Rig
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 0; UNDISTURBED 1
14. TOTAL NUMBER CORE BOXES: 0
15. ELEVATION GROUND WATER: 175.5 ft
16. DATE HOLE: STARTED 5/22/13; COMPLETED 5/22/13
17. ELEVATION TOP OF HOLE: 192.0 ft
18. TOTAL CORE RECOVERY FOR BORING: %
19. GEOLOGIST: J. Krupansky

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g	Blows/0.5 FT
192.0	0.0		0 - 16.5 ft: Unsampled			Offset boring 2.0' east from BOB-2 to obtain undisturbed sample	

0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE 192.0 ft

Hole No. BOB-2A

PROJECT: BoRit Reservoir

INSTALLATION: Philadelphia District

SHEET 2 OF 2 SHEETS

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g	Blows/ 0.5 FT
			0 - 16.5 ft: Unsampled *(continued)*				
175.5	16.5		Sandy SILT (ML), contains organic matter, brown, wet, very soft to soft, homogeneous (Alluvial)	100	U-1 16.5 18.5	Pushed Shelby Tube Hydraulic Down Pressure = 200 psi PP = 0.3 TSF TV = 0.8 TSF U-1: Wc= 40.8%, LL= 26, PL= 22, Fines= 62.1%	
173.5	18.5		Bottom of borehole at 18.5 feet.			Boring tremie grouted 5/23/13. Abbreviations: PP= Pocket Penetrometer TV= Torvane Wc= Water Content LL= Liquid Limit PL= Plastic Limit	

14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0

Gannett Fleming

Hole No. BOB-3

DRILLING LOG

DIVISION: North Atlantic

INSTALLATION: Philadelphia District

SHEET 1 OF 2 SHEETS

1. PROJECT: BoRit Reservoir
2. LOCATION (Coordinates or Station): STA. 11+00.0
3. DRILLING AGENCY: L.G. Hetager Drilling, Inc.
4. HOLE NO. *(As shown on drawing title and file number)*: BOB-3
5. NAME OF DRILLER: Jim Hopkins
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 28.8
8. DEPTH DRILLED INTO ROCK: 0.0
9. TOTAL DEPTH OF HOLE: 28.8
10. SIZE AND TYPE OF BIT: 3-1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*: NAVD 88
12. MANUFACTURER'S DESIGNATION OF DRILL: HH-250 Track Rig
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 15; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: 0
15. ELEVATION GROUND WATER: 170.2 ft
16. DATE HOLE: STARTED 5/22/13; COMPLETED 5/22/13
17. ELEVATION TOP OF HOLE: 192.0 ft
18. TOTAL CORE RECOVERY FOR BORING: %
19. GEOLOGIST: J. Krupansky

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g	Blows/0.5 FT	
191.9	0.1		1" Topsoil	50	S-1 0.0 2.0		4	0.0
			Silty SAND (sm), contains rock fragments, brown, moist, medium dense, homogeneous (Fill)				5	
							6	
							4	2.0
				60	S-2 2.0 4.0		3	
189.0	3.0						2	
			Silty SAND with Gravel (SM) with asbestos-containing material, gray, orange-brown, and white, moist, loose to medium dense, heterogeneous (Fill)				10	
							11	4.0
				55	S-3 4.0 6.0	S-3 & S-4: Wc= 19.4%, LL= 32, PL= 26, Fines= 35.2%	3	
							2	
							4	
							2	6.0
				50	S-4 6.0 8.0		6	
							6	
							6	
							4	8.0
183.5	8.5			100	S-5 8.0 10.0	PP = 0.5 TSF	2	
			Silty CLAY with Sand (cl-ml), trace Gravel, contains root fragments, brown, moist to wet, soft to medium stiff, homogeneous (Fill)				2	
							2	
							3	10.0
				100	S-6 10.0 12.0	PP = 0.5 TSF	3	
							3	
							4	
							2	12.0
				30	S-7 12.0 14.0	PP = 0.5 TSF wet soil seams	3	
							4	
							3	
178.0	14.0						2	14.0

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE 192.0 ft

Hole No. BOB-3

PROJECT: BoRit Reservoir

INSTALLATION: Philadelphia District

SHEET 2 OF 2 SHEETS

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g	Blows/ 0.5 FT	
			SILT with Sand (ML), contains organic matter and roots, brown, moist to wet, very soft to medium stiff, homogeneous, (Alluvial)	100	S-8 14.0 16.0	PP = 0.3 TSF S-8 & S-9: Wc= 30.0%, LL= 30, PL= 24, Fines= 75.2%, Organic Content= 6.9%	4 4 4 4	14.0 16.0
			S-9: organic rich	100	S-9 16.0 18.0	PP = 0.5 TSF	4 8 9 8	18.0
				100	S-10 18.0 20.0	PP = <0.25 tsf	WOH 1 3 2	20.0
				100	S-11 20.0 22.0	PP = <0.25 tsf	1 1 2 2	22.0
169.0	23.0			100	S-12 22.0 24.0		4 3	
			Silty SAND with Gravel (SM), brown and red-brown, wet, medium dense to very dense, homogeneous (Alluvial)				3 4	24.0
				100	S-13 24.0 26.0	S-13: Wc= 17.5%, LL= 23, PL= 21, Fines= 24.5%	7 23 37 26	26.0
164.5	27.5			35	S-14 26.0 28.0		21 22 28	
			Silty GRAVEL with Sand (gm), brown and gray, moist to wet, dense to very dense, homogeneous (Residual/Decomposed Rock)				17	28.0
163.2	28.8			100	S-15 28.0 28.8		46 50/0.3'	
			Bottom of borehole at 28.8 feet.			Auger Refusal at 28.8 ft Boring tremie grouted 5/23/13. WATER LEVEL READINGS: 5/22/13 14:10: 22.6 ft - At end of Drilling 5/23/13 07:35: 21.8 ft Abbreviations: PP= Pocket Penetrometer Wc= Water Content LL= Liquid Limit PL= Plastic Limit		30.0 32.0

Gannett Fleming

Hole No. BOB-3A

DRILLING LOG

DIVISION: North Atlantic

INSTALLATION: Philadelphia District

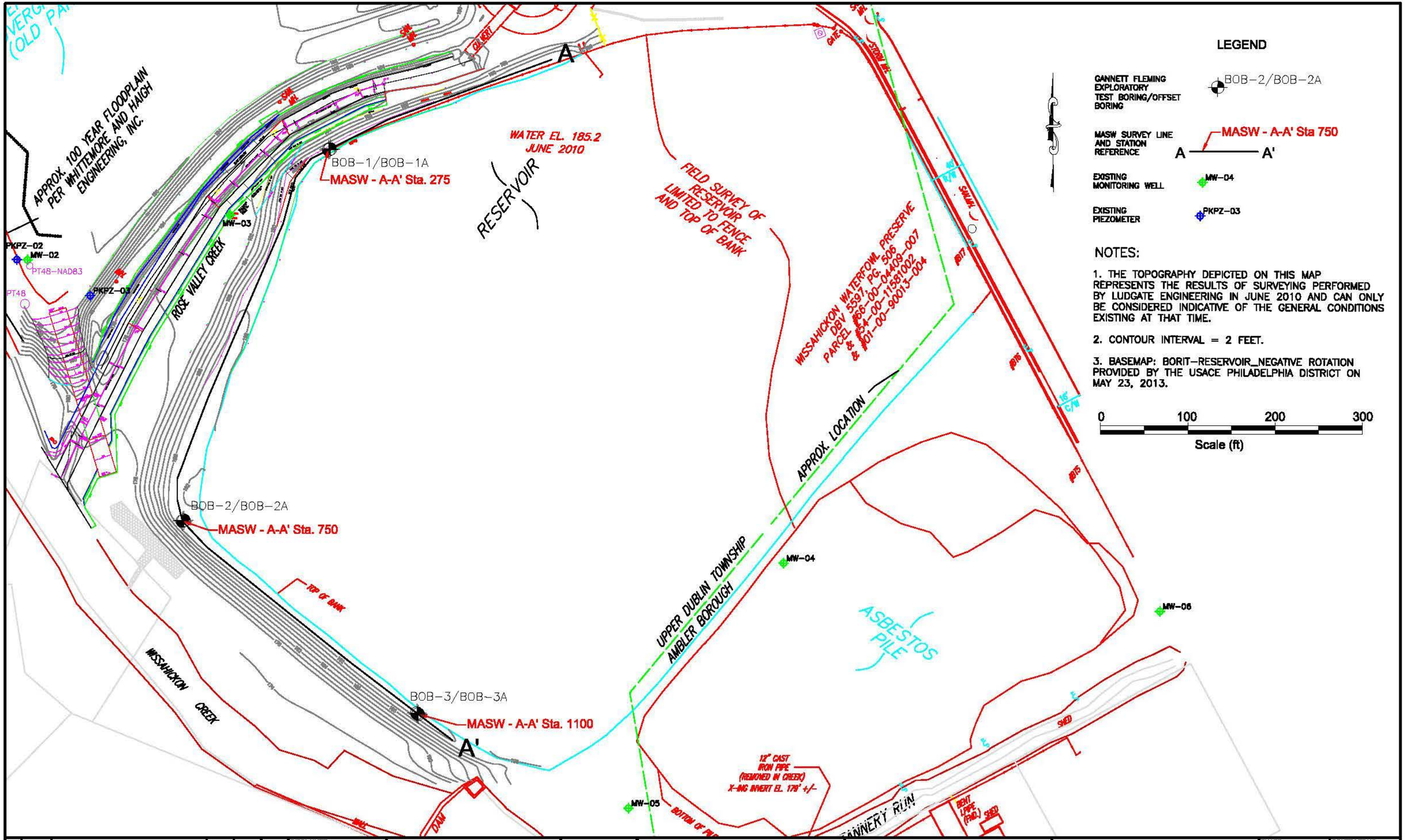
SHEET 1 OF 1 SHEETS

1. PROJECT: BoRit Reservoir
2. LOCATION (Coordinates or Station): STA. 10+98.0
3. DRILLING AGENCY: L.G. Hetager Drilling, Inc.
4. HOLE NO. *(As shown on drawing title and file number)*: BOB-3A
5. NAME OF DRILLER: Jim Hopkins
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN:
8. DEPTH DRILLED INTO ROCK:
9. TOTAL DEPTH OF HOLE: 11.0
10. SIZE AND TYPE OF BIT: 3-1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*: NAVD 88
12. MANUFACTURER'S DESIGNATION OF DRILL: HH-250 Track Rig
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 0; UNDISTURBED 1
14. TOTAL NUMBER CORE BOXES: 0
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED 5/22/13; COMPLETED 5/22/13
17. ELEVATION TOP OF HOLE: 192.0 ft
18. TOTAL CORE RECOVERY FOR BORING: %
19. GEOLOGIST: J. Krupansky

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g	Blows/0.5 FT
192.0	0.0		0 - 9.0 ft: Unsampled			Offset boring 2.0' northwest from BOB-3 to obtain undisturbed sample	
183.0	9.0		Sandy SILT (ML), contains root fragments, brown, moist to wet, soft to medium stiff, homogeneous (Alluvial)	95	U-1 9.0 11.0	PP = 1.0 TSF TV = 1.5 TSF Pushed Shelby Tube Hydraulic Down Pressure = 200 psi PP = 1.0 TSF TV = 1.5 TSF U-1: Wc= 21.1%, LL= 27, PL= 22, Fines= 66.6%	
181.0	11.0		Bottom of borehole at 11.0 feet.			Boring tremie grouted 5/23/13. Water not encountered in boring during or after drilling Abbreviations: PP= Pocket Penetrometer TV= Torvane Wc= Water Content LL= Liquid Limit PL= Plastic Limit	

0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0

APPENDIX B
Test Boring Location Plan



LEGEND

GANNETT FLEMING EXPLORATORY TEST BORING/OFFSET BORING — BOB-2/BOB-2A

MASW SURVEY LINE AND STATION REFERENCE — A — MASW - A-A' Sta 750 — A'

EXISTING MONITORING WELL — MW-04

EXISTING PIEZOMETER — PKPZ-03

NOTES:

1. THE TOPOGRAPHY DEPICTED ON THIS MAP REPRESENTS THE RESULTS OF SURVEYING PERFORMED BY LUDGATE ENGINEERING IN JUNE 2010 AND CAN ONLY BE CONSIDERED INDICATIVE OF THE GENERAL CONDITIONS EXISTING AT THAT TIME.

2. CONTOUR INTERVAL = 2 FEET.

3. BASEMAP: BORIT-RESERVOIR_NEGATIVE ROTATION PROVIDED BY THE USACE PHILADELPHIA DISTRICT ON MAY 23, 2013.

0 100 200 300

Scale (ft)

NO.	DATE	MODIFICATION	DRAWN	CHKD.	APPRVD.

REVISIONS

U.S. ARMY CORPS OF ENGINEERS

NORTH ATLANTIC DIVISION
PHILADELPHIA DISTRICT

Gannett Fleming

USACE
BORIT ASBESTOS SITE

UPPER DUBLIN AND WHITPAIN TOWNSHIPS, PENNSYLVANIA

BORING LOCATION PLAN

MONTGOMERY COUNTY

PHASE	CONTRACT NO. W912BU-10-D0005
SCALE: 1"=100'	DATE: JUNE 10, 2013
DRAWING NAME: BORING LOCATION PLAN.dwg	
SHEET 1	OF 1

APPENDIX C
Typed Boring Logs

Gannett Fleming

Hole No. BOB-1

DRILLING LOG

DIVISION: North Atlantic

INSTALLATION: Philadelphia District

SHEET 1 OF 2 SHEETS

1. PROJECT: BoRit Reservoir
2. LOCATION (Coordinates or Station): STA. 2+75.0
3. DRILLING AGENCY: L.G. Hetager Drilling, Inc.
4. HOLE NO. *(As shown on drawing title and file number)*: BOB-1
5. NAME OF DRILLER: Jim Hopkins
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 20.8
8. DEPTH DRILLED INTO ROCK: 0.0
9. TOTAL DEPTH OF HOLE: 20.8
10. SIZE AND TYPE OF BIT: 3-1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*: NAVD 88
12. MANUFACTURER'S DESIGNATION OF DRILL: HH-250 Track Rig
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 12; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: 0
15. ELEVATION GROUND WATER: 173.8 ft
16. DATE HOLE: STARTED 5/21/13; COMPLETED 5/21/13
17. ELEVATION TOP OF HOLE: 190.0 ft
18. TOTAL CORE RECOVERY FOR BORING: %
19. GEOLOGIST: J. Krupansky

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g	Blows/0.5 FT
189.9	0.1		1" Topsoil	60	S-1 0.0 1.5		4
			Sandy SILT (ML), contains rock fragments, brown and red-brown, moist, medium dense, heterogeneous (Fill)				8
							11
				33	S-2 1.5 3.0		5
			S-2: some black and white soil particles				5
							6
				67	S-3 3.0 4.5	S-3: Wc= 18.6%, LL= 26, PL= 22, Fines= 55.3%	8
							6
185.5	4.5						5
			Sandy LEAN CLAY (cl), contains roots, brown, moist, medium stiff, homogeneous (Fill)	73	S-4 4.5 6.0	PP = 0.3 TSF	3
							3
							4
183.5	6.5			45	S-5 6.0 8.0		2
			SANDY SILT (ML), brown, moist to wet, very loose to medium dense, varies homogeneous to lensed, (Fill)				4
							7
							11
				20	S-6 8.0 10.0	wet soil seams S-6 & S-7: Wc= 20.7%, LL= 27, PL= 22, Fines= 57.4%	4
			S-6: contains concrete fragments				4
							3
							3
				75	S-7 10.0 12.0		2
							2
							2
178.0	12.0						3
			Silty SAND (SM), trace gravel, brown, wet, loose, homogeneous (Alluvial)	75	S-8 12.0 14.0	S-8: perched water - sample & spoon wet S-8: Wc= 18.9%, LL= 24, PL= 21, Fines= 36.6%	3
							3
							4
176.0	14.0						3

