S&ME

Carmen Johnson
Fac/Perm/Co ID # 18-09 | Date 1/24/12 | Doc ID# | DIN

Received JUN 2004 Waste Management

May 20, 2004

Duke Power
Mail Code: EC11E
P.O. Box 1006
Charlotte, North Carolina 28201-1006

Attention: William Miller, P.E.

Reference: **Response to Comments**
FGD Scrubber Landfill
Duke Power – Marshall Steam Station
Terrell, Catawba County, North Carolina
S&ME Project 1264-02-578

Dear Mr. Miller:

S&ME, Inc. (S&ME) is submitting this response to the North Carolina Department of Environment and Natural Resources letter dated April 5, 2004 regarding the Permit Application for the above referenced landfill. As discussed, the following pages present three selected comments from NCDENR's letter italicized with our response after each. The attached revisions should be inserted into their appropriate sections of the Hydrogeologic Study (Volume 2). This letter is provided for your use and submittal.

S&ME appreciates this and every opportunity we have to be of service to you and Duke Power. We trust this information is responsive to your needs at this time. If you have any questions, please contact us at your convenience. Thank you for choosing S&ME.

Respectfully Submitted,

S&ME, Inc.

Julie R. Petersen
Staff Professional

Al Quarles, L.G.
Senior Hydrogeologist

NORTH CAROLINA LICENSED SEAL 1133 GEOLOGIST AL QUARLES

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Volume 1

A determination of whether the stream is actually overland flow versus spring fed may also have to be made after the stream is rerouted. If information is available as to why this is believed to be so please include it in the application.

Based on the subsurface soil conditions and groundwater level data evident from our (S&ME's) borings/wells located adjacent to the wetlands (MS-7, OW-1 and OW-2), we believe that the stream is actually overland flow rather than spring fed. The upper most soil in the area of the wetlands is clay rich and high plasticity clay and extends to depths of 11 to 14 feet below land surface at these borings. As discussed in Section 2.0 of the Hydrogeologic Study, "The presence of the high plasticity clay inhibits the infiltration of surface water/precipitation and allows surface water to "pool" at the land surface. S&ME believes that "Section A" and "Section B" of the stream and wetlands are products of stormwater runoff and surface water storage and are not directly connected with the underlying groundwater surface. The average depth to groundwater during our study at these boring/well locations ranged from approximately 15.6 to 16.9 feet below land surface. Of the water level data collected, only MW-7 had groundwater levels above the base of the clay layer by approximately 0.4 feet at the highest groundwater level. Thus, further evaluation after the stream is rerouted does not appear to be necessary.

Volume 2

On Page 5, it states that excessive Iron, Manganese and Sulfates may occur in some areas. What is the source of these contaminants and at what levels are considered excessive?

The paragraph in question refers to regional groundwater quality in Catawba County based on local variations of rock type. Iron, manganese and sulfates may be present in groundwater where igneous and metamorphic rocks underlie the area. Igneous and metamorphic rock minerals such as pyroxenes and amphiboles have high iron contents and contain divalent manganese as a minor constituent. Manganese and iron both precipitate in redox processes in weathering environments (WSP 2254a, p 85). Metallic sulfides present in igneous rocks, which undergo weathering when in contact with aerated water, oxidize to yield sulfate ions that go into solution in water (WSP 2254a, p112).

In relation to local groundwater quality, excessive amounts may be considered as enough iron to form red oxyhydroxide precipitates that stain laundry and plumping fixtures or enough manganese to deposit black oxide stains, but may not exceed groundwater quality standards.

The NCDENR, Division of Water Quality, Mooresville Regional Office, provided water quality data for several inorganic compounds (including iron and manganese) from the sampling of public water supply wells for Catawba, Lincoln and Iredell Counties. No data for sulphates were provided. These data are provided for reference only. The hydrogeologic formations for the intake of the wells were not provided. The data are included in the attached tables. As indicated by the data, the geometric mean values for iron and manganese is close to or above the 15A NCAC 2L .0202 groundwater quality standards (0.3 and 0.05 mg/L, respectively). However, the geometric mean values are well below the EPA Region 9 Preliminary Remediation Goals for tap water (11 and 0.88 mg/L, respectively).

