S&ME
ENGINEERING • TESTING
ENVIRONMENTAL SERVICES

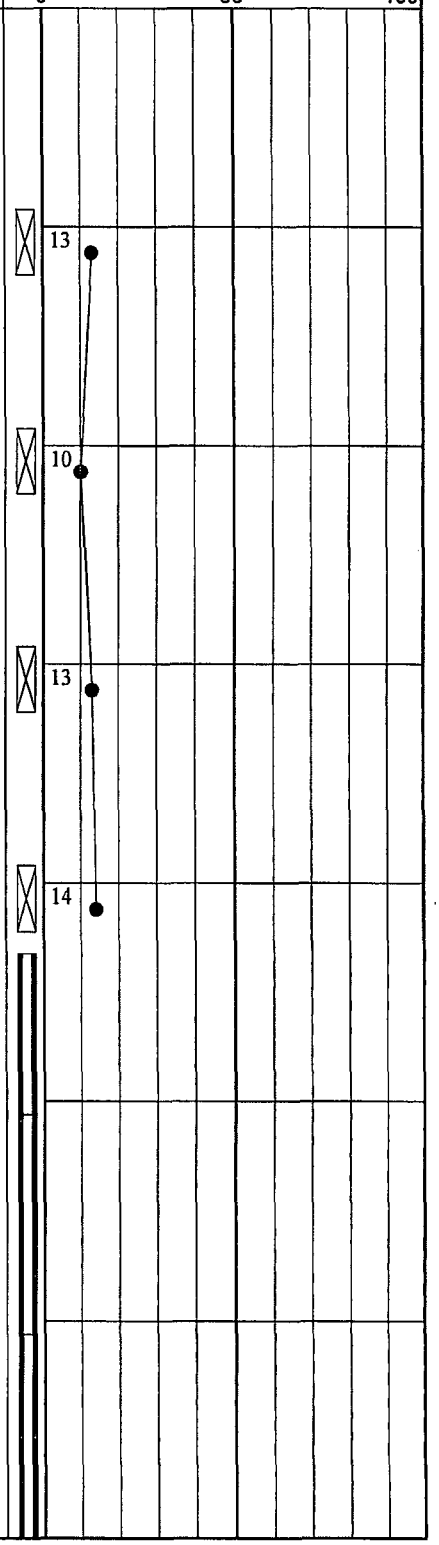
S&ME, Inc.
9751 Southern Pine Blvd.
Charlotte, North Carolina
Telephone: 704-523-4726
Fax: 704-525-3953

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.

Project: **MNS - Groundwater Protection Project**			**Boring No. M-48DR**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 1 of 3
Boring Depth (ft): **90.3**	Elevation (ft): **760.5**	Driller: **Jay Little, NC Cert No. 2717**	Date Drilled: **6/12/07**
Logged By: **Courtney Withers**	Water Level: **Stabilized Water Level at 20.71 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lithology	Material Description
760			**GRAVEL**
			FILL (F): Red and Yellow, Micaceous, **SILT**
			GRAVEL
755	5		FILL (F): Reddish-Brown, Micaceous, Medium to Fine Sandy, Silty, **CLAY**
750	10		
745	15		FILL (F): Red, Micaceous, Clayey, Medium to Fine **SAND**
740	20		**Roller Cone Refusal at 21.60 ft bls**
			SOUND ROCK (D): Coarse-Grained **QUARTZ DIORITE** With Intermittent Soil Seams, Moderately Fractured With Intermittent Zones of Intense Fracturing
735	25		
730	30		PARTIALLY WEATHERED/FRACTURED ROCK (WF): Fine-Grained **QUARTZ DIORITE** With Intermittent Soil Seams and Quartz Veins, Intensely Fractured

Well Construction



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Project: **MNS - Groundwater Protection Project**			**Boring No. M-48DR**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 2 of 3
Boring Depth (ft): **90.3**	Elevation (ft): **760.5**	Driller: **Jay Little, NC Cert No. 2717**	Date Drilled: **6/12/07**
Logged By: **Courtney Withers**	Water Level: **Stabilized Water Level at 20.71 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lithology	Material Description
725			PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **GRANITE**, Intensely Fractured
			WEATHERED ROCK (M2): When Sampled Becomes White, Black, and Gold, Micaceous, Silty, Coarse to Fine **SAND** (Granitic)
	40		SOUND ROCK (D): Fine-Grained **QUARTZ DIORITE** Interlayered With Fine-Grained **GRANITE** With Pyrite and Quartz Veins, Slightly Fractured
720			
	45		
715			SOUND ROCK (D): Medium-Grained **QUARTZ DIORITE**, Unfractured
			SOUND ROCK (D): Fine-Grained **GRANITE**, Unfractured
	50		SOUND ROCK (D): Medium-Grained **QUARTZ DIORITE**, Unfractured
710			SOUND ROCK (D): Fine-Grained **QUARTZ DIORITE** With Intermittent Fine-Grained **GRANITE** and Coarse-Grained **QUARTZ DIORITE**; Pegmatitic Granite Vein from 53.35 to 53.50 ft bls, Slightly Fractured
	55		
705			SOUND ROCK (D): Fine-Grained **QUARTZ DIORITE**, Slightly Fractured
	60		
700			SOUND ROCK (D): Fine-Grained **DIORITE**, Unfractured
			SOUND ROCK (D): Fine-Grained **QUARTZ DIORITE**, Slightly Fractured
	65		
695			
			SOUND ROCK (D): Fine-Grained **GRANITE**, Slightly Fractured

Well Construction

Penetration Resistance (Blows/Foot)
0 50 100

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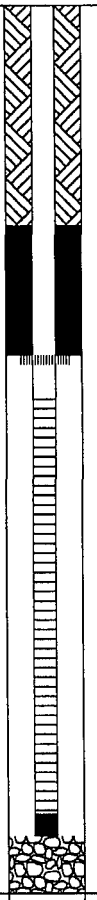
Project: **MNS - Groundwater Protection Project**			**Boring No. M-48DR**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 3 of 3
Boring Depth (ft): **90.3**	Elevation (ft): **760.5**	Driller: **Jay Little, NC Cert No. 2717**	Date Drilled: **6/12/07**
Logged By: **Courtney Withers**	Water Level: **Stabilized Water Level at 20.71 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lithology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
690			SOUND ROCK (D): Fine-Grained **QUARTZ DIORITE**, Unfractured		
			SOUND ROCK (D): Fine-Grained, Quartz-Rich **GRANITE**, Slightly Fractured		
	75		SOUND ROCK (D): Fine-Grained **QUARTZ DIORITE**, Unfractured		
685					
	80				
680			SOUND ROCK (D): Fine-Grained **GRANITE**, Unfractured		
			SOUND ROCK (D): Fine-Grained **META GABBRO**, Slightly Fractured		
			SOUND ROCK (D): Fine-Grained, Quartz-Rich **GRANITE** With Orbicuals, Unfractured		
	85				
675					
	90				
			Boring Terminated at 90.30 ft bls		

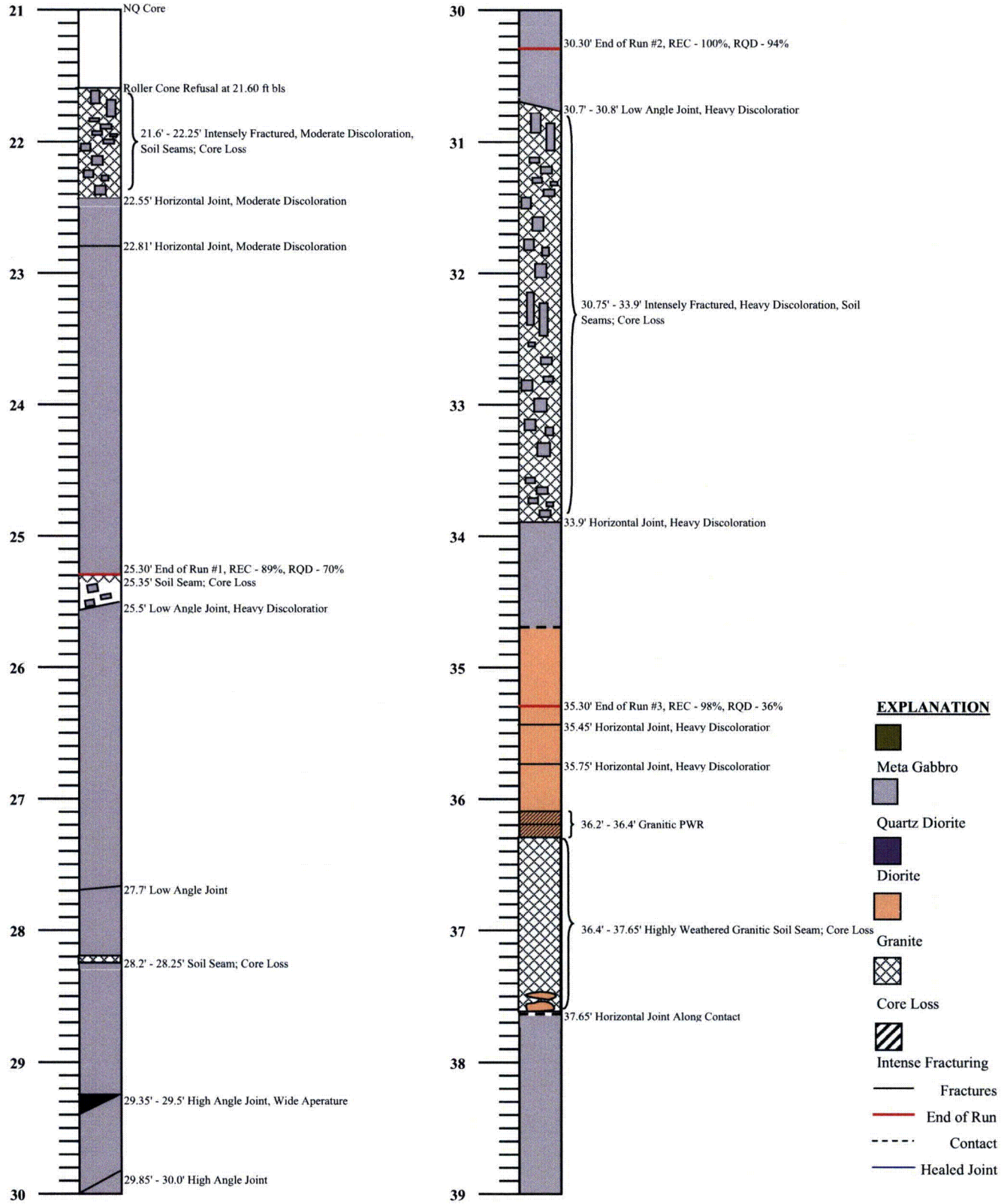


FIELD ROCK CORE LOG

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-48DR

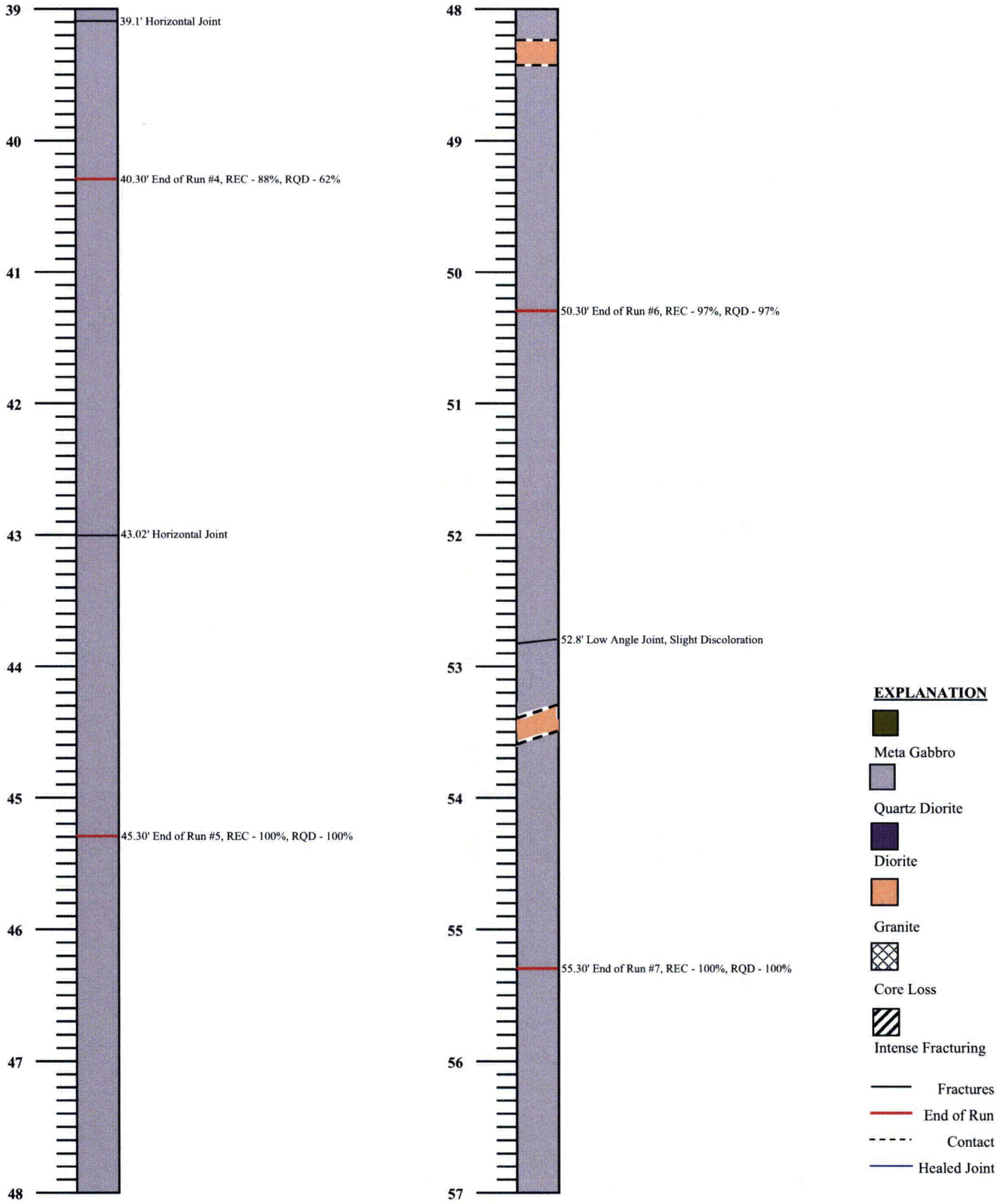


FIELD ROCK CORE LOG

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-48DR

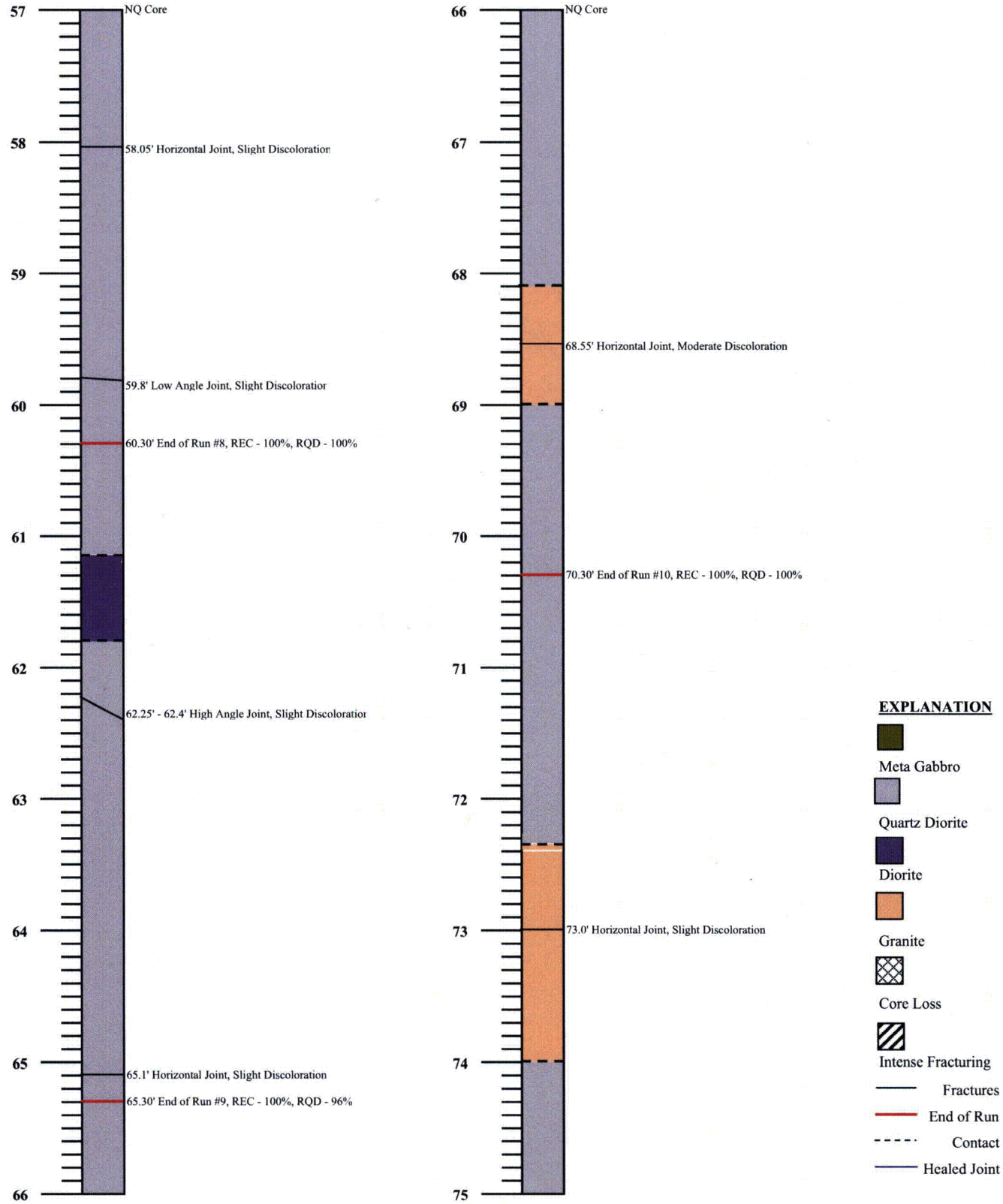


FIELD ROCK CORE LOG

McGuire Nuclear Station - Groundwater Protection Project

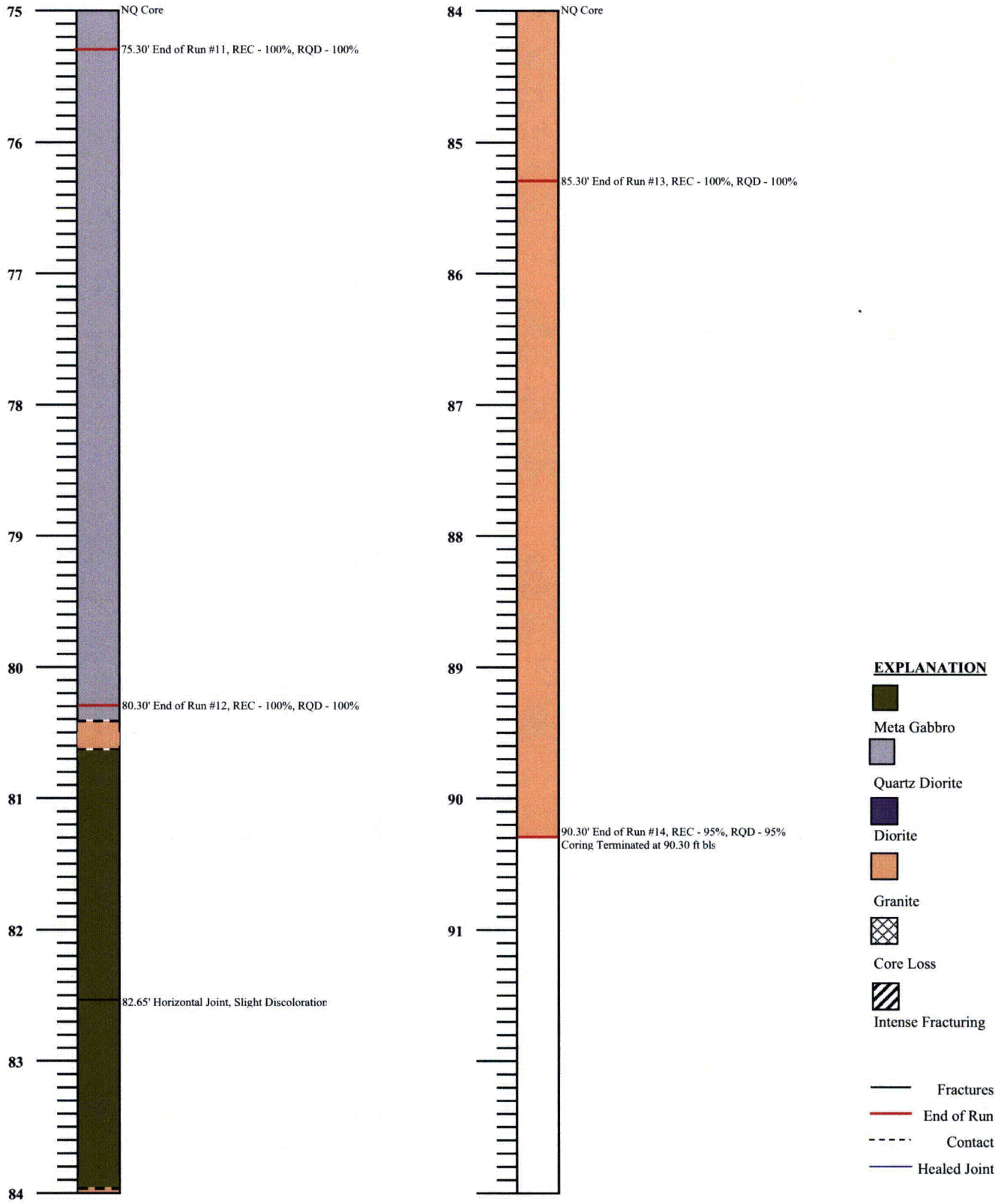
S&ME Project No: 1264-06-724

Core Location: M-48DR



FIELD ROCK CORE LOG

Core Location: M-48DR



COMPLETION REPORT OF WELL No. M-48DR

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

WATER LEVEL: **Stabilized Water Level at 20.71 ft bls**

LATITUDE: **35 26 00.80**
LONGITUDE: **80 56 51.67**
TOP OF CASING ELEVATION: **760.22**
DATUM: **MSL**
LOGGED BY: **Courtney Withers**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **Mud Rotary**
DATE DRILLED: **6/12/07**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00		760.51
GRAVEL		0				
FILL (F): Red and Yellow, Micaceous, **SILT**						
GRAVEL		5				
FILL (F): Reddish-Brown, Micaceous, Medium to Fine Sandy, Silty, **CLAY**		10				
FILL (F): Red, Micaceous, Clayey, Medium to Fine **SAND**		15				
		20				
SOUND ROCK (D): Coarse-Grained **QUARTZ DIORITE** With Intermittent Soil Seams, Moderately Fractured With Intermittent Zones of Intense Fracturing		25				
		30				
PARTIALLY WEATHERED/FRACTURED ROCK (WF): Fine-Grained **QUARTZ DIORITE** With Intermittent Soil						

WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter: **8"**
Type: **Steel Flush Mount**
Interval: **At Grade**

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 79 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 75 ft bls**

SEAL
Type: **K-Packer + Bentonite**
Interval: **75 to 78.2 ft bls**

FILTERPACK
Type: **N/A**
Interval: **N/A**

SCREEN
Diameter: **2"**
Type: **0.010 Slotted Sch. 40 PVC**
Interval: **79 to 89 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

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COMPLETION REPORT OF WELL No. M-48DR

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

GROUND SURFACE ELEVATION: **760.5**
LOGGED BY: **Courtney Wither**
CHECKED BY:

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
							(See Page 1)
Seams and Quartz Veins, Intensely Fractured		35					
PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **GRANITE**, Intensely Fractured *(continued)*		40					
WEATHERED ROCK (M2): When Sampled Becomes White, Black, and Gold, Micaceous, Silty, Coarse to Fine **SAND** (Granitic)		45					
SOUND ROCK (D): Fine-Grained **QUARTZ DIORITE** Interlayered With Fine-Grained **GRANITE** With Pyrite and Quartz Veins, Slightly Fractured		50					
SOUND ROCK (D): Medium-Grained **QUARTZ DIORITE**, Unfractured		55					
SOUND ROCK (D): Fine-Grained **GRANITE**, Unfractured							
SOUND ROCK (D): Medium-Grained **QUARTZ DIORITE**, Unfractured		60					
SOUND ROCK (D): Fine-Grained **QUARTZ DIORITE** With Intermittent Fine-Grained **GRANITE** and Coarse-Grained **QUARTZ DIORITE**; Pegmatitic Granite Vein from 53.35 to 53.50 ft bls, Slightly Fractured		65					
SOUND ROCK (D): Fine-Grained **QUARTZ DIORITE**, Slightly Fractured		70					
SOUND ROCK (D): Fine-Grained **DIORITE**, Unfractured		75		75.00		685.51	
SOUND ROCK (D): Fine-Grained **QUARTZ DIORITE**, Slightly Fractured				78.00 78.20		682.51 682.31	

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL MNSLOG.GPJ S&ME.GDT 3/26/08

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COMPLETION REPORT OF WELL No. M-48DR

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

GROUND SURFACE ELEVATION: **760.5**
LOGGED BY: **Courtney Wither**
CHECKED BY:

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
							(See Page 1)
SOUND ROCK (D): Fine-Grained **GRANITE**, Slightly Fractured		80		79.00		681.51	
SOUND ROCK (D): Fine-Grained **QUARTZ DIORITE**, Unfractured							
SOUND ROCK (D): Fine-Grained, Quartz-Rich **GRANITE**, Slightly Fractured		85		88.50		672.01	
SOUND ROCK (D): Fine-Grained **QUARTZ DIORITE**, Unfractured *(continued)*		90		89.00 90.30		671.51 670.21	
SOUND ROCK (D): Fine-Grained **GRANITE**, Unfractured							
SOUND ROCK (D): Fine-Grained **META GABBRO**, Slightly Fractured							
SOUND ROCK (D): Fine-Grained, Quartz-Rich **GRANITE** With Orbicuals, Unfractured							

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL MNSLOG.GPJ S&ME.GDT 3/26/08

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COMPLETION REPORT OF WELL No. M-48DR

SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

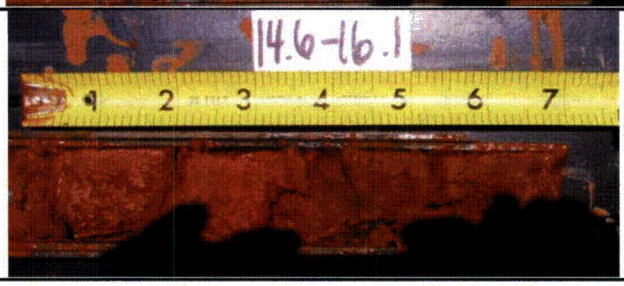
S&ME Project No: 1264-06-724

Boring Number: M-48DR

Sample No: 1
Depth (ft-bls): 4.6-6.1
Blow Count: 9 * 9 * 4

Sample No: 2
Depth (ft-bls): 9.6-11.1
Blow Count: 5 * 4 * 6

Sample No: 3
Depth (ft-bls): 14.6-16.1
Blow Count: 3 * 6 * 7



Sample No: 4
Depth (ft-bls): 19.6-21.1
Blow Count: 4 *7 * 7

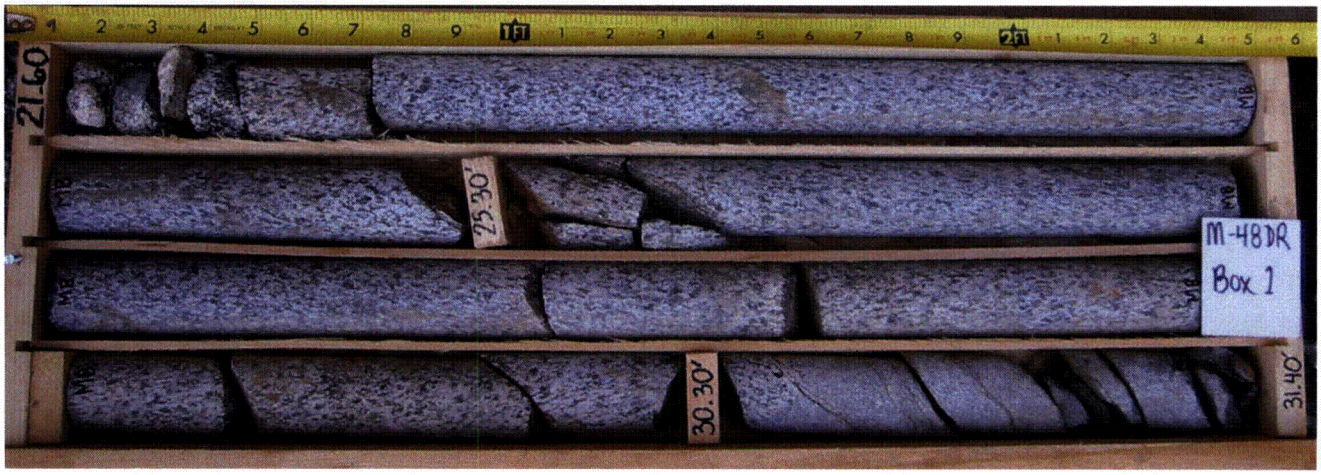
No Recovery

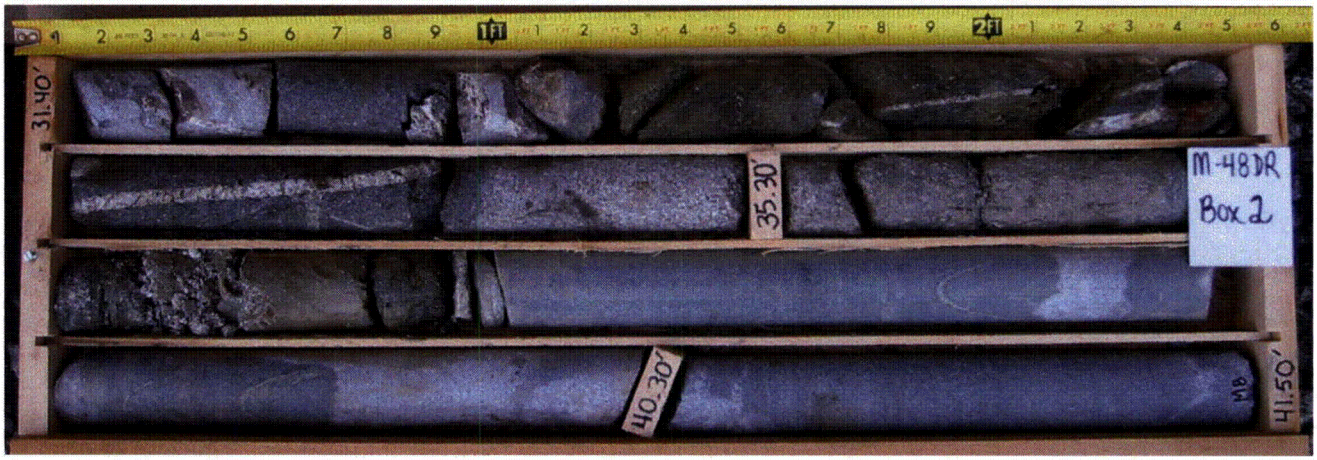
ROCK CORE PICTURES

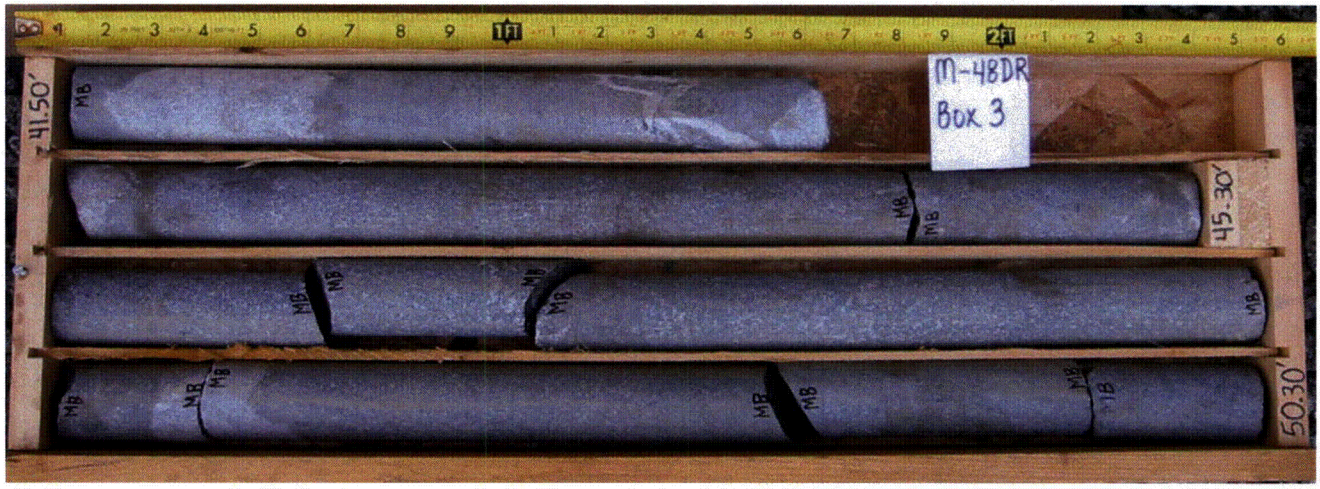
McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-48DR





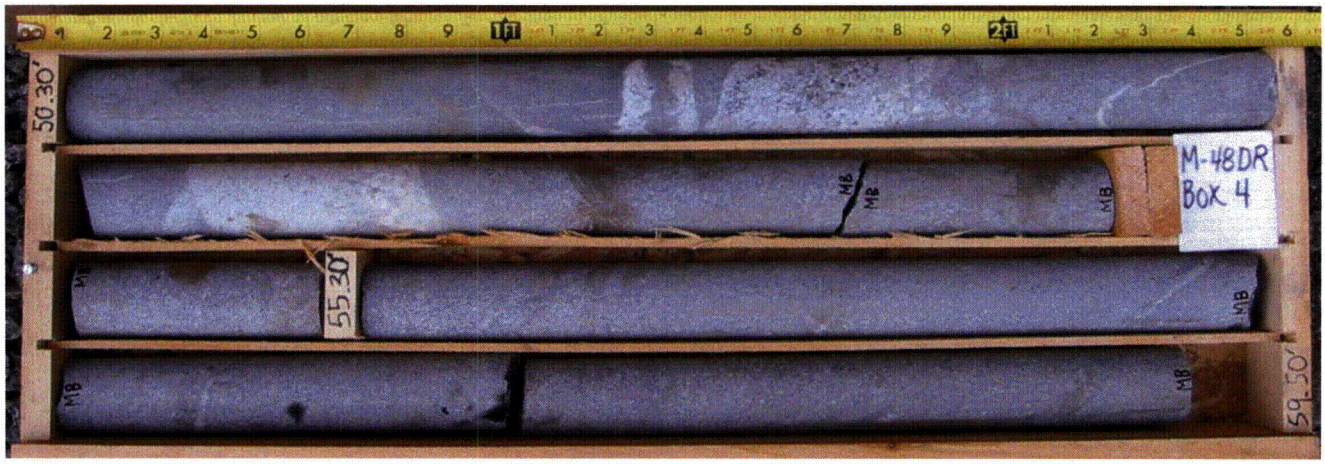


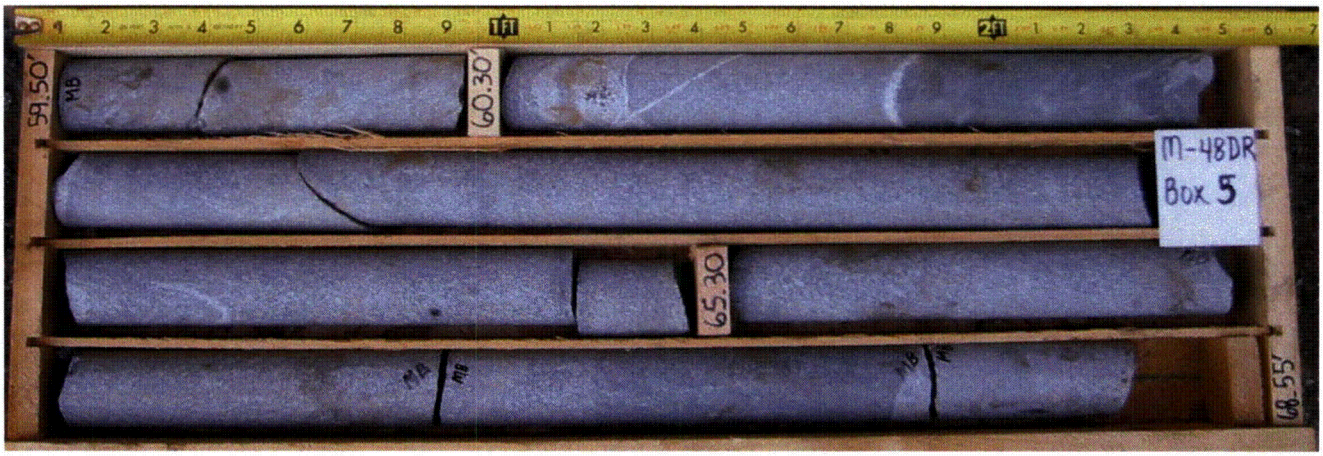
ROCK CORE PICTURES

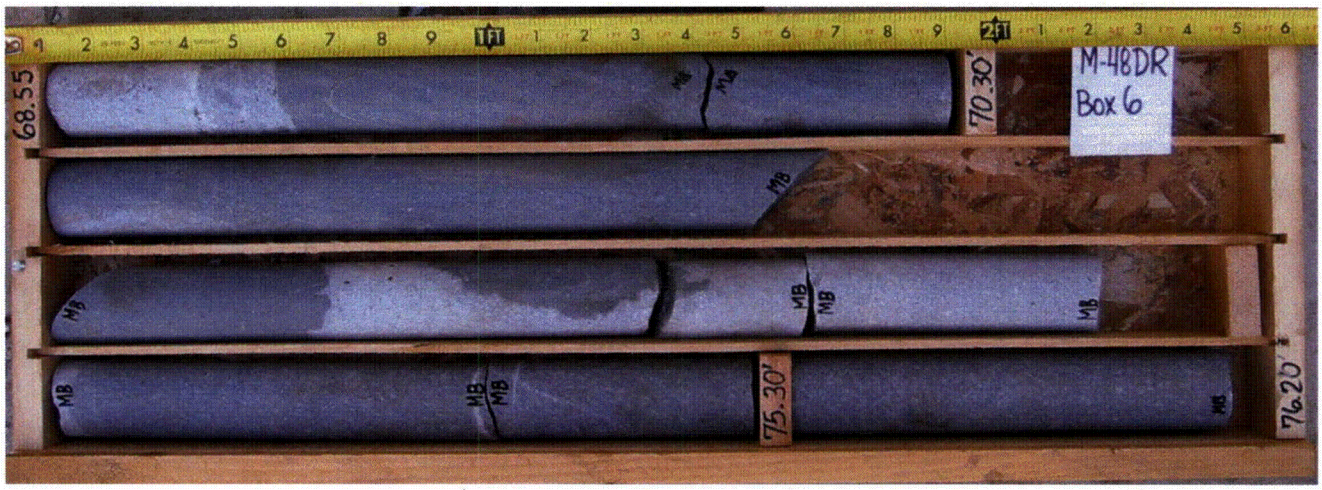
McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-48DR





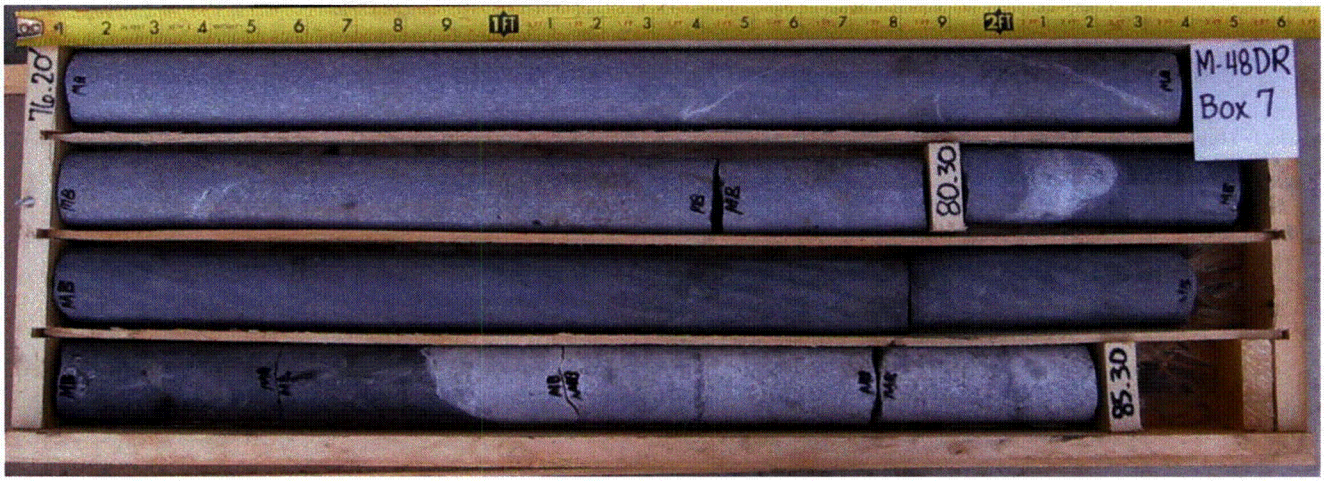


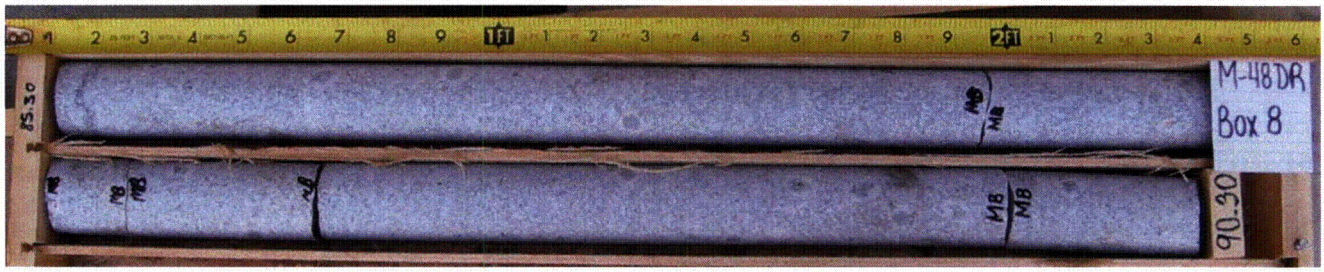
ROCK CORE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-48DR





CLASSIFICATION:

21.60' - 30.45': Coarse-Grained Quartz Diorite With Intermittent Soil Seams

30.45' - 34.7': Fine-Grained Quartz Diorite

34.7' - 36.4': Medium-Grained Granite

36.4' - 36.95': Soil Seam

36.95' - 45.3': Fine-Grained Quartz Diorite With Intermittent Fine-Grained Granite and Soil Seams

45.3' - 48.25': Medium-Grained Quartz Diorite

48.25' - 48.45': Fine-Grained Granite

48.45' - 49.1': Medium-Grained Quartz Diorite

49.1' - 55.3': Fine-Grained Quartz Diorite With Intermittent Fine-Grained Granite and Coarse-Grained Quartz Diorite

55.3' - 61.15': Fine-Grained Quartz Diorite

61.15' - 61.8': Fine-Grained Diorite

61.8' - 68.1': Fine-Grained Quartz Diorite

68.1' - 69.0': Fine-Grained Granite

69.0' - 72.35': Fine-Grained Quartz Diorite

72.35' - 74.0': Fine-Grained, Quartz-Rich Granite

74.0' - 80.42': Fine-Grained Quartz Diorite

80.42' - 80.62': Fine-Grained Granite

80.62' - 83.97': Fine-Grained Meta Gabbro

83.97' - 90.3': Fine-Grained, Quartz-Rich Granite With Orbicuals

BOREHOLE PERMEABILITY TEST USING PACKERS
FIELD DATA SHEET

S&ME

PROJECT NAME AND NO.:	MNS - GWPP	**BOREHOLE NO.:**	M-48DR				
LOCATION:	Huntersville, NC	**TEST INTERVAL:**	81.3	to	86.3	bgs	
TEST DATE:	6/15/2007	**TEST INTERVAL:**	679.1	to	674.1	EL	
TESTED BY:	Jay Little and Courtney Withers						
GROUND ELEV (ft MSL):	760.4						

TEST METHOD: Double Packer Method using Multiple Pressure Tests
METHOD REFERENCE: Ground Water Manual, US Bureau of Reclamation, 1995, Chapter 10

TEST DATA (Enter data in underlined cells):

Rock Description of test interval:	Sound Rock: Meta Gabbro to 84.0 ft bls with horizontal fracture at 82.65 ft bls; Unfractured Granite from 84.0 to 86.3 ft bls			
Source of test water and clarity:	Catawba River (treated)			
Method of cleaning hole prior to testing:	Flushed			
Drilling Fluid (water or type of drilling mud)	Mud			
Packer Brand and Model:				
Packer Inflation Pressure	160	psi		
Packer Length:	2.00	feet		
Method: Single (1) or double (2) packer (Enter 1 or 2):	2			
Interval below base of packer for Method 1 (single packer test), A_1:	-	feet		
Interval between packers for Method 2 (double packer test), A_2:	5.0	feet		
Depth of hole at time of test:	90.3	feet below ground surface (bgs)		
Diameter of borehole, d:	3.0	inches	0.3	feet
Radius of the borehole, r	0.13	feet		
Depth to water table (thickness of unsaturated material above water table, U):	21.3	feet		
Height above ground surface of pressure gauge:	4.7	feet ags		
Top of test section (bottom of upper packer), h_t:	81.8	feet bgs		
Bottom of test section (top of lower packer if double packer used, bottom of hole for a single packer, D):	86.8	feet bgs		
Is test section above or below water table?	below			
For tests below the water table determine h_1, the distance between the gauge and the water table:	26.0	feet		
Length of pipe over which head loss occurs (distance from gauge to outlet of pipe in test section):	88.5	feet		
Diameter and type of pipe used:	1.25-inch I.D.			

BOREHOLE PERMEABILITY TEST USING PACKERS
FIELD DATA SHEET

S&ME

PROJECT NAME AND NO.: MNS - GWPP
LOCATION: Huntersville, NC
TEST DATE: 6/15/07

BOREHOLE NO.: M-48DR
TEST INTERVAL: 81.3 to 86.3 bgs
TEST INTERVAL: 679.06 to 674.06 EL

Gauge Pressure (h_2) in psi	Elapsed Time (minutes)	Water Level (feet bgs)	Flow Rate (total flow in gal)	Flow Rate (gpm)
Step 1				
40	0		2029.00	
40	1		2029.70	0.70
40	2		2030.20	0.50
40	5		2032.00	0.60
40	10		2035.30	0.66
40	15		2043.50	1.64
40	20		2051.50	1.60
		Average	1.13	0.95
		Selected stabilized flow rate to be used in calculations		0.95
Step 2				
45	0		2052.90	
45	1		2053.50	0.60
45	2		2054.00	0.50
45	5		2056.20	0.73
45	10		2059.30	0.62
45	15		2062.20	0.58
45	20		2065.30	0.62
		Average	0.62	0.61
		Selected stabilized flow rate to be used in calculations		0.61
Step 3				
50	0		2065.50	
50	1		2066.30	0.80
50	2		2067.20	0.90
50	5		2068.80	0.53
50	10		2071.80	0.60
50	15		2075.00	0.64
50	20		2078.00	0.60
		Average	0.63	0.68
		Selected stabilized flow rate to be used in calculations		0.68
Step 4				
45	0		2078.30	
45	1		2078.90	0.60
45	3		2080.00	0.55
45	5		2081.60	0.80
		Average	0.66	0.65
		Selected stabilized flow rate to be used in calculations		0.65
Step 5				
40	0		2081.90	
40	1		2082.50	0.60
40	3		2083.80	0.65
40	5		2085.30	0.75
		Average	0.68	0.67
		Selected stabilized flow rate to be used in calculations		0.67

NOTES:

BOREHOLE PERMEABILITY TEST USING PACKERS CALCULATIONS

S&ME

PROJECT NAME AND NO.:	MNS-GWPP	**BOREHOLE NO.:**	M-48DR
LOCATION:	Huntersville, NC	**TEST INTERVAL:**	81.3 to 86.3 bgs
TEST DATE:	6/15/2007	**TEST INTERVAL:**	679.1 to 674.1 EL
TESTED BY:	Jay Little and Courtney Withers		
GROUND ELEV (ft MSL):	760.4		

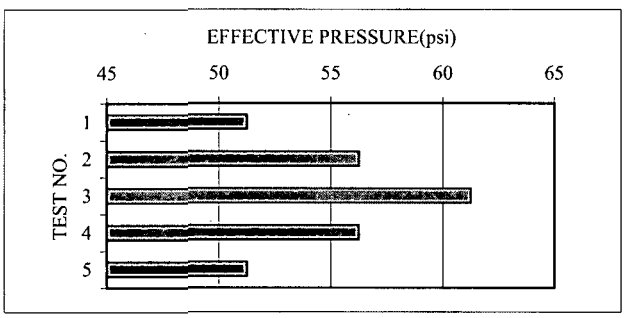
TEST METHOD: Double Packer Method using Multiple Pressure Tests
METHOD REFERENCE: Ground Water Manual, US Bureau of Reclamation, 1995, Chapter 10

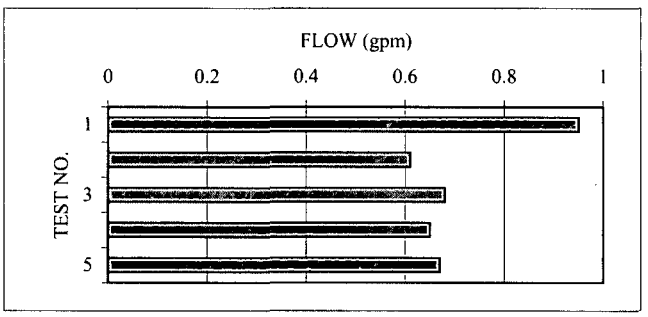
RESULTS OF PERMEABILITY CALCULATIONS
MULTIPLE STEP TEST

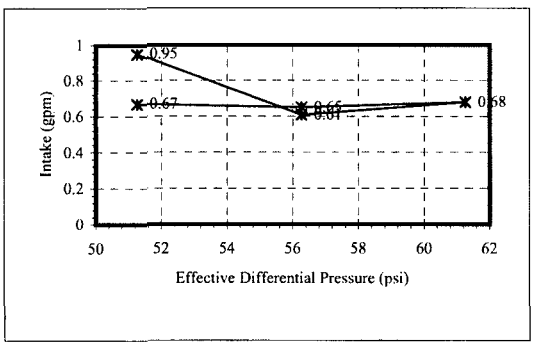
Step	Flow (Q) (gpm)	Pressure (psi) Gauge	Pressure (psi) Effective	Lugeons	Permeability (ft/sec)	Permeability (cm/sec)
1	0.95	40	51	7	2.23E-06	6.8E-05
2	0.61	45	56	4	1.3E-06	4.0E-05
3	0.68	50	61	4	1.3E-06	4.1E-05
4	0.65	45	56	4	1.4E-06	4.2E-05
5	0.67	40	51	5	1.6E-06	4.8E-05
			AVERAGE	5	1.6E-06	4.8E-05
			SELECTED VALUES			

Rock Description of Tested Interval:
Sound Rock: Meta Gabbro to 84.0 ft bls with horizontal fracture at 82.65 ft bls; Unfractured Granite from 84.0 to 86.3 ft bls

TEST INTERPRETATION
Text here
Text here







PERMEABILITY CALCULATIONS FOR EACH STEP OF TEST

S&ME

CALCULATED PERMEABILITY FOR STEP 1

Gauge Pressure, **h2**:	40	psi	92.4	feet of water
Flow Rate, **Q**:	0.95	gpm	0.002	ft^3/sec
Head loss per TEN foot section of pipe:	0.0	psi		(per tables)
Head Loss, ***L*** :	0.0	psi	0.0	feet of water
Distance from pressure gauge to bottom of test section, $\mathbf{h_1}$:	26.0	feet		
Value of $\mathbf{h_1}$:	26.0	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	118.4	feet	51.3	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	52.9	feet		
X = (H/Tu)*100	223.9	%		
Tu/A	10.6			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	40		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	64		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	2.23E-06	ft/sec	6.81E-05	cm/sec

Is this step valid?

If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow

Calculate a, the total open area of the test section: 3.9 square feet

Is Q/a * (estimated porosity) > 10?? True, Test Valid

CALCULATED PERMEABILITY FOR STEP 2

Gauge Pressure, **h2**:	45	psi	103.9	feet of water
Flow Rate, **Q**:	0.61	gpm	0.001	ft^3/sec
Head loss per TEN foot section of pipe:	0.0	psi		(per tables)
Head Loss, ***L*** :	0.0	psi	0.0	feet of water
Distance from pressure gauge to bottom of test section, $\mathbf{h_1}$:	26.0	feet		
Value of h_1:	26.0	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	129.9	feet	56.3	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	64.4	feet		
X = (H/Tu)*100	201.7	%		
Tu/A	12.9			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	40		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	64		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	1.31E-06	ft/sec	3.99E-05	cm/sec

Is this step valid?

If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow

Calculate a, the total open area of the test section: 3.9 square feet

Is Q/a * (estimated porosity) > 10?? True, Test Valid

CALCULATED PERMEABILITY FOR STEP 3				
Gauge Pressure, **h2**:	50	psi	115.5	feet of water
Flow Rate, **Q**:	0.68	gpm	0.002	ft^3/sec
Head loss per TEN foot section of pipe:	0.0	psi		(per tables)
Head Loss, ***L*** :	0.0	psi	0.0	feet of water
Distance from pressure gauge to bottom of test section, $\mathbf{h_1}$:	26.0	feet		
Value of h_1:	26.0	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	141.5	feet	61.3	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	76.0	feet		
X = (H/Tu)*100	186.2	%		
Tu/A	15.2			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	40		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	64		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	1.34E-06	ft/sec	4.08E-05	cm/sec
Is this step valid?				
If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow				
Calculate a, the total open area of the test section:			3.9	square feet
Is Q/a * (estimated porosity) > 10??			True, Test Valid	

CALCULATED PERMEABILITY FOR STEP 4				
Gauge Pressure, **h2**:	45	psi	103.9	feet of water
Flow Rate, **Q**:	0.65	gpm	0.001	ft^3/sec
Head loss per TEN foot section of pipe:	0.0	psi		(per tables)
Head Loss, ***L*** :	0.0	psi	0.0	feet of water
Distance from pressure gauge to bottom of test section, $\mathbf{h_1}$:	26.0	feet		
Value of h_1:	26.0	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	129.9	feet	56.3	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	64.4	feet		
X = (H/Tu)*100	201.7	%		
Tu/A	12.9			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	40		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	64		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	1.39E-06	ft/sec	4.25E-05	cm/sec
Is this step valid?				
If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow				
Calculate a, the total open area of the test section:			3.9	square feet
Is Q/a * (estimated porosity) > 10??			True, Test Valid	

CALCULATED PERMEABILITY FOR STEP 5				
Gauge Pressure, **h2**	40	psi	92.4	feet of water
Flow Rate, **Q**:	0.67	gpm	0.001	ft^3/sec
Head loss per TEN foot section of pipe:	0.0	psi		(per tables)
Head Loss, ***L*** :	0.0	psi	0.0	feet of water
Distance from pressure gauge to bottom of test section, $\mathbf{h_1}$:	26.0	feet		
Value of h_1:	26.0	feet		
Effective Head, ***H*** where ***H = h1+h2-L*** :	118.4	feet	51.3	psi
Determine Saturation Zone:		-		
Select Zone 1, 2, or 3	3		Zones 1 and 2 are unsaturated, 3 is saturated	
Tu = U-D+H	52.9	feet		
X = (H/Tu)*100	223.9	%		
Tu/A	10.6			
Determine Conductivity Coefficient				
H/r	-		Value for Zone 1 analysis	
A/H	-		Value for Zone 1 analysis	
A/r	40		Value for Zone 2 and 3 analysis	
Select Cu from Fig 10-7 for Zone 1 tests:			Cu for Zone 1	
Cs for Zone 2 and 3 tests:	64		Cs for Zones 2 and 3	
Calculate K if Zone 1 and using single or double packer	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 2 and using double packer (Method 2)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using single packer (Method 1)	-	ft/sec	-	cm/sec
Calculate K if Zone 3 and using double packer (Method 2)	1.58E-06	ft/sec	4.80E-05	cm/sec

Is this step valid?