0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE 190.0 ft

Hole No. BOB-1

PROJECT: BoRit Reservoir

INSTALLATION: Philadelphia District

SHEET 2 OF 2 SHEETS

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g	Blows/ 0.5 FT
175.0	15.0		Sandy LEAN CLAY (cl), brown and gray, moist to wet, medium stiff, stratified (Alluvial)	85	S-9 14.0 16.0		3 9
			Silty SAND with Gravel (SM), brown and gray, moist to wet, dense to very dense, homogeneous (Residual)				36 31
			15 - 16 ft: auger grinding (possible boulder)	75	S-10 16.0 18.0	S-10: Wc= 11.3%, LL= NP, PL= NP, Fines= 12.2%	22 18 19 23
172.0	18.0		Silty GRAVEL with Sand (gm), brown and gray, moist to wet, very dense, stratified (Decomposed Rock)	60	S-11 18.0 20.0	18 - 20.8 ft: choppy drill action	53 39 40 20
169.2	20.8			62	S-12 20.0 20.8		45 50/0.3'
			Bottom of borehole at 20.8 feet.			Auger Refusal at 20.5 ft Spoon Refusal at 20.8 ft Boring tremie grouted 5/23/13. WATER LEVEL READINGS: 5/21/13 10:10: 12.0 ft - At time of Drilling 5/22/13 07:25: 17.2 ft 5/23/13 07:30: 16.2 ft Abbreviations: PP= Pocket Penetrometer Wc= Water Content LL= Liquid Limit PL= Plastic Limit NP= Non-plastic	

14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0

Gannett Fleming

Hole No. BOB-1A

DRILLING LOG

DIVISION: North Atlantic

INSTALLATION: Philadelphia District

SHEET 1 OF 1 SHEETS

1. PROJECT: BoRit Reservoir
2. LOCATION (Coordinates or Station): STA. 2+77.0
3. DRILLING AGENCY: L.G. Hetager Drilling, Inc.
4. HOLE NO. *(As shown on drawing title and file number)*: BOB-1A
5. NAME OF DRILLER: Jim Hopkins
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN:
8. DEPTH DRILLED INTO ROCK:
9. TOTAL DEPTH OF HOLE: 6.5
10. SIZE AND TYPE OF BIT: 3-1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*: NAVD 88
12. MANUFACTURER'S DESIGNATION OF DRILL: HH-250 Track Rig
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 0; UNDISTURBED 1
14. TOTAL NUMBER CORE BOXES: 0
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED 5/22/13; COMPLETED 5/22/13
17. ELEVATION TOP OF HOLE: 190.0 ft
18. TOTAL CORE RECOVERY FOR BORING: %
19. GEOLOGIST: J. Krupansky

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g	Blows/ 0.5 FT
190.0	0.0		0 - 4.5 ft: Unsampled			Offset boring 2.0' southwest from BOB-1 to obtain undisturbed sample	
185.5	4.5		Sandy SILT (ML), contains roots, brown, moist, medium stiff, homogeneous (Fill)	80	U-1 4.5 6.5	Pushed Shelby Tube Hydraulic Down Pressure = 250 psi PP = 1.8 TSF TV = 0.9 TSF U-1: Wc= 20.5%, LL= 30, PL= 23, Fines= 59.1%	
183.5	6.5		Bottom of borehole at 6.5 feet.			Boring tremie grouted 5/23/13. Water not encountered in boring during or after drilling. Abbreviations: PP= Pocket Penetrometer TV= Torvane Wc= Water Content LL= Liquid Limit PL= Plastic Limit	

0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0

Gannett Fleming

Hole No. BOB-2

DRILLING LOG

DIVISION: North Atlantic

INSTALLATION: Philadelphia District

SHEET 1 OF 2 SHEETS

1. PROJECT: BoRit Reservoir
2. LOCATION (Coordinates or Station): STA. 7+50.0
3. DRILLING AGENCY: L.G. Hetager Drilling, Inc.
4. HOLE NO. *(As shown on drawing title and file number)*: BOB-2
5. NAME OF DRILLER: Jim Hopkins
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 23.0
8. DEPTH DRILLED INTO ROCK: 0.0
9. TOTAL DEPTH OF HOLE: 23.0
10. SIZE AND TYPE OF BIT: 3-1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*: NAVD 88
12. MANUFACTURER'S DESIGNATION OF DRILL: HH-250 Track Rig
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 12; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: 0
15. ELEVATION GROUND WATER: 174.4 ft
16. DATE HOLE: STARTED 5/21/13; COMPLETED 5/21/13
17. ELEVATION TOP OF HOLE: 192.0 ft
18. TOTAL CORE RECOVERY FOR BORING: %
19. GEOLOGIST: J. Krupansky

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g	Blows/0.5 FT	
								0.0
191.9	0.1		1" Topsoil	50	S-1 0.0 2.0	S-1 & S-2: Wc= 15.9%, LL= 37%, PL= 26%, Fines= 46.9%	4	
			Silty SAND with Gravel (SM), contains rock fragments, brown, moist, medium dense, homogeneous (Fill)				4	
							7	
							9	2.0
				77	S-2 2.0 3.3		7	
							8	
							50/0.3'	
			S-2: large piece of wood (tree or root) encountered at 3.5 ft (in spoon and auger)			Auger through wood obstruction		
188.0	4.0							4.0
			Silty SAND (sm) with asbestos-containing material, gray, tan, red-brown, and white, moist, very loose to medium dense, heterogeneous (Fill)	100	S-3 4.0 6.0		4	
							23	
							14	
							8	6.0
				60	S-4 6.0 8.0		4	
							6	
							8	
							12	8.0
			8.0 - 18.0 ft: Cuttings not exiting hole (very little recovery in spoon samples)	15	S-5 8.0 10.0	8.0 - 18.0 ft: Auger cuttings not exiting hole (very little recovery in spoon samples)	2	
							2	
							1	
							1	10.0
				10	S-6 10.0 12.0		3	
							1	
							1	
							1	12.0
				50	S-7 12.0 14.0	wet soil seams	2	
							1	
							3	
							6	14.0

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE 192.0 ft

Hole No. BOB-2

PROJECT: BoRit Reservoir

INSTALLATION: Philadelphia District

SHEET 2 OF 2 SHEETS

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g	Blows/ 0.5 FT
			Silty SAND (sm) with asbestos-containing material, gray, tan, red-brown, and white, moist, very loose to medium dense, heterogeneous (Fill) *(continued)*	20	S-8 14.0 16.0		3 2 1 1
176.0	16.0						
			Sandy LEAN CLAY (cl), contains organic matter, brown, wet, very soft to soft, homogeneous (Alluvial)	30	S-9 16.0 18.0	PP = <0.25 tsf	2 2 2 2
				100	S-10 18.0 20.0	PP = <0.25 tsf	1 1 1 WOH
171.0	21.0			100	S-11 20.0 22.0		4 7 12 10
			Poorly-graded SAND with Silt and Gravel (sp-sm), brown and gray, wet, medium dense, homogeneous (Alluvial)	100	S-12 22.0 22.8		19 50/0.3'
169.5	22.5						
169.0	23.0		Silty GRAVEL with Sand (gm), gray, wet, very dense, homogeneous (Residual/Decomposed Rock)			Auger Refusal at 23.0 ft	
			Bottom of borehole at 23.0 feet.			Boring tremie grouted 5/23/13. WATER LEVEL READINGS: 5/21/13 13:30: 16.0 ft - At time of Drilling 5/22/13 07:20: 16.9 ft 5/23/13 07:33: 17.6 ft Abbreviations: PP= Pocket Penetrometer Wc= Water Content LL= Liquid Limit PL= Plastic Limit	

14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0

Gannett Fleming

Hole No. BOB-2A

DRILLING LOG	DIVISION: North Atlantic	INSTALLATION: Philadelphia District	SHEET 1 OF 2 SHEETS

1. PROJECT: BoRit Reservoir
2. LOCATION (Coordinates or Station): STA. 7+50.0
3. DRILLING AGENCY: L.G. Hetager Drilling, Inc.
4. HOLE NO. *(As shown on drawing title and file number)*: BOB-2A
5. NAME OF DRILLER: Jim Hopkins
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN:
8. DEPTH DRILLED INTO ROCK:
9. TOTAL DEPTH OF HOLE: 18.5
10. SIZE AND TYPE OF BIT: 3-1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*: NAVD 88
12. MANUFACTURER'S DESIGNATION OF DRILL: HH-250 Track Rig
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 0; UNDISTURBED 1
14. TOTAL NUMBER CORE BOXES: 0
15. ELEVATION GROUND WATER: 175.5 ft
16. DATE HOLE: STARTED 5/22/13; COMPLETED 5/22/13
17. ELEVATION TOP OF HOLE: 192.0 ft
18. TOTAL CORE RECOVERY FOR BORING: %
19. GEOLOGIST: J. Krupansky

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g	Blows/0.5 FT
192.0	0.0		0 - 16.5 ft: Unsampled			Offset boring 2.0' east from BOB-2 to obtain undisturbed sample	

0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE 192.0 ft

Hole No. BOB-2A

PROJECT: BoRit Reservoir

INSTALLATION: Philadelphia District

SHEET 2 OF 2 SHEETS

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g	Blows/ 0.5 FT
			0 - 16.5 ft: Unsampled *(continued)*				
175.5	16.5		Sandy SILT (ML), contains organic matter, brown, wet, very soft to soft, homogeneous (Alluvial)	100	U-1 16.5 18.5	Pushed Shelby Tube Hydraulic Down Pressure = 200 psi PP = 0.3 TSF TV = 0.8 TSF U-1: Wc= 40.8%, LL= 26, PL= 22, Fines= 62.1%	
173.5	18.5		Bottom of borehole at 18.5 feet.			Boring tremie grouted 5/23/13. Abbreviations: PP= Pocket Penetrometer TV= Torvane Wc= Water Content LL= Liquid Limit PL= Plastic Limit	

14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0

Gannett Fleming

Hole No. BOB-3

DRILLING LOG

DIVISION: North Atlantic

INSTALLATION: Philadelphia District

SHEET 1 OF 2 SHEETS

1. PROJECT: BoRit Reservoir
2. LOCATION (Coordinates or Station): STA. 11+00.0
3. DRILLING AGENCY: L.G. Hetager Drilling, Inc.
4. HOLE NO. *(As shown on drawing title and file number)*: BOB-3
5. NAME OF DRILLER: Jim Hopkins
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 28.8
8. DEPTH DRILLED INTO ROCK: 0.0
9. TOTAL DEPTH OF HOLE: 28.8
10. SIZE AND TYPE OF BIT: 3-1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*: NAVD 88
12. MANUFACTURER'S DESIGNATION OF DRILL: HH-250 Track Rig
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 15; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: 0
15. ELEVATION GROUND WATER: 170.2 ft
16. DATE HOLE: STARTED 5/22/13; COMPLETED 5/22/13
17. ELEVATION TOP OF HOLE: 192.0 ft
18. TOTAL CORE RECOVERY FOR BORING: %
19. GEOLOGIST: J. Krupansky

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g	Blows/0.5 FT	
191.9	0.1		1" Topsoil	50	S-1 0.0 2.0		4	0.0
			Silty SAND (sm), contains rock fragments, brown, moist, medium dense, homogeneous (Fill)				5	
							6	
							4	2.0
				60	S-2 2.0 4.0		3	
189.0	3.0						2	
			Silty SAND with Gravel (SM) with asbestos-containing material, gray, orange-brown, and white, moist, loose to medium dense, heterogeneous (Fill)				10	
							11	4.0
				55	S-3 4.0 6.0	S-3 & S-4: Wc= 19.4%, LL= 32, PL= 26, Fines= 35.2%	3	
							2	
							4	
							2	6.0
				50	S-4 6.0 8.0		6	
							6	
							6	
							4	8.0
183.5	8.5			100	S-5 8.0 10.0	PP = 0.5 TSF	2	
			Silty CLAY with Sand (cl-ml), trace Gravel, contains root fragments, brown, moist to wet, soft to medium stiff, homogeneous (Fill)				2	
							2	
							3	10.0
				100	S-6 10.0 12.0	PP = 0.5 TSF	3	
							3	
							4	
							2	12.0
				30	S-7 12.0 14.0	PP = 0.5 TSF wet soil seams	3	
							4	
							3	
178.0	14.0						2	14.0

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE 192.0 ft

Hole No. BOB-3

PROJECT: BoRit Reservoir

INSTALLATION: Philadelphia District

SHEET 2 OF 2 SHEETS

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g	Blows/ 0.5 FT	
			SILT with Sand (ML), contains organic matter and roots, brown, moist to wet, very soft to medium stiff, homogeneous, (Alluvial)	100	S-8 14.0 16.0	PP = 0.3 TSF S-8 & S-9: Wc= 30.0%, LL= 30, PL= 24, Fines= 75.2%, Organic Content= 6.9%	4 4 4 4	14.0 16.0
			S-9: organic rich	100	S-9 16.0 18.0	PP = 0.5 TSF	4 8 9 8	18.0
				100	S-10 18.0 20.0	PP = <0.25 tsf	WOH 1 3 2	20.0
				100	S-11 20.0 22.0	PP = <0.25 tsf	1 1 2 2	22.0
169.0	23.0			100	S-12 22.0 24.0		4 3	
			Silty SAND with Gravel (SM), brown and red-brown, wet, medium dense to very dense, homogeneous (Alluvial)				3 4	24.0
				100	S-13 24.0 26.0	S-13: Wc= 17.5%, LL= 23, PL= 21, Fines= 24.5%	7 23 37 26	26.0
164.5	27.5			35	S-14 26.0 28.0		21 22 28	
			Silty GRAVEL with Sand (gm), brown and gray, moist to wet, dense to very dense, homogeneous (Residual/Decomposed Rock)				17	28.0
163.2	28.8			100	S-15 28.0 28.8		46 50/0.3'	
			Bottom of borehole at 28.8 feet.			Auger Refusal at 28.8 ft Boring tremie grouted 5/23/13. WATER LEVEL READINGS: 5/22/13 14:10: 22.6 ft - At end of Drilling 5/23/13 07:35: 21.8 ft Abbreviations: PP= Pocket Penetrometer Wc= Water Content LL= Liquid Limit PL= Plastic Limit		30.0 32.0

Gannett Fleming

Hole No. BOB-3A

DRILLING LOG

DIVISION: North Atlantic

INSTALLATION: Philadelphia District

SHEET 1 OF 1 SHEETS

1. PROJECT: BoRit Reservoir
2. LOCATION (Coordinates or Station): STA. 10+98.0
3. DRILLING AGENCY: L.G. Hetager Drilling, Inc.
4. HOLE NO. *(As shown on drawing title and file number)*: BOB-3A
5. NAME OF DRILLER: Jim Hopkins
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN:
8. DEPTH DRILLED INTO ROCK:
9. TOTAL DEPTH OF HOLE: 11.0
10. SIZE AND TYPE OF BIT: 3-1/4" I.D. HSA
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*: NAVD 88
12. MANUFACTURER'S DESIGNATION OF DRILL: HH-250 Track Rig
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 0; UNDISTURBED 1
14. TOTAL NUMBER CORE BOXES: 0
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED 5/22/13; COMPLETED 5/22/13
17. ELEVATION TOP OF HOLE: 192.0 ft
18. TOTAL CORE RECOVERY FOR BORING: %
19. GEOLOGIST: J. Krupansky

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g	Blows/0.5 FT
192.0	0.0		0 - 9.0 ft: Unsampled			Offset boring 2.0' northwest from BOB-3 to obtain undisturbed sample	
183.0	9.0		Sandy SILT (ML), contains root fragments, brown, moist to wet, soft to medium stiff, homogeneous (Alluvial)	95	U-1 9.0 11.0	PP = 1.0 TSF TV = 1.5 TSF Pushed Shelby Tube Hydraulic Down Pressure = 200 psi PP = 1.0 TSF TV = 1.5 TSF U-1: Wc= 21.1%, LL= 27, PL= 22, Fines= 66.6%	
181.0	11.0		Bottom of borehole at 11.0 feet.			Boring tremie grouted 5/23/13. Water not encountered in boring during or after drilling Abbreviations: PP= Pocket Penetrometer TV= Torvane Wc= Water Content LL= Liquid Limit PL= Plastic Limit	