According to the Geological map the rock types change from gneiss to granite within or close to the footprint of the landfill. Do the hydrogeological characteristics of the two types of rock differ? The photographs and the RQD and recovery values indicate there is a difference. Discuss. The rock types should be shown on the cross-sections, and on the map view if it is known where the contact lies.

Based on our rock cores in borings B-2, B-5, B-7, MS-1 and MS-7, it appears that the pink granite found typically in the upper 1 to 2 feet of three of the five rock cores had RQD values of 100% in two borings (B-2 and B-5) and 0% in a third boring (MW-7). The pink granite typically had less fracturing than the other rock types and its rock quality would be classified as excellent, except in boring MS-7 where the granite was highly weathered as indicated by the 0% RQD value.

The fine grained granite gneiss found in three of the five rock cores (B-2, B-7 and MW-1) had RQD values ranging from 53% to 63% classifying it as fair. The granite gneiss had many high angled water bearing fractures and appeared relatively competent in the rock cores.

The coarser grained gneiss found in three of the five rock cores (B-5, B-7 and MW-7) had RQD values of 0%, 16%, and 61%. The majority of the coarse grained gneiss was highly weathered and

fractured and would not be considered a very competent rock. Based on the RQD values it would be classified as very poor, except for the RQD value of 61% found in boring MS-7. The gneiss found in core MS-7 transitioned from coarse to fine grain with depth. The finer grained gneiss was generally more competent than the overlying coarse grained gneiss.

Based on the rock cores and the RQD values for the different rock types, we estimate that the coarse grained gneiss would have higher permeability values followed by the fine grained gneiss and the pink granite, in order of decreasing permeability.

Based on our limited evaluation of the bedrock beneath the site, we could not estimate the contact between the granite and the gneiss on the map view on the drawings, however the different rock types have been added to the cross-sections and their respective boring logs have been modified. Revised Cross-Sections and boring logs have been attached to this letter to be included in the Hydrogeologic Study.

Descriptive Statistics [Subset]

Lincoln County Groundwater Samples
Total Samples collected by DHHS - 106
Data compiled by Chuck Pippin, NCDENR-Div. Water Quality, Groundwater Section, Mooresville Regional Office (2003)

	AS mg/L	CA mg/L	CU mg/L	FE mg/L	HARDNESS mg/L	MN mg/L	PB mg/L	ZN mg/L
Detection Limits	<0.01	<1	<0.05	<0.05	<1	<0.03	<0.005	<0.05
Valid cases	17	106	32	56	106	5	16	37
Mean	0.006764706	9.367924528	0.4590625	1.153392857	33.43396226	0.21	0.02625	0.248918919
Std. error of mean	0.003354682	1.027853377	0.144680097	0.280918516	2.987846567	0.085790442	0.017154324	0.052655866
Variance	0.000191316	111.9871518	0.669834577	4.419251916	946.2860737	0.0368	0.004708333	0.102587688
Std. Deviation	0.013831709	10.58239821	0.818434223	2.102201683	30.76176318	0.191833261	0.068617296	0.320293128
Variation Coefficient	2.044687431	1.129641702	1.782838334	1.822624156	0.920075309	0.913491719	2.613992235	1.286736778
rel. V.coefficient(%)	49.59095442	10.97205015	31.51642689	24.35583977	8.936561404	40.8525916	65.34980587	21.15382233
Skew	3.445190095	3.571641206	3.027442373	3.4858456	2.715807884	0.908669555	3.58832255	3.306040283
Kurtosis	10.52504989	19.01197398	9.535174658	15.07457868	12.03024718	-0.630839068	10.9447609	12.68864044
Minimum	0.001	0	0.05	0.05	0	0.06	0.005	0.05
Maximum	0.059	81	4.01	12.73	221	0.52	0.283	1.79
Range	0.058	81	3.96	12.68	221	0.46	0.278	1.74
Sum	0.115	993	14.69	64.59	3544	1.05	0.42	9.21
1st percentile	----	0	----	----	0	----	----	----
5th percentile	----	0	0.05	0.0585	2.35	----	----	0.059
10th percentile	0.001	1	0.06	0.06	5	----	0.0057	0.06
25th percentile	0.0015	3	0.08	0.1025	15	0.06	0.006	0.08
Median	0.003	6.5	0.13	0.215	26	0.15	0.0085	0.12
75th percentile	0.005	12	0.4475	1.8875	42.25	0.39	0.01	0.285
90th percentile	0.023	19	1.549	3.326	67.9	----	0.1017	0.65
95th percentile	----	27	2.749	4.691	94.6	----	----	0.863
99th percentile	----	78.13	----	----	213.51	----	----	----
Geom. mean	0.003118704	----	0.191055154	0.34887922	----	0.148824383	0.010446761	0.158508187