If (Q/a)*(estimated porosity) > 10 the calculations may not be valid due to turbulent flow

Calculate a, the total open area of the test section: 3.9 square feet

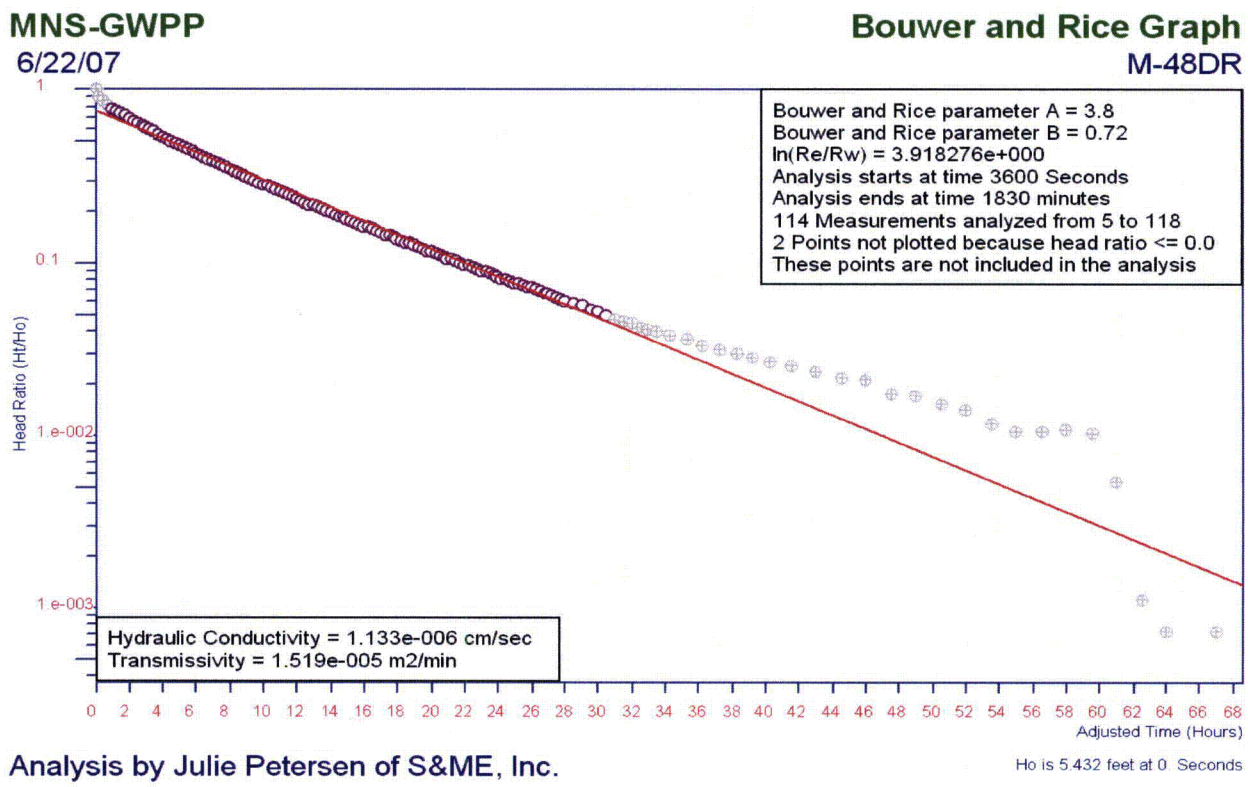
Is Q/a * (estimated porosity) > 10?? True, Test Valid

Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	MNS-GWPP
Test Date:	6/22/2007
Well Label:	M-48DR
Aquifer Thickness:	73.29 feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	1.5 Inches
Static Water Level:	20.71 feet
Water Table to Screen Bottom:	68.29 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 150 time and drawdown measurements
Maximum head is 5.432 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



Analysis by Julie Petersen of S&ME, Inc.

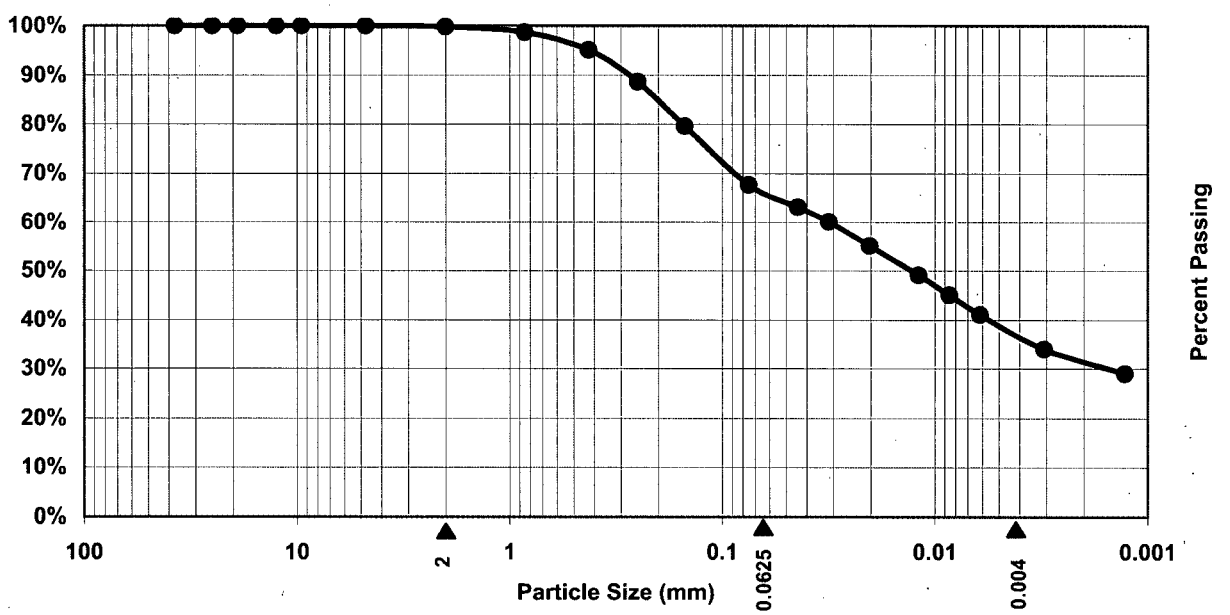
PERMEABILITY

1.13E-06 cm/sec

PARTICLE SIZE ANALYSIS OF SOILS
FOR USE IN FETTER AND BEAR DIAGRAMS

Boring No.:	**Sample No.:**	**Depth:**
M-48DR	SS-2	9.6 - 11.1 ft bls

Sample Description:
Reddish-Brown, Fine to Medium Sandy, Silty, Clay With Mica



	> 2 mm	2 mm - 0.0625 mm	0.0625 mm - 0.004 mm	<0.004 mm
From Graph:	% Gravel 0.2%	% Sand 33.6%	% Silt 30.1%	% Clay 36.2%
Adjusted for Calculations	**0%**	**34%**	**30%**	**36%**

Notes:
Grain size distribution taken from grain size with hydrometer data located in Appendix II.
Gravel, sand, silt and clay sizes based on Wentworth Scale.

S&ME Project:
McGuire Nuclear Station - GWPP

S&ME Project No.:
1264-06-724

S&ME

FETTER AND BEAR DIAGRAMS

S&ME PROJECT: McGuire Nuclear Station - GWPP
S&ME PROJECT NO.: 1264-06-724

Boring No. M-48DR

Boring Depth: 9.6 to 11.1 ft bls

% Sand: 34%

% Silt: 30%

% Clay: 36%

Estimated Specific Yield: 3.2%

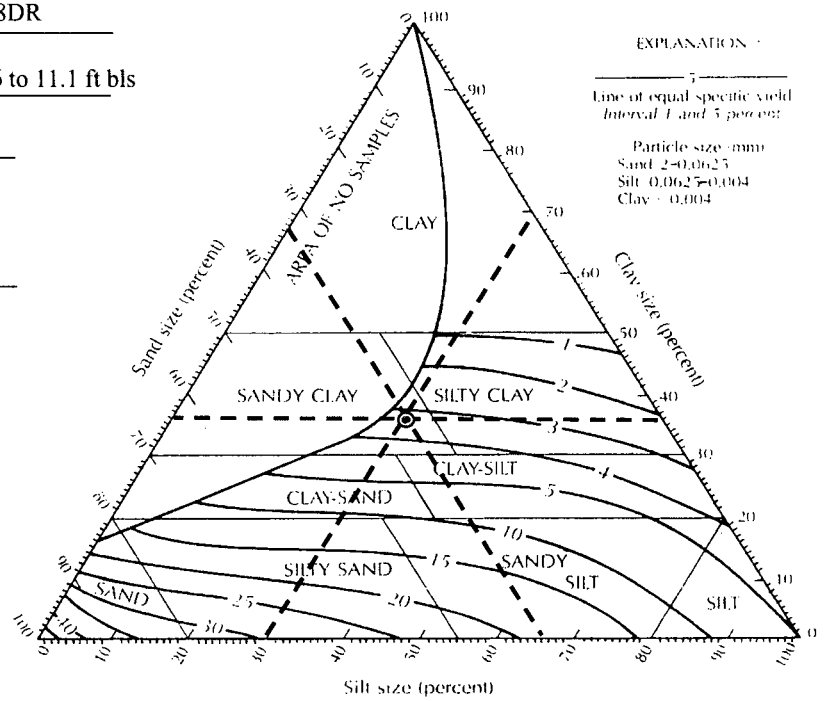
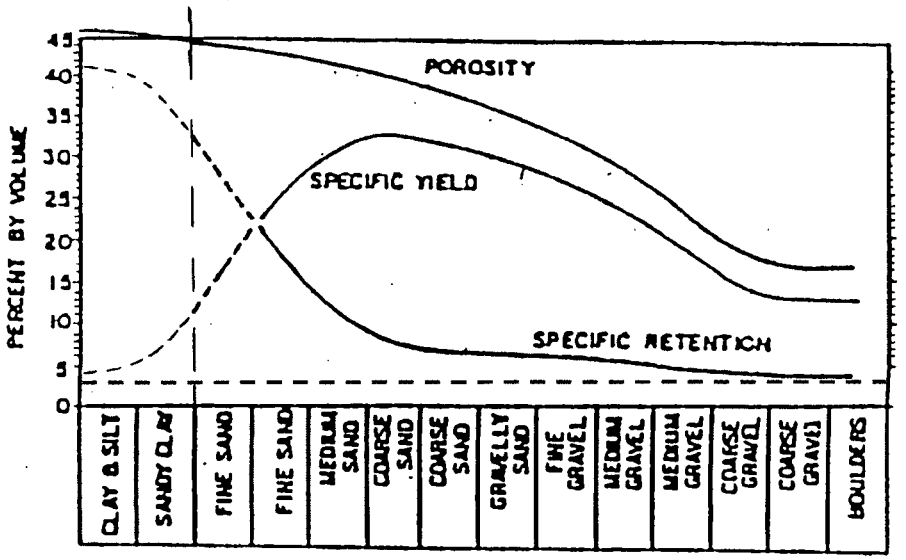


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.



Estimated Porosity: 48%**

**Based on Table of Selected Values of Porosity, Specific Yield and Specific Retention, USGS Water Supply Paper 2220.

Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

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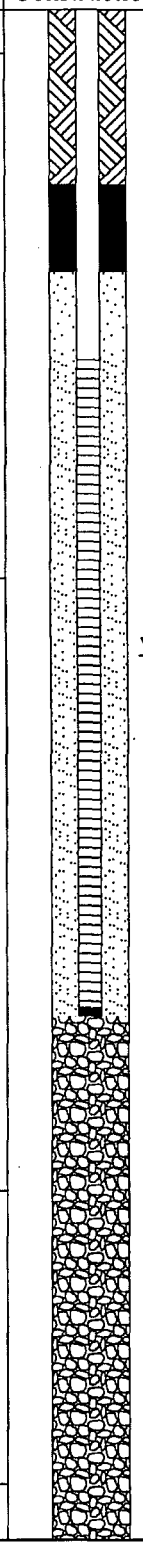
S&ME, Inc.
9751 Southern Pine Blvd.
Charlotte, North Carolina
Telephone: 704-523-4726
Fax: 704-525-3953

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.

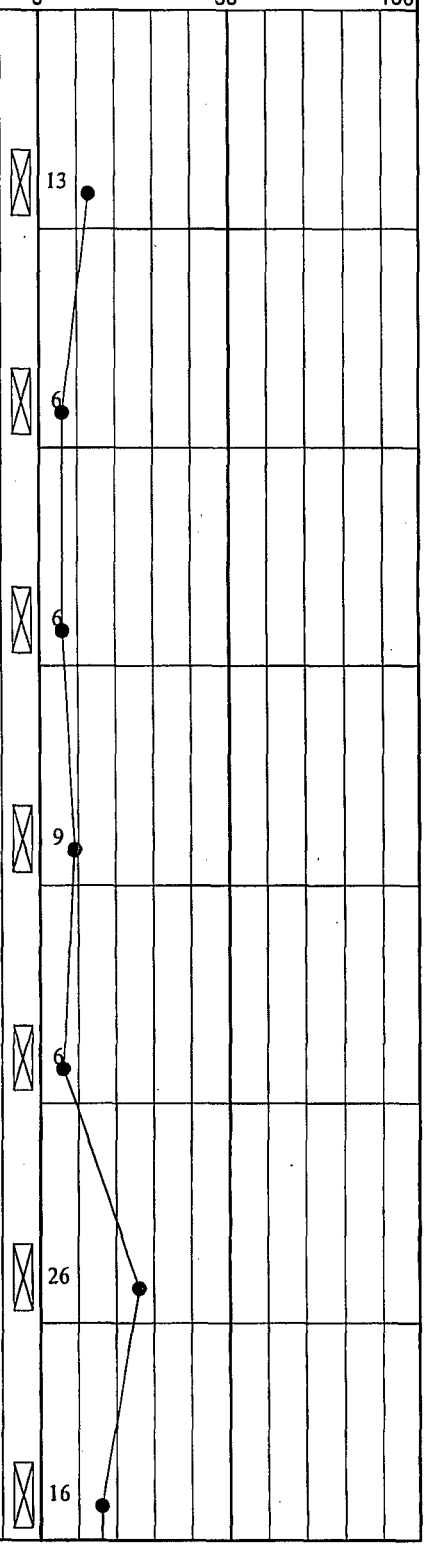
Project: **MNS - Groundwater Protection Project**			**Boring No. M-53**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 1 of 2
Boring Depth (ft): **50.0**	Elevation (ft): **760.6**	Driller: **Jay Little, NC Cert No. 2717**	Date Drilled: **5/29/07**
Logged By: **Julie Petersen**	Water Level: **Stabilized Water Level at 14.77 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lithology	Material Description
760			**ASPHALT**
			FILL (F): Red, Fine Sandy, Silty, **CLAY**
755	5		
750	10		
			SOIL/SAPROLITE (M1): Orange to Light Brown, Fine Sandy, **SILT** with Manganese Banding
745	15		
740	20		
735	25		
			SOIL/SAPROLITE (M1): Olive Green and Brown, Slightly Micaceous, Silty, Fine **SAND**
730	30		
			SOIL/SAPROLITE (M1): White and Gray, Silty, Medium to Fine **SAND** (Granitic)

Well Construction



Penetration Resistance (Blows/Foot)



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Project: **MNS - Groundwater Protection Project**			**Boring No. M-53**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 2 of 2
Boring Depth (ft): **50.0**	Elevation (ft): **760.6**	Driller: **Jay Little, NC Cert No. 2717**	Date Drilled: **5/29/07**
Logged By: **Julie Petersen**	Water Level: **Stabilized Water Level at 14.77 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lithology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
725					
			SOIL/SAPROLITE (M1): Brown, Micaceous, Silty, Fine **SAND** with Manganese Staining		17
	40				
720					50/4 >>
			WEATHERED ROCK (M2): When Sampled Becomes White, Silty, Coarse to Fine **SAND**		
	45		WEATHERED ROCK (M2): When Sampled Becomes Olive Green and Brown, Silty, Coarse to Fine **SAND** with Rock Fragments		
715					50/4 >>
			WEATHERED ROCK (M2): When Sampled Becomes Brown, Micaceous, Fine Sandy **SILT** with Manganese Staining		
	50				
			Boring Terminated at 50.00 ft bls		

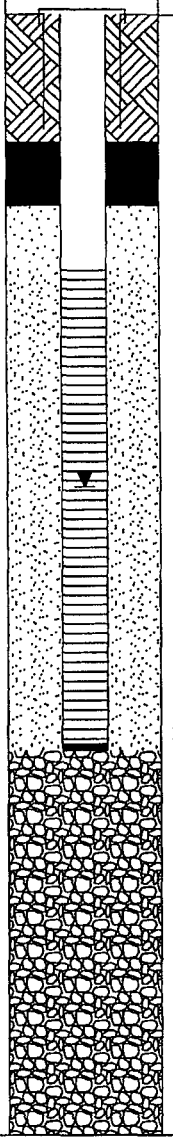
COMPLETION REPORT OF WELL No. M-53

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

WATER LEVEL: **Stabilized Water Level at 14.77 ft bls**
LATITUDE: **35 26 02.56**
LONGITUDE: **80 56 52.43**
TOP OF CASING ELEVATION: **760.32**
DATUM: **MSL**
LOGGED BY: **Julie Petersen**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **Mud Rotary**
DATE DRILLED: **5/29/07**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00		760.57
ASPHALT		0				
FILL (F): Red, Fine Sandy, Silty, **CLAY**				4.00		756.57
		5		6.00		754.57
		10				
SOIL/SAPROLITE (M1): Orange to Light Brown, Fine Sandy, **SILT** with Manganese Banding		15				
		20		22.80		737.77
				23.00		737.57
		25				
SOIL/SAPROLITE (M1): Olive Green and Brown, Slightly Micaceous, Silty, Fine **SAND**		30				



WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter: **8"**
Type: **Steel Flush Mount**
Interval: **At Grade**

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 8 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 4 ft bls**

SEAL
Type: **Bentonite**
Interval: **4 to 6 ft bls**

FILTERPACK
Type: **#1 Filter Sand**
Interval: **6 to 23 ft bls**

SCREEN
Diameter: **2"**
Type: **0.010 Slotted Sch. 40 PVC**
Interval: **8 to 23 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL MNSLOG.GPJ S&ME.GDT 3/26/08

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COMPLETION REPORT OF WELL No. M-53

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

GROUND SURFACE ELEVATION: **760.6**
LOGGED BY: **Julie Petersen**
CHECKED BY:

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
							(See Page 1)
SOIL/SAPROLITE (M1): White and Gray, Silty, Medium to Fine **SAND** (Granitic) *(continued)*		35					
SOIL/SAPROLITE (M1): Brown, Micaceous, Silty, Fine **SAND** with Manganese Staining		40					
WEATHERED ROCK (M2): When Sampled Becomes White, Silty, Coarse to Fine **SAND**		45					
WEATHERED ROCK (M2): When Sampled Becomes Olive Green and Brown, Silty, Coarse to Fine **SAND** with Rock Fragments		50		50.00		710.57	
WEATHERED ROCK (M2): When Sampled Becomes Brown, Micaceous, Fine Sandy **SILT** with Manganese Staining							

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL MNSLOG.GPJ S&ME.GDT 3/26/08

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COMPLETION REPORT OF WELL No. M-53

SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

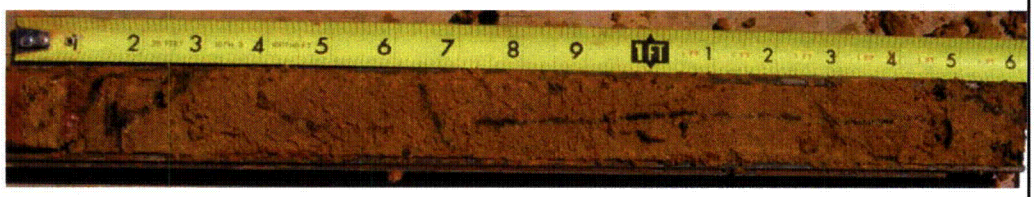
S&ME Project No: 1264-06-724

Boring Number: M-53

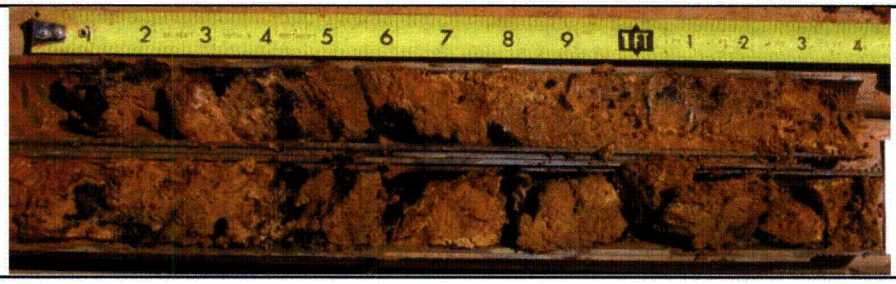
Sample No: 1
Depth (ft-bls): 3.2 - 4.7
Blow Count: 5 * 6 * 7

Sample No: 2
Depth (ft-bls): 8.2 - 9.7
Blow Count: 3 * 3 * 3

Sample No: 3
Depth (ft-bls): 13.2 - 14.7
Blow Count: 3 * 3 * 3



Sample No: 4
Depth (ft-bls): 18.2 - 19.7
Blow Count: 3 * 4 * 5



Sample No: 5
Depth (ft-bls): 23.2 - 24.7
Blow Count: 2 * 3 * 3

Sample No: 6
Depth (ft-bls): 28.2 - 29.7
Blow Count: 7 * 12 * 14

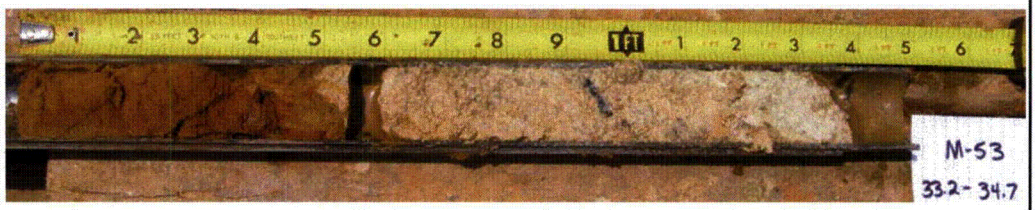
SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Boring Number: M-53

Sample No: 7
Depth (ft-bls): 33.2 - 34.7
Blow Count: 5 * 7 * 9



Sample No: 8
Depth (ft-bls): 38.2 - 39.7
Blow Count: 7 * 7 * 10

Sample No: 9
Depth (ft-bls): 43.2 - 44.7
Blow Count: 50/4

Sample No: 10
Depth (ft-bls): 48.2 - 49.7
Blow Count: 43 * 50/4

CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD
(Open Hole in Uniform Material)

S&ME

Site Name:	MNS - GWPP	
Date:	5/30/2007	
Boring I.D.	M-53	
Test Interval:	19.4' to 22.5'	(Soil/Saprolite)
Total Depth of Hole:	22.5 ft	685.98 cm
Length of Open Hole:	3.1 ft	94.51 cm
Transformation Ratio m=	1	
Performed by:	Julie Petersen	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	677.56	
60	668.69	5.42E-05
120	660.00	5.38E-05
180	651.55	5.29E-05
240	643.29	5.25E-05
300	635.24	5.17E-05
360	627.53	5.02E-05
420	619.73	5.14E-05
480	612.10	5.09E-05
540	604.76	4.96E-05
600	597.32	5.09E-05
900	563.29	4.82E-05
1200	532.20	4.67E-05
1500	503.84	4.50E-05
1800	477.74	4.37E-05
2400	431.43	4.19E-05
3000	392.20	3.92E-05
3600	358.72	3.67E-05

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

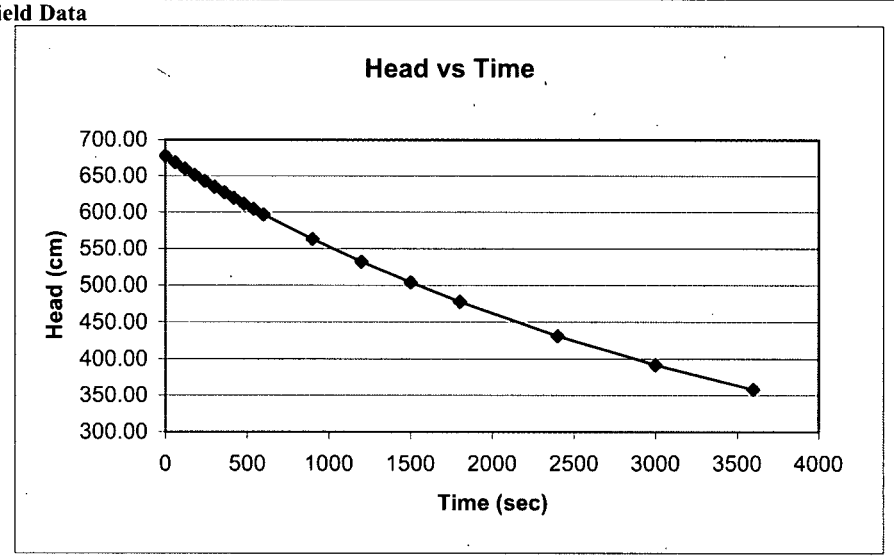
K_h	is the Horizontal Coefficient of Permeability (cm/sec)
H_1	is the Piezometric Head for time; $t = t_1$ (cm)
H_2	is the Piezometric Head for time; $t = t_2$ (cm)
D	is the Diameter of the Standpipe (cm)
d	is the diameter of the Open Length (cm),
m	is the Transformation Ratio, Where
	$m = \sqrt{K_h / K_v}$ — K_h is the Horizontal Permeability; K_v is the Vertical Permeability
L	is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

4.82E-05

Graph of Field Data

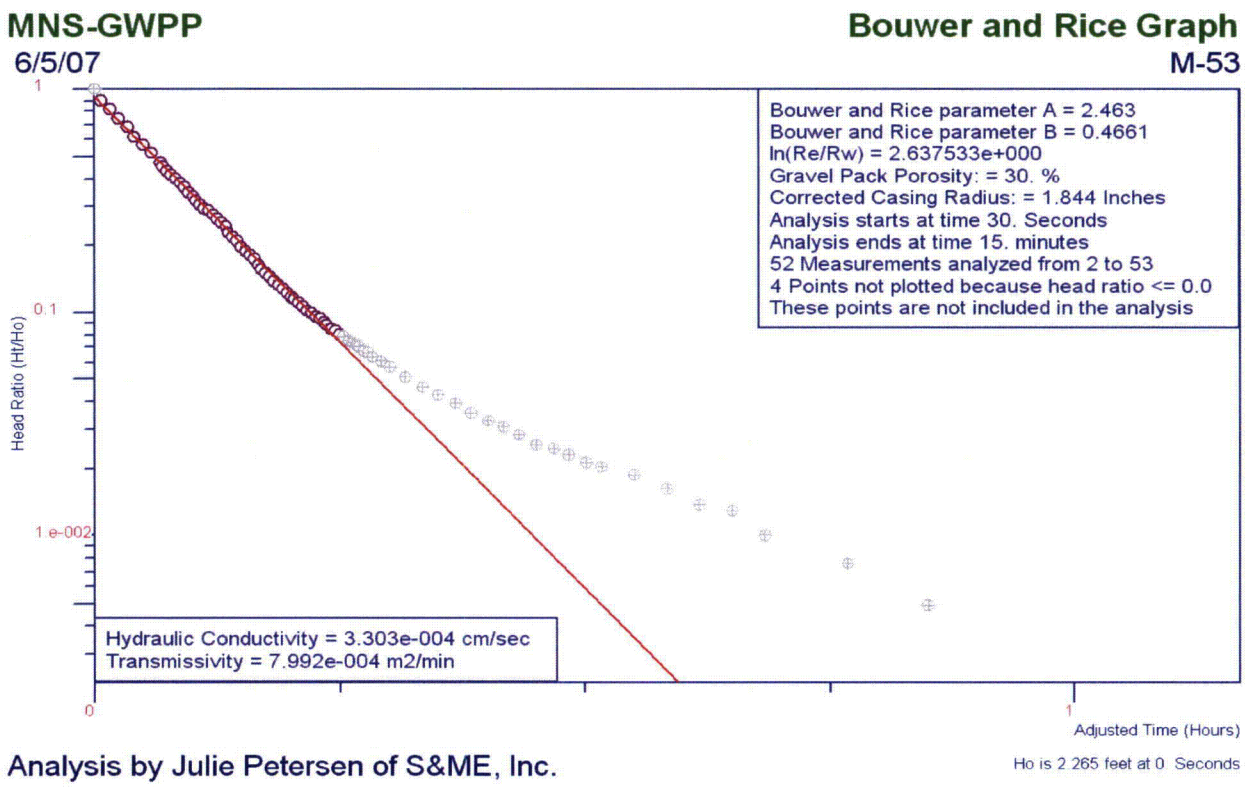


Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	MNS-GWPP
Test Date:	6/5/2007
Well Label:	M-53
Aquifer Thickness:	13.23 feet
Screen Length:	15. feet
Casing Radius:	1. Inches
Effective Radius:	3. Inches
Gravel Pack Porosity:	30.00%
Corrected Casing Radius:	3.391 Inches
Static Water Level:	14.77 feet
Water Table to Screen Bottom:	8.23 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 87 time and drawdown measurements
Maximum head is 2.265 feet
Minimum head is -2.e-003 feet

Calculation by Bouwer and Rice Graphical Method



Analysis by Julie Petersen of S&ME, Inc.