0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0

APPENDIX D
Drillers Boring Logs

DRILLER'S BORING LOG

Boring No. Bob-1
Sheet 1 of 1

Location: S.R. _____ Sec. _____ Co. Montgomery Job No. 05693.010
Station 275 Offset from CL _____ Elevation _____
Date Started/Completed 5/21/13 Drill Contractor: L.G. HETAGER DRILLING, INC.
Driller James Hopkins Helper Phil / Chris
Engineer GT Engineer's Rep. Joe K
Drilling Methods Sample / Auger
Drill Rig Type: ATV/Truck/Track/Skid 220 Casing Diameter OD/ID _____ in.
Soil Sampling: Hammer Type: Safety/Donut/Trip: Weight 140 lb. Drop 30 in.
No. Rope Turns 1-3/4 or 2-1/4 _____ : Sampler Diameter 2 in.
Rock Sampling: Core Barrel Type _____ Size _____
Water Level Depth: 17.2 feet Time 7:25 Date 5/22/13
16.2 feet Time 7:30 Date 5/23/13
_____ feet Time _____ Date _____

Depth (ft.)	Sample No./ Type or Run No.	Blows 0.5 ft. on Soil Sampler	Rec. (ft.)	Description (Color, Type, Moisture)	RQD (ft.)/%	Remarks
1.5	S-1	4-8-11	0.9	FILL BR SILTY SAND		
3.0	S-2	5-5-6	0.5	0-4.5		
4.5	S-3	8-6-5	1.0			
6.0	S-4	3-3-4	1.1	BR SANDY clay 4.5-6.5		
8.0	S-5	2-4-7-11	0.9	BR clayey sand 6.5-12.0		
10.0	S-6	4-4-3-3	0.4	BR sand & clay 12.0-14.5		
12.0	S-7	2-2-2-3	1.5	BR sand & gravel 14.5-20.0		
14.0	S-8	3-3-4-3	1.5			
16.0	S-9	3-5-36-31	1.7	BR/GR shale 20.0-20.8		
18.0	S-10	22-18-19-23	1.5	Auger Refusal 20.5		
20.0	S-11	53-35-40-20	1.2			
20.8	S-12	45-50/3	0.5			

Notes: 20.6 Sample 12 Jars

Signatures:

Driller _____ Inspector Signature _____ Date 5/23/13

(Print Name) Joe Krupenski

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Figure 214 (a)-1

DRILLER'S BORING LOG

Boring No. Bob 1A
Sheet 1 of 1

Location: S.R. _____ Sec. _____ Co. Montgomery Job No. 0568 33-010
Station 750 Offset from CL _____ Elevation _____
Date Started/Completed 5-22-13 Drill Contractor: **L.G. HETAGER DRILLING, INC.**
Driller James Hyle Helper Chris / Phil
Engineer GE Engineer's Rep. Joe K.
Drilling Methods Auger / Tube
Drill Rig Type: ATV/Truck/Track/Skid 221 Casing Diameter OD/ID _____ in.
Soil Sampling: Hammer Type: Safety/Donut/Trip: Weight _____ lb. Drop _____ in.
No. Rope Turns 1-3/4 or 2-1/4 _____ : Sampler Diameter _____ in.
Rock Sampling: Core Barrel Type _____ Size _____
Water Level Depth: Dry feet Time 5:00 Date 5-22-13
_____ feet Time _____ Date _____
_____ feet Time _____ Date _____

Depth (ft.)	Sample No./ Type or Run No.	Blows 0.5 ft. on Soil Sampler	Rec. (ft.)	Description (Color, Type, Moisture)	RQD (ft.)/%	Remarks
				unsample 0 - 4.5		
			19"	Tube 4.5 - 6.5		

Notes: 4.5 unsample
2.0 Tube

Signatures:

Driller James Hyle Inspector Signature _____ Date 5-22-13
(Print Name) Joe Krupansky

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Figure 214 (a)-1

DRILLER'S BORING LOG

Boring No. Bob-2
Sheet 1 of 1

Location: S.R. _____ Sec. _____ Co. Montgomery Job No. 0 56833.010
Station 750 Offset from CL _____ Elevation _____
Date Started/Completed 5-21-13 Drill Contractor: L.G. HETAGER DRILLING, INC.
Driller James Hopkins Helper Phil / Cross
Engineer GF Engineer's Rep. DOE IC
Drilling Methods Sample / Auger
Drill Rig Type: ATV/Truck/Track/Skid 221 Casing Diameter OD/ID _____ in.
Soil Sampling: Hammer Type: Safety/Donut/Trip: Weight 140 lb. Drop 30 in.
No. Rope Turns 1-3/4 or 2-1/4 _____ : Sampler Diameter 2 in.
Rock Sampling: Core Barrel Type ~~Diamond~~ Size _____
Water Level Depth: 16.0 feet Time 13:30 Date 5/21/13
16.9 feet Time 7:20 Date 5/22/13
17.6 feet Time 7:33 Date 5/25/13

Depth (ft.)	Sample No./ Type or Run No.	Blows 0.5 ft. on Soil Sampler	Rec. (ft.)	Description (Color, Type, Moisture)	RQD (ft.)/%	Remarks
2.0	S-1	4-4-7-9	1.0	BR SILTY SAND 0 - 4.0		
4.0	S-2	7-8-5⅔	1.0			
6.0	S-3	4-23-14-8	2.0	ASBESTOS 4.0 - 16.0		
8.0	S-4	4-6-8-12	1.2	BR SANDY clay 16.0 - 22.5		
10.0	S-5	2-2-1-1	0.3			
12.0	S-6	~~2-1-2-6~~ 3-1-1-1	1.0	BR/GRAY shale 12.5 - 22.8		
14.0	S-7	24-36	1.0			
16.0	S-8	3-2-1-1	0.4	23.0 Auger Refusal		
18.0	S-9	2-2-2-2	0.6			
20.0	S-10	1-1-1-WH	2.0			
22.0	S-11	4-7-12-10	2.0			
22.8	S-12	19-5⅔	0.8			

Notes: 23.0 Sample - Auger Refusal 12 Jars

Signatures:

Driller _____ Inspector Signature _____ Date 5/23/13

(Print Name) Joe Krupansky

Revision 01/00 , DL

Figure 214 (a)-1

DRILLER'S BORING LOG

Boring No. Bob-2A
Sheet 1 of 1

Location: S.R. _____ Sec. _____ Co. Montgomery Job No. 056533.010
Station 750 Offset from CL _____ Elevation _____
Date Started/Completed 5-22-13 Drill Contractor: L.G. HETAGER DRILLING, INC.
Driller James Hopkins Helper Phil / Chris
Engineer GF Engineer's Rep. Joe K
Drilling Methods Auger / Tube
Drill Rig Type: ATV/Truck/Track/Skid 221 Casing Diameter OD/ID _____ in.
Soil Sampling: Hammer Type: Safety/Donut/Trip: Weight _____ lb. Drop _____ in.
No. Rope Turns 1-3/4 or 2-1/4 _____ : Sampler Diameter _____ in.
Rock Sampling: Core Barrel Type _____ Size _____
Water Level Depth: 16.5 feet Time 3:00 Date 5-22-13
_____ feet Time _____ Date _____
_____ feet Time _____ Date _____

Depth (ft.)	Sample No./ Type or Run No.	Blows 0.5 ft. on Soil Sampler	Rec. (ft.)	Description (Color, Type, Moisture)	RQD (ft.)/%	Remarks
				unsample 0-16.5		
			2.0	Tube 16.5-18.5		

Notes: 16.5 unsample
2.0 Tube

Signatures:

Driller James Hopkins Inspector Signature _____ Date 5-22-13
(Print Name) Joe Krupansky

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Figure 214 (a)-1

DRILLER'S BORING LOG

Boring No. Bob-3
Sheet 1 of 1

Location: S.R. _____ Sec. _____ Co. Montgomery Job No. 056533.010
Station 1100 Offset from CL _____ Elevation _____
Date Started/Completed 5-22-13 Drill Contractor: L.G. HETAGER DRILLING, INC.
Driller James Hopkins Helper Criss / Phil
Engineer GT Engineer's Rep. Joe K
Drilling Methods Auger / Sample
Drill Rig Type: ATV/Truck/Track/Skid 321 Casing Diameter OD/ID _____ in.
Soil Sampling: Hammer Type: Safety/Donut/Trip: Weight 140 lb. Drop 30 in.
No. Rope Turns 1-3/4 or 2-1/4 _____ : Sampler Diameter 2 in.
Rock Sampling: Core Barrel Type _____ Size _____
Water Level Depth: 22.6 feet Time 14:10 Date 5/22/13
21.8 feet Time 7:35 Date 5/23/13
_____ feet Time _____ Date _____

Depth (ft.)	Sample No./ Type or Run No.	Blows 0.5 ft. on Soil Sampler	Rec. (ft.)	Description (Color, Type, Moisture)	RQD (ft.)/%	Remarks
2.0	S-1	4-5-6-4	1.0	BR SILTY SAND 0-3.0		
4.0	S-2	3-2-10-11	1.2			
6.0	S-3	3-2-4-2	1.1	ASBESTOS MATERIALS 3.0-8.5		
8.0	S-4	6-6-6-4	1.0	BR SILTY clay 8.5-27.5		
10.0	S-5	2-2-2-3	2.0			
12.0	S-6	3-3-4-2	2.0			
14.0	S-7	3-4-3-2	0.6	BR SAND & GRAVEL 27.5-28.8		
16.0	S-8	4-4-4-4	2.0			
18.0	S-9	4-8-8-8	2.0			
20.0	S-10	4-1-1-2	2.0			
22.0	S-11	1-1-2-2	2.0			
24.0	S-12	4-3-3-4	2.0			
26.0	S-13	7-23-37-26	2.0			
28.0	S-14	21-22-28-17	0.7			
28.8	S-15	46-50/3	0.8			

Notes: 28.8 SAMPLE 15 JARS

Signatures:

Driller _____ Inspector Signature _____ Date 5/23/13

(Print Name) Joe Krupansky

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Figure 214 (a)-1

DRILLER'S BORING LOG

Boring No. Bob-3A
Sheet 1 of 1

Location: S.R. _____ Sec. _____ Co. Montgomery Job No. 05633-40
Station 1026 Offset from CL _____ Elevation _____
Date Started/Completed 5-22-13 Drill Contractor: L.G. HETAGER DRILLING, INC.
Driller James Hyatt Helper Chris/Phil
Engineer GF Engineer's Rep. Joe K
Drilling Methods Auger / Tube
Drill Rig Type: ATV/Truck/Track/Skid 221 Casing Diameter OD/ID _____ in.
Soil Sampling: Hammer Type: Safety/Donut/Trip: Weight _____ lb. Drop _____ in.
No. Rope Turns 1-3/4 or 2-1/4 _____ : Sampler Diameter _____ in.
Rock Sampling: Core Barrel Type _____ Size _____
Water Level Depth: Dry feet Time 12:00 Date 5-22-13
_____ feet Time _____ Date _____
_____ feet Time _____ Date _____

Depth (ft.)	Sample No./ Type or Run No.	Blows 0.5 ft. on Soil Sampler	Rec. (ft.)	Description (Color, Type, Moisture)	RQD (ft.)/%	Remarks
			2.0	unsample 0-9 Tube 9-11		

Notes: 9.0 unsample
2.0 Tube

Signatures:

Driller _____ Inspector Signature _____ Date 5-22-13
(Print Name) Joe Krupczynsky

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Figure 214 (a)-1

APPENDIX E
Laboratory Test Results

GeoStructures

Bashar S. Qubain, Ph.D., P.E.
Eric J. Seksinsky, P.G., P.E.
Jianchao Li, P.E.

GEOTECHNICAL ENGINEERING CONSULTANTS

Project No. G13-148
June 7, 2013

Mr. Craig Benedict, P.E.
Gannett Fleming, Inc.
1010 Adams Avenue
Audubon, PA 19403

Re: Geotechnical Laboratory Testing
BoRit Asbestos Site

Dear Mr. Benedict:

GeoStructures, Inc. has completed the requested geotechnical laboratory testing program for the referenced projects. Included in this work order are:

2 Triaxial Compression tests, CU with Pore Pressure (ASTM D4767)
1 Unconfined Compressive Strength test (ASTM D2166)
1 Organic Ignition Content (ASTM D2974)
11 Water Content (ASTM D2216)
11 Sieve Analysis tests (ASTM D422)
11 Atterberg Limits (ASTM D4318)

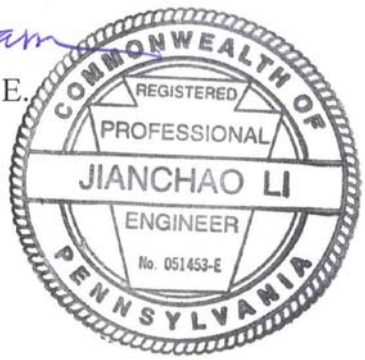
GeoStructures is an AMRL accredited and US Army Corps of Engineers validated lab. The laboratory tests have been performed in compliance with ASTM, AASHTO, and USACE standard test methods.

We appreciate your request for services and look forward to assisting you in the future. Please feel free to call me if you have any questions.

Sincerely,

Jianchao Li, P.E.
Associate

Attachments



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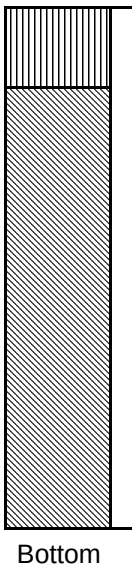
SHELBY TUBE LOG

Project Name:	BoRit Asbestos Site			Boring No.:	BOB 1A
Project No.:	G13-148	Sample No.: Shelby tube		Depth:	4.5' - 6.5'
Sample Length :	14"	Recovery :	18"	Ejected By: ONR	Date: 5/31/2013



Description

Cave in material mixed with wax.

Brown sandy silt (ML)

Measurements

Natural moisture :	20.5 %
Dry Unit weight :	102.6 pcf
Depth :	6.0'

Photo

BOB 1A 4.5' - 6.5' sample extruded from Shelby tube

Phone (610) 265-1818
Fax (610) 265-1833

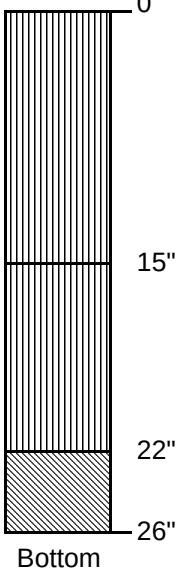
1000 W. 9th Avenue
King of Prussia, PA 19406

www.geostructures.net

GeoStructures

SHELBY TUBE LOG

Project Name:	BoRit Asbestos Site			Boring No.:	BOB 2A
Project No.:	G13-148	Sample No.: Shelby tube		Depth:	16.5' - 18.5'
Sample Length :	22"	Recovery :	26"	Ejected By: ONR	Date: 5/31/2013



Description

Dark brown sandy silt, very wet, deformed under its own weight.