Descriptive Statistics

Catawba County Groundwater Samples
Total Samples collected by DHHS - 161
Data compiled by Chuck Pippin, NCDENR-Div. Water Quality, Groundwater Section, Mooresville Regional Office (2003)

	AS mg/L	CA mg/L	CU mg/L	FE mg/L	HARDNESS mg/L	MN mg/L	PB mg/L	ZN mg/L
Detection Limits	<0.01	<1	<0.05	<0.05	<1	<0.03	<0.005	<0.05
Valid cases	23	161	43	80	161	5	18	53
Mean	0.006347826	9.937888199	0.517209302	1.0765	34.72670807	0.21	0.025166667	0.381509434
Std. error of mean	0.002517613	0.846654424	0.132495565	0.240060257	2.438832254	0.085790442	0.015216789	0.07640669
Variance	0.000145783	115.408618	0.754868217	4.610314177	957.6123447	0.0368	0.004167912	0.309413062
Std. Deviation	0.012074047	10.74284031	0.868831524	2.147164218	30.94531216	0.191833261	0.064559366	0.556249101
Variation Coefficient	1.902075883	1.080998307	1.679845123	1.994578929	0.891109865	0.913491719	2.565272829	1.458021877
rel. V.coefficient(%)	39.66102381	8.519460146	25.61739796	22.30007036	7.022929581	40.8525916	60.46406044	20.02747073
Skew	3.840591318	3.203799045	2.670852244	3.585069621	2.534928286	0.908669555	3.838505015	2.981618788
Kurtosis	14.21506414	14.72401889	6.923080038	14.51137082	10.02377721	-0.630839068	12.84991627	9.946563147
Minimum	0.001	0	0.05	0.05	0	0.06	0.005	0.05
Maximum	0.059	81	4.01	12.73	221	0.52	0.283	3.09
Range	0.058	81	3.96	12.68	221	0.46	0.278	3.04
Sum	0.146	1600	22.24	86.12	5591	1.05	0.453	20.22
1st percentile	----	0	----	----	0	----	----	----
5th percentile	0.001	1	0.05	0.06	4	----	----	0.057
10th percentile	0.001	1	0.06	0.07	7	----	0.0059	0.06
25th percentile	0.002	3	0.07	0.11	15	0.06	0.006	0.08
Median	0.003	7	0.14	0.21	26	0.15	0.009	0.14
75th percentile	0.005	13	0.47	0.84	49	0.39	0.01175	0.475
90th percentile	0.014	19	1.588	3.164	66.8	----	0.0499	1.048
95th percentile	0.05	27	3.166	4.3605	95.6	----	----	1.734
99th percentile	----	67.98	----	----	193.72	----	----	----
Geom. mean	0.003186785	----	0.208713967	0.330159932	----	0.148824383	0.010919321	0.200166112