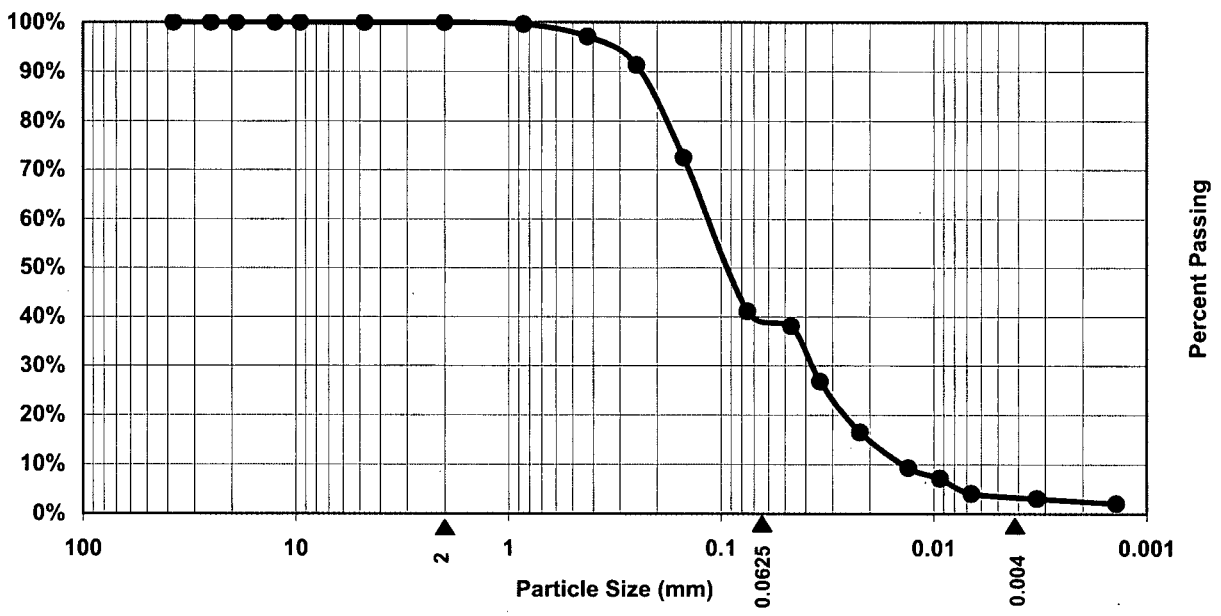
PERMEABILITY

3.30E-04 cm/sec

PARTICLE SIZE ANALYSIS OF SOILS
FOR USE IN FETTER AND BEAR DIAGRAMS

Boring No.:	Sample No.:	Depth:
M-53	SS-8	38.2 to 39.7 ft bls

Sample Description:
Brown, Silty, Fine Sand With Mica



	> 2 mm	2 mm - 0.0625 mm	0.0625 mm - 0.004 mm	<0.004 mm
From Graph:	% Gravel 0.0%	% Sand 60.0%	% Silt 36.7%	% Clay 3.3%
Adjusted for Calculations	**0%**	**60%**	**37%**	**3%**

Notes:
Grain size distribution taken from grain size with hydrometer data located in Appendix II.
Gravel, sand, silt and clay sizes based on Wentworth Scale.

S&ME Project:
McGuire Nuclear Station - GWPP

S&ME Project No.:
1264-06-724

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FETTER AND BEAR DIAGRAMS

S&ME PROJECT: McGuire Nuclear Station - GWPP
S&ME PROJECT NO.: 1264-06-724

Boring No. M-53

Boring Depth: 38.2 to 39.7 ft bls

% Sand: 60%

% Silt: 37%

% Clay: 3%

Estimated Specific Yield: 24.5%

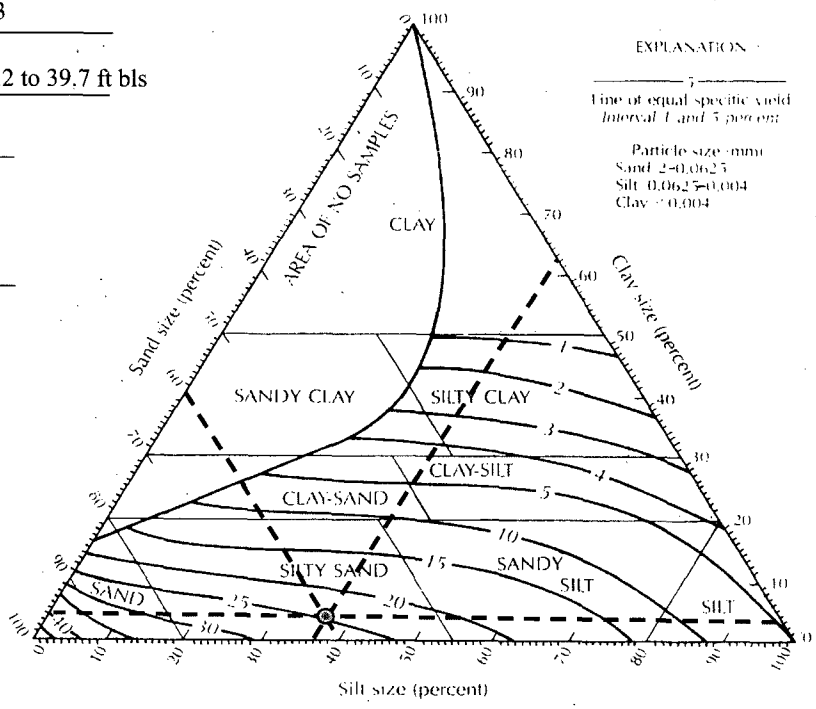
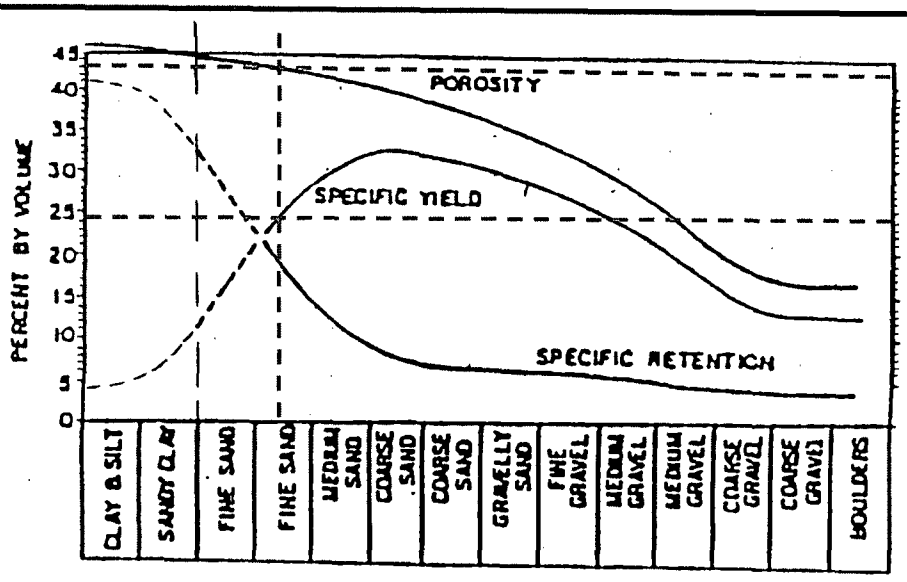


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.



Estimated Porosity: 43%

Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

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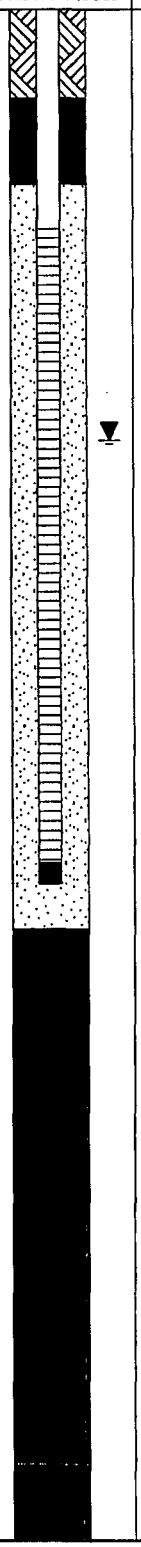
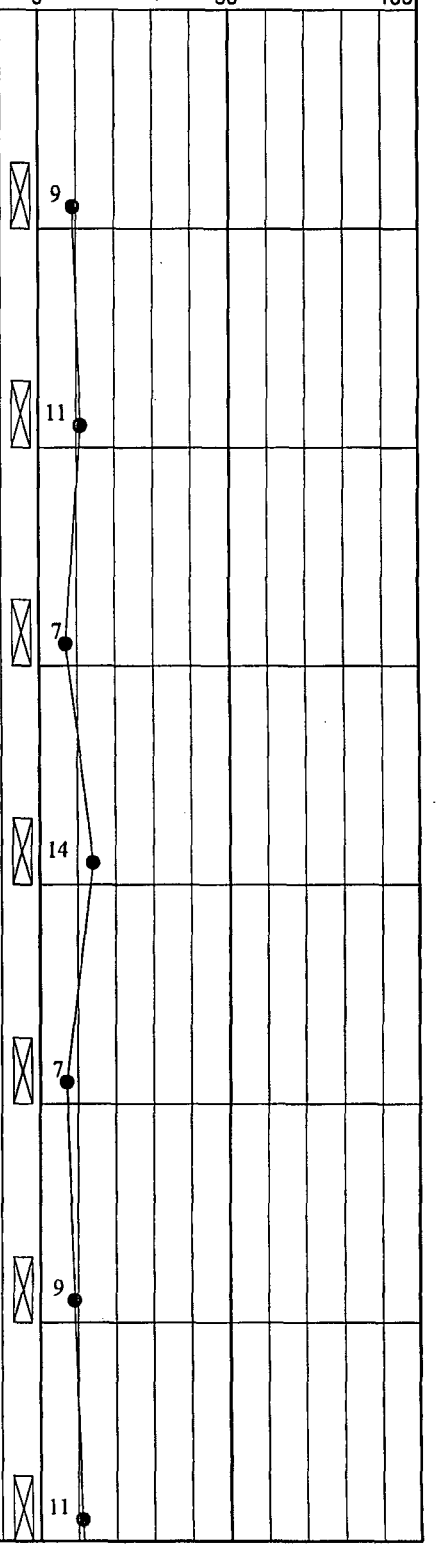
Project: **MNS - Groundwater Protection Project**			**Boring No. M-55**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 1 of 2
Boring Depth (ft): **50.0**	Elevation (ft): **760.1**	Driller: **Justin Millwood, NC Cert. No. 3439**	Date Drilled: **6/7/07**
Logged By: **Scott Dacus**	Water Level: **Stabilized Water Level at 9.84 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lithology	Material Description
			ASPHALT
			FILL (F): Red and Orange, Micaceous, Clayey, **SILT**
755	5		
750	10		
			FILL (F): Brown, Micaceous, Clayey, **SILT** With Manganese Nodules and White, Feldspar Nodules
745	15		
			FILL (F): Brown and Red, Clayey, **SILT** With Manganese Nodules
740	20		
			SOIL/SAPROLITE (M1): Red and Gray, Micaceous, **SILT**
735	25		
			SOIL/SAPROLITE (M1): Brown and Tan, Micaceous, Fine Sandy, **SILT** With Iron and Manganese Staining
730	30		
			SOIL/SAPROLITE (M1): Red and Orange, Micaceous, **SILT** With Feldspar Veins and Manganese Staining

Well Construction



Penetration Resistance (Blows/Foot)



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Project: **MNS - Groundwater Protection Project**			**Boring No. M-55**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 2 of 2
Boring Depth (ft): **50.0**	Elevation (ft): **760.1**	Driller: **Justin Millwood, NC Cert. No. 3439**	Date Drilled: **6/7/07**
Logged By: **Scott Dacus**	Water Level: **Stabilized Water Level at 9.84 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
720	40		SOIL/SAPROLITE (M1): White and Brown, Micaceous, Silty, Medium to Fine **SAND** With Manganese Staining		14
			SOIL/SAPROLITE (M1): White and Brown, Micaceous, Fine Sandy, **SILT**		62
715	45		SOIL/SAPROLITE (M1): Black and White, Micaceous, Coarse to Fine **SAND** (Granitic)		
			SOIL/SAPROLITE (M1): Brown and Gray, Micaceous, Silty, Fine **SAND** (Granitic)		23
	50		**Boring Terminated at 50.00 ft bls**		

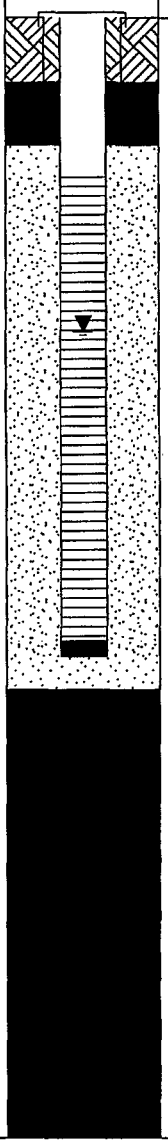
COMPLETION REPORT OF WELL No. M-55

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

WATER LEVEL: **Stabilized Water Level at 9.84 ft bls**
LATITUDE: **35 26 01.39**
LONGITUDE: **80 56 47.75**
TOP OF CASING ELEVATION: **759.73**
DATUM: **MSL**
LOGGED BY: **Scott Dacus**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **4¼" H.S.A.**
DATE DRILLED: **6/7/07**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
ASPHALT		0		0.00		760.09
FILL (F): Red and Orange, Micaceous, Clayey, **SILT**				2.00		758.09
				4.00		756.09
		5				
		10				
FILL (F): Brown, Micaceous, Clayey, **SILT** With Manganese Nodules and White, Feldspar Nodules		15				
FILL (F): Brown and Red, Clayey, **SILT** With Manganese Nodules				19.50		740.59
		20		20.00		740.09
				21.00		739.09
SOIL/SAPROLITE (M1): Red and Gray, Micaceous, **SILT**		25				
SOIL/SAPROLITE (M1): Brown and Tan, Micaceous, Fine Sandy, **SILT** With Iron and Manganese Staining		30				



WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter: **8"**
Type: **Steel Flush Mount**
Interval: **At Grade**

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 5 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 2 ft bls**

SEAL
Type: **Bentonite**
Interval: **2 to 4 ft bls**

FILTERPACK
Type: **#1 Filter Sand**
Interval: **4 to 21 ft bls**

SCREEN
Diameter: **2"**
Type: **0.010 Slotted Sch. 40 PVC**
Interval: **5 to 20 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL MNSLOG.GPJ S&ME.GDT 3/26/08

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COMPLETION REPORT OF WELL No. M-55

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

GROUND SURFACE ELEVATION:
LOGGED BY: **760.1**
CHECKED BY: **Scott Dacus**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
							(See Page 1)
SOIL/SAPROLITE (M1): Red and Orange, Micaceous, **SILT** With Feldspar Veins and Manganese Staining *(continued)*		35					
SOIL/SAPROLITE (M1): White and Brown, Micaceous, Silty, Medium to Fine **SAND** With Manganese Staining		40					
SOIL/SAPROLITE (M1): White and Brown, Micaceous, Fine Sandy, **SILT**		45					
SOIL/SAPROLITE (M1): Black and White, Micaceous, Coarse to Fine **SAND** (Granitic)		50		50.00		710.09	
SOIL/SAPROLITE (M1): Brown and Gray, Micaceous, Silty, Fine **SAND** (Granitic)							

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

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COMPLETION REPORT OF WELL No. M-55

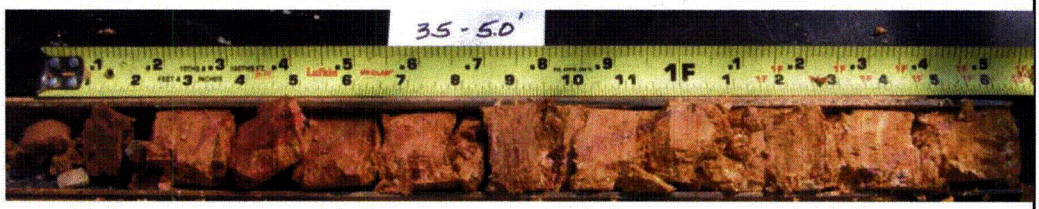
SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Boring Number: M-55

Sample No: 1
Depth (ft-bls): 3.5 - 5.0
Blow Count: 3 * 4 * 5



Sample No: 2
Depth (ft-bls): 8.5 - 10
Blow Count: 3 * 4 * 7

Sample No: 3
Depth (ft-bls): 13.5 - 15
Blow Count: 2 * 3 * 4

Sample No: 4
Depth (ft-bls): 18.5 - 20
Blow Count: 3 * 6 * 8

Sample No: 5
Depth (ft-bls): 23.5 - 25
Blow Count: 2 * 3 * 4

Sample No: 6
Depth (ft-bls): 28.5 - 30
Blow Count: 2 * 4 * 5

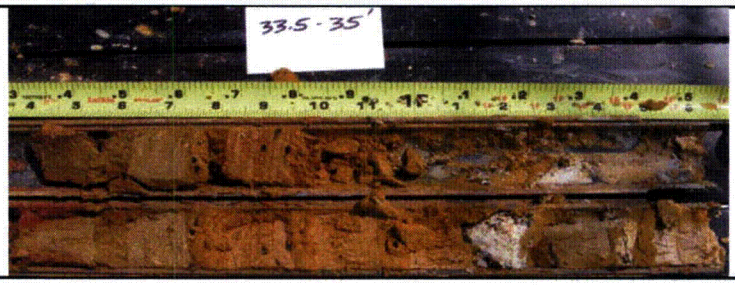
SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

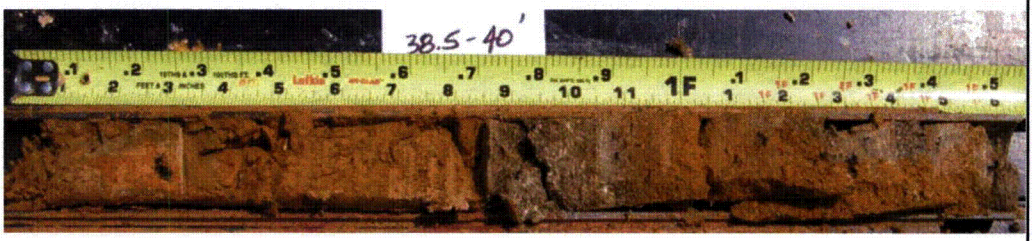
S&ME Project No: 1264-06-724

Boring Number: M-55

Sample No: 7
Depth (ft-bls): 33.5 - 35
Blow Count: 3 * 4 * 7

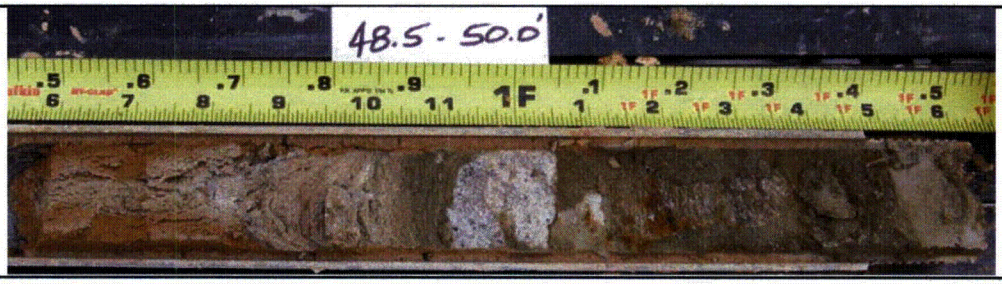


Sample No: 8
Depth (ft-bls): 38.5 - 40
Blow Count: 5 * 5 * 9



Sample No: 9
Depth (ft-bls): 43.5 - 45
Blow Count: 10 * 28 * 34

Sample No: 10
Depth (ft-bls): 48.5 - 50
Blow Count: 3 * 5 * 18



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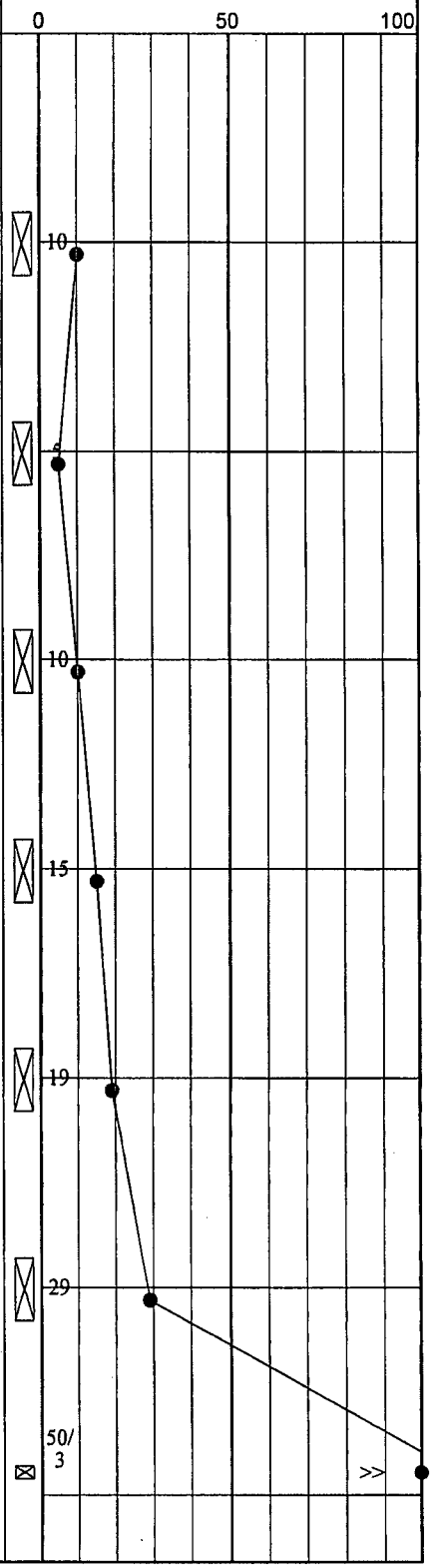
Project: **MNS - Groundwater Protection Project**			**Boring No. M-59**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 1 of 3
Boring Depth (ft): **85.1**	Elevation (ft): **760.0**	Driller: **Jay Little, NC Cert No. 2717**	Date Drilled: **6/1/07**
Logged By: **Julie Petersen**	Water Level: **Stabilized Water Level at 24.62 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description
			GRAVEL
			FILL (F): Red, Silty, **CLAY** With Medium to Fine Sand
755	5		
750	10		
745	15		
740	20		
			SOIL/SAPROLITE (M1): Black and White, Silty, Medium to Fine **SAND** With Mica (Dioritic)
735	25		
			SOIL/SAPROLITE (M1): Brown to White, Silty, Coarse to Fine **SAND**
730	30		
			WEATHERED ROCK (M2): Grayish-Green, Silty, Fine **SAND**
725	35		**Roller Cone Refusal at 36.40 ft bls**

Well Construction

Penetration Resistance (Blows/Foot)



BORING LOG WITH WELL MNSLOG.GPJ LAGWGN01.GDT 3/26/08

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Project: **MNS - Groundwater Protection Project**			**Boring No. M-59**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 2 of 3
Boring Depth (ft): **85.1**	Elevation (ft): **760.0**	Driller: **Jay Little, NC Cert No. 2717**	Date Drilled: **6/1/07**
Logged By: **Julie Petersen**	Water Level: **Stabilized Water Level at 24.62 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
			PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **QUARTZ DIORITE** With Intermittent **GRANITE**, Intensely Fractured; Heavily Weathered Void from 37.45 to 37.95 ft bls		
720	40		SOUND ROCK (D): Medium-Grained **QUARTZ DIORITE**, Unfractured		
715	45				
710	50				
			SOUND ROCK (D): Medium-Grained **GRANITE**, Unfractured		
			SOUND ROCK (D): Medium-Grained **QUARTZ DIORITE**, Unfractured		
705	55				
700	60		SOUND ROCK (D): Medium-Grained **GRANITE**, Unfractured		
			SOUND ROCK (D): Medium-Grained **META DIORITE** With Intermittent **QUARTZ DIORITE** Inclusions, Unfractured		
695	65				
			SOUND ROCK (D): Medium-Grained **META QUARTZ DIORITE**, Unfractured		
			SOUND ROCK (D): Medium-Grained **META DIORITE**, Unfractured		
690	70		SOUND ROCK (D): Medium-Grained **META QUARTZ DIORITE**, Unfractured		
			SOUND ROCK (D): Medium-Grained **QUARTZ DIORITE**, Slightly Fractured		

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Project: **MNS - Groundwater Protection Project**			**Boring No. M-59**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 3 of 3
Boring Depth (ft): **85.1**	Elevation (ft): **760.0**	Driller: **Jay Little, NC Cert No. 2717**	Date Drilled: **6/1/07**
Logged By: **Julie Petersen**	Water Level: **Stabilized Water Level at 24.62 ft bls**		Drilling Method: **Mud Rotary**

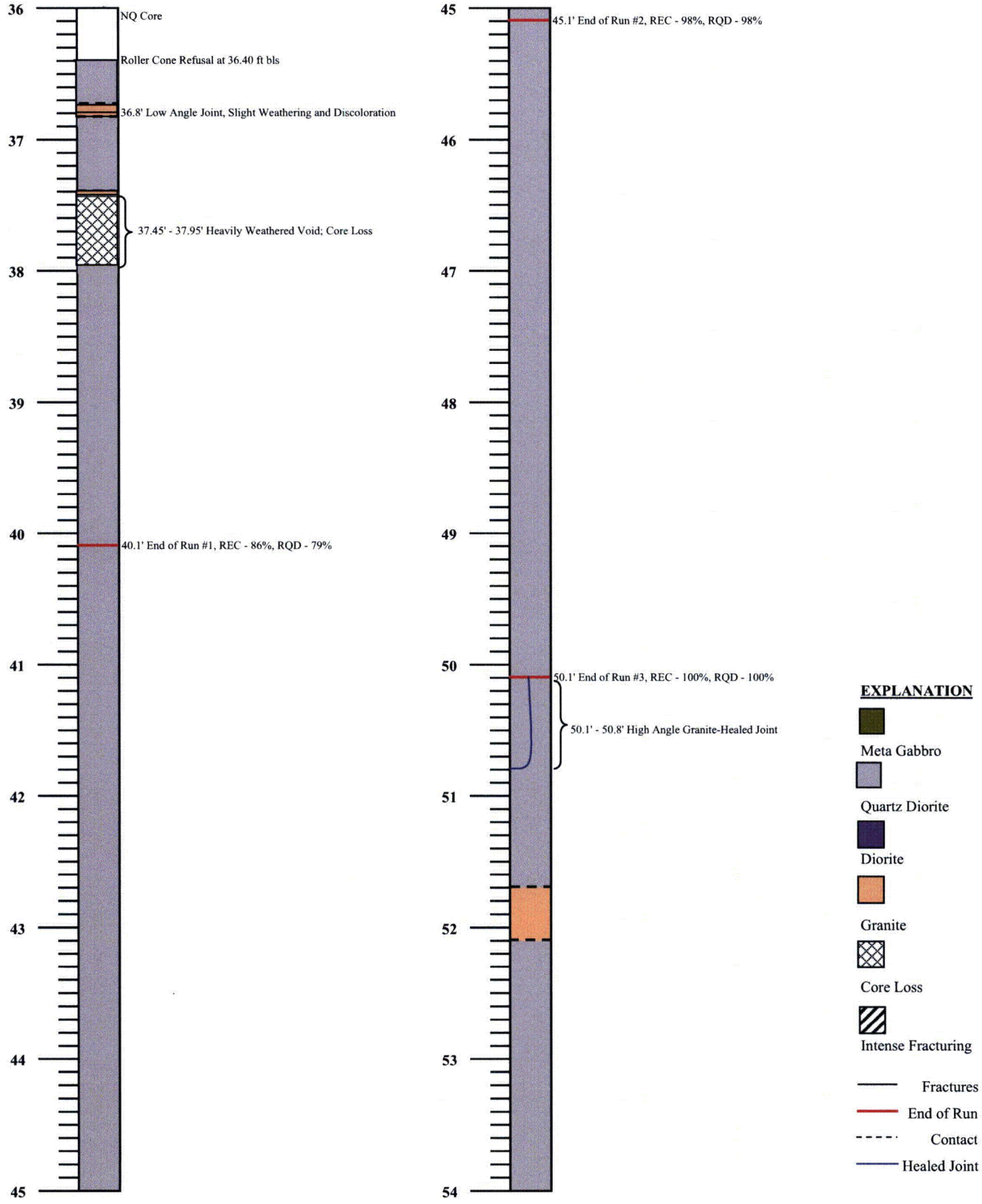
Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
685	75				
680	80				
			SOUND ROCK (D): Medium-Grained **DIORITE**, Unfractured		
			SOUND ROCK (D): Medium-Grained **QUARTZ DIORITE**, Unfractured		
675	85		**Boring Terminated at 85.10 ft bls**		