Dark brown wet sandy silt (ML)

Dark brown and gray, light weight material (visually)

Measurements

Natural moisture :	40.8 %
Dry Unit weight :	84.9 pcf
Depth :	16.0'

Photo

BOB 2A 16.5 - 18.5' sample extruded from Shelby tube

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Fax (610) 265-1833

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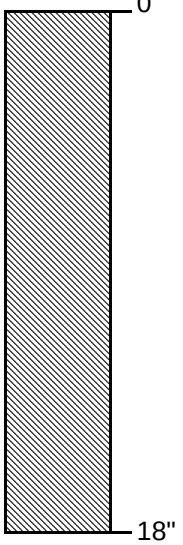
King of Prussia, PA 19406

www.geostructures.net

GeoStructures

SHELBY TUBE LOG

Project Name:	BoRit Asbestos Site			Boring No.:	BOB 3A
Project No.:	G13-148	Sample No.: Shelby tube		Depth:	9.0' - 11.0'
Sample Length :	18"	Recovery :	18"	Ejected By: ONR	Date: 5/31/2013



Description

Brown and gray sandy silt (ML)

Measurements

Natural moisture :	26.1 %
Dry Unit weight :	95.9pcf
Depth :	9.5'

Photo

BOB 3A 9.0' - 11.0' sample extruded from Shelby tube

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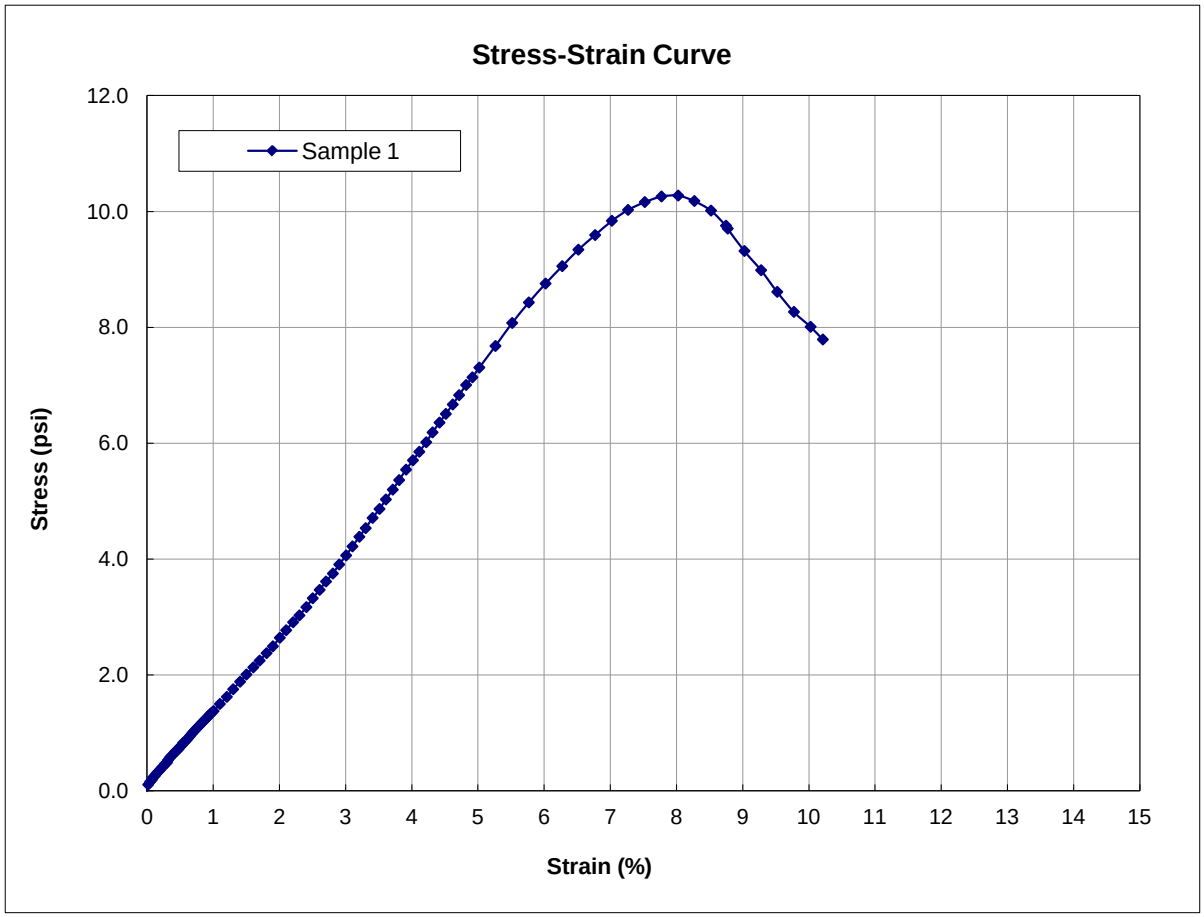
UNCONFINED COMPRESSION TEST REPORT (ASTM D2166)



Sample	1
Moisture Content (%)	22.5%
Moist Unit Weight (pcf)	125.7
Dry Unit Weight (pcf)	102.6
Height (in)	4.754
Diameter (in)	2.861

Boring #	Sample #	Depth (ft)	Material Description	USCS	LL	PL	PI	Compressive Strength (psi)
BOB 1A	U-1	4.5 - 6.5	Brown sandy silt	ML	30	23	7	10.3

Remarks:

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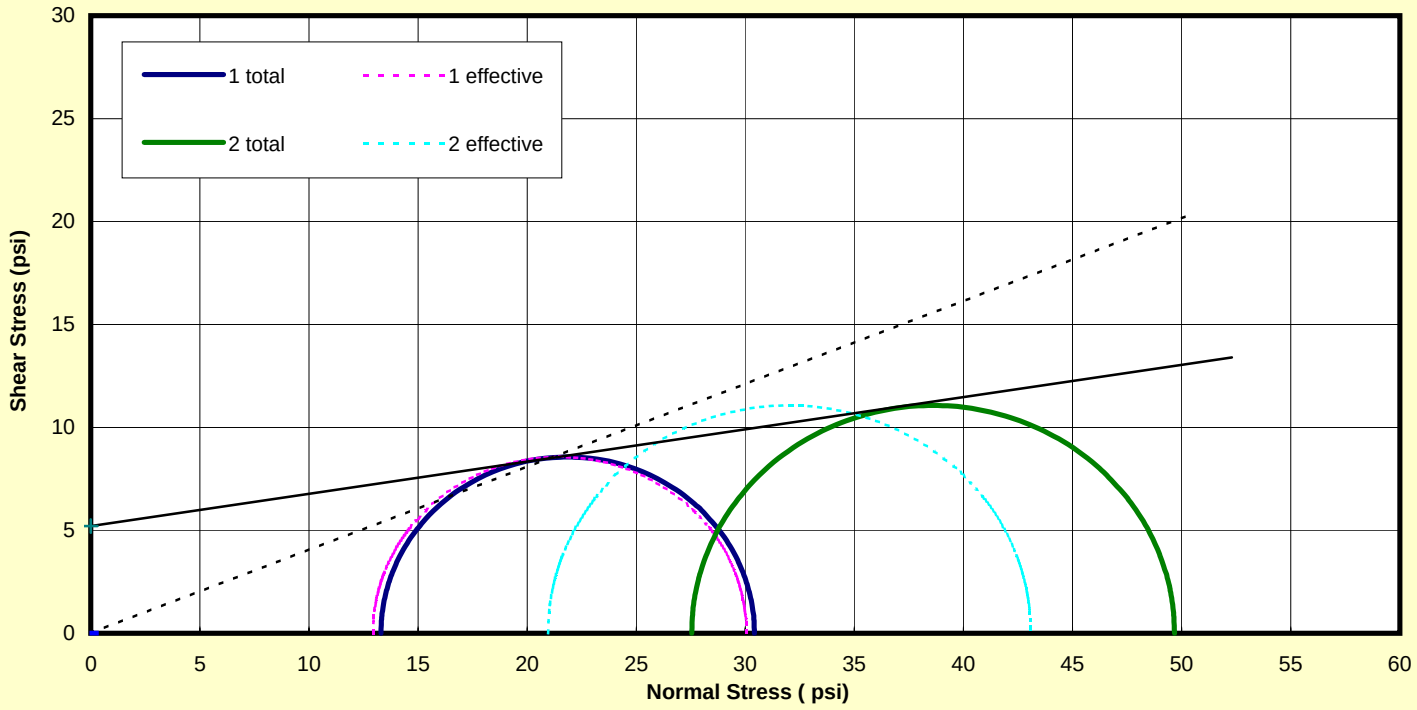
Ph. 610-265-1818 1000 W. 9th Avenue, King of Prussia, PA 19406 www.geostructures.net Fax 610-265-1833

CU TRIAXIAL SHEAR REPORT (ASTM D4767)

	Friction Angle (degree)	Cohesion (psi)
Total Stress	8.9	5.2
Effective Stress	22.0	0.0



	Specimen No.	1	2	3	
Initial	Water Content (%)	31.1%	32.3%		
	Dry Density (pcf)	90.9	84.9		
	Saturation (%)	100.0%	100.0%		
	Void Ratio	0.8	1.0		
	Diameter (in.)	1.421	1.479		
	Height (in.)	2.831	2.553		
At test	B value	0.98	0.98		
	Back Press. (psi)	80.6	80.2		
	Effect. Consol. Stress (psi)	13.3	27.5		
	Strain rate (in./min)	0.005	0.005		
Failure	Cell Press. (psi)	93.9	107.7		
	Back Press. (psi)	80.6	80.2		
	Deviator Stress (psi)	17.1	22.1		
	Sigma 1 (psi)	30.4	49.7		
	Sigma 3 (psi)	13.3	27.5		
	Excess Pore Press. (psi)	0.4	6.6		

Boring #	Sample #	Depth (ft)	Material Description	USCS	LL	PL	PI	Gs
BOB 2A	U-1	16.5 - 18.5	Dark brown sandy silt	ML	26	22	4	2.68

Remarks: Specimens were trimmed from 17.5 to 18.0 ft of the tube. Specimen 2 (on top) was observed to be softer than specimen 1 (see dry density measurement)

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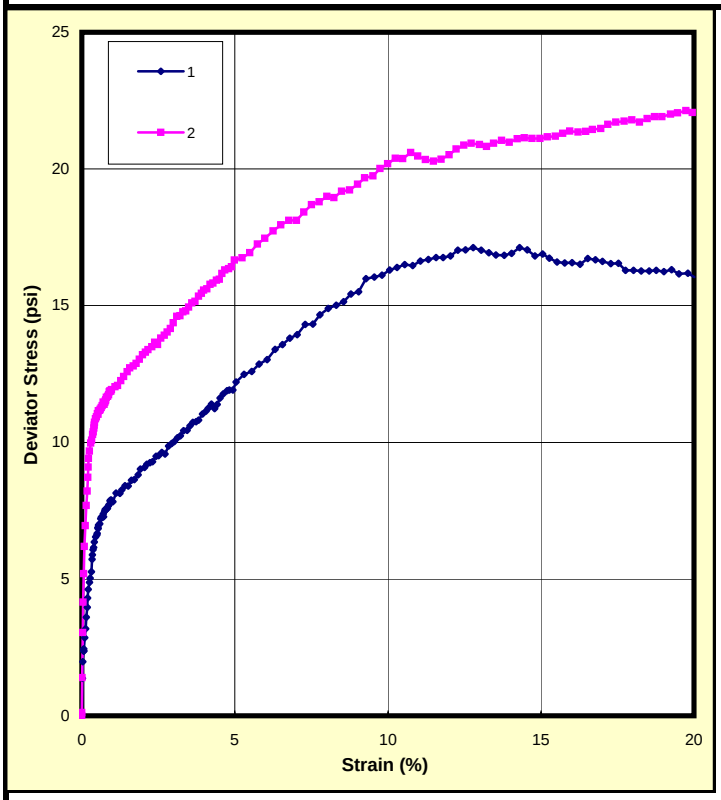
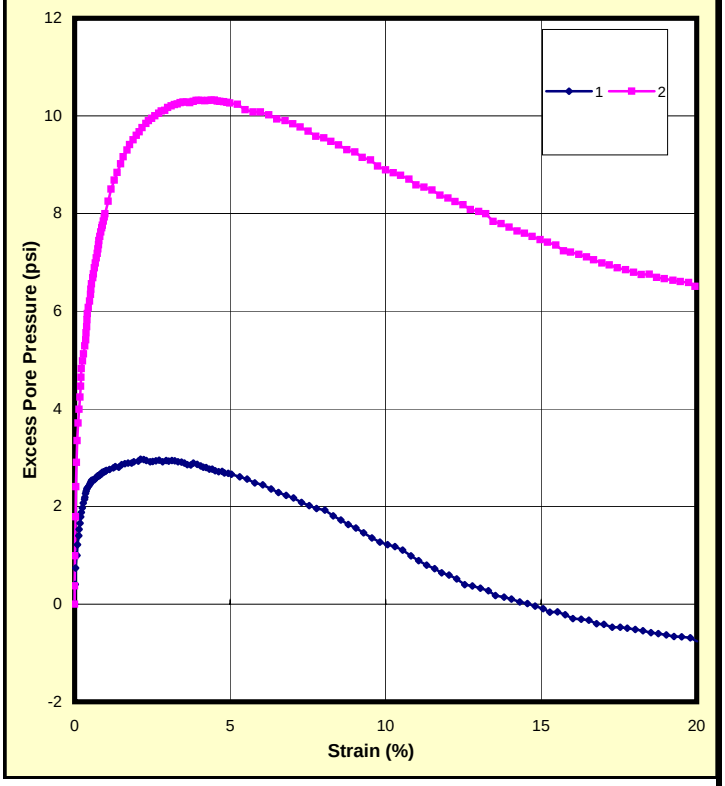
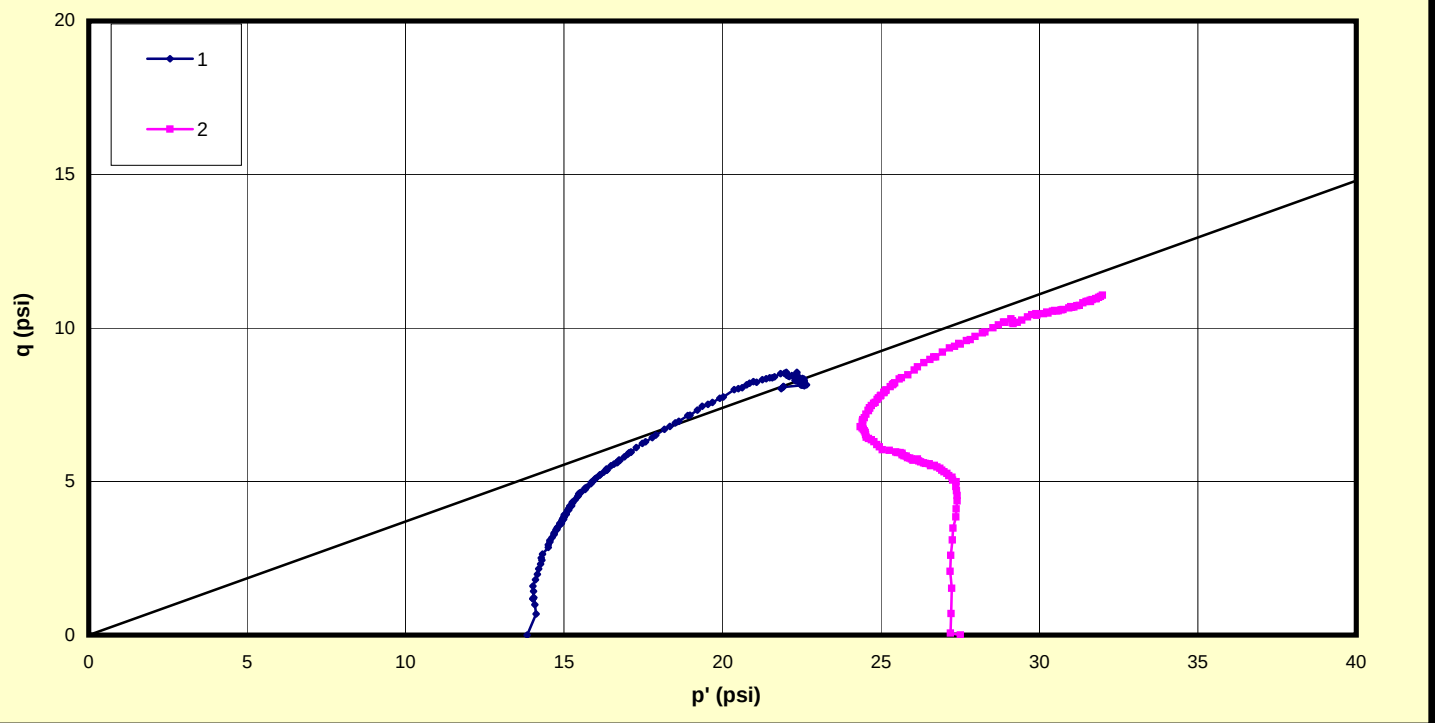
CU TRIAXIAL SHEAR REPORT (Cont.)