Descriptive Statistics [Subset]

Iredell County Groundwater Samples
Total Samples collected by DHHS - 123
Data compiled by Chuck Pippin, NCDENR-Div. Water Quality, Groundwater Section, Mooresville Regional Office (2003)

	AS mg/L	CA mg/L	CU mg/L	FE mg/L	HARDNESS mg/L	MN mg/L	PB mg/L	ZN mg/L
Detection Limits	<0.01	<1	<0.05	<0.05	<1	<0.03	<0.005	<0.05
Valid cases	4	123	28	49	123	1	9	56
Mean	0.00425	19.74796748	0.143571429	0.85122449	62.19512195	0.15	0.026888889	0.627678571
Std. error of mean	0.001600781	3.475578696	0.022795469	0.242979072	8.874655899	----	0.012740404	0.131546987
Variance	0.00001025	1485.796615	0.014549735	2.892902636	9687.420632	----	0.001460861	0.969058149
Std. Deviation	0.003201562	38.54603241	0.120622284	1.700853502	98.42469523	----	0.038221213	0.984407512
Variation Coefficient	0.753308734	1.951898718	0.840155213	1.998125668	1.582514708	----	1.421450064	1.568330602
rel. V.coefficient(%)	37.66543669	17.59967804	15.87744112	28.5446524	14.26905458	----	47.38166881	20.95769922
Skew	-0.048382273	5.489169488	2.269154302	3.498808382	5.110903531	----	2.15399472	3.155556773
Kurtosis	-1.935752528	33.5999497	6.044137065	12.74215984	30.16311572	----	3.153029367	9.933467304
Minimum	0.001	0	0.05	0.05	0	0.15	0.006	0.05
Maximum	0.007	314	0.61	9.23	796	0.15	0.125	5
Range	0.006	314	0.56	9.18	796	0	0.119	4.95
Sum	0.017	2429	4.02	41.71	7650	0.15	0.242	35.15
1st percentile	----	0	----	----	0	----	----	----
5th percentile	----	3	0.05	0.05	9.2	----	----	0.0585
10th percentile	----	4	0.05	0.05	16	----	0.006	0.07
25th percentile	0.00125	7	0.0525	0.075	25	----	0.007	0.12
Median	0.0045	10	0.11	0.26	36	0.15	0.01	0.315
75th percentile	0.007	17	0.18	0.825	60	----	0.032	0.615
90th percentile	----	35.8	0.302	2.44	108.2	----	0.125	1.353
95th percentile	----	55.2	0.4795	5.38	181.4	----	----	3.35
99th percentile	----	290.48	----	----	735.76	----	----	----
Geom. mean	0.003146346	----	0.111747377	0.282057605	----	0.15	0.015311945	0.31174187

PROJECT: **Marshall Steam Station**
Terrell, North Carolina
1264-02-578

BORING LOG B-2

DATE DRILLED: **12/16/02**
ELEVATION: **857.9**
DRILLING METHOD: **4¼" H.S.A.**
BORING DEPTH: **80.0**
LOGGED BY: **Julie Petersen**
WATER LEVEL: **45.64 ft bls at 24 hrs.**
DRILLER: **Jay Little, NC Cert No. 2717**
DRILL RIG: **Diedrich D-50**

NOTES: **Bag samples collected every 10 ft to 60 ft bls.**
Auger Refusal Encountered at 70 ft bls.