FIELD ROCK CORE LOG

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-59

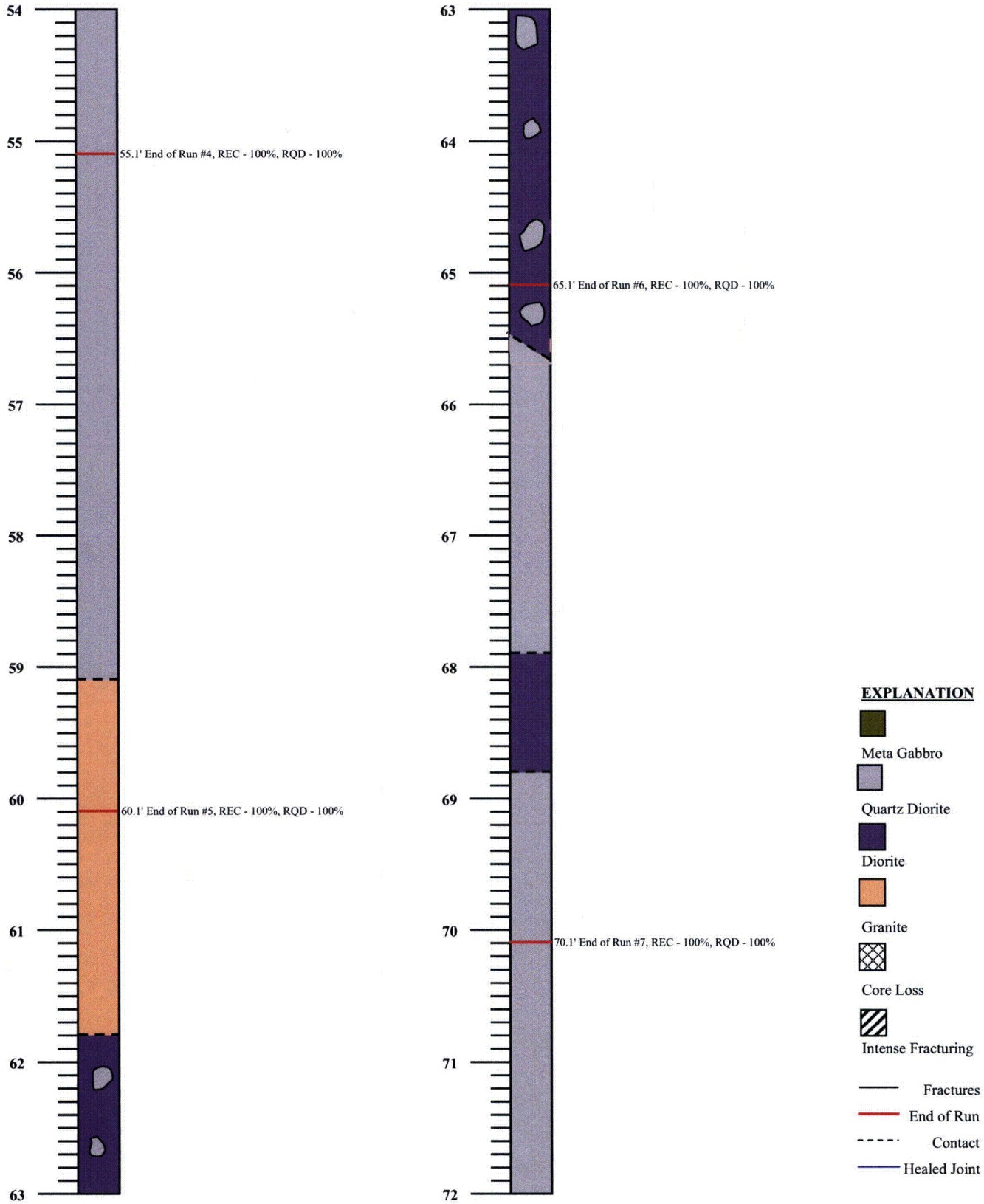


FIELD ROCK CORE LOG

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-59

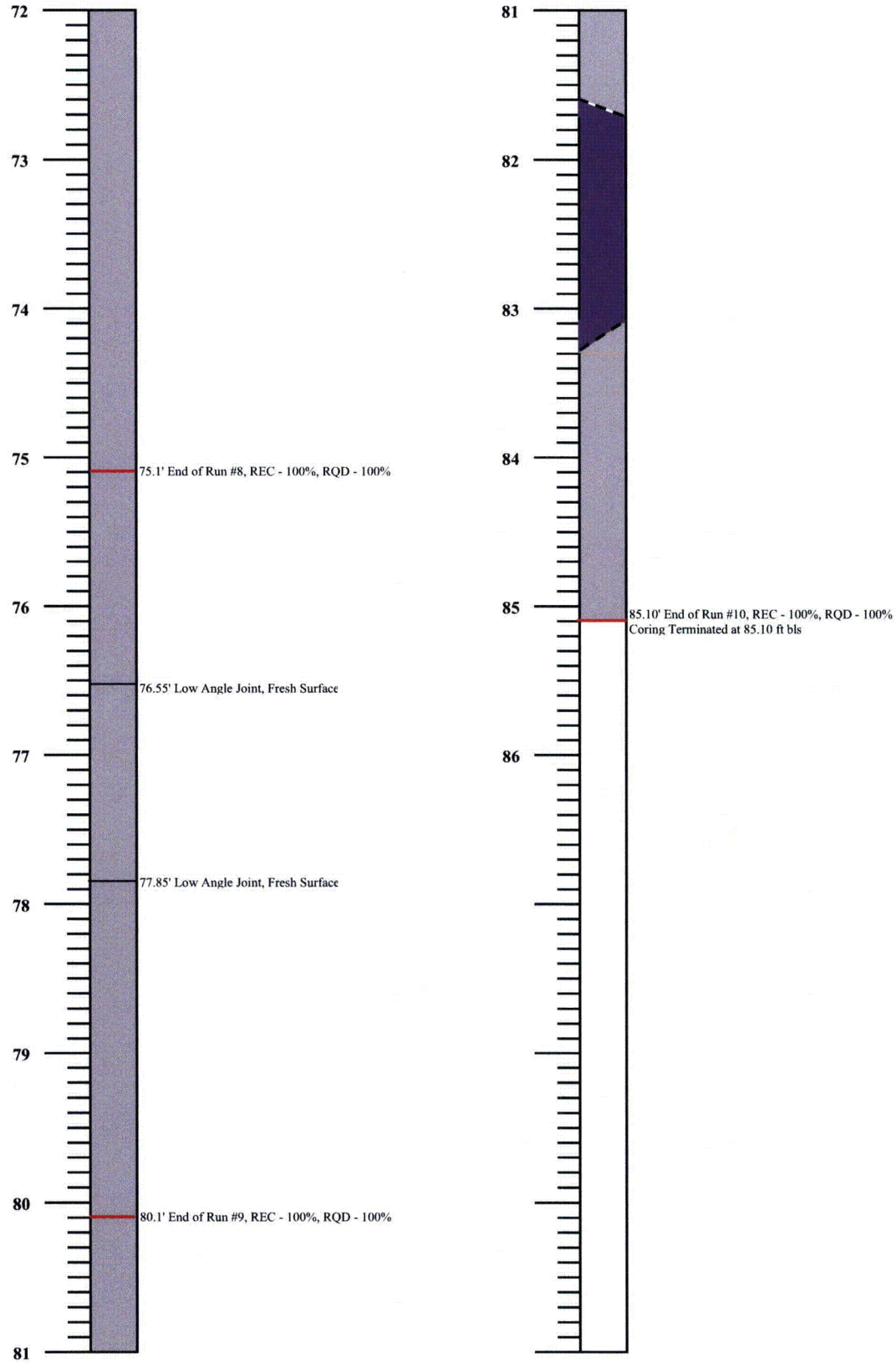


FIELD ROCK CORE LOG

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-59



EXPLANATION

- Meta Gabbro
- Quartz Diorite
- Diorite
- Granite
- Core Loss
- Intense Fracturing
- Fractures
- End of Run
- Contact
- Healed Joint

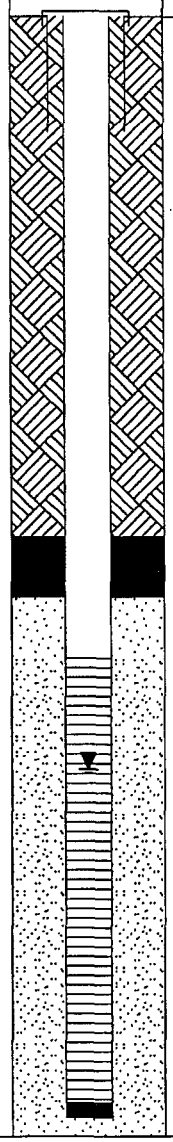
COMPLETION REPORT OF WELL No. M-59

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

WATER LEVEL: **Stabilized Water Level at 24.62 ft bls**
LATITUDE: **35 25 58.83**
LONGITUDE: **80 56 50.81**
TOP OF CASING ELEVATION: **759.68**
DATUM: **MSL**
LOGGED BY: **Julie Petersen**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **Mud Rotary**
DATE DRILLED: **6/1/07**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00		760.03
GRAVEL		0				
FILL (F): Red, Silty, **CLAY** With Medium to Fine Sand		5, 10, 15, 20				
				17.00		743.03
				19.00		741.03
SOIL/SAPROLITE (M1): Black and White, Silty, Medium to Fine **SAND** With Mica (Dioritic)		25				
SOIL/SAPROLITE (M1): Brown to White, Silty, Coarse to Fine **SAND**		30				
WEATHERED ROCK (M2): Grayish-Green, Silty, Fine **SAND**		35		35.50		724.53
				36.00		724.03



WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter: **8"**
Type: **Steel Flush Mount**
Interval: **At Grade**

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 21 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 17 ft bls**

SEAL
Type: **Bentonite**
Interval: **17 to 19 ft bls**

FILTERPACK
Type: **#1 Filter Sand**
Interval: **19 to 37 ft bls**

SCREEN
Diameter: **2"**
Type: **0.010 Slotted Sch. 40 PVC**
Interval: **21 to 36 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

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COMPLETION REPORT OF WELL No. M-59

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

GROUND SURFACE ELEVATION: **760.0**
LOGGED BY: **Julie Petersen**
CHECKED BY:

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
							(See Page 1)
PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **QUARTZ DIORITE** With Intermittent **GRANITE**, Intensely Fractured; Heavily Weathered Void from 37.45 to 37.95 ft bls *(continued)*				37.00		723.03	
SOUND ROCK (D): Medium-Grained **QUARTZ DIORITE**, Unfractured		40, 45, 50					
SOUND ROCK (D): Medium-Grained **GRANITE**, Unfractured							
SOUND ROCK (D): Medium-Grained **QUARTZ DIORITE**, Unfractured		55					
SOUND ROCK (D): Medium-Grained **GRANITE**, Unfractured		60					
SOUND ROCK (D): Medium-Grained **META DIORITE** With Intermittent **QUARTZ DIORITE** Inclusions, Unfractured		65					
SOUND ROCK (D): Medium-Grained **META QUARTZ DIORITE**, Unfractured							
SOUND ROCK (D): Medium-Grained **META DIORITE**, Unfractured		70					
SOUND ROCK (D): Medium-Grained **META QUARTZ DIORITE**, Unfractured		75					
SOUND ROCK (D): Medium-Grained **QUARTZ DIORITE**, Slightly Fractured		80					

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL MNSLOG.GPJ S&ME.GDT 3/26/08

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COMPLETION REPORT OF WELL No. M-59

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

GROUND SURFACE ELEVATION: **760.0**
LOGGED BY: **Julie Petersen**
CHECKED BY:

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
							(See Page 1)
SOUND ROCK (D): Medium-Grained **DIORITE**, Unfractured *(continued)*		85		85.10		674.93	
SOUND ROCK (D): Medium-Grained **QUARTZ DIORITE**, Unfractured							

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL MNSLOG.GPJ S&ME.GDT 3/26/08

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COMPLETION REPORT OF WELL No. M-59

SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Boring Number: M-59

Sample No: 1
Depth (ft-bls): 4.3 - 5.8
Blow Count: 3 * 5 * 5

Sample No: 2
Depth (ft-bls): 9.3 - 10.8
Blow Count: 3 * 2 * 3

Sample No: 3
Depth (ft-bls): 14.3 - 15.8
Blow Count: 3 * 4 * 6

No Recovery

Sample No: 4
Depth (ft-bls): 19.3 - 20.8
Blow Count: 5 * 6 * 9

No Recovery

Sample No: 5
Depth (ft-bls): 24.3 - 25.8
Blow Count: 6 * 9 * 10

Sample No: 6
Depth (ft-bls): 29.3 - 30.8
Blow Count: 5 * 12 * 17

SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Boring Number: M-59

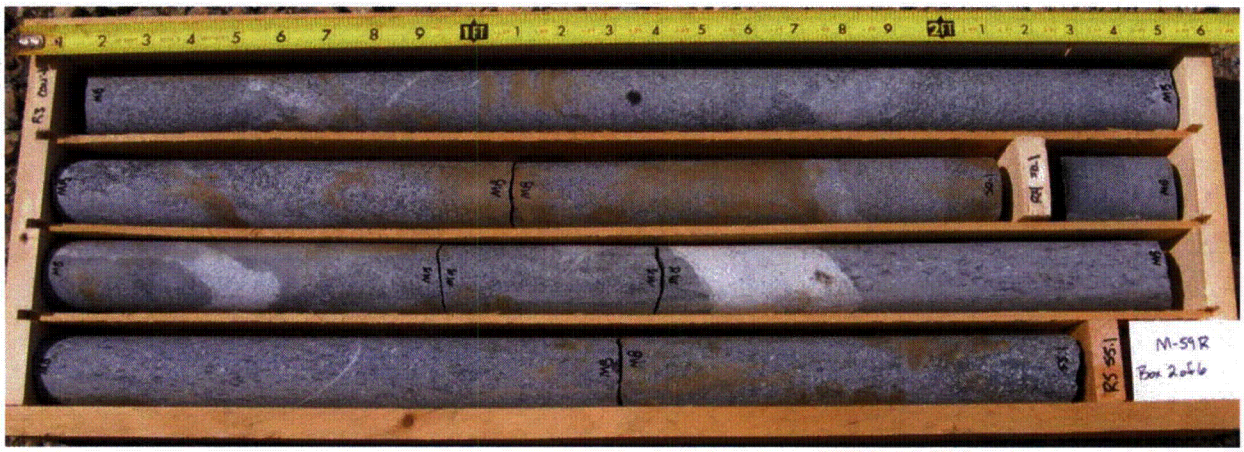
Sample No: 7
Depth (ft-bls): 34.3 - 35.8
Blow Count: 50/3

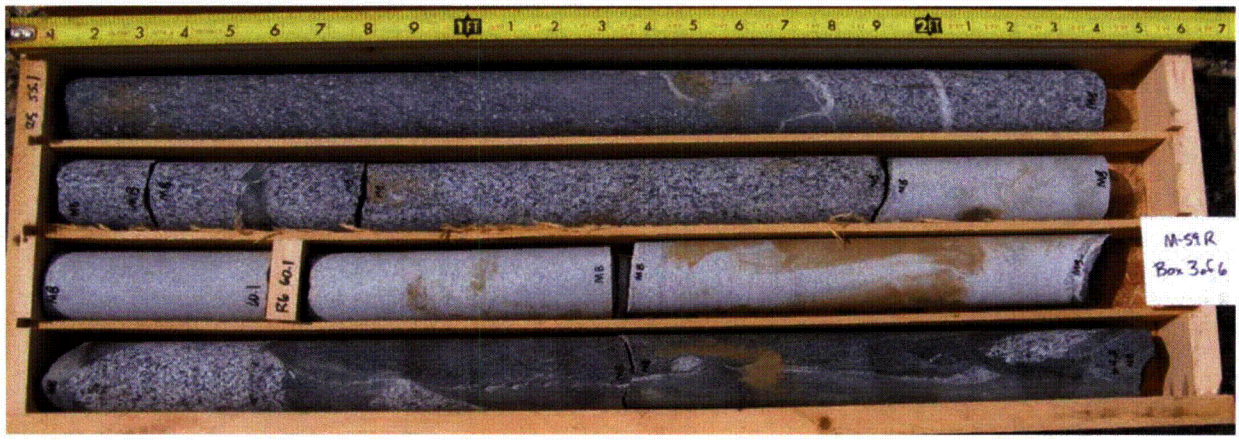
ROCK CORE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-59



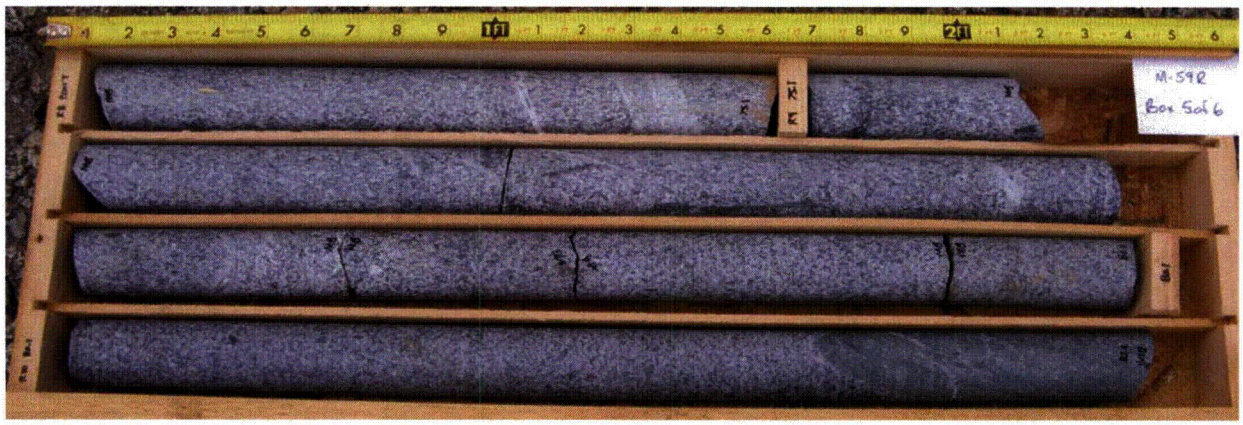


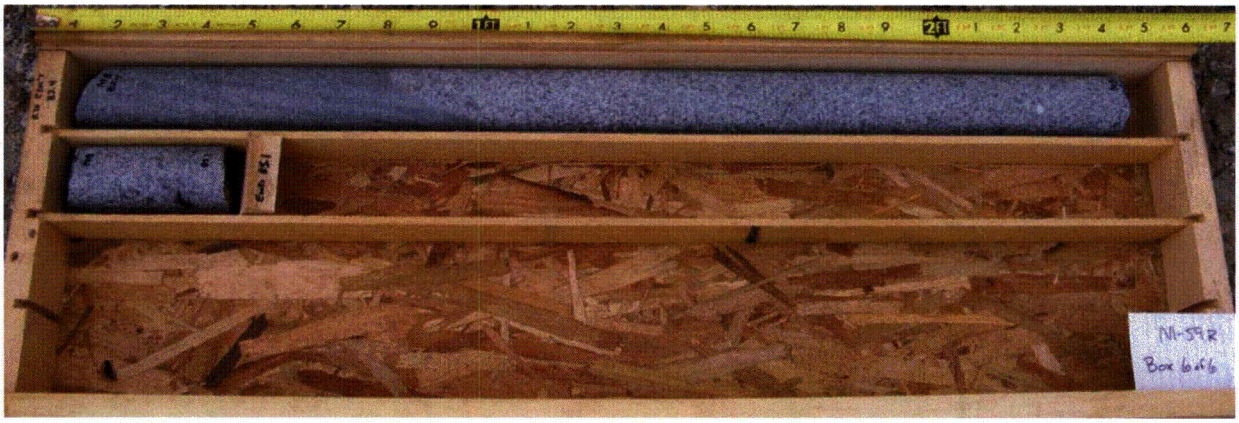
ROCK CORE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-59





CLASSIFICATION:

36.40' to 51.70' Coarse-Grained Quartz Diorite

51.70' to 52.10' Medium-Grained Granite

52.10' to 59.10' Coarse-Grained Quartz Diorite

59.10' to 61.80' Medium-Grained Granite

61.80' to 65.60' Fine-Grained Meta Diorite With Coarse-Grained Quartz Diorite Inclustions

65.60' to 67.90' Coarse-Grained Meta Quartz Diorite

67.90' to 68.80' Fine-Grained Meta Diorite

68.80' to 81.70' Coarse-Grained Meta Quartz Diorite

81.70' - 83.30' Fine-Grained Diorite

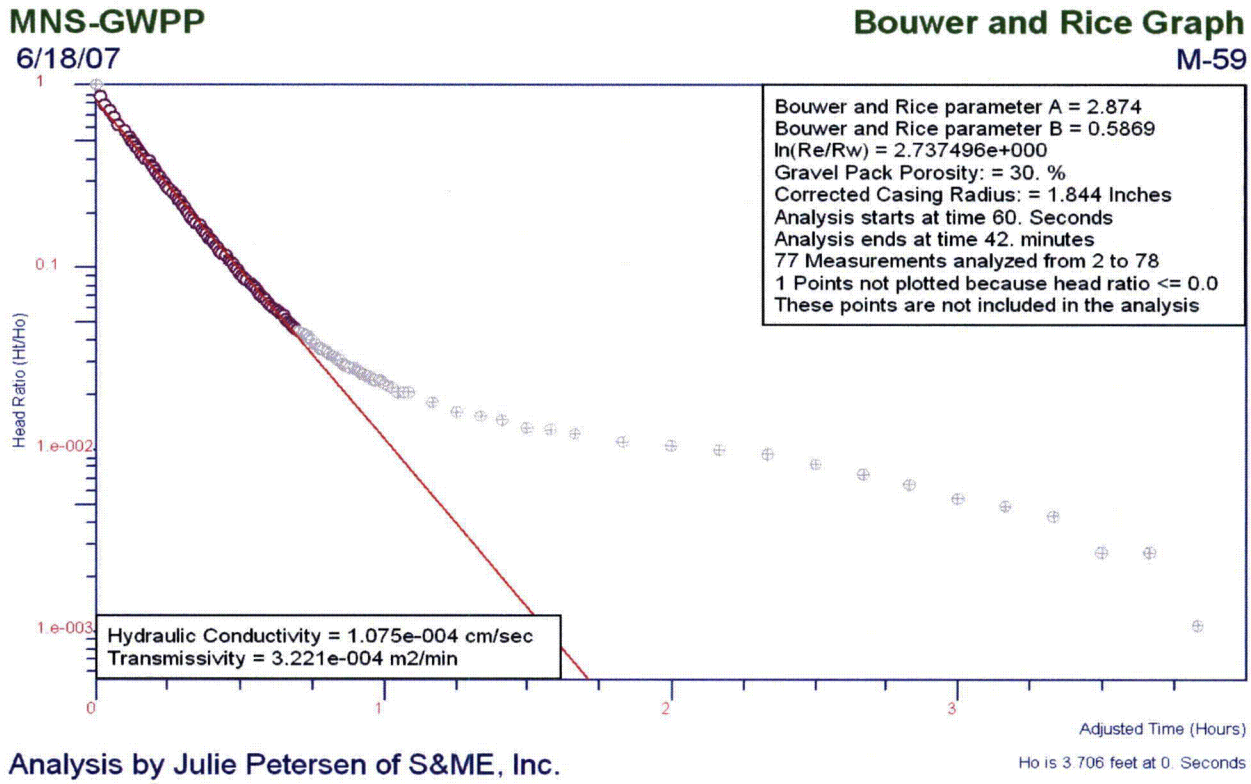
83.30' - 85.10' Coarse-Grained Quartz Diorite

Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	MNS-GWPP
Test Date:	6/18/2007
Well Label:	M-59
Aquifer Thickness:	16.38 feet
Screen Length:	15. feet
Casing Radius:	1. Inches
Effective Radius:	3. Inches
Gravel Pack Porosity:	30.00%
Corrected Casing Radius:	3.391 Inches
Static Water Level:	24.62 feet
Water Table to Screen Bottom:	11.38 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 140 time and drawdown measurements
Maximum head is 3.706 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



Analysis by Julie Petersen of S&ME, Inc.

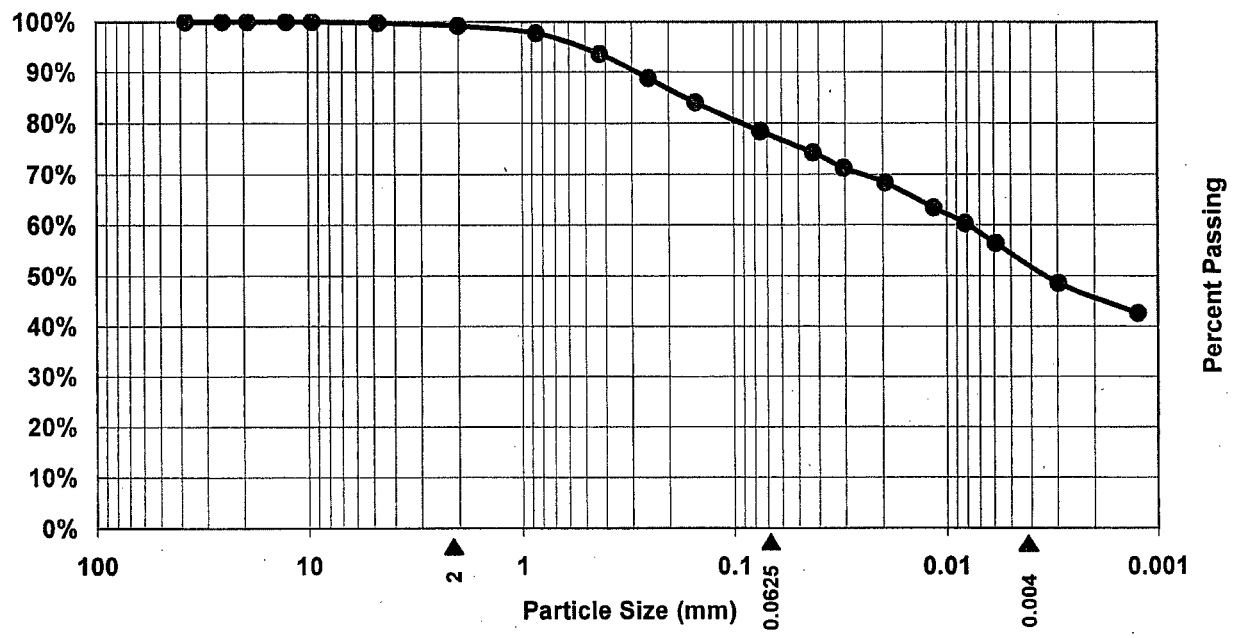
PERMEABILITY

1.08E-04 cm/sec

PARTICLE SIZE ANALYSIS OF SOILS
FOR USE IN FETTER AND BEAR DIAGRAMS

Boring No.:	Sample No.:	Depth:
M-59	SS-2	9.3 to 10.8 ft bls

Sample Description:
Red, Silty, Clay With Fine to Medium Sand



	> 2 mm	2 mm - 0.0625 mm	0.0625 mm - 0.004 mm	<0.004 mm
From Graph:	% Gravel 0.8%	% Sand 22.1%	% Silt 25.8%	% Clay 51.4%
Adjusted for Calculations	**0%**	**22%**	**26%**	**52%**

Notes:
Grain size distribution taken from grain size with hydrometer data located in Appendix II.
Gravel, sand, silt and clay sizes based on Wentworth Scale.