Stress Path	α (degree)	a (psi)
Effective Stress	20.3	0.0

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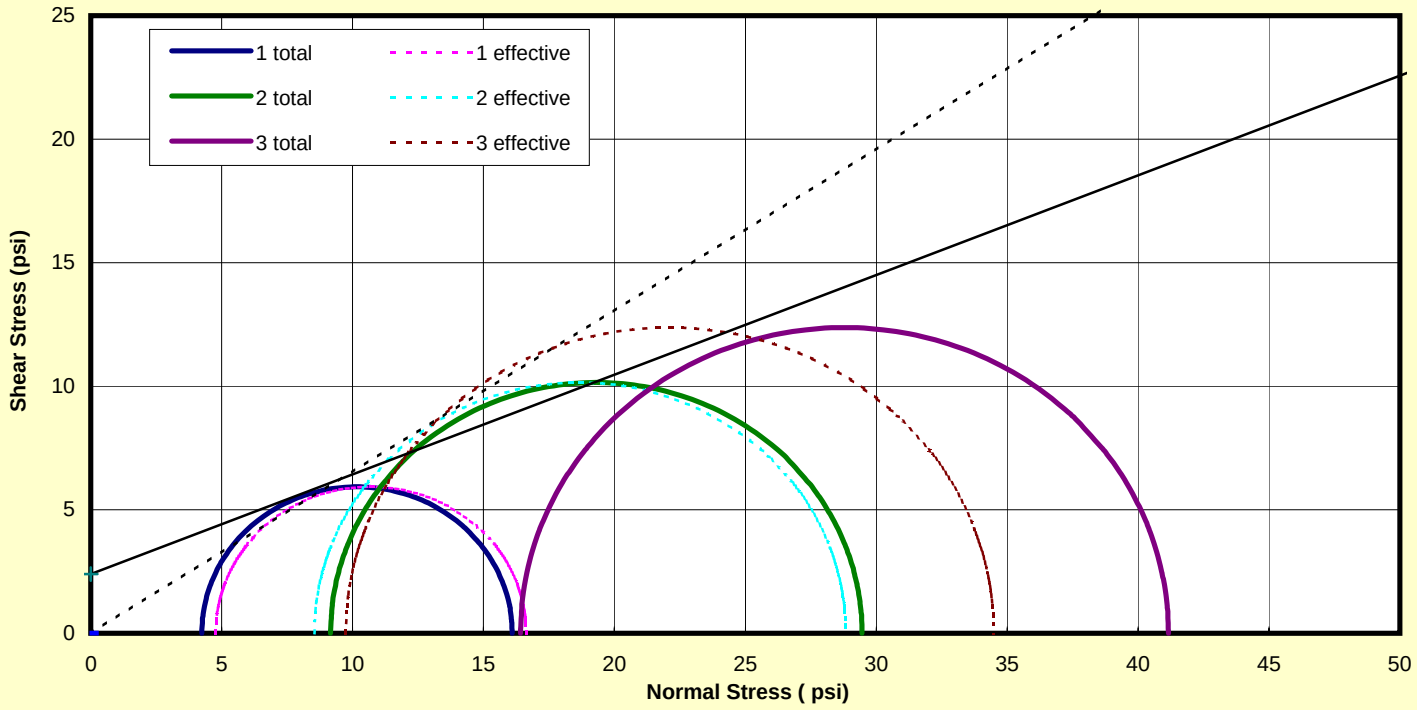
CU TRIAXIAL SHEAR REPORT (ASTM D4767)

	Friction Angle (degree)	Cohesion (psi)
Total Stress	22.0	2.4
Effective Stress	33.2	0.0



Specimen No.		1	2	3	
Initial	Water Content (%)	26.1%	24.4%	25.0%	
	Dry Density (pcf)	95.9	99.6	96.4	
	Saturation (%)	100.0%	100.0%	100.0%	
	Void Ratio	0.7	0.7	0.7	
	Diameter (in.)	2.836	2.830	2.827	
	Height (in.)	5.517	5.537	5.526	
At test	B value	0.99	0.99	0.99	
	Back Press. (psi)	90.4	90.1	90.3	
	Effect. Consol. Stress (psi)	4.2	9.2	16.4	
	Strain rate (in./min)	0.009	0.009	0.009	
Failure	Cell Press. (psi)	94.7	99.3	106.7	
	Back Press. (psi)	90.4	90.1	90.3	
	Deviator Stress (psi)	11.9	20.3	24.8	
	Sigma 1 (psi)	16.1	29.5	41.2	
	Sigma 3 (psi)	4.2	9.2	16.4	
	Excess Pore Press. (psi)	-0.5	0.6	6.7	

Boring #	Sample #	Depth (ft)	Material Description	USCS	LL	PL	PI	Gs
BOB 3A	U-1	9.0 - 11.0	Brown and gray sandy silt	ML	27	22	5	2.68

Remarks

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BoRit Asbestos Site

GeoStructures Project # G13-148 6/6/2013

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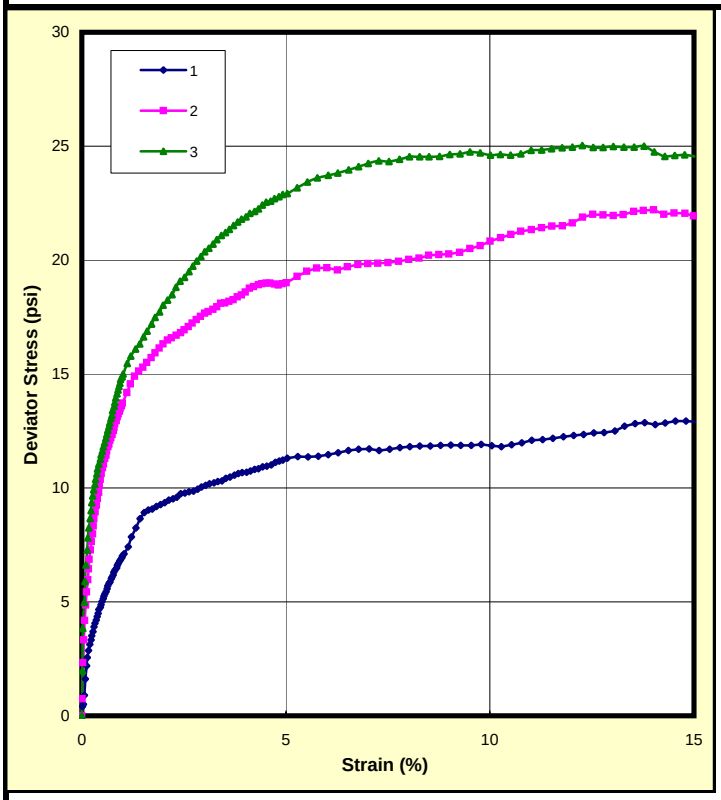
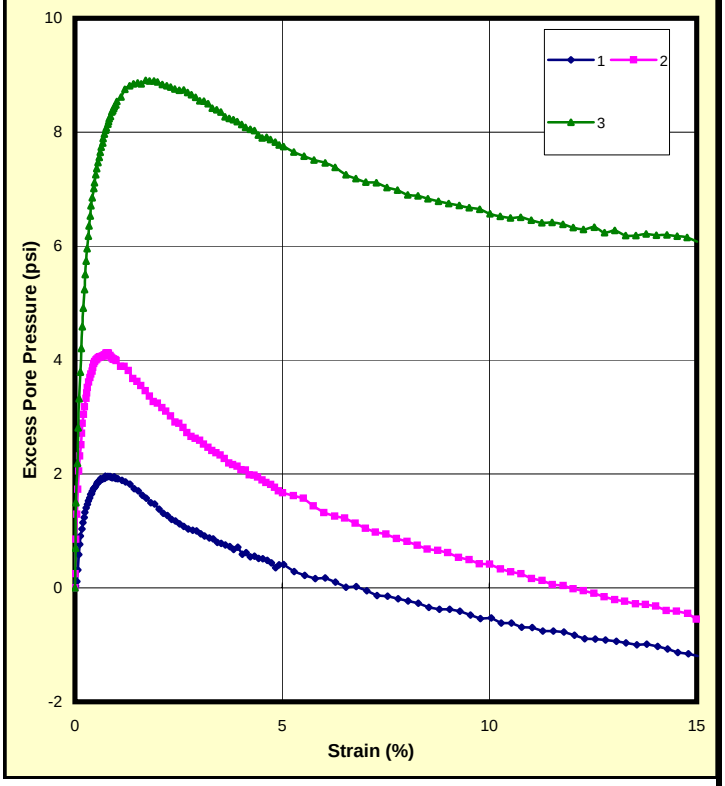
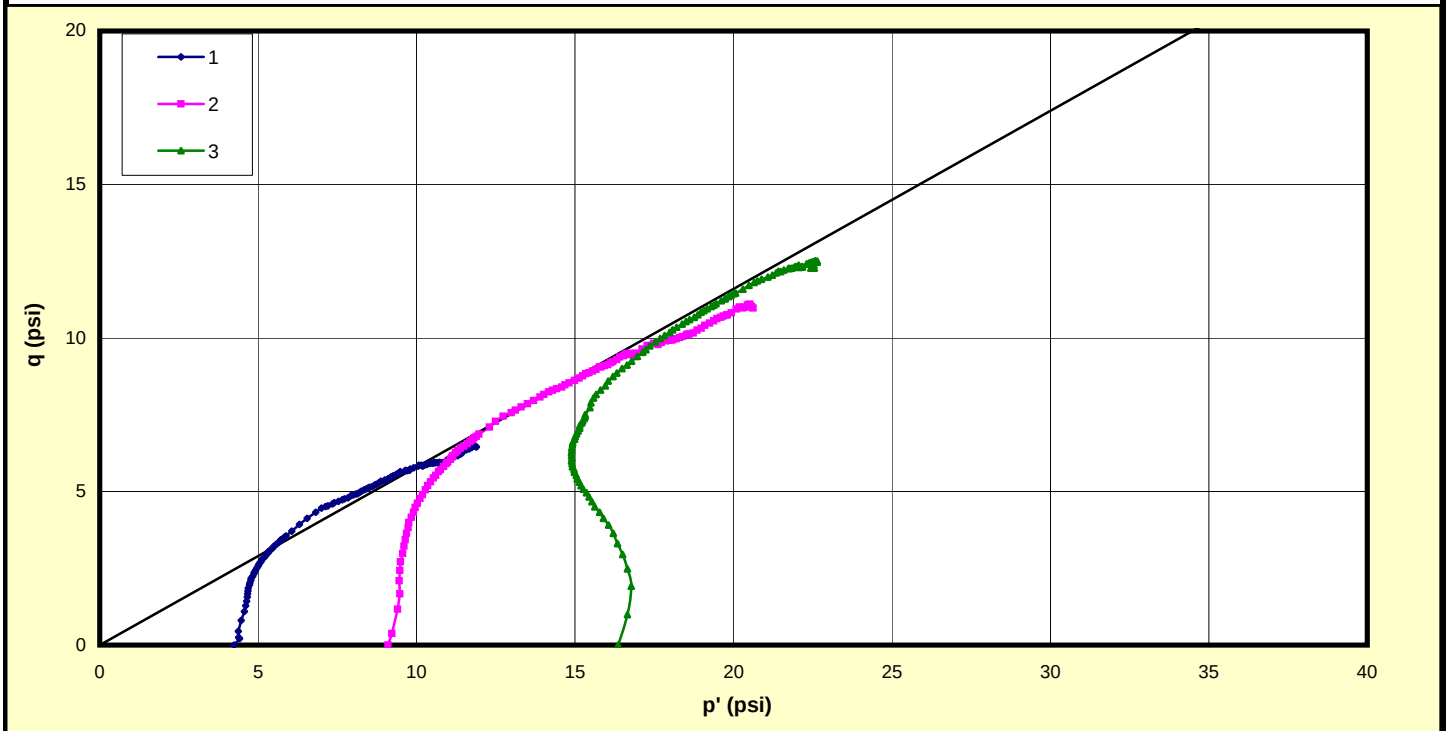
CU TRIAXIAL SHEAR REPORT (Cont.)







Stress Path	α (degree)	a (psi)
Effective Stress	30.1	0.0

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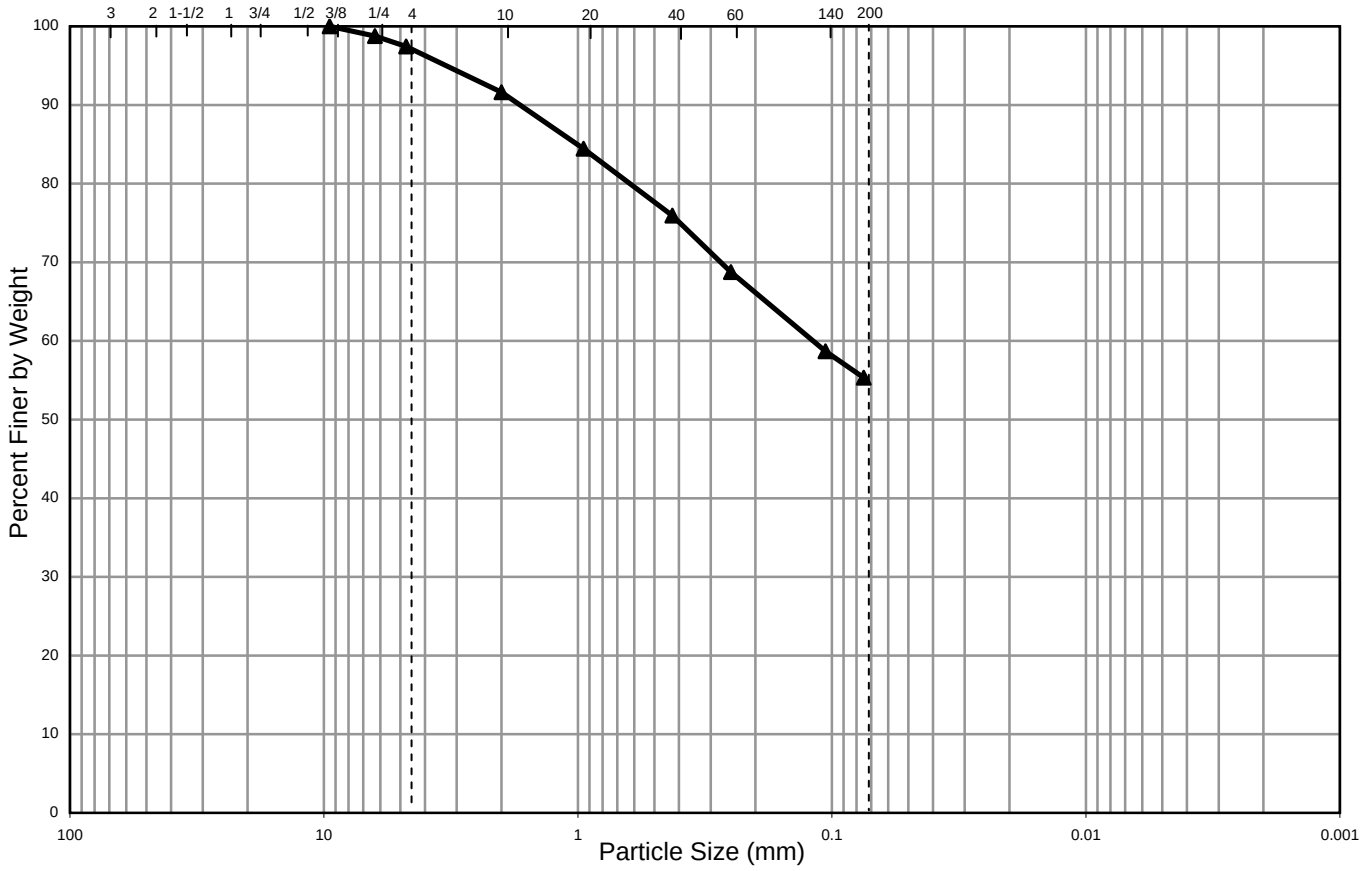
PARTICLE SIZE ANALYSIS OF SOILS