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	N VALUE
0	Topsoil/Rootmat			
5	RESIDUUM: Red Slightly Micaceous Fine Sandy Silty **CLAY**	852.9	1	15
10	RESIDUUM: Tannish Red Micaceous Slightly Sandy **SILT**	847.9	2	17
15	SAPROLITE: Tannish Red Very Micaceous Slightly Sandy **SILT**	842.9	3	18
20	SAPROLITE: Grey and White Very Micaceous Fine Sandy **SILT**	837.9	4	13
25	SAPROLITE: Reddish Tan and White Micaceous Silty Fine **SAND** with Manganese Staining	832.9	REC 100% 5	14
30	SAPROLITE: Greyish Tan and White Micaceous Fine Sandy **SILT**	827.9	6	18
35	SAPROLITE: Reddish Tan and White Fine Sandy **SILT** with Manganese Staining	822.9	7	26
40	SAPROLITE: Greyish Tan and White Very Micaceous Fine Sandy **SILT** with Manganese Staining	817.9	8	19
45	SAPROLITE: Greyish Tan and White Very Micaceous Silty Medium to Fine **SAND (SM)**	812.9	9	29
50		807.9	10	53
55	SAPROLITE: Reddish Tan Micaceous Fine Sandy **SILT** with Manganese Staining	802.9	REC 40% 11	67
60	PARTIALLY WEATHERED ROCK: When Sampled Becomes Greyish Tan and White Very Micaceous Silty Fine **SAND**	797.9	12	50/5
65	PARTIALLY WEATHERED ROCK: When Sampled Becomes Reddish Tan Micaceous Fine to Medium Sandy **SILT** with Manganese Staining	792.9	13	50/2
70	**Auger Refusal at 70 ft bls**	787.9		
	BEDROCK: Sampled as Pink Granite			
75	BEDROCK: Sampled as Fine Grained Granite-Gneiss (Very Weathered)	782.9	REC 86% RQD 58%	
80		777.9		

STANDARD PENETRATION TEST DATA (blows/ft)
10 20 30 60 80

BORING LOG WELLLOGS.GPJ S&ME.GDT 5/13/04

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

Revised on May 14, 2004

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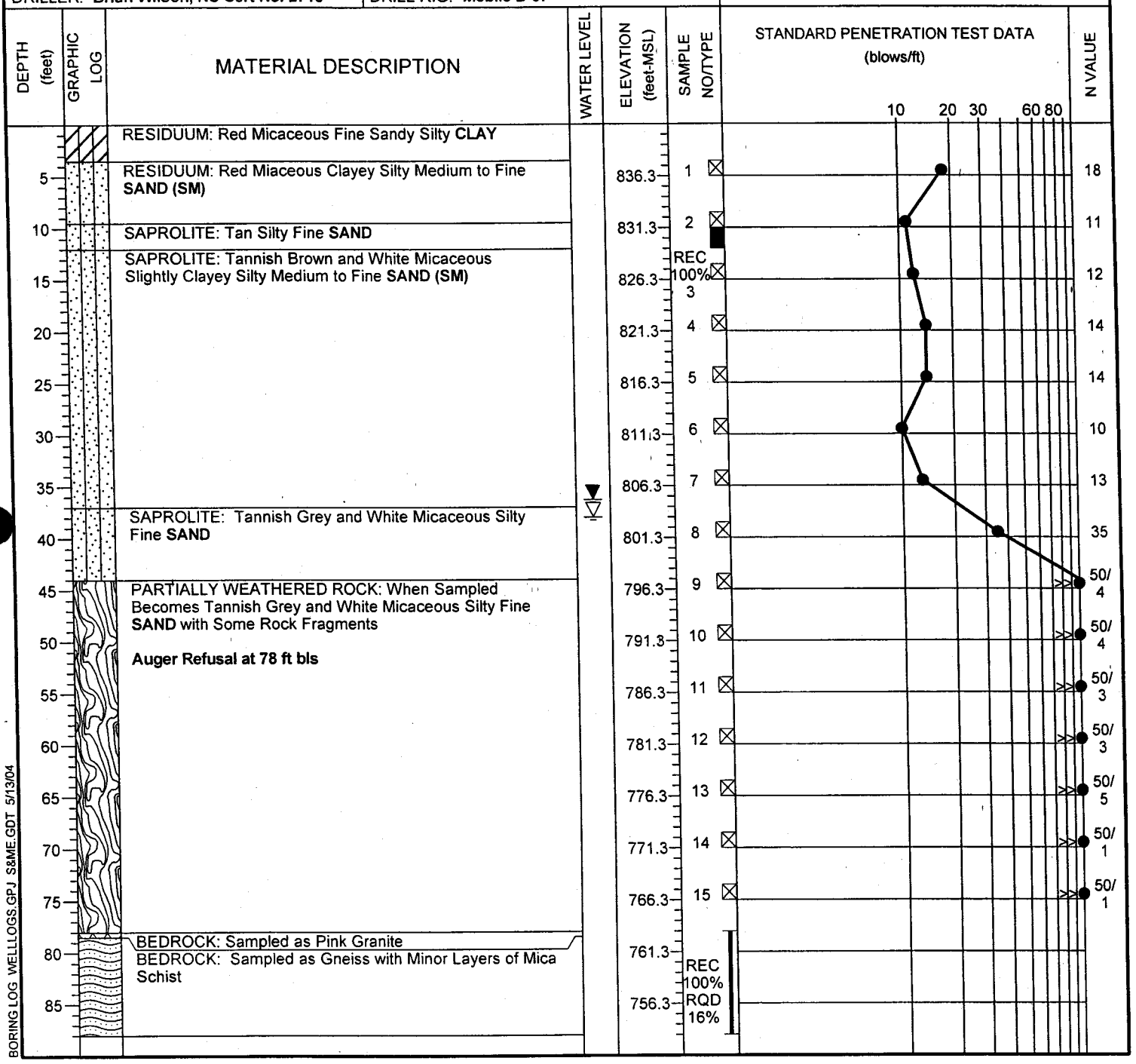
9751 Southern Pine Blvd.
Charlotte, NC 28273