S&ME Project:
McGuire Nuclear Station - GWPP

S&ME Project No.:
1264-06-724

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FETTER AND BEAR DIAGRAMS

S&ME PROJECT: McGuire Nuclear Station - GWPP
S&ME PROJECT NO.: 1264-06-724

Boring No. M-59

Boring Depth: 9.3 to 10.8 ft bls

% Sand: 22%

% Silt: 26%

% Clay: 52%

Estimated Specific Yield: 0.9%*

* Estimated Value

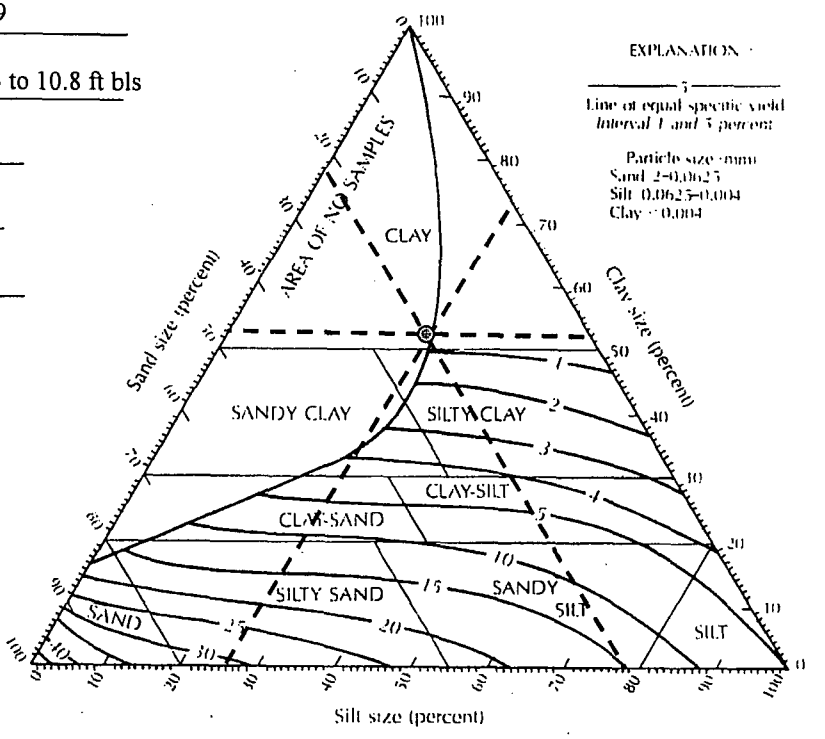
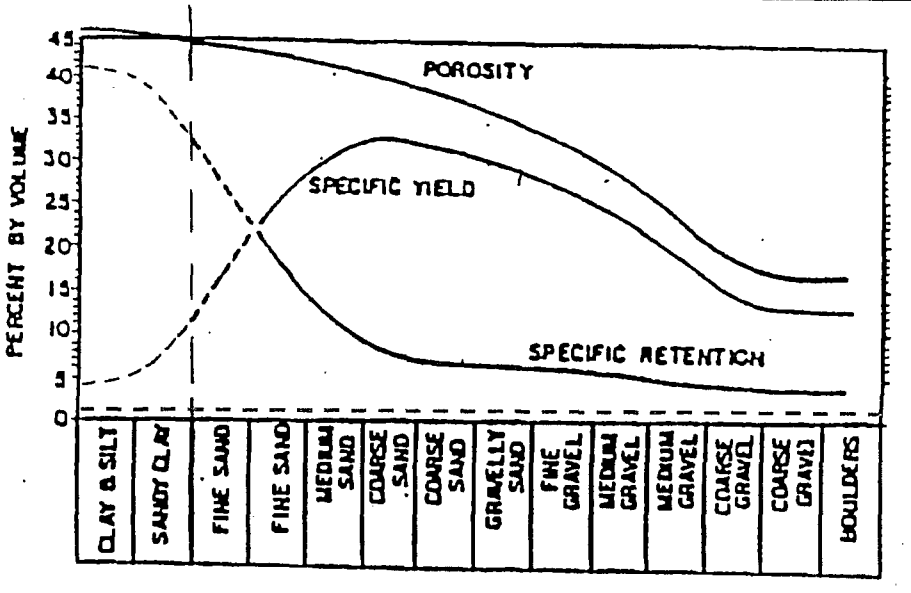


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.



Estimated Porosity: 49%**

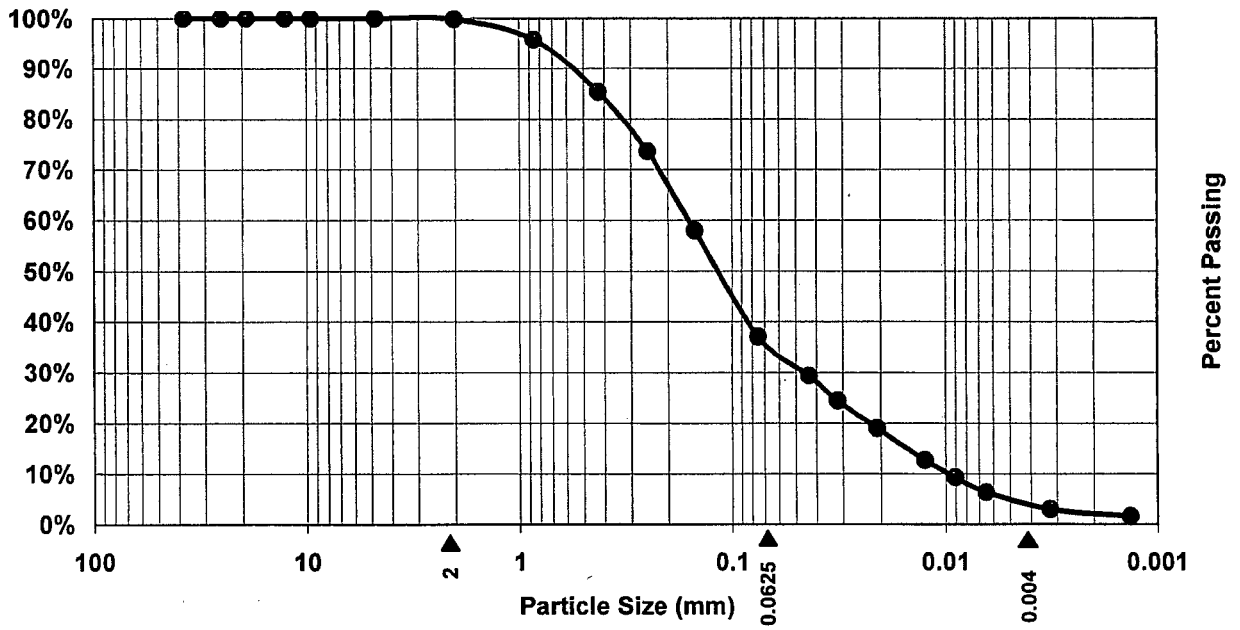
**Based on Table of Selected Values of Porosity, Specific Yield and Specific Retention, USGS Water Supply Paper 2220.

Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

PARTICLE SIZE ANALYSIS OF SOILS
FOR USE IN FETTER AND BEAR DIAGRAMS

Boring No.:	Sample No.:	Depth:
M-59	SS-5	24.3 to 25.8 ft bls

Sample Description:
Black and White, Silty, Fine to Medium Sand With Mica



	> 2 mm	2 mm - 0.0625 mm	0.0625 mm - 0.004 mm	<0.004 mm
From Graph:	% Gravel 0.1%	% Sand 65.3%	% Silt 30.9%	% Clay 3.7%
Adjusted for Calculations	**0%**	**65%**	**31%**	**4%**

Notes:
Grain size distribution taken from grain size with hydrometer data located in Appendix II.
Gravel, sand, silt and clay sizes based on Wentworth Scale.

S&ME Project:
McGuire Nuclear Station - GWPP

S&ME Project No.:
1264-06-724

S&ME

FETTER AND BEAR DIAGRAMS

S&ME PROJECT: McGuire Nuclear Station - GWPP
S&ME PROJECT NO.: 1264-06-724

Boring No. M-59

Boring Depth: 24.3 to 25.8 ft bls

% Sand: 65%

% Silt: 31%

% Clay: 4%

Estimated Specific Yield: 25%

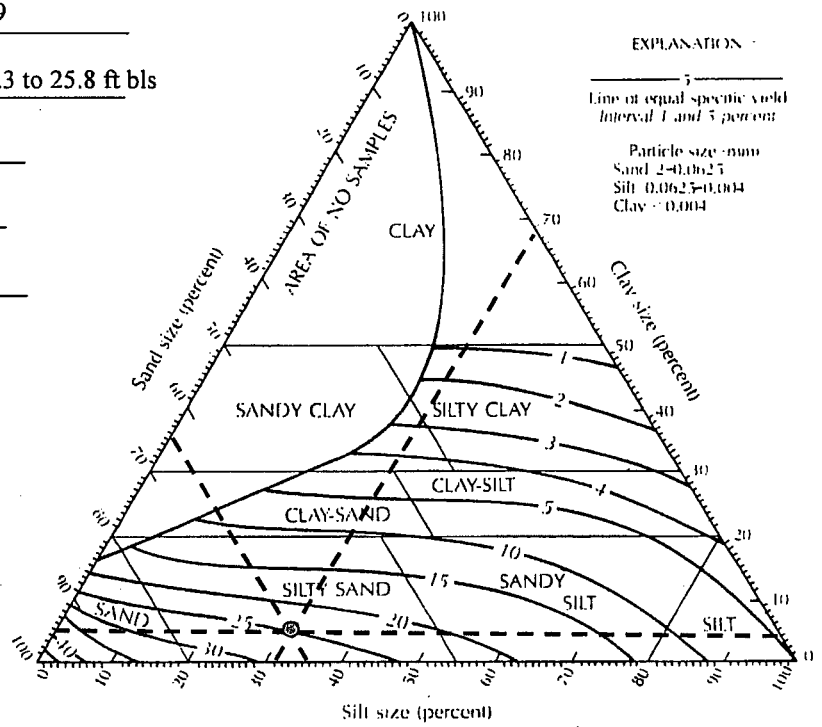
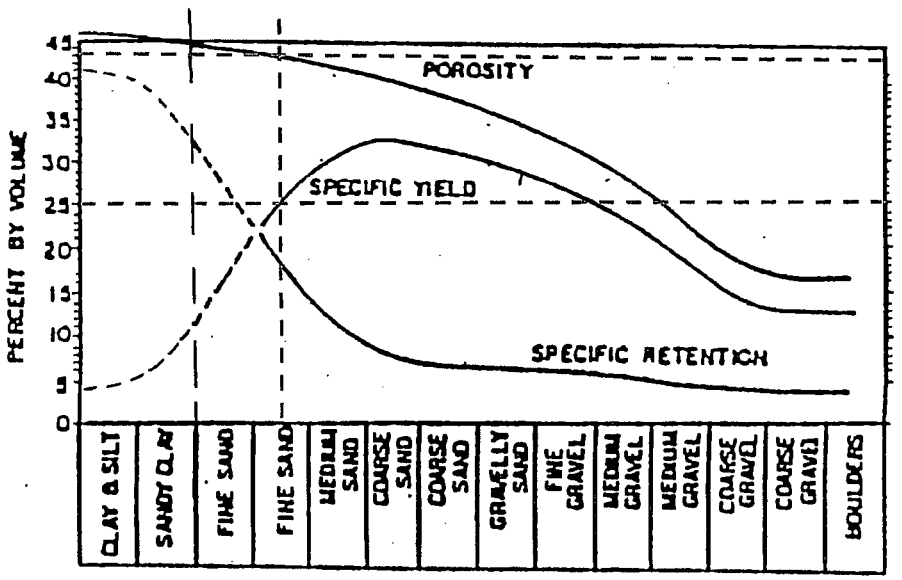


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.



Estimated Porosity: 43%

Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

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Charlotte, North Carolina
Telephone: 704-523-4726
Fax: 704-525-3953

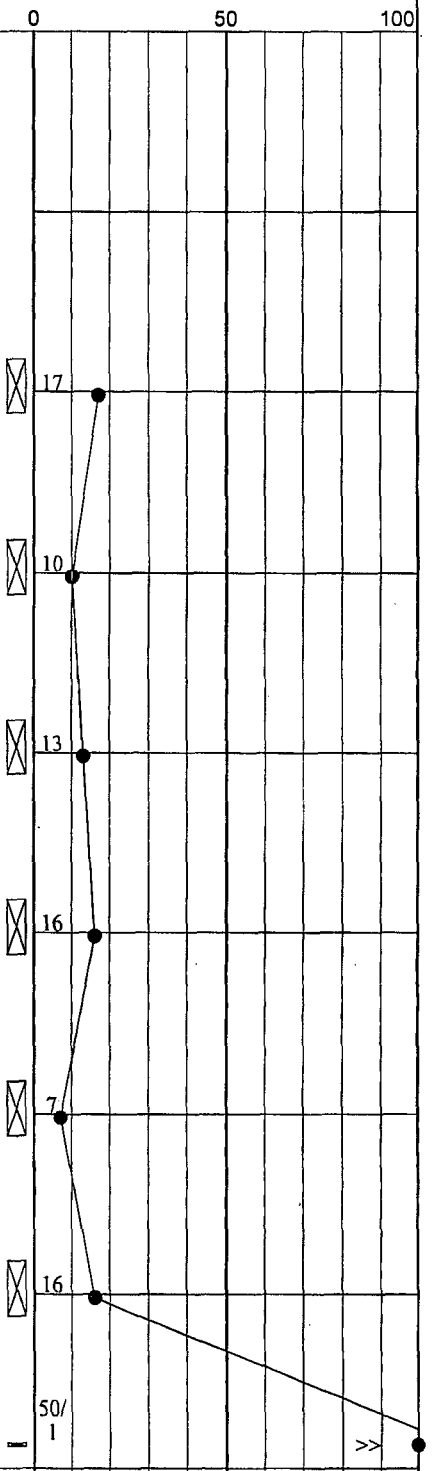
1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

Project: **MNS - Groundwater Protection Project**			**Boring No. M-60**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 1 of 1
Boring Depth (ft): **39.8**	Elevation (ft): **779.5**	Driller: **Justin Millwood, NC Cert. No. 3439**	Date Drilled: **11/27/07**
Logged By: **Courtney Withers**	Water Level: **Stabilized Water Level at 31.43 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lithology	Material Description
			GRASS and TOPSOIL
			SOIL/SAPROLITE (M1): Reddish-Brown, Micaceous, Clayey, **SILT**
775	5		
			SOIL/SAPROLITE (M1): Tan, Silty, Fine **SAND**
770	10		
			SOIL/SAPROLITE (M1): Tan and Orange-Brown, Micaceous, Fine Sandy, **SILT** With Manganese Staining and Rock Fragments
765	15		
760	20		
755	25		
750	30		
			SOIL/SAPROLITE (M1): White and Tan, Clayey, Silty, Coarse to Fine **SAND**
745	35		
740			WEATHERED ROCK (M2): When Sampled Becomes, White and Tan, Clayey, Silty, Coarse to Fine **SAND** With Rock Fragments
			Auger Refusal at 39.80 ft bls

Well Construction

Penetration Resistance (Blows/Foot)



COMPLETION REPORT OF WELL No. M-60

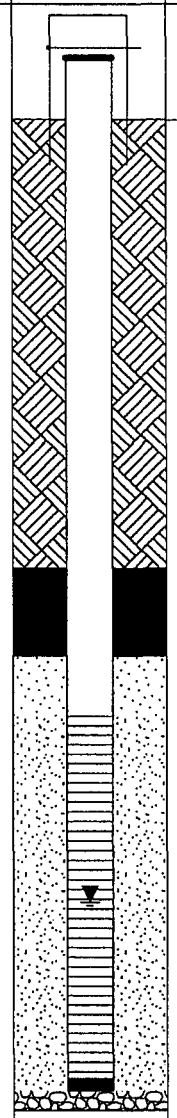
PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

WATER LEVEL: **Stabilized Water Level at 31.43 ft bls**

LATITUDE: **35 26 03.01**
LONGITUDE: **80 56 38.95**
TOP OF CASING ELEVATION: **781.90**
DATUM: **MSL**
LOGGED BY: **Courtney Withers**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **4¼" H.S.A.**
DATE DRILLED: **11/27/07**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00		779.50
GRASS and **TOPSOIL**		0				
SOIL/SAPROLITE (M1): Reddish-Brown, Micaceous, Clayey, **SILT**		5				
SOIL/SAPROLITE (M1): Tan, Silty, Fine **SAND**						
SOIL/SAPROLITE (M1): Tan and Orange-Brown, Micaceous, Fine Sandy, **SILT** With Manganese Staining and Rock Fragments		10				
		15		18.00		761.50
		20		21.60		757.90
		25				
		30				
SOIL/SAPROLITE (M1): White and Tan, Clayey, Silty, Coarse to Fine **SAND**		35				
				39.00		740.50
WEATHERED ROCK (M2): When Sampled Becomes, White and Tan, Clayey, Silty, Coarse to Fine **SAND** With Rock Fragments				39.80		739.70



WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter: **4" X 4"**
Type: **Lockable Steel**
Interval: **Above Grade**

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **-2.40 to 24 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 18 ft bls**

SEAL
Type: **Bentonite**
Interval: **18 to 21.6 ft bls**

FILTERPACK
Type: **#1 Filter Sand**
Interval: **21.6 to 39 ft bls**

SCREEN
Diameter: **2"**
Type: **0.010 Slotted Sch. 40 PVC**
Interval: **24 to 39 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL MNSLOG.GPJ S&ME.GDT 6/30/08

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COMPLETION REPORT OF WELL No. M-60

SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Boring Number: M-60

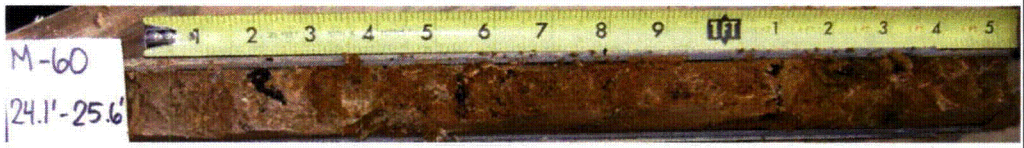
Sample No: 1
Depth (ft-bls): 9.1 - 10.6
Blow Count: 5 * 7 * 10

No Photo

Sample No: 2
Depth (ft-bls): 14.1 - 15.6
Blow Count: 3 * 4 * 6

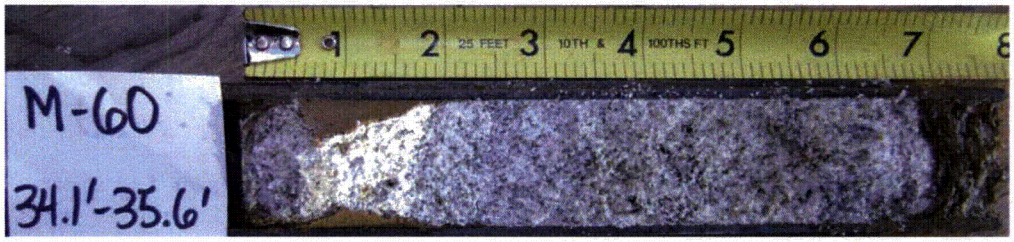
Sample No: 3
Depth (ft-bls): 19.1 - 20.6
Blow Count: 4 * 5 * 8

Sample No: 4
Depth (ft-bls): 24.1 - 25.6
Blow Count: 4 * 7 * 9



Sample No: 5
Depth (ft-bls): 29.1 - 30.6
Blow Count: 2 * 3 * 4

Sample No: 6
Depth (ft-bls): 34.1 - 35.6
Blow Count: 19 * 7 * 9



SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Boring Number: M-60

Sample No: 7
Depth (ft-bls): 39.1 - 40.6 **No Recovery**
Blow Count: 50/1

CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD
(Open Hole in Uniform Material)

S&ME

Site Name:	MNS - GWPP	
Date:	11/27/2007	
Boring I.D.	M-60	
Test Interval:	31' to 34'	(Soil/Saprolite)
Total Depth of Hole:	34 ft bls	1036.58 cm
Length of Open Hole:	3 ft	91.46 cm
Transformation Ratio m=	1	
Performed by:	Courtney Withers	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	975.52	
60	946.95	1.25E-04
120	921.34	1.15E-04
180	898.32	1.06E-04
240	877.56	9.83E-05
300	857.44	9.75E-05
360	839.02	9.13E-05
420	823.57	7.82E-05
480	809.91	7.03E-05
540	796.98	6.76E-05
600	785.61	6.04E-05
900	739.70	5.06E-05

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

K_h	is the Horizontal Coefficient of Permeability (cm/sec)
H_1	is the Piezometric Head for time; $t = t_1$ (cm)
H_2	is the Piezometric Head for time; $t = t_2$ (cm)
D	is the Diameter of the Standpipe (cm)
d	is the diameter of the Open Length (cm),
m	is the Transformation Ratio, Where

$$m = \sqrt{K_h / K_v}$$

K_h is the Horizontal Permeability
K_v is the Vertical Permeability

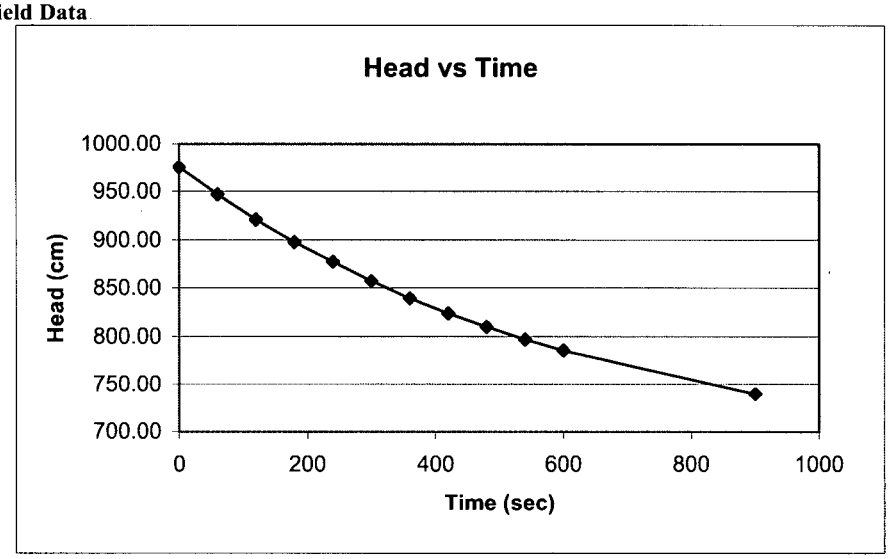
L	is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

8.73E-05

Graph of Field Data

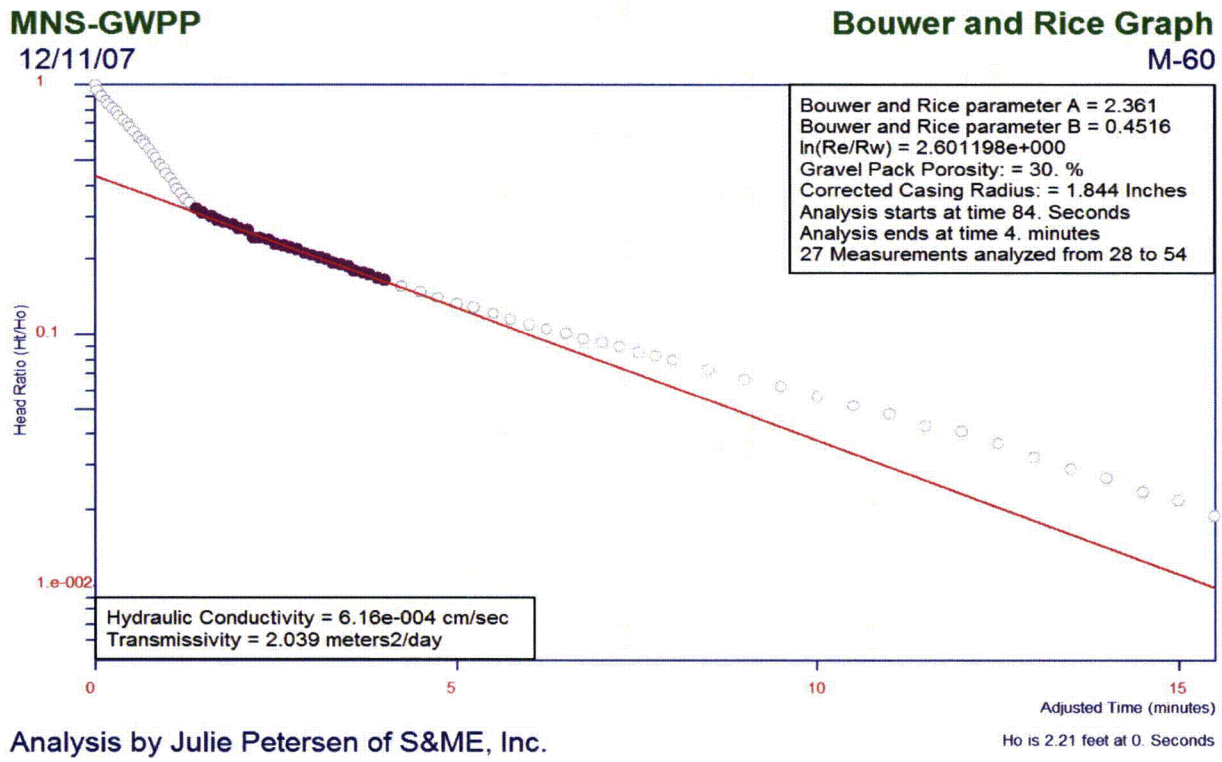


Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	MNS-GWPP
Test Date:	12/11/2007
Well Label:	M-60
Aquifer Thickness:	12.57 feet
Screen Length:	15. feet
Casing Radius:	1. Inches
Effective Radius:	3. Inches
Gravel Pack Porosity:	30.00%
Corrected Casing Radius:	1.844 Inches
Static Water Level:	31.43 feet
Water Table to Screen Bottom:	7.57 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 85 time and drawdown measurements
Maximum head is 2.21 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



Analysis by Julie Petersen of S&ME, Inc.

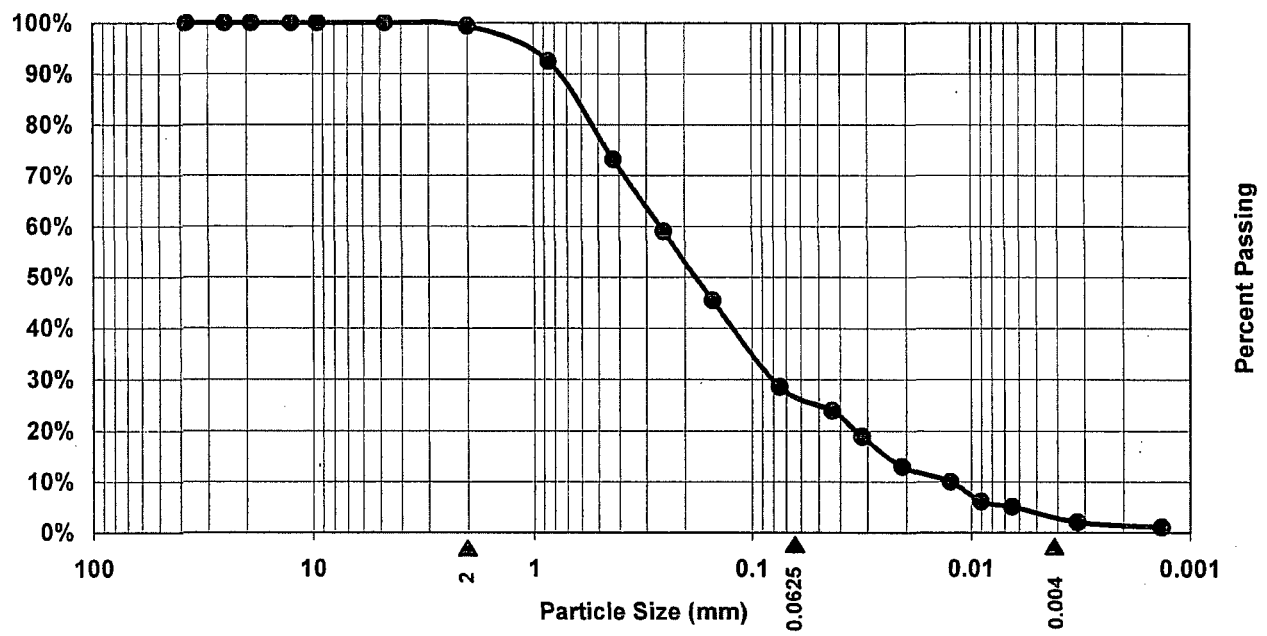
PERMEABILITY

6.16×10^{-04} cm/sec

PARTICLE SIZE ANALYSIS OF SOILS
FOR USE IN FETTER AND BEAR DIAGRAMS

Boring No.:	Sample No.:	Depth:
M-60	SS-6	34.1 to 35.6 ft bls

Sample Description:
White and Tan, Clayey, Silty, Coarse to Fine Sand



	> 2 mm	2 mm - 0.0625 mm	0.0625 mm - 0.004 mm	<0.004 mm
From Graph:	% Gravel 0.6%	% Sand 72.4%	% Silt 24.3%	% Clay 2.7%
Adjusted for Calculations	**0%**	**73%**	**24%**	**3%**

Notes:
Grain size distribution taken from grain size with hydrometer data located in Appendix II.
Gravel, sand, silt and clay sizes based on Wentworth Scale.