%	Cobbles	Gravel		Sand			Fines (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	
▲	0.0	2.6		42.1			55.3

Sieve	Percent Finer ▲
3"	
2"	
1-1/2"	
1"	
3/4"	
1/2"	
3/8"	100.0
1/4"	98.8
No. 4	97.4
No. 10	91.6
No. 20	84.4
No. 40	75.9
No. 60	68.8
No. 140	58.7
No. 200	55.3

	▲
Stratum	
Boring	BOB 1
Sample	S-3
Depth (ft)	3.0 - 4.5
C_u	
C_c	
w (%)	18.6
LL	26
PL	22
PI	4
USCS	ML

	Color	USCS Group Name
▲	Brown	Sandy silt

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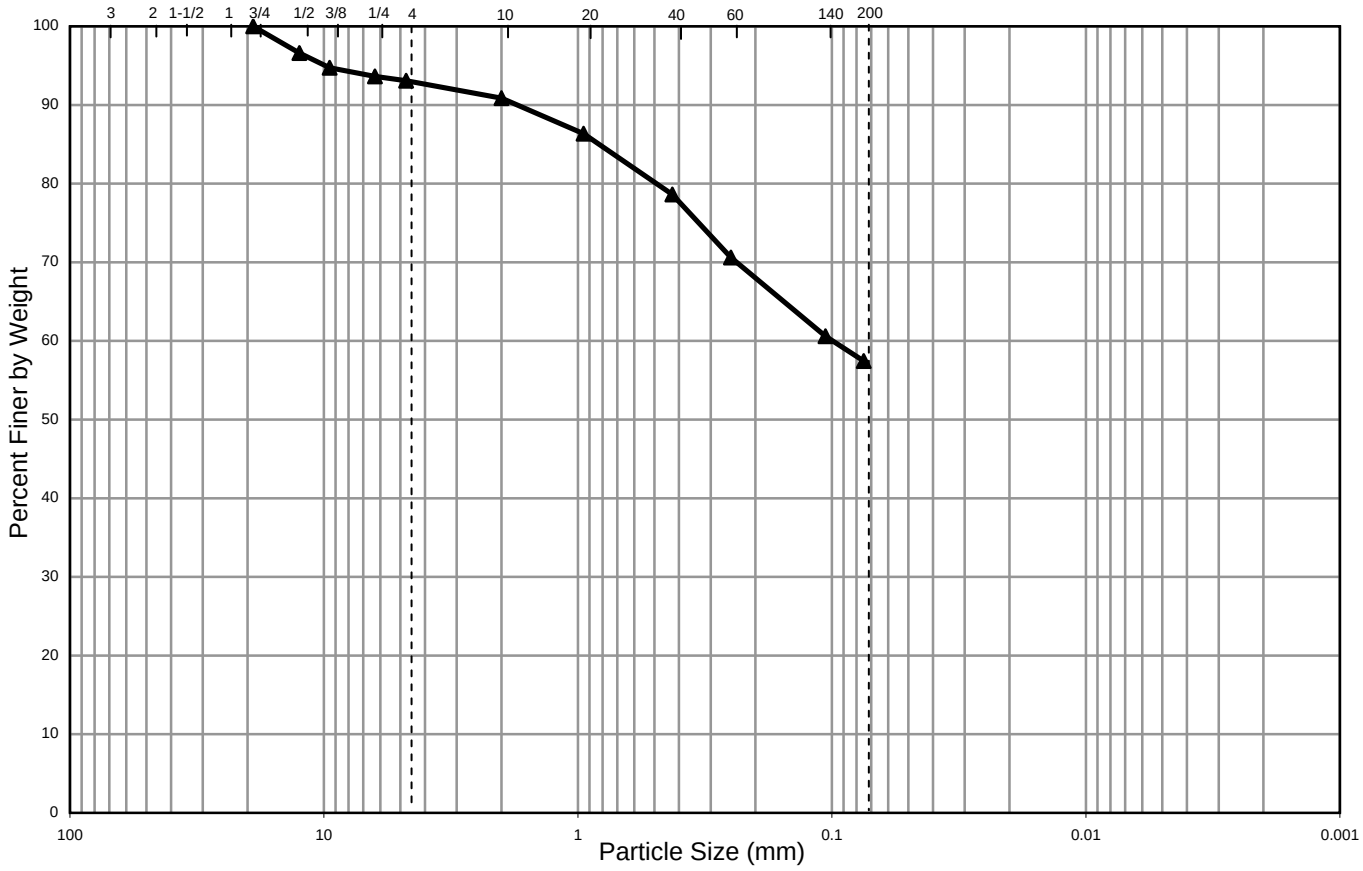
PARTICLE SIZE ANALYSIS OF SOILS



%	Cobbles	Gravel		Sand			Fines (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	
▲	0.0	6.9		35.6			57.4

Sieve	Percent Finer ▲
3"	
2"	
1-1/2"	
1"	
3/4"	100.0
1/2"	96.6
3/8"	94.7
1/4"	93.6
No. 4	93.1
No. 10	90.9
No. 20	86.3
No. 40	78.6
No. 60	70.6
No. 140	60.6
No. 200	57.4

	▲
Stratum	
Boring	BOB 1
Sample	S-6 & S-7
Depth (ft)	8.0 - 12.0
C_u	
C_c	
w (%)	20.7
LL	27
PL	22
PI	5
USCS	ML

	Color	USCS Group Name
▲	Brown	Sandy silt

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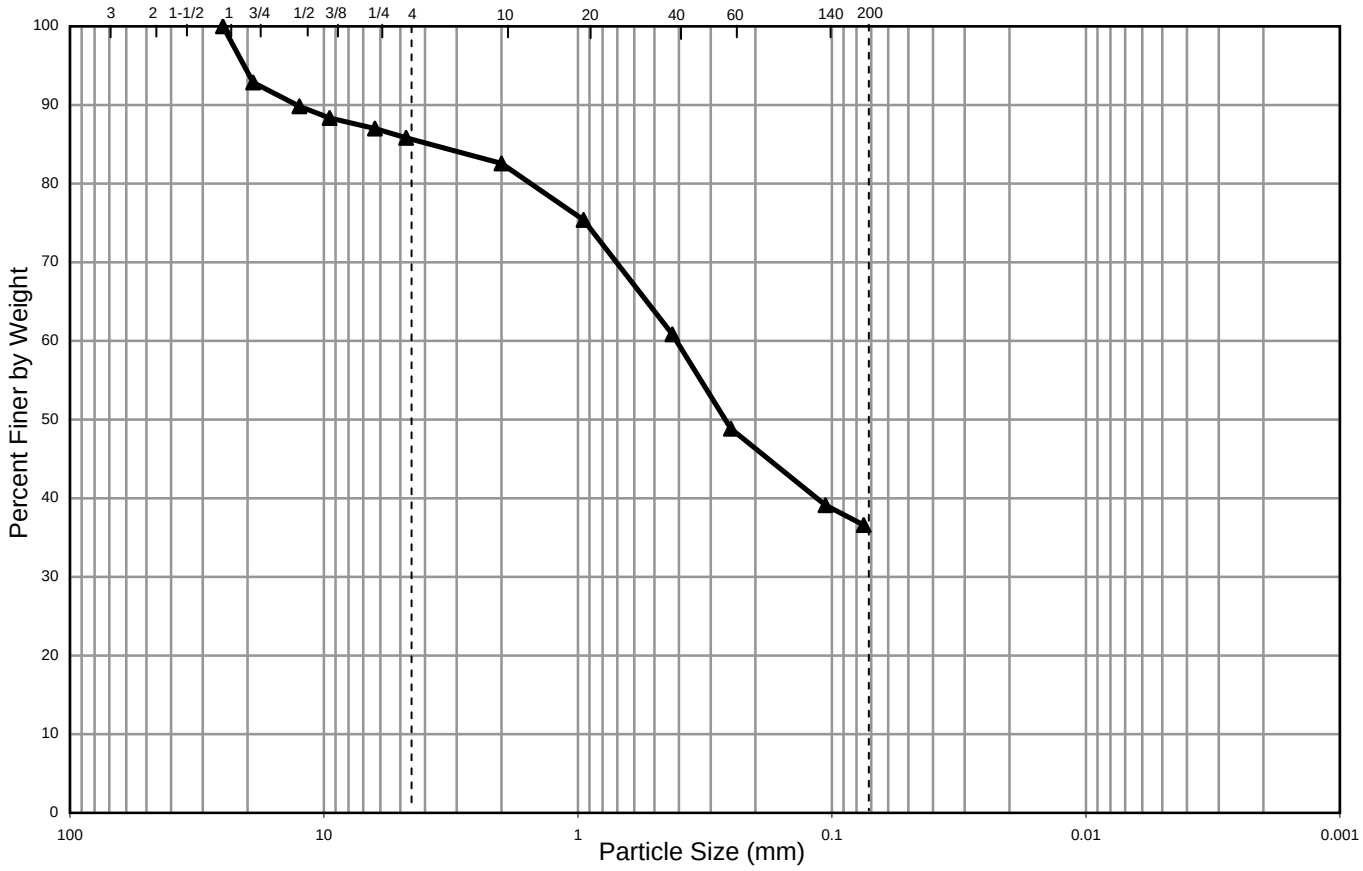
PARTICLE SIZE ANALYSIS OF SOILS

U.S. SIEVE OPENING IN INCHES | U.S. STANDARD SIEVE NUMBERS | HYDROMETER



%	Cobbles	Gravel		Sand			Fines (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	
▲	0.0	14.2		49.2			36.6

Sieve	Percent Finer ▲
3"	
2"	
1-1/2"	
1"	100.0
3/4"	92.9
1/2"	89.8
3/8"	88.4
1/4"	87.0
No. 4	85.8
No. 10	82.6
No. 20	75.4
No. 40	60.9
No. 60	48.8
No. 140	39.1
No. 200	36.6

	▲
Stratum	
Boring	BOB 1
Sample	S-8
Depth (ft)	12.0 - 14.0
C_u	
C_c	
w (%)	18.9
LL	24
PL	21
PI	3
USCS	SM

	Color	USCS Group Name
▲	Brown	Silty sand

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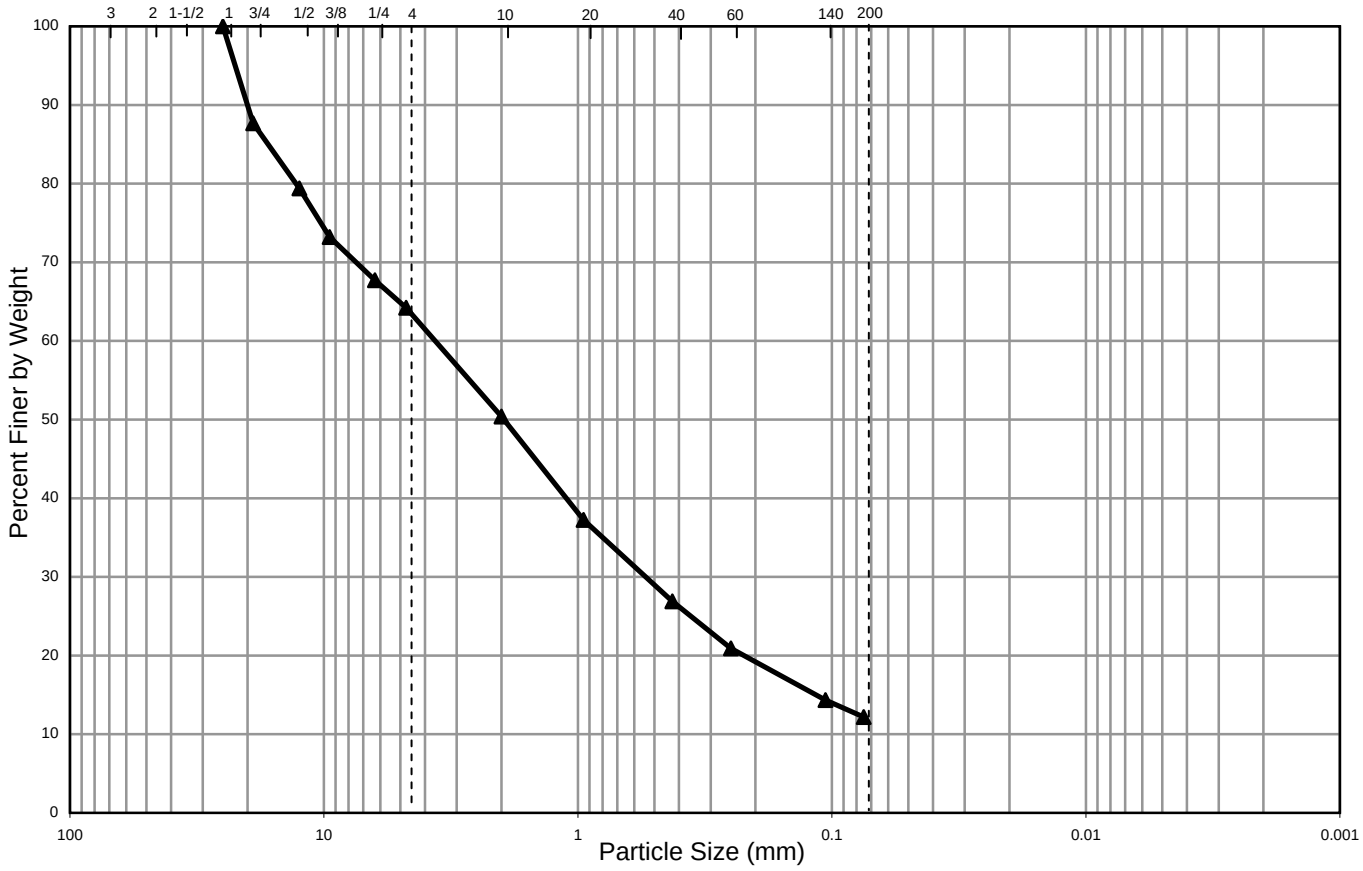
PARTICLE SIZE ANALYSIS OF SOILS



%	Cobbles	Gravel		Sand			Fines (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	
▲	0.0	35.8		52.0			12.2

Sieve	Percent Finer ▲
3"	
2"	
1-1/2"	
1"	100.0
3/4"	87.7
1/2"	79.4
3/8"	73.2
1/4"	67.7
No. 4	64.2
No. 10	50.4
No. 20	37.3
No. 40	26.9
No. 60	20.9
No. 140	14.4
No. 200	12.2

	▲
Stratum	
Boring	BOB 1
Sample	S-10
Depth (ft)	16.0 - 18.0
C_u	
C_c	
w (%)	11.3
LL	N.P.
PL	N.P.
PI	N.P.
USCS	SM