PROJECT: Marshall Steam Station Terrell, North Carolina 1264-02-578	BORING LOG B-5
DATE DRILLED: 1/7/03	ELEVATION: 841.3
DRILLING METHOD: 4¼" H.S.A.	BORING DEPTH: 88.0
LOGGED BY: Julie Petersen	WATER LEVEL: 36.3 ft bls at 24 hrs.
DRILLER: Brian Wilson, NC Cert No. 2718	DRILL RIG: Mobile B-57

NOTES: Bag Samples Collected every 10 ft to 50 ft bls.
Auger Refusal Encountered at 78 ft bls.



BORING LOG WELLLOGS.GPJ S&ME.GDT 5/13/04

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

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PROJECT:	Marshall Steam Station Terrell, North Carolina 1264-02-578	BORING LOG B-7
DATE DRILLED: 1/10/03	ELEVATION: 851.7	NOTES: Bag Samples Collected every 10 ft to 50 ft bls. Auger Refusal Encountered at 64.5 ft bls.
DRILLING METHOD: 4¼" H.S.A.	BORING DEPTH: 74.5	
LOGGED BY: Julie Petersen	WATER LEVEL: 46.5 ft bls at 24 hrs.	
DRILLER: Brian Wilson, NC Cert No. 2718	DRILL RIG: Mobile B-57	