S&ME Project:
McGuire Nuclear Station - GWPP

S&ME Project No.:
1264-06-724

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FETTER AND BEAR DIAGRAMS

S&ME PROJECT: McGuire Nuclear Station - GWPP
S&ME PROJECT NO.: 1264-06-724

Boring No. M-60

Boring Depth: 34.1 to 35.6 ft bls

% Sand: 73%

% Silt: 24%

% Clay: 3%

Estimated Specific Yield: 27%

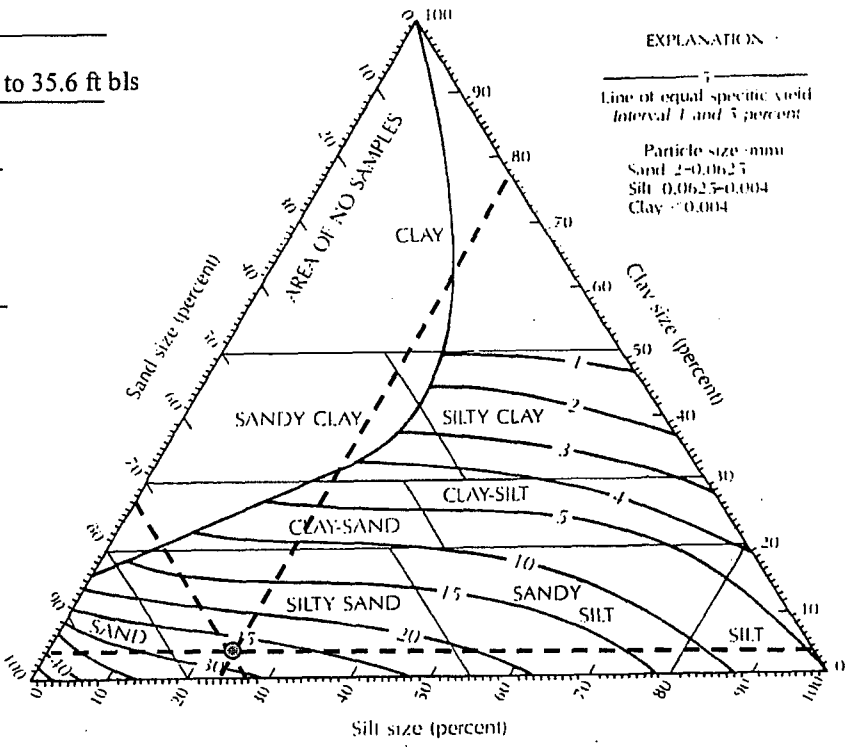
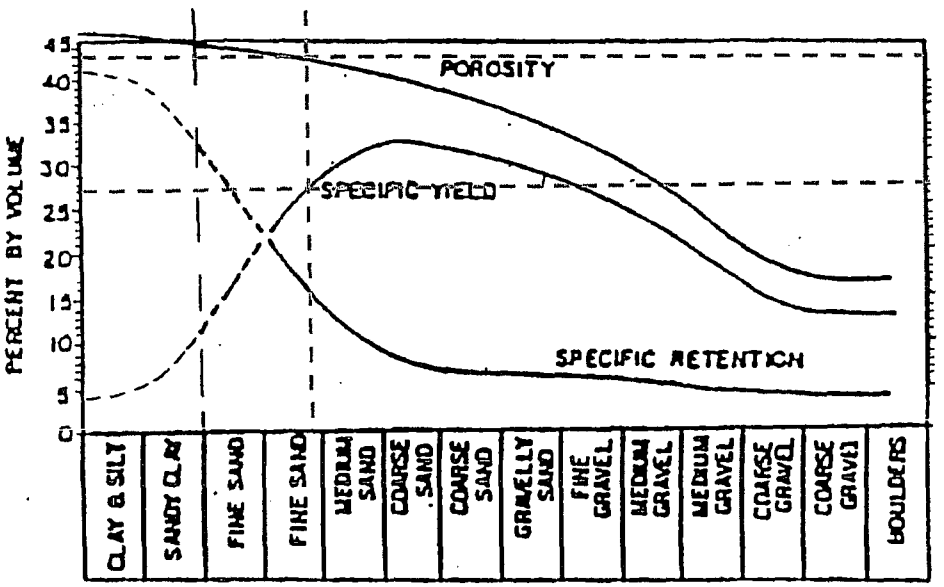


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.



Estimated Porosity: 43%

Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

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Charlotte, North Carolina
Telephone: 704-523-4726
Fax: 704-525-3953

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.

Project: **MNS - Groundwater Protection Project**			**Boring No. M-62**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. **1** of **2**
Boring Depth (ft): **50.8**	Elevation (ft): **760.4**	Driller: **Jay Little, NC Cert No. 2717**	Date Drilled: **5/24/07**
Logged By: **Julie Petersen**	Water Level: **Stabilized Water Level at 25.51 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
760			**GRAVEL**: Road Bed		
			CONCRETE		
			FILL (F): Grayish-Tan, Micaceous, Silty, Fine**SAND** with Red **CLAY** Layers (Striated)		
755	5				11
750	10				12
			FILL (F): Brown, Micaceous, Medium to Fine Sandy, Clayey, **SILT** with Grayish-Tan, Micaceous, Silty, Fine **SAND** Layers (Striated)		
745	15				16
			SOIL/SAPROLITE (M1): Red, Micaceous, Fine Sandy, Silty, **CLAY** with Manganese Staining		
740	20				11
			SOIL/SAPROLITE (M1): Orange, Micaceous, Slightly Sandy, **SILT** with Manganese Banding		
735	25			▼	11
			SOIL/SAPROLITE (M1): Gray and White, Micaceous, Silty, Fine **SAND**		
730	30				13
725	35				19

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Project: **MNS - Groundwater Protection Project**			**Boring No. M-62**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 2 of 2
Boring Depth (ft): **50.8**	Elevation (ft): **760.4**	Driller: **Jay Little, NC Cert No. 2717**	Date Drilled: **5/24/07**
Logged By: **Julie Petersen**	Water Level: **Stabilized Water Level at 25.51 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
720	40				50
715	45		WEATHERED ROCK (M2): When Sampled Becomes Gray and White, Micaceous, Silty, Fine **SAND**		50/5 >>
710	50				50/4 >>
			Boring Terminated at 50.80 ft bls		

BORING LOG WITH WELL MNSLOG.GPJ LAGWGN01.GDT 3/26/08

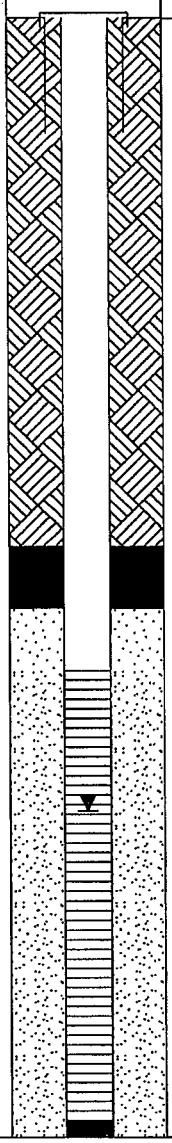
COMPLETION REPORT OF WELL No. M-62

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

WATER LEVEL: **Stabilized Water Level at 25.51 ft bls**
LATITUDE: **35 25 59.09**
LONGITUDE: **80 57 02.67**
TOP OF CASING ELEVATION: **760.09**
DATUM: **MSL**
LOGGED BY: **Julie Petersen**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **Mud Rotary**
DATE DRILLED: **5/24/07**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00		760.37
GRAVEL: Road Bed		0				
CONCRETE						
FILL (F): Grayish-Tan, Micaceous, Silty, Fine **SAND** with Red **CLAY** Layers (Striated)		5, 10				
FILL (F): Brown, Micaceous, Medium to Fine Sandy, Clayey, **SILT** with Grayish-Tan, Micaceous, Silty, Fine **SAND** Layers (Striated)		15		17.00		743.37
SOIL/SAPROLITE (M1): Red, Micaceous, Fine Sandy, Silty, **CLAY** with Manganese Staining		20		19.00		741.37
SOIL/SAPROLITE (M1): Orange, Micaceous, Slightly Sandy, **SILT** with Manganese Banding		25				
SOIL/SAPROLITE (M1): Gray and White, Micaceous, Silty, Fine **SAND**		30, 35		35.50		724.87



WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter: **8"**
Type: **Steel Flush Mount**
Interval: **At Grade**

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 21 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 17 ft bls**

SEAL
Type: **Bentonite**
Interval: **17 to 19 ft bls**

FILTERPACK
Type: **#1 Filter Sand**
Interval: **19 to 36 ft bls**

SCREEN
Diameter: **2"**
Type: **0.010 Slotted Sch. 40 PVC**
Interval: **21 to 36 ft bls**

LEGEND

FILTER PACK
BENTONITE
CEMENT GROUT
CUTTINGS / BACKFILL
STATIC WATER LEVEL

TOC TOP OF CASING
GS GROUND SURFACE
BS BENTONITE SEAL
FP FILTER PACK
TSC TOP OF SCREEN
BSC BOTTOM OF SCREEN
TD TOTAL DEPTH
CG CEMENT GROUT

MONITORING WELL MNSLOG.GPJ S&ME.GDT 3/26/08

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COMPLETION REPORT OF WELL No. M-62

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

GROUND SURFACE ELEVATION: **760.4**
LOGGED BY: **Julie Petersen**
CHECKED BY:

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
							(See Page 1)
SOIL/SAPROLITE (M1): Gray and White, Micaceous, Silty, Fine **SAND** *(continued)*		40		36.00		724.37	
WEATHERED ROCK (M2): When Sampled Becomes Gray and White, Micaceous, Silty, Fine **SAND**		45 50		50.80		709.57	

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL MNSLOG.GPJ S&ME.GDT 3/26/08

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COMPLETION REPORT OF WELL No. M-62

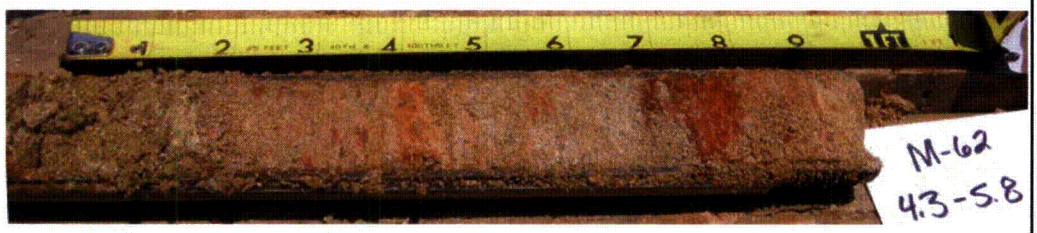
SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

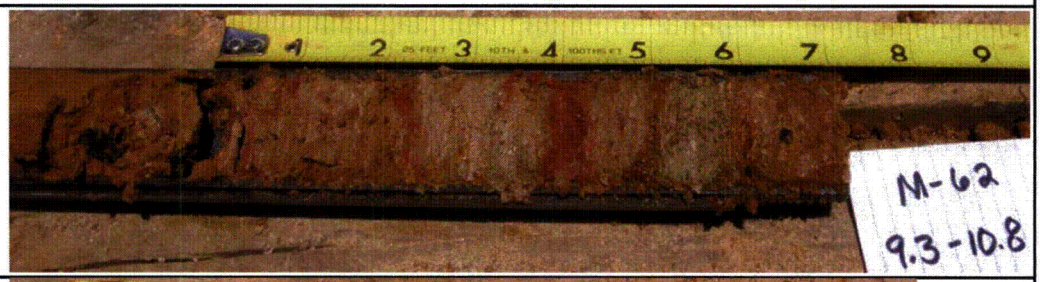
S&ME Project No: 1264-06-724

Boring Number: M-62

Sample No: 1
Depth (ft-bls): 4.3 - 5.8
Blow Count: 3 * 4 * 7



Sample No: 2
Depth (ft-bls): 9.3 - 10.8
Blow Count: 4 * 6 * 6



Sample No: 3
Depth (ft-bls): 14.3 - 15.8
Blow Count: 6 * 7 * 9

Sample No: 4
Depth (ft-bls): 19.3 - 20.8
Blow Count: 4 * 5 * 6

Sample No: 5
Depth (ft-bls): 24.3 - 25.8
Blow Count: 3 * 5 * 6

Sample No: 6
Depth (ft-bls): 29.3 - 30.8
Blow Count: 4 * 6 * 7

No Recovery

SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Boring Number: M-62

Sample No: 7
Depth (ft-bls): 34.3 - 35.8
Blow Count: 5 * 8 * 11

Sample No: 8
Depth (ft-bls): 39.3 - 40.8
Blow Count: 14 * 20 * 30

Sample No: 9
Depth (ft-bls): 44.3 - 45.8
Blow Count: 50/5

Sample No: 10
Depth (ft-bls): 49.3 - 50.8
Blow Count: 50/4

No Recovery

CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD
(Open Hole in Uniform Material)

S&ME

Site Name:	MNS - GWPP		
Date:	5/24/2007		
Boring I.D.	M-62	(Soil/Saprolite)	
Test Interval:	24.5' to 28.7'		
Total Depth of Hole:	28.7 ft		875 cm
Length of Open Hole:	4.20 ft		128.05 cm
Transformation Ratio m=	1		
Performed by:	Julie Petersen		

Time (sec)	Head (cm)	Permeability (cm/sec)
0	895.03	
60	877.10	6.72E-05
120	860.34	6.41E-05
180	844.76	6.07E-05
240	830.00	5.85E-05
300	815.82	5.72E-05
360	802.23	5.58E-05
420	789.09	5.48E-05
480	776.31	5.42E-05
540	763.96	5.32E-05
600	751.92	5.28E-05
900	696.25	5.11E-05
1200	646.74	4.90E-05
1500	601.59	4.81E-05
1800	560.55	4.69E-05
2400	487.80	4.62E-05
3000	425.40	4.55E-05
3600	371.59	4.49E-05

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

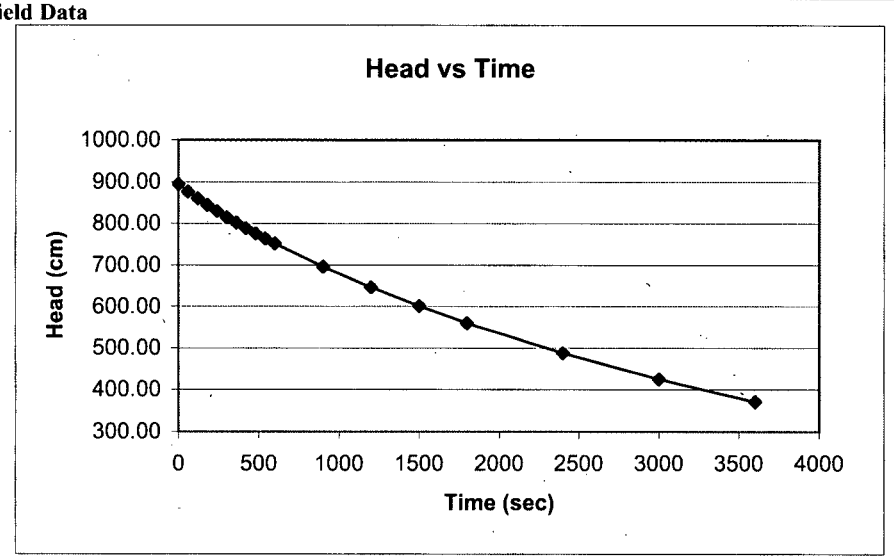
K_h	is the Horizontal Coefficient of Permeability (cm/sec)
H_1	is the Piezometric Head for time; $t = t_1$ (cm)
H_2	is the Piezometric Head for time; $t = t_2$ (cm)
D	is the Diameter of the Standpipe (cm)
d	is the diameter of the Open Length (cm),
m	is the Transformation Ratio, Where
	$m = \sqrt{K_h / K_v}$ — K_h is the Horizontal Permeability; K_v is the Vertical Permeability
L	is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

5.35E-05

Graph of Field Data

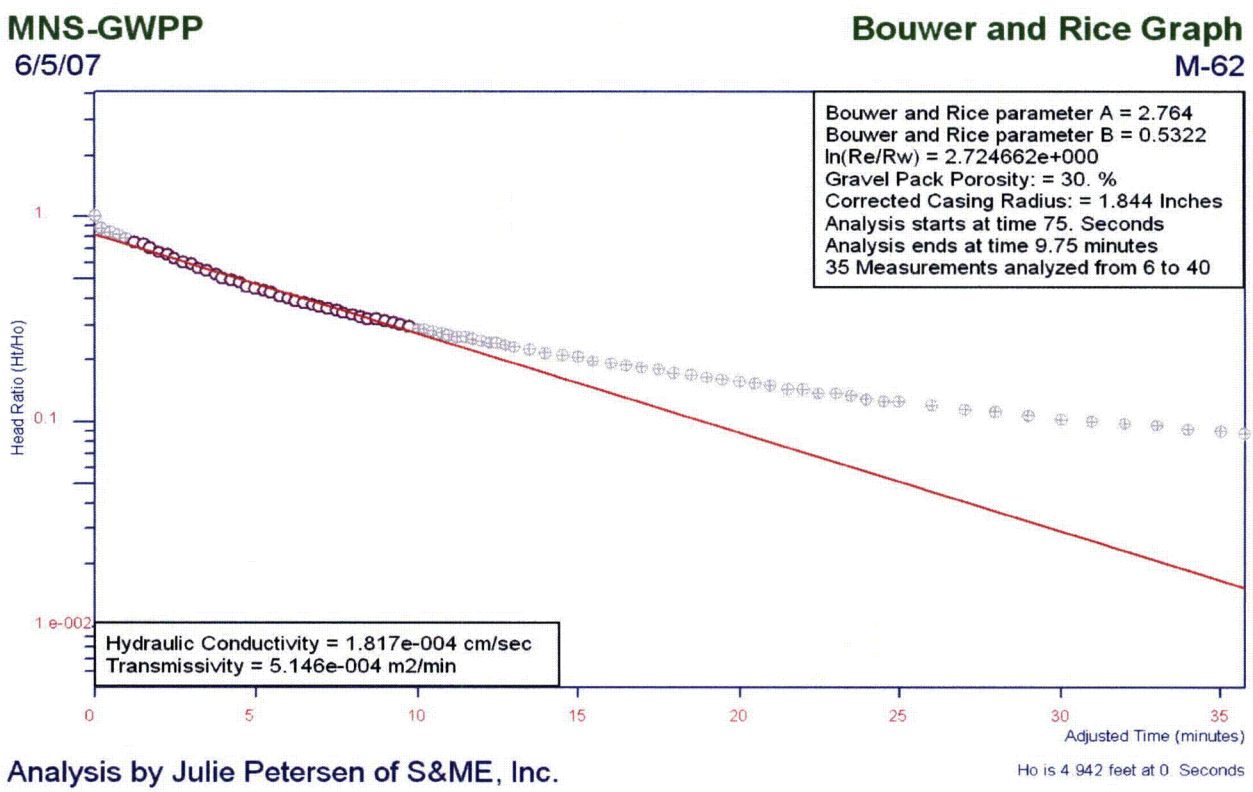


Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	MNS-GWPP
Test Date:	6/5/2007
Well Label:	M-62
Aquifer Thickness:	15.49 feet
Screen Length:	15. feet
Casing Radius:	1. Inches
Effective Radius:	3. Inches
Gravel Pack Porosity:	30.00%
Corrected Casing Radius:	3.391 Inches
Static Water Level:	25.51 feet
Water Table to Screen Bottom:	10.49 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 88 time and drawdown measurements
Maximum head is 4.942 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



Analysis by Julie Petersen of S&ME, Inc.

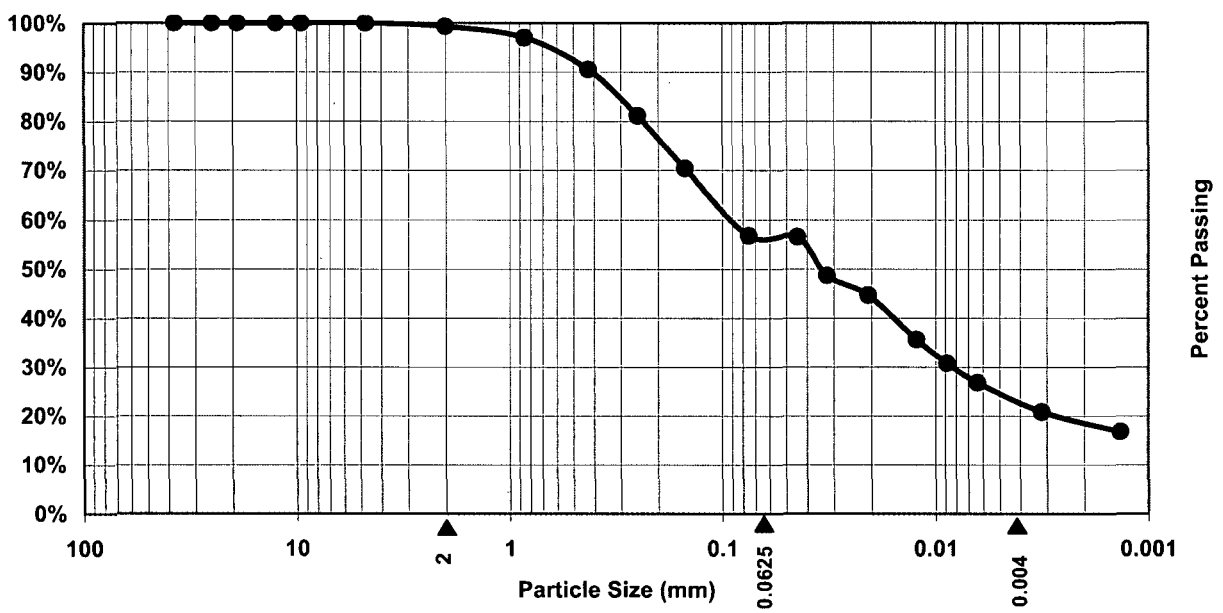
PERMEABILITY

1.82E-04 cm/sec

PARTICLE SIZE ANALYSIS OF SOILS
FOR USE IN FETTER AND BEAR DIAGRAMS

Boring No.:	**Sample No.:**	**Depth:**
M-62	SS-3	14.3 to 15.8 ft bls

Sample Description:
Brown, Fine to Medium Sandy, Clayey, Silt With Mica



	> 2 mm	2 mm - 0.0625 mm	0.0625 mm - 0.004 mm	<0.004 mm
From Graph:	% Gravel 0.7%	% Sand 42.5%	% Silt 34.3%	% Clay 22.5%
Adjusted for Calculations	**0%**	**43%**	**35%**	**23%**

Notes:
Grain size distribution taken from grain size with hydrometer data located in Appendix II.
Gravel, sand, silt and clay sizes based on Wentworth Scale.

S&ME Project:
McGuire Nuclear Station - GWPP

S&ME Project No.:
1264-06-724

S&ME

FETTER AND BEAR DIAGRAMS

S&ME PROJECT: McGuire Nuclear Station - GWPP
S&ME PROJECT NO.: 1264-06-724

Boring No. M-62

Boring Depth: 14.3 to 15.8 ft bls

% Sand: 43%

% Silt: 35%

% Clay: 23%

Estimated Specific Yield: 7.5%

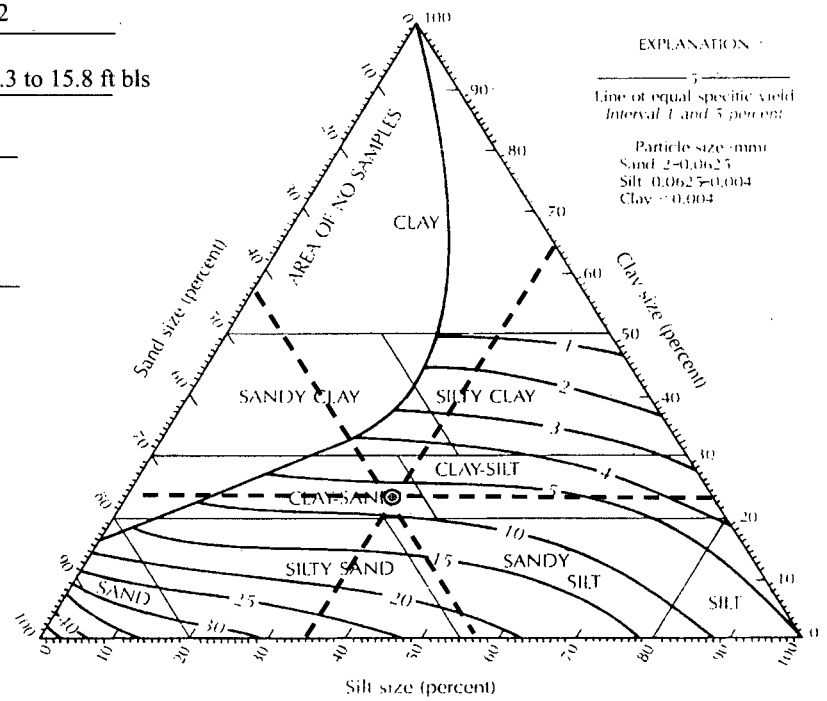
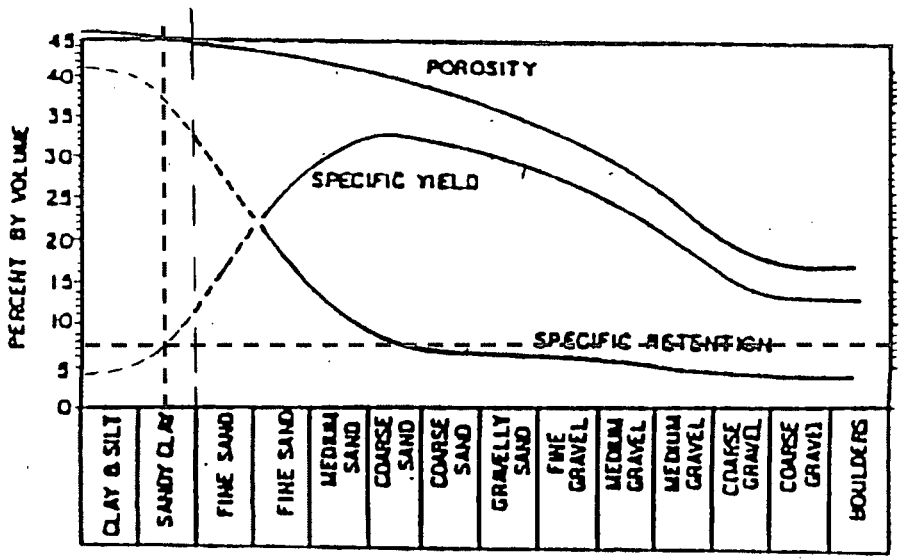


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.



Estimated Porosity: 45%

Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

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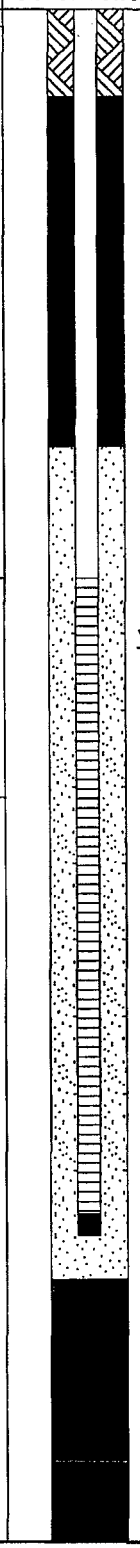
1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

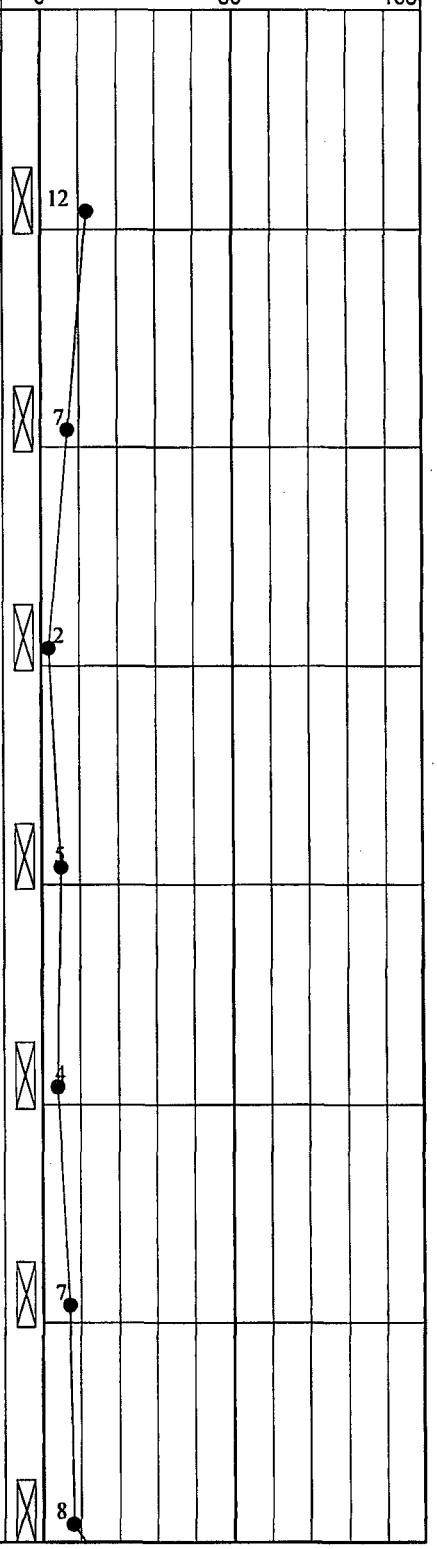
Project: **MNS - Groundwater Protection Project**			**Boring No. M-64**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 1 of 2
Boring Depth (ft): **50.1**	Elevation (ft): **760.8**	Driller: **Justin Millwood, NC Cert. No. 3439**	Date Drilled: **5/24/07**
Logged By: **Courtney Withers**	Water Level: **Stabilized Water Level at 14.58 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lithology	Material Description
760			**GRAVEL**
			FILL (F): Red, Micaceous, Silty, **CLAY**
755	5		
750	10		
745	15		SOIL/SAPROLITE (M1): Tan and Red Striated, Micaceous, Slightly Sandy, **SILT** With Manganese Staining
740	20		SOIL/SAPROLITE (M1): Tan and Red Mottled, Micaceous, Clayey, Silty, Fine **SAND** With Manganese Staining
735	25		
730	30		

Well Construction



Penetration Resistance (Blows/Foot)



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Telephone: 704-523-4726
Fax: 704-525-3953

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.