	Color	USCS Group Name
▲	Brown	Silty sand with gravel

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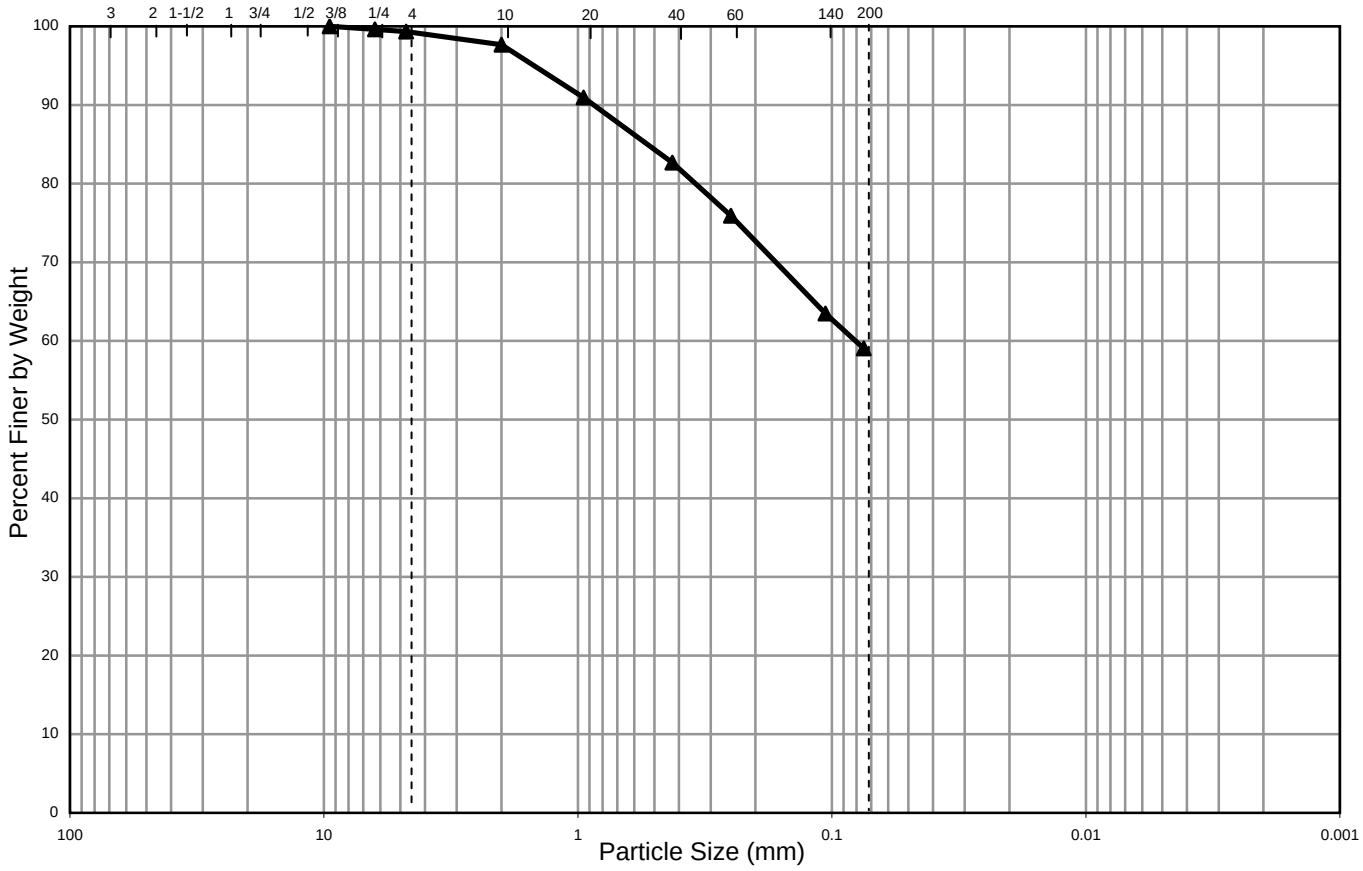
PARTICLE SIZE ANALYSIS OF SOILS



%	Cobbles	Gravel		Sand			Fines (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	
▲	0.0	0.7		40.3			59.1

Sieve	Percent Finer ▲
3"	
2"	
1-1/2"	
1"	
3/4"	
1/2"	
3/8"	100.0
1/4"	99.6
No. 4	99.3
No. 10	97.7
No. 20	90.9
No. 40	82.7
No. 60	75.9
No. 140	63.5
No. 200	59.1

	▲
Stratum	
Boring	BOB 1A
Sample	U-1
Depth (ft)	4.5 - 6.5
C_u	
C_c	
w (%)	20.5
LL	30
PL	23
PI	7
USCS	ML

	Color	USCS Group Name
▲	Brown	Sandy silt

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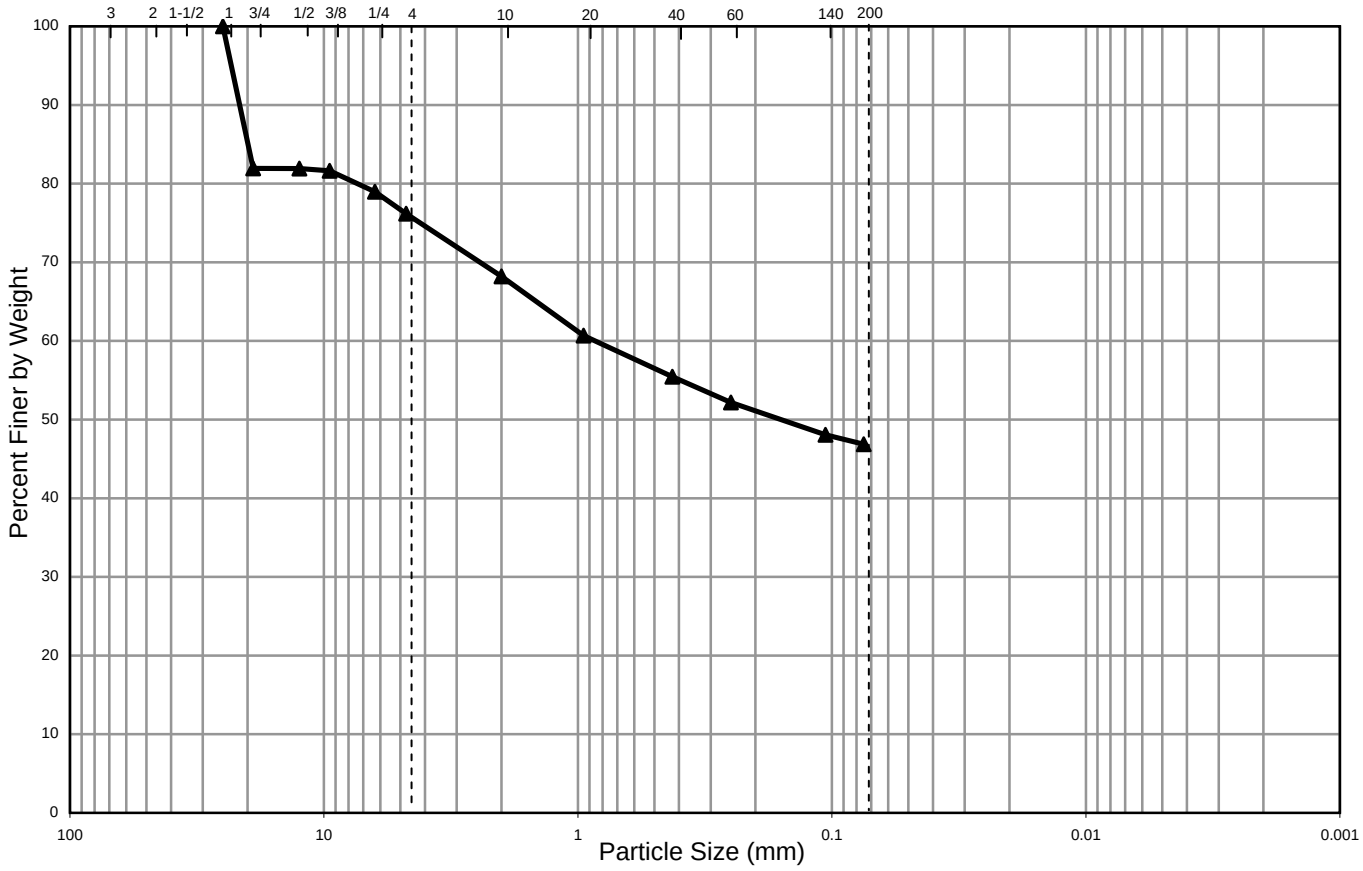
PARTICLE SIZE ANALYSIS OF SOILS



%	Cobbles	Gravel		Sand			Fines (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	
▲	0.0	23.8		29.3			46.9

Sieve	Percent Finer ▲
3"	
2"	
1-1/2"	
1"	100.0
3/4"	81.9
1/2"	81.9
3/8"	81.6
1/4"	79.0
No. 4	76.2
No. 10	68.2
No. 20	60.7
No. 40	55.5
No. 60	52.2
No. 140	48.1
No. 200	46.9

	▲
Stratum	
Boring	BOB 2
Sample	S-1 & S-2
Depth (ft)	0.0 - 4.0
C_u	
C_c	
w (%)	15.9
LL	37
PL	26
PI	11
USCS	SM

	Color	USCS Group Name
▲	Brown	Silty sand with gravel

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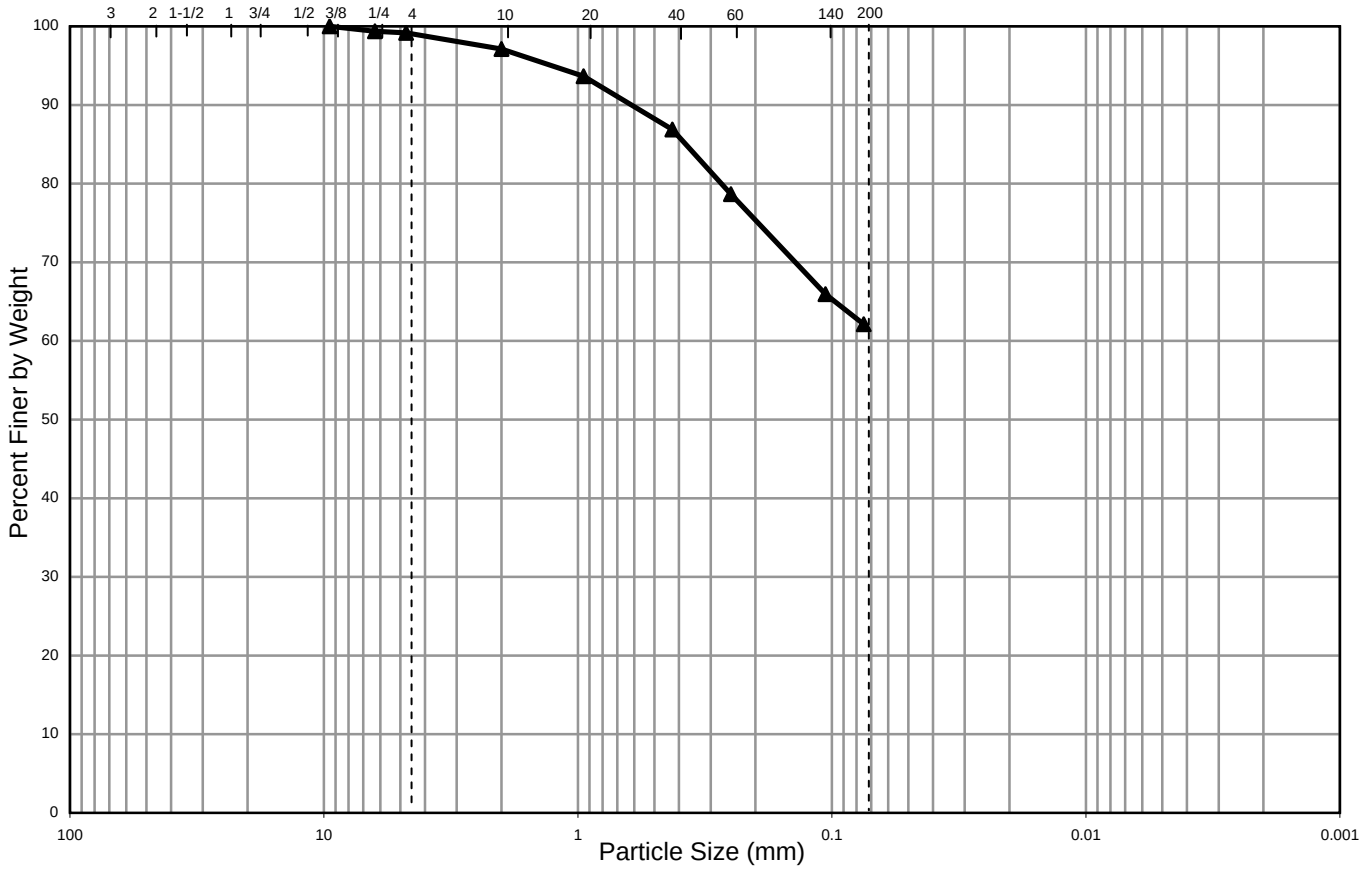
PARTICLE SIZE ANALYSIS OF SOILS



%	Cobbles	Gravel		Sand			Fines (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	
▲	0.0	0.8		37.0			62.1

Sieve	Percent Finer ▲
3"	
2"	
1-1/2"	
1"	
3/4"	
1/2"	
3/8"	100.0
1/4"	99.4
No. 4	99.2
No. 10	97.1
No. 20	93.7
No. 40	86.9
No. 60	78.7
No. 140	66.0
No. 200	62.1

	▲
Stratum	
Boring	BOB 2A
Sample	U-1
Depth (ft)	16.5 - 18.5
C_u	
C_c	
w (%)	40.8
LL	26
PL	22
PI	4
USCS	ML

	Color	USCS Group Name
▲	Dark brown	Sandy silt

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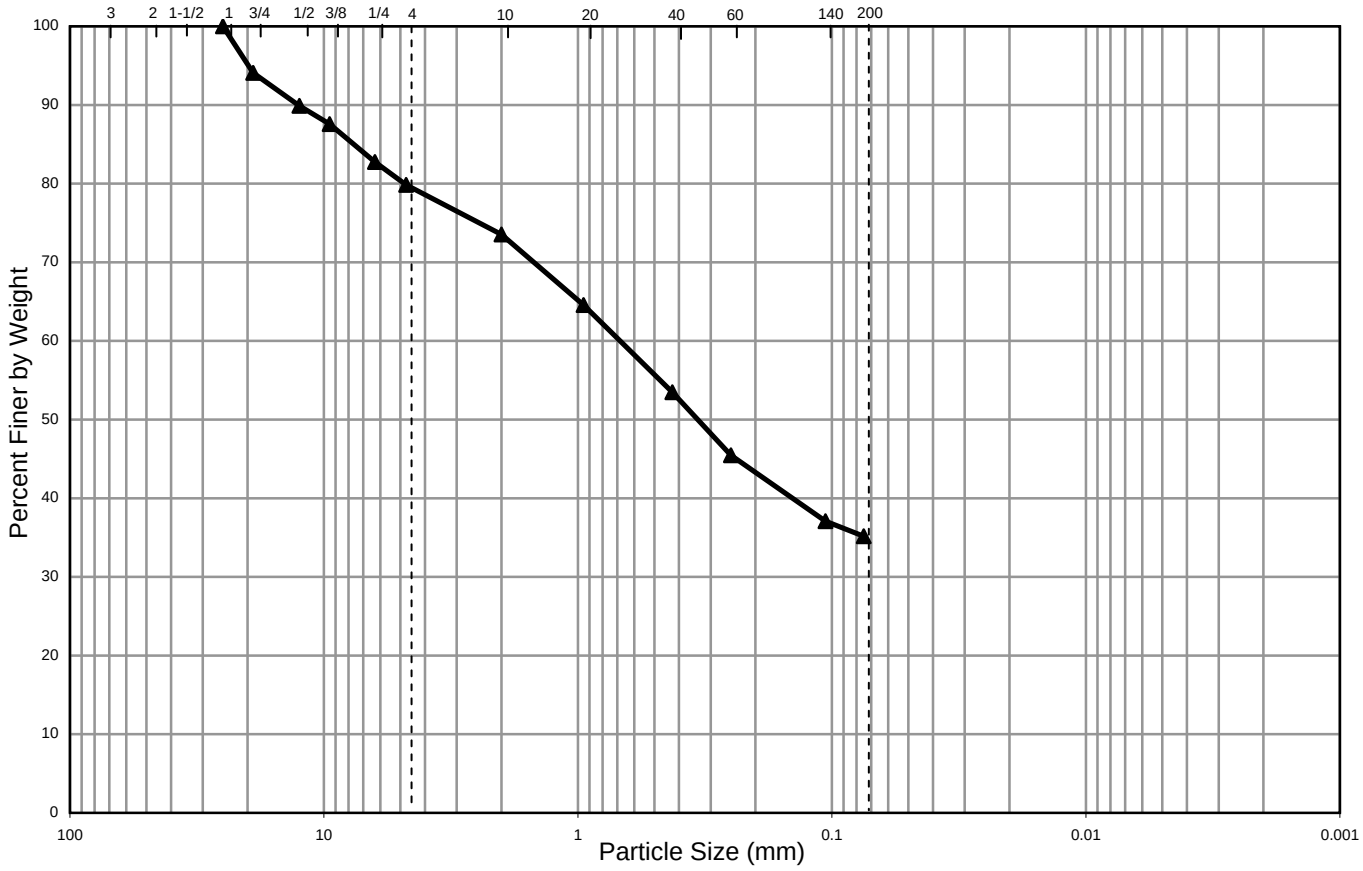
PARTICLE SIZE ANALYSIS OF SOILS