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	N VALUE
0	Rootmat/Topsoil			
	RESIDUUM: Red Slightly Sandy Silty **CLAY**			
5	RESIDUUM: Red Micaceous Slightly Sandy Clayey **SILT**	846.7	1	14
10	SAPROLITE: Reddish Brown Micaceous Fine Sandy **SILT**	841.7	2	8
15	SAPROLITE: Brown Very Micaceous Fine Sandy **SILT** with Some Manganese Staining	836.7	3	9
20	SAPROLITE: Brown Very Micaceous Silty Fine **SAND**	831.7	4	15
25		826.7	5	11
30	SAPROLITE: Greyish Brown and White Micaceous Slightly Clayey Silty Medium to Fine **SAND** with Some Manganese Staining **(SM)**	821.7	6	13
			REC 100%	
35		816.7	7	35
40	PARTIALLY WEATHERED ROCK: When Sampled Becomes Greyish Brown and White Micaceous Silty Medium to Fine **SAND**	811.7	8	50/6
45	PARTIALLY WEATHERED ROCK: When Sampled Becomes Greyish Brown, Black and White Very Micaceous Silty Medium to Fine **SAND**	806.7	9	50/4
50	PARTIALLY WEATHERED ROCK: When Sampled Becomes Grey, Black and White Micaceous Slightly Clayey Silty Medium to Fine **SAND** with Rock Fragments **(SM)**	801.7	10	50/4
55	**Auger Refusal at 64.5 ft bls**	796.7	11	50/1
60		791.7	12	50/3
65	BEDROCK: Sampled as Gneiss with Minor Layers of Mica Schist	786.7		
	BEDROCK: Sampled as Fine Grained Granite-Gneiss		REC 100% RQD 45%	
70		781.7		

STANDARD PENETRATION TEST DATA (blows/ft): 10, 20, 30, 60, 80

BORING LOG WELLLOGS.GPJ S&ME.GDT 5/13/04

1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.

2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

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PROJECT:	Marshall Steam Station Terrell, North Carolina 1264-02-578	BORING LOG MS-1
DATE DRILLED: 12/3/02	ELEVATION: 813.3	NOTES: Bag Samples Collected at 30 and 40 ft bls. Auger Refusal Encountered at 54.5 ft bls.
DRILLING METHOD: 4¼" H.S.A.	BORING DEPTH: 64.5	
LOGGED BY: Julie Petersen	WATER LEVEL: 14 ft bls at 24 hrs.	
DRILLER: Jay Little, NC Cert No. 2717	DRILL RIG: Diedrich D-50	

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet-MSL)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/ft) 10 20 30 60 80	N VALUE
5		RESIDUUM: Brownish Red Micaceous Silty Fine **SAND** with Manganese Staining		808.3	1		10
10		SAPROLITE: Yellowish Red Micaceous Slightly Clayey Silty Medium to Fine **SAND (SM)**		803.3	2		13
15		SAPROLITE: Reddish Brown Micaceous Slightly Sandy **SILT** with Manganese Staining	▼	798.3	3		8
20		SAPROLITE: Grey and White Clayey Medium to Fine Sandy **SILT (ML)**	▽	793.3	4		67
25		SAPROLITE: Reddish Brown and Grey Micaceous Silty Fine **SAND**		788.3	REC 100% 5		23
30				783.3	6		27
35		PARTIALLY WEATHERED ROCK: When Sampled Becomes Grey and White Silty Medium to Fine **SAND** **Auger Refusal at 54.5 ft bls**		778.3	7		50/5
40				773.3	8		50/2
45				768.3	9		50/3
50				763.3			
55		BEDROCK: Sampled as Fine Grained Granite-Gneiss with a Coarse Grained Granite Seam at 63.5 ft.		758.3	REC 99% RQD 63%		
60				753.3			