%	Cobbles	Gravel		Sand			Fines (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	
▲	0.0	20.2		44.7			35.2

Sieve	Percent Finer ▲
3"	
2"	
1-1/2"	
1"	100.0
3/4"	94.1
1/2"	89.9
3/8"	87.6
1/4"	82.7
No. 4	79.8
No. 10	73.5
No. 20	64.6
No. 40	53.5
No. 60	45.5
No. 140	37.1
No. 200	35.2

	▲
Stratum	
Boring	BOB 3
Sample	S-3 & S-4
Depth (ft)	4.0 - 8.0
C_u	
C_c	
w (%)	19.4
LL	32
PL	26
PI	6
USCS	SM

	Color	USCS Group Name
▲	Dark brown	Silty sand with gravel

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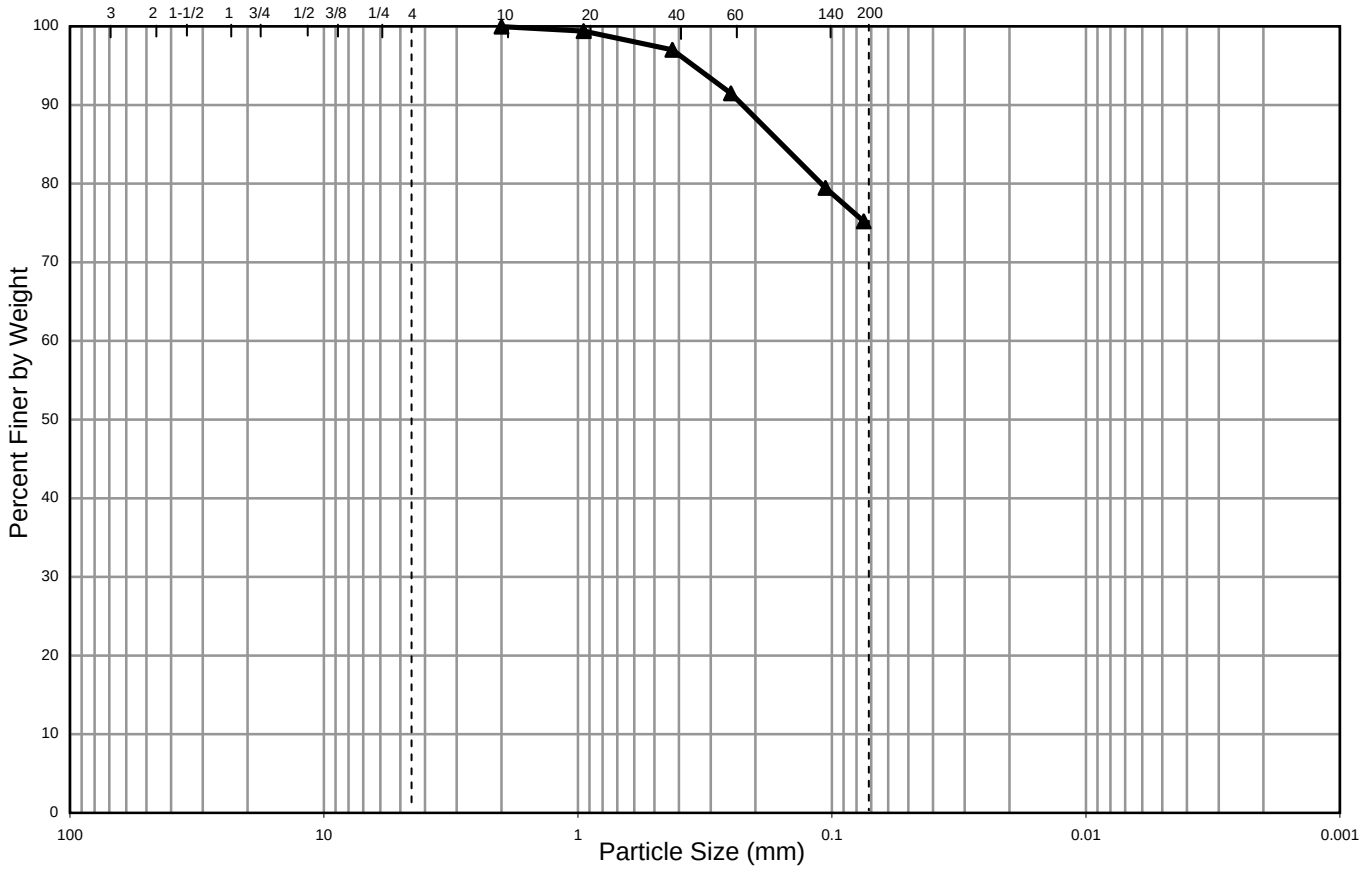
PARTICLE SIZE ANALYSIS OF SOILS

U.S. SIEVE OPENING IN INCHES | U.S. STANDARD SIEVE NUMBERS | HYDROMETER



%	Cobbles	Gravel		Sand			Fines (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	
▲	0.0	0.0		24.8			75.2

Sieve	Percent Finer ▲
3"	
2"	
1-1/2"	
1"	
3/4"	
1/2"	
3/8"	
1/4"	
No. 4	
No. 10	100.0
No. 20	99.4
No. 40	97.0
No. 60	91.5
No. 140	79.5
No. 200	75.2

	▲
Stratum	
Boring	BOB 3
Sample	S-8 & S-9
Depth (ft)	14.0 - 18.0
C_u	
C_c	
w (%)	30.0
LL	30
PL	24
PI	6
USCS	ML

Organic content
6.85%

	Color	USCS Group Name
▲	Dark brown	Silt with sand

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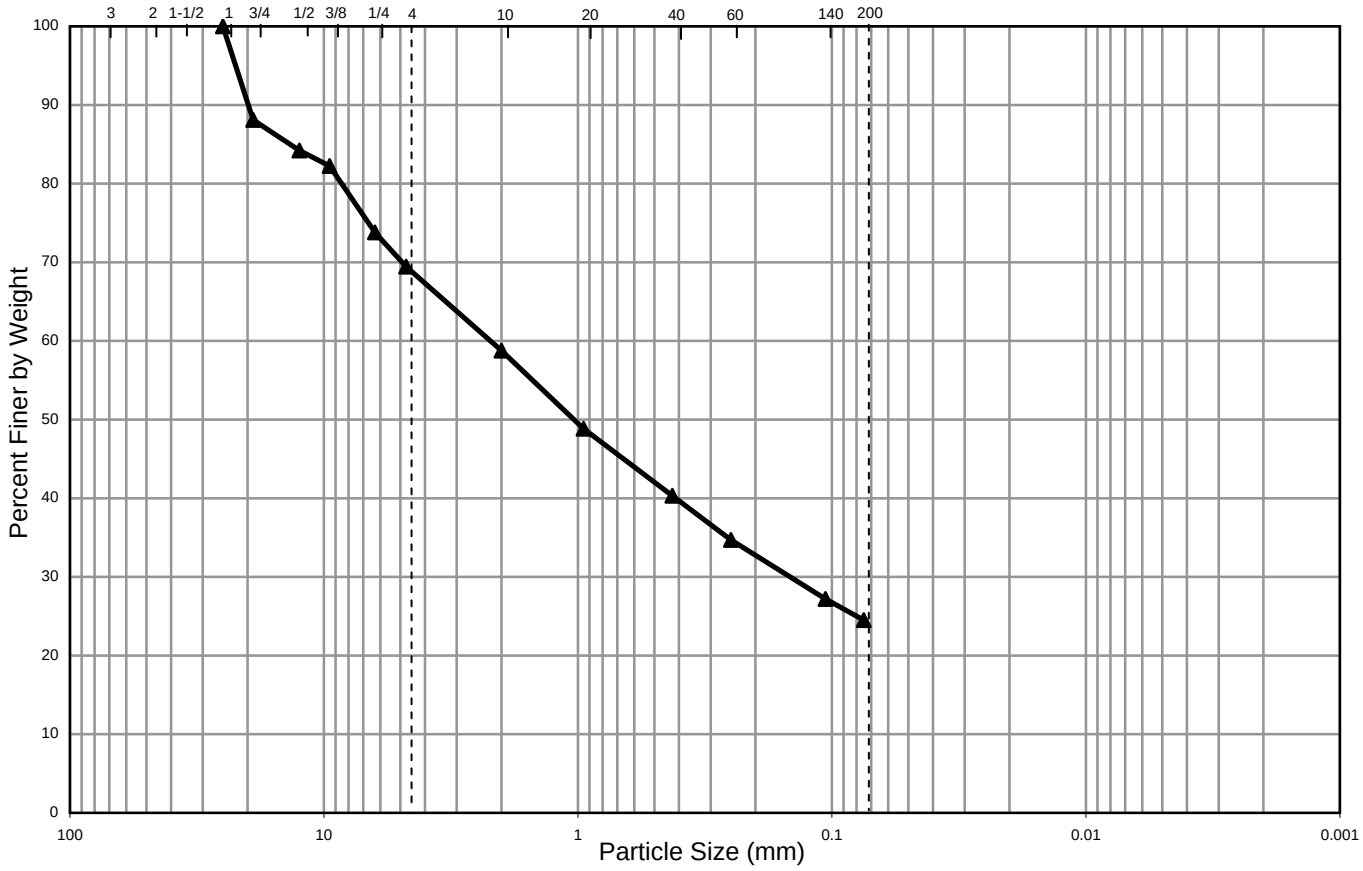

%	Cobbles	Gravel		Sand			Fines (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	
▲	0.0	30.6		44.9			24.5

Sieve	Percent Finer ▲
3"	
2"	
1-1/2"	
1"	100.0
3/4"	88.1
1/2"	84.2
3/8"	82.2
1/4"	73.8
No. 4	69.4
No. 10	58.8
No. 20	48.8
No. 40	40.3
No. 60	34.7
No. 140	27.2
No. 200	24.5

	▲
Stratum	
Boring	BOB 3
Sample	S-13
Depth (ft)	24.0 - 26.0
C_u	
C_c	
w (%)	17.5
LL	23
PL	21
PI	2
USCS	SM

	Color	USCS Group Name
▲	Brown	Silty sand with gravel

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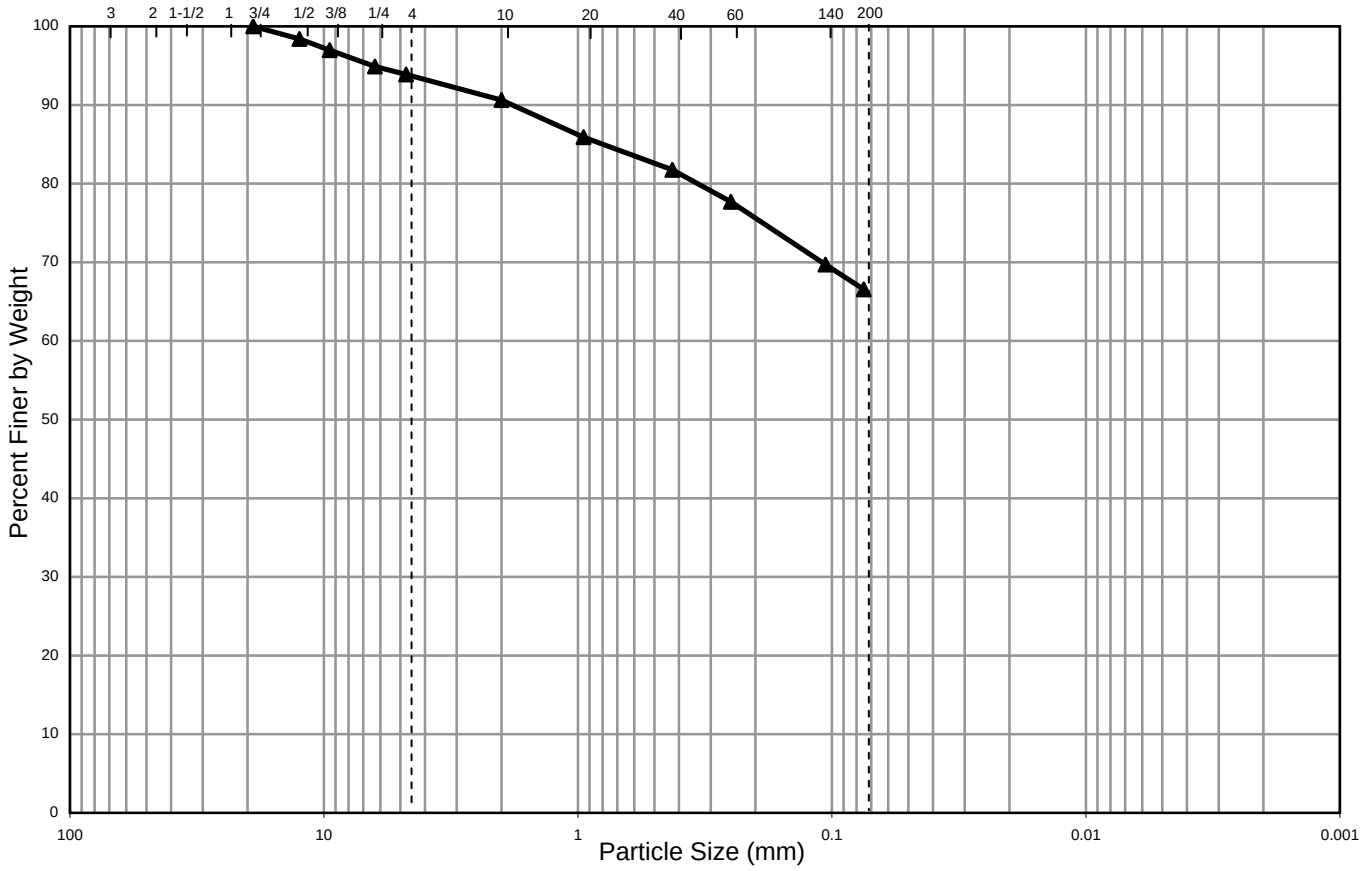

%	Cobbles	Gravel		Sand			Fines (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	
▲	0.0	6.1		27.3			66.6

Sieve	Percent Finer ▲
3"	
2"	
1-1/2"	
1"	
3/4"	100.0
1/2"	98.4
3/8"	97.0
1/4"	94.9
No. 4	93.9
No. 10	90.6
No. 20	85.9
No. 40	81.8
No. 60	77.7
No. 140	69.7
No. 200	66.6

	▲
Stratum	
Boring	BOB 3A
Sample	U-1
Depth (ft)	9.0 - 11.0
C_u	
C_c	
w (%)	21.1
LL	27
PL	22
PI	5
USCS	ML

	Color	USCS Group Name
▲	Brown and gray	Sandy silt

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