BORING LOG WELLLOGS.GPJ S&ME.GDT 5/13/04

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

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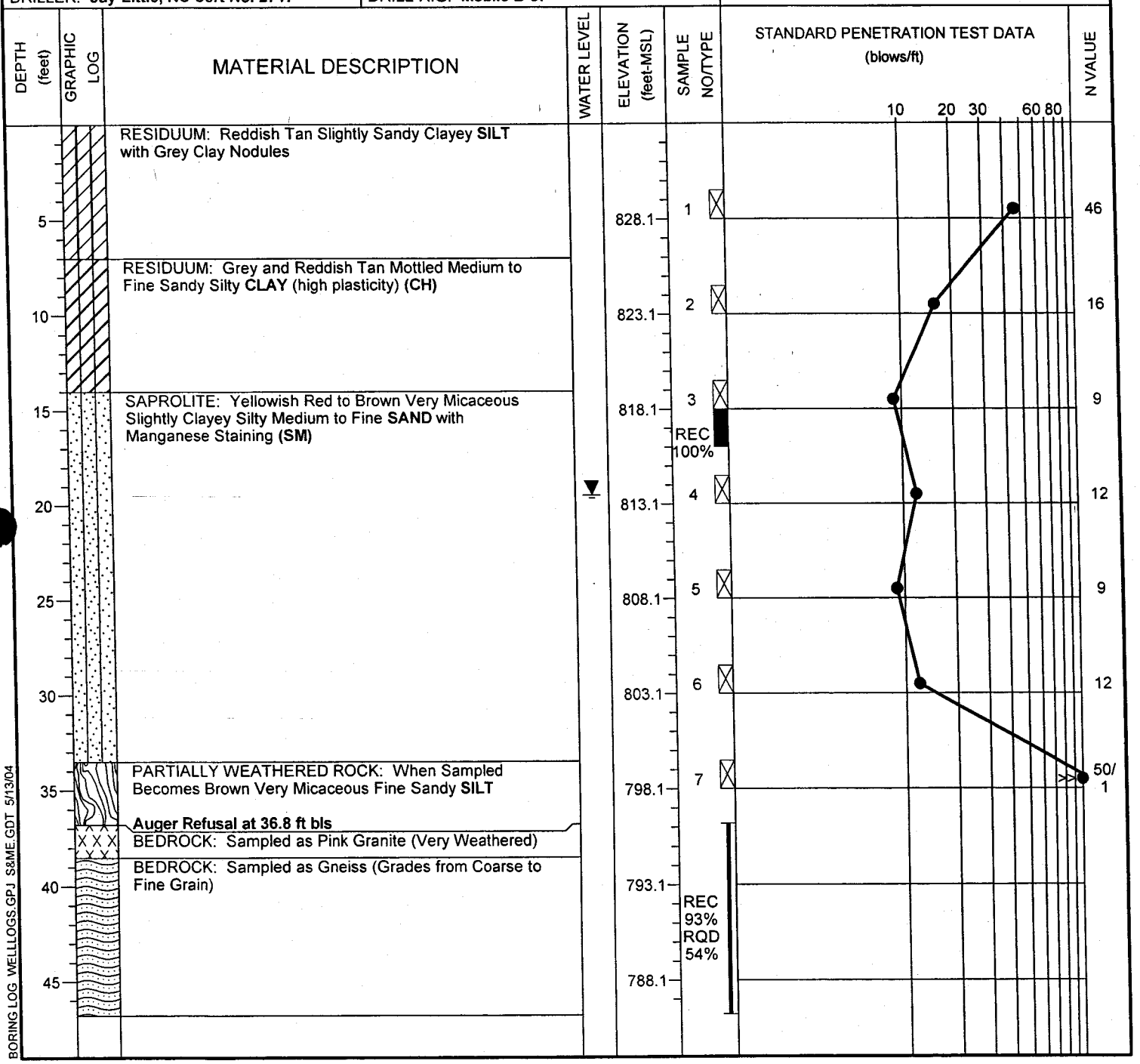
PROJECT: Marshall Steam Station Terrell, North Carolina 1264-02-578	BORING LOG MS-7
DATE DRILLED: 1/3/03	ELEVATION: 833.1
DRILLING METHOD: 4¼" H.S.A.	BORING DEPTH: 46.8
LOGGED BY: Julie Petersen	WATER LEVEL: 19.5 ft bls at 24 hrs.
DRILLER: Jay Little, NC Cert No. 2717	DRILL RIG: Mobile B-57

NOTES: Bag Samples Collected at 20 and 30 ft bls.
Auger Refusal Encountered at 36.8 ft bls.



BORING LOG WELLLOGS.GPJ S&ME.GDT 5/13/04

1. *BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.*
2. *PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.*

Revised on May 14, 2004

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