Project: **MNS - Groundwater Protection Project**			**Boring No. M-64**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 2 of 2
Boring Depth (ft): **50.1**	Elevation (ft): **760.8**	Driller: **Justin Millwood, NC Cert. No. 3439**	Date Drilled: **5/24/07**
Logged By: **Courtney Withers**	Water Level: **Stabilized Water Level at 14.58 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lithology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
725					
	40		SOIL/SAPROLITE (M1): Brown and Black, Micaceous, Slightly Sandy, **SILT** With Quartz Rocks (Schistose)		49
720					
	45		SOIL/SAPROLITE (M1): Tan and White, Slightly Sandy, **SILT** With Manganese Staining and Medium to Fine Sand Lenses		20
715					
			SOIL/SAPROLITE (M1): Brown and Black, Micaceous, Slightly Sandy, **SILT**		17
	50		SOIL/SAPROLITE (M1): Tan and White, Micaceous, **SILT** With Manganese Staining and Medium to Fine Sand Lenses		
			Boring Terminated at 50.10 ft bls		

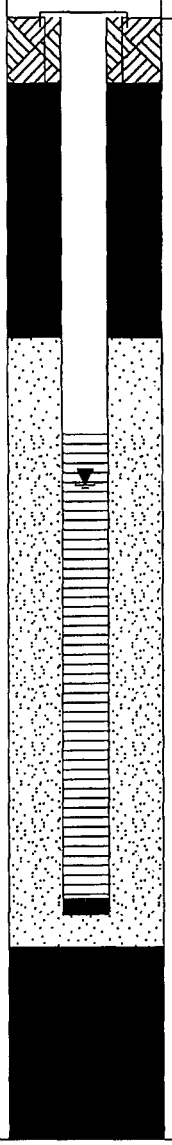
COMPLETION REPORT OF WELL No. M-64

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

WATER LEVEL: **Stabilized Water Level at 14.58 ft bls**
LATITUDE: **35 26 00.08**
LONGITUDE: **80 57 00.77**
TOP OF CASING ELEVATION: **760.30**
DATUM: **MSL**
LOGGED BY: **Courtney Withers**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **Mud Rotary**
DATE DRILLED: **5/24/07**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00		760.84
GRAVEL		0				
FILL (F): Red, Micaceous, Silty, **CLAY**				2.00		758.84
		5				
		10		10.00		750.84
SOIL/SAPROLITE (M1): Tan and Red Striated, Micaceous, Slightly Sandy, **SILT** With Manganese Staining		15				
SOIL/SAPROLITE (M1): Tan and Red Mottled, Micaceous, Clayey, Silty, Fine **SAND** With Manganese Staining		20				
		25		27.50		733.34
				28.00		732.84
		30		29.00		731.84



WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter: **8"**
Type: **Steel Flush Mount**
Interval: **At Grade**

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 13 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 2 ft bls**

SEAL
Type: **Bentonite**
Interval: **2 to 10 ft bls**

FILTERPACK
Type: **#1 Filter Sand**
Interval: **10 to 29 ft bls**

SCREEN
Diameter: **2"**
Type: **0.010 Slotted Sch. 40 PVC**
Interval: **13 to 28 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL MNSLOG.GPJ S&ME.GDT 3/26/08

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COMPLETION REPORT OF WELL No. M-64

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

GROUND SURFACE ELEVATION: **760.8**
LOGGED BY: **Courtney Wither**
CHECKED BY:

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
							(See Page 1)
		35					
SOIL/SAPROLITE (M1): Brown and Black, Micaceous, Slightly Sandy, **SILT** With Quartz Rocks (Schistose)		40					
SOIL/SAPROLITE (M1): Tan and White, Slightly Sandy, **SILT** With Manganese Staining and Medium to Fine Sand Lenses		45					
SOIL/SAPROLITE (M1): Brown and Black, Micaceous, Slightly Sandy, **SILT**		50		50.10		710.74	
SOIL/SAPROLITE (M1): Tan and White, Micaceous, **SILT** With Manganese Staining and Medium to Fine Sand Lenses							

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

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COMPLETION REPORT OF WELL No. M-64

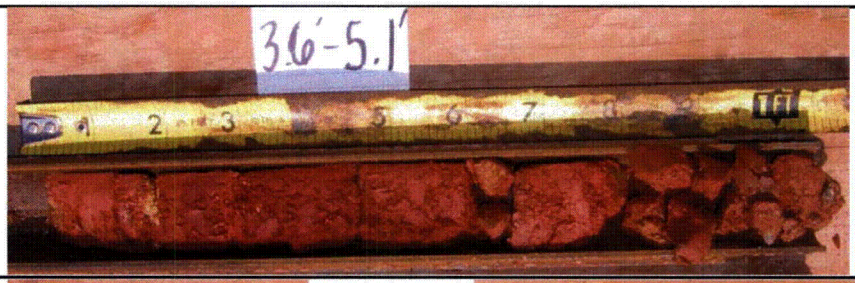
SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

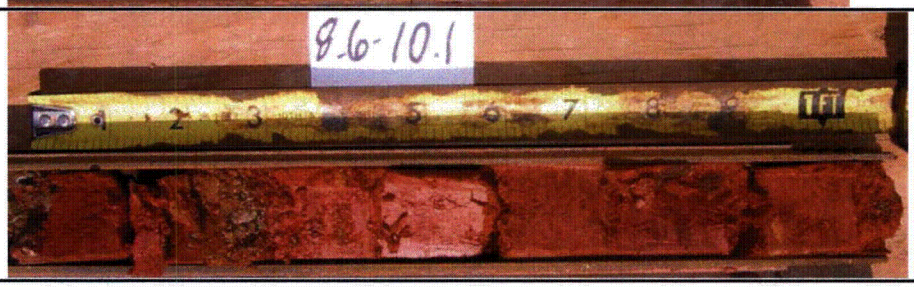
S&ME Project No: 1264-06-724

Boring Number: M-64

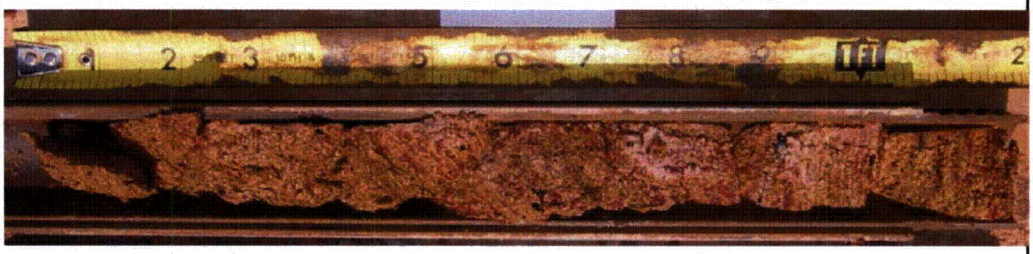
Sample No: 1
Depth (ft-bls): 3.6 - 5.1
Blow Count: 5 * 5 * 7



Sample No: 2
Depth (ft-bls): 8.6 - 10.1
Blow Count: 2 * 3 * 4



Sample No: 3
Depth (ft-bls): 13.6 - 15.1
Blow Count: 1 * 1 * 1



Sample No: 4
Depth (ft-bls): 18.6 - 20.1
Blow Count: 2 * 2 * 3

Sample No: 5
Depth (ft-bls): 23.6 - 25.1
Blow Count: 1 * 1 * 3

Sample No: 6
Depth (ft-bls): 28.6 - 30.1
Blow Count: 2 * 2 * 5

SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

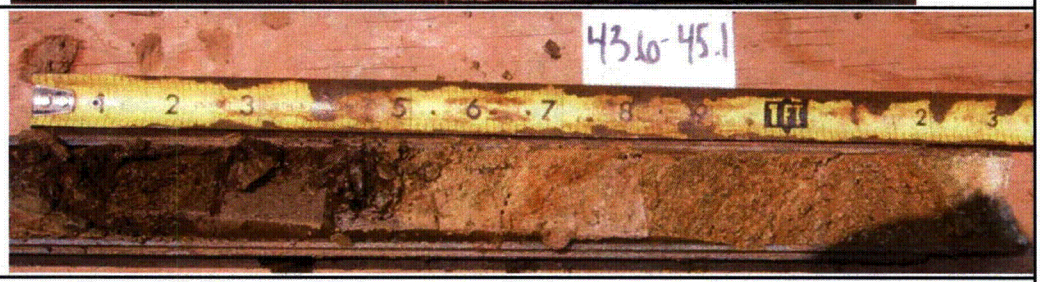
S&ME Project No: 1264-06-724

Boring Number: M-64

Sample No: 7
Depth (ft-bls): 33.6 - 35.1
Blow Count: 3 * 3 * 5

Sample No: 8
Depth (ft-bls): 38.6 - 40.1
Blow Count: 12 * 23 * 26

Sample No: 9
Depth (ft-bls): 43.6 - 45.1
Blow Count: 3 * 6 * 14



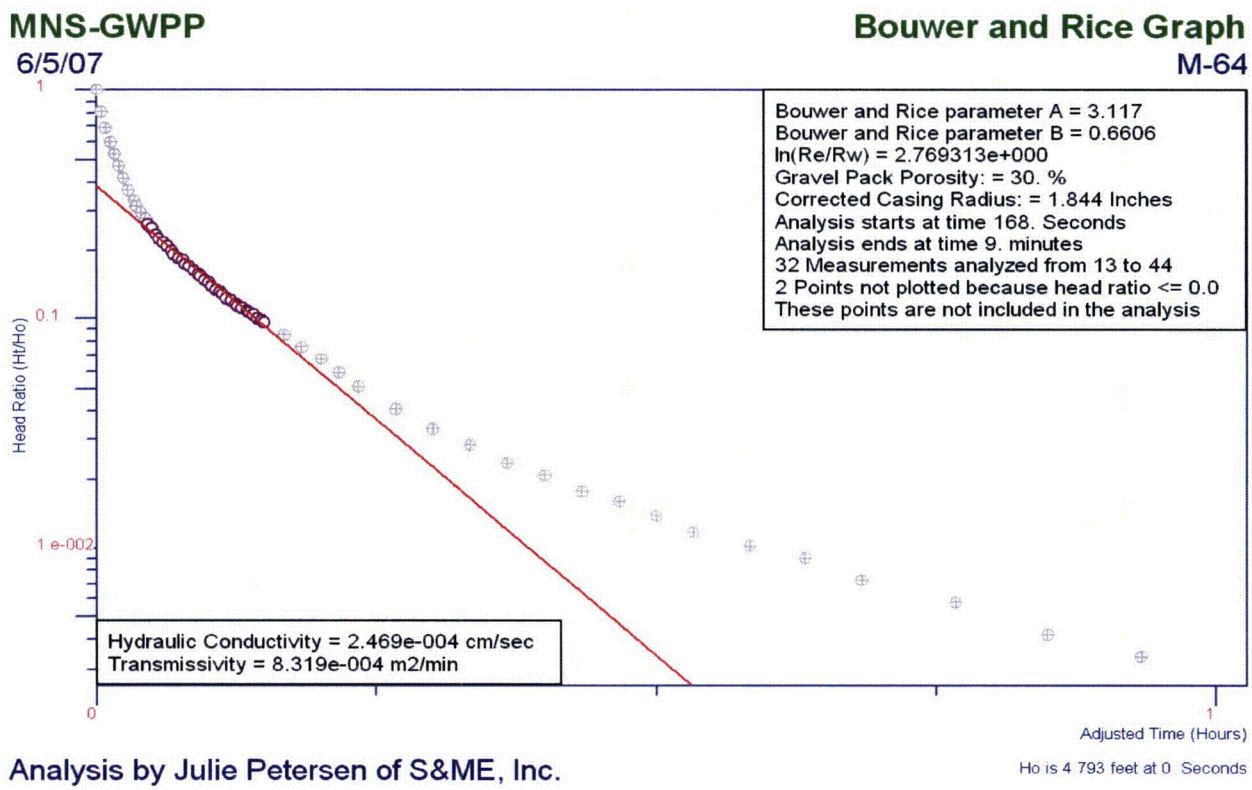
Sample No: 10
Depth (ft-bls): 48.6 - 50.1
Blow Count: 4 * 6 * 11

Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	MNS-GWPP
Test Date:	6/5/2007
Well Label:	M-64
Aquifer Thickness:	18.42 feet
Screen Length:	15. feet
Casing Radius:	1. Inches
Effective Radius:	3. Inches
Gravel Pack Porosity:	30.00%
Corrected Casing Radius:	3.391 Inches
Static Water Level:	14.58 feet
Water Table to Screen Bottom:	13.42 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 66 time and drawdown measurements
Maximum head is 4.793 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



Analysis by Julie Petersen of S&ME, Inc.

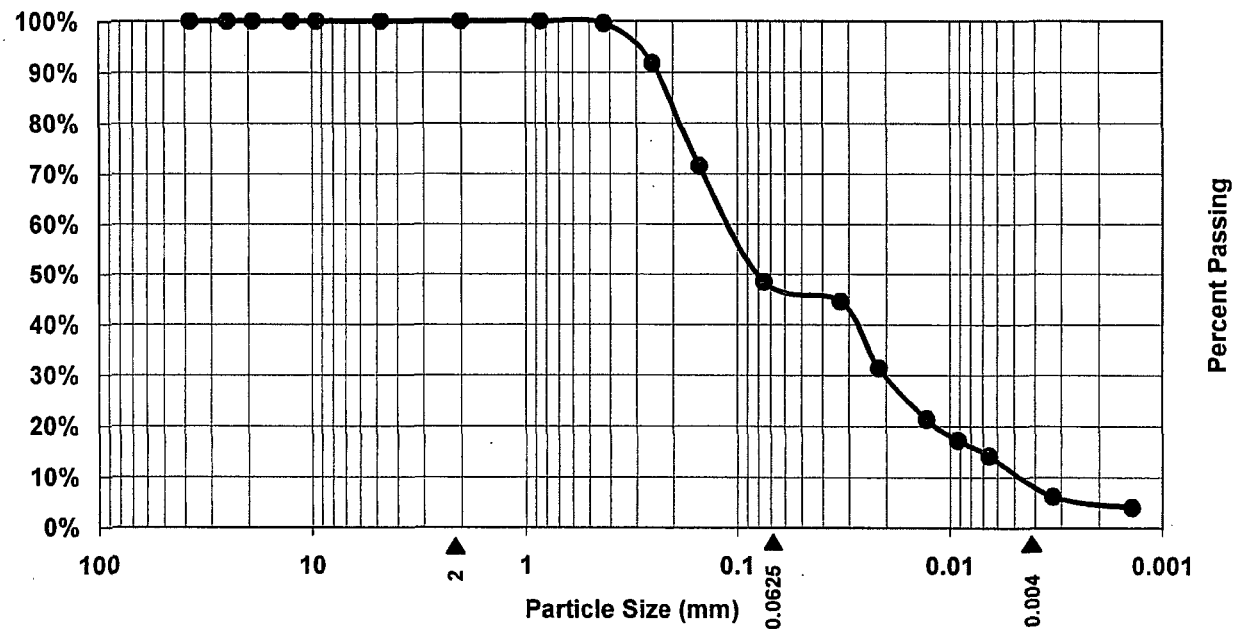
PERMEABILITY

2.47E-04 cm/sec

PARTICLE SIZE ANALYSIS OF SOILS
FOR USE IN FETTER AND BEAR DIAGRAMS

Boring No.:	Sample No.:	Depth:
M-64	SS-5	23.6 to 25.1 ft bls

Sample Description:
Tan and Red, Clayey, Silty, Fine Sand With Mica



	> 2 mm	2 mm - 0.0625 mm	0.0625 mm - 0.004 mm	<0.004 mm
From Graph:	% Gravel 0.0%	% Sand 52.5%	% Silt 40.6%	% Clay 6.9%
Adjusted for Calculations	**0%**	**53%**	**41%**	**7%**

Notes:
Grain size distribution taken from grain size with hydrometer data located in Appendix II.
Gravel, sand, silt and clay sizes based on Wentworth Scale.

S&ME Project:
McGuire Nuclear Station - GWPP

S&ME Project No.:
1264-06-724

S&ME

FETTER AND BEAR DIAGRAMS

S&ME PROJECT: McGuire Nuclear Station - GWPP
S&ME PROJECT NO.: 1264-06-724

Boring No. M-64

Boring Depth: 23.6 to 25.1 ft bls

% Sand: 53%

% Silt: 41%

% Clay: 7%

Estimated Specific Yield: 20%

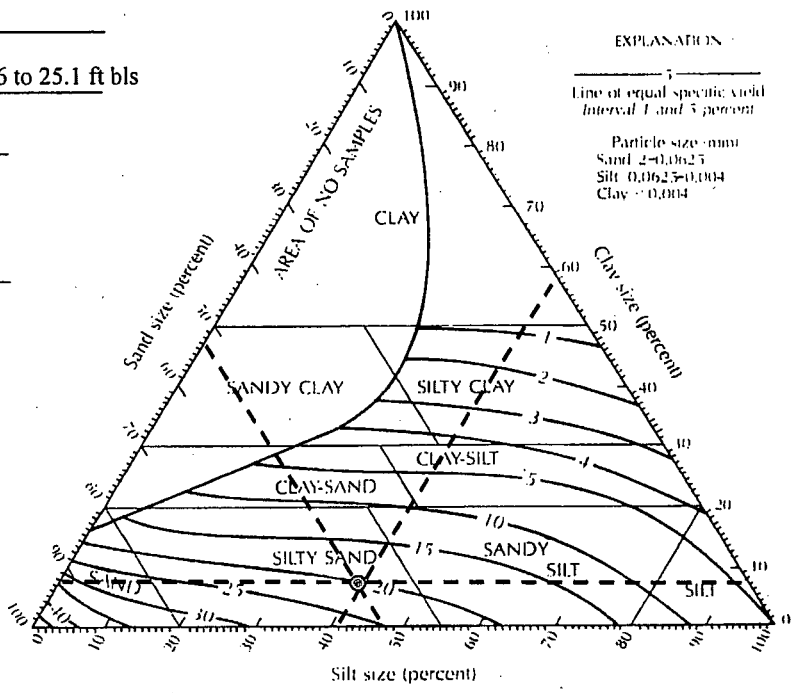
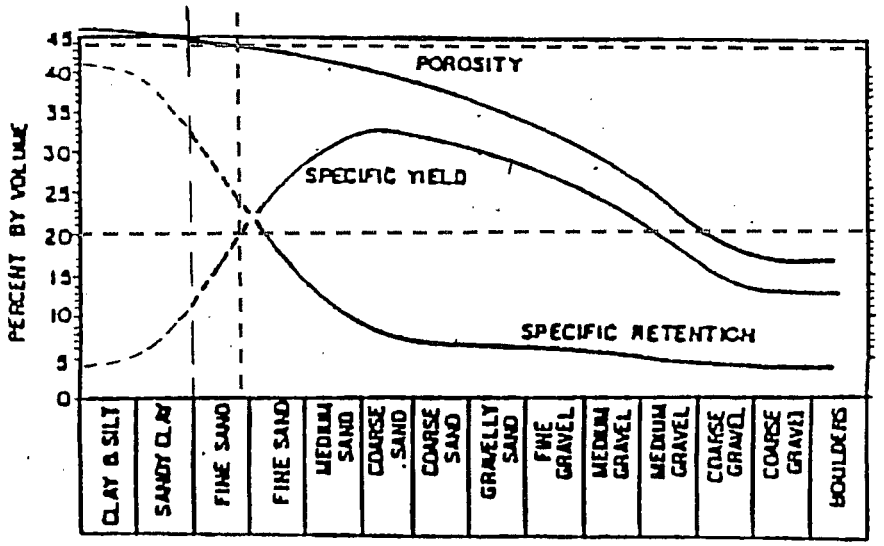


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.



Estimated Porosity: 43.5%

Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

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Project: **MNS - Groundwater Protection Project**			**Boring No. M-66**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 1 of 1
Boring Depth (ft): **27.0**	Elevation (ft): **760.4**	Driller: **Justin Millwood, NC Cert. No. 3439**	Date Drilled: **6/4/07**
Logged By: **Courtney Withers**	Water Level: **Stabilized Water Level at 15.10 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lithology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
760			**GRAVEL**		
			FILL (F): Red, Micaceous, Silty, **CLAY** Interlayered With Tan, Micaceous, Fine Sandy, **SILT** With Rock Fragments		
755	5				
750	10		FILL (F): Yellow-Brown and Red, Micaceous, Clayey, **SILT** With Rock Fragments		
745	15				
			SOIL/SAPROLITE (M1): Tan, Red, Yellow, and White Mottled, Micaceous, Slightly Clayey, Fine Sandy, **SILT** With Manganese Nodules		
740	20				
			SOIL/SAPROLITE (M1): Tan and White, Micaceous, Slightly Clayey, Fine Sandy, **SILT** With Manganese Staining		
735	25				
			Boring Terminated at 27.00 ft bls **Lithologic Descriptions Obtained From M-66R**		

COMPLETION REPORT OF WELL No. M-66

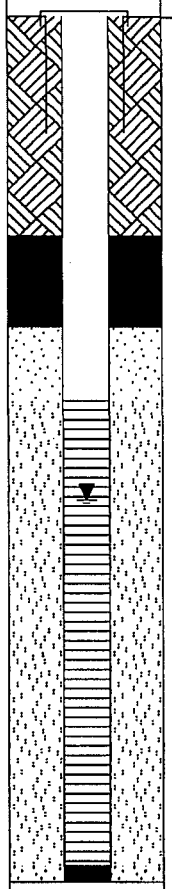
PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

WATER LEVEL: **Stabilized Water Level at 15.10 ft bls**

LATITUDE: **35 26 00.03**
LONGITUDE: **80 56 59.36**
TOP OF CASING ELEVATION: **760.09**
DATUM: **MSL**
LOGGED BY: **Courtney Withers**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **4¼" H.S.A.**
DATE DRILLED: **6/4/07**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00		760.43
GRAVEL		0				
FILL (F): Red, Micaceous, Silty, **CLAY** Interlayered With Tan, Micaceous, Fine Sandy, **SILT** With Rock Fragments		5		6.80		753.63
		10		9.70		750.73
FILL (F): Yellow-Brown and Red, Micaceous, Clayey, **SILT** With Rock Fragments		15				
SOIL/SAPROLITE (M1): Tan, Red, Yellow, and White Mottled, Micaceous, Slightly Clayey, Fine Sandy, **SILT** With Manganese Nodules		20				
SOIL/SAPROLITE (M1): Tan and White, Micaceous, Slightly Clayey, Fine Sandy, **SILT** With Manganese Staining		25		26.50		733.93
				27.00		733.43



WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter: **8"**
Type: **Steel Flush Mount**
Interval: **At Grade**

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 12 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 6.8 ft bls**

SEAL
Type: **Bentonite**
Interval: **6.8 to 9.7 ft bls**

FILTERPACK
Type: **#1 Filter Sand**
Interval: **9.7 to 27 ft bls**

SCREEN
Diameter: **2"**
Type: **0.010 Slotted Sch. 40 PVC**
Interval: **12 to 27 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

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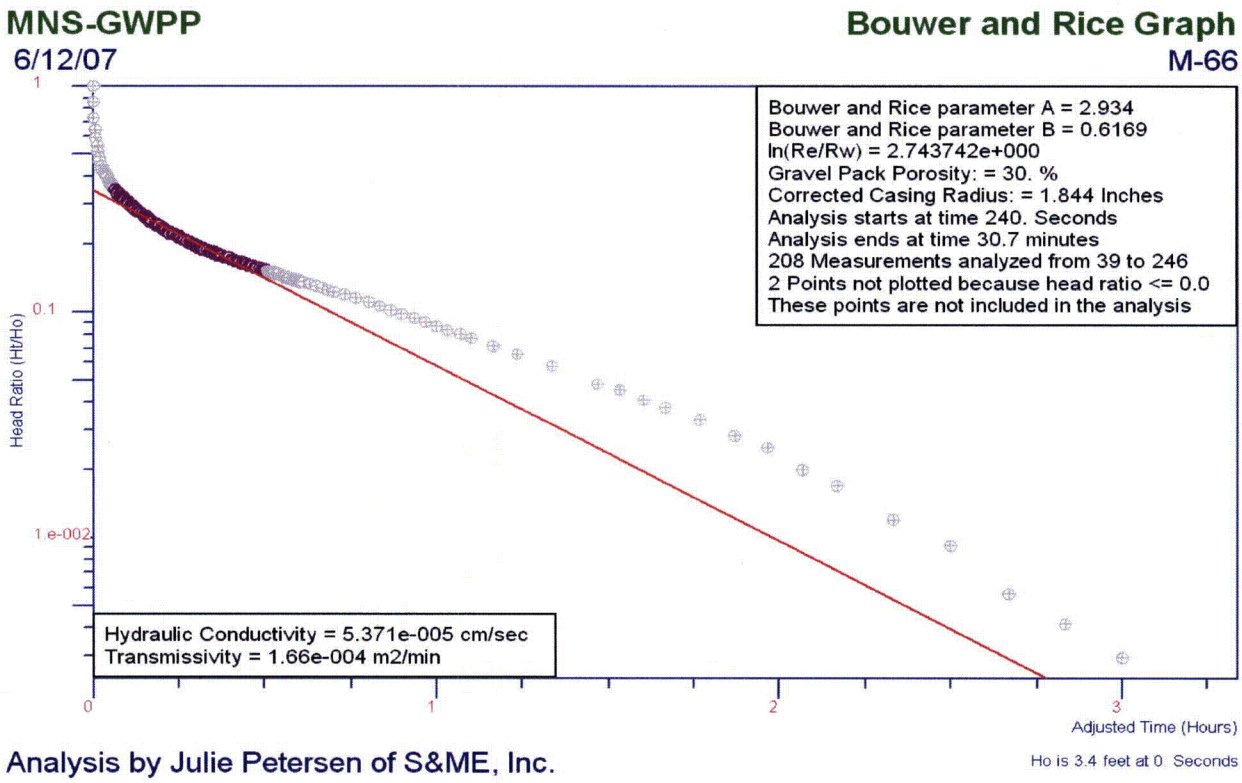
COMPLETION REPORT OF WELL No. M-66

Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	MNS-GWPP
Test Date:	6/12/2007
Well Label:	M-66
Aquifer Thickness:	16.9 feet
Screen Length:	15. feet
Casing Radius:	1. Inches
Effective Radius:	3. Inches
Gravel Pack Porosity:	30.00%
Corrected Casing Radius:	1.844 Inches
Static Water Level:	15.1 feet
Water Table to Screen Bottom:	11.9 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 315 time and drawdown measurements
Maximum head is 3.4 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



Analysis by Julie Petersen of S&ME, Inc.

PERMEABILITY

5.37E-05 cm/sec

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Project: **MNS - Groundwater Protection Project**			**Boring No. M-66R**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 1 of 3
Boring Depth (ft): **89.5**	Elevation (ft): **760.5**	Driller: **Justin Millwood, NC Cert. No. 3439**	Date Drilled: **5/29/07**
Logged By: **Courtney Withers**	Water Level: **Stabilized Water Level at 48.96 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lithology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
760			**GRAVEL**		
			FILL (F): Red, Micaceous, Silty, **CLAY** Interlayered With Tan, Micaceous, Fine Sandy, **SILT** With Rock Fragments		6
755	5				8
750	10		FILL (F): Yellow-Brown and Red, Micaceous, Clayey, **SILT** With Rock Fragments		5
745	15		SOIL/SAPROLITE (M1): Tan, Red, Yellow, and White Mottled, Micaceous, Slightly Clayey, Fine Sandy, **SILT** With Manganese Nodules		5
740	20		SOIL/SAPROLITE (M1): Tan and White, Micaceous, Slightly Clayey, Fine Sandy, **SILT** With Manganese Staining		5
735	25				8
730	30				8

BORING LOG WITH WELL MNSLOG.GPJ LAGWGN01.GDT 3/26/08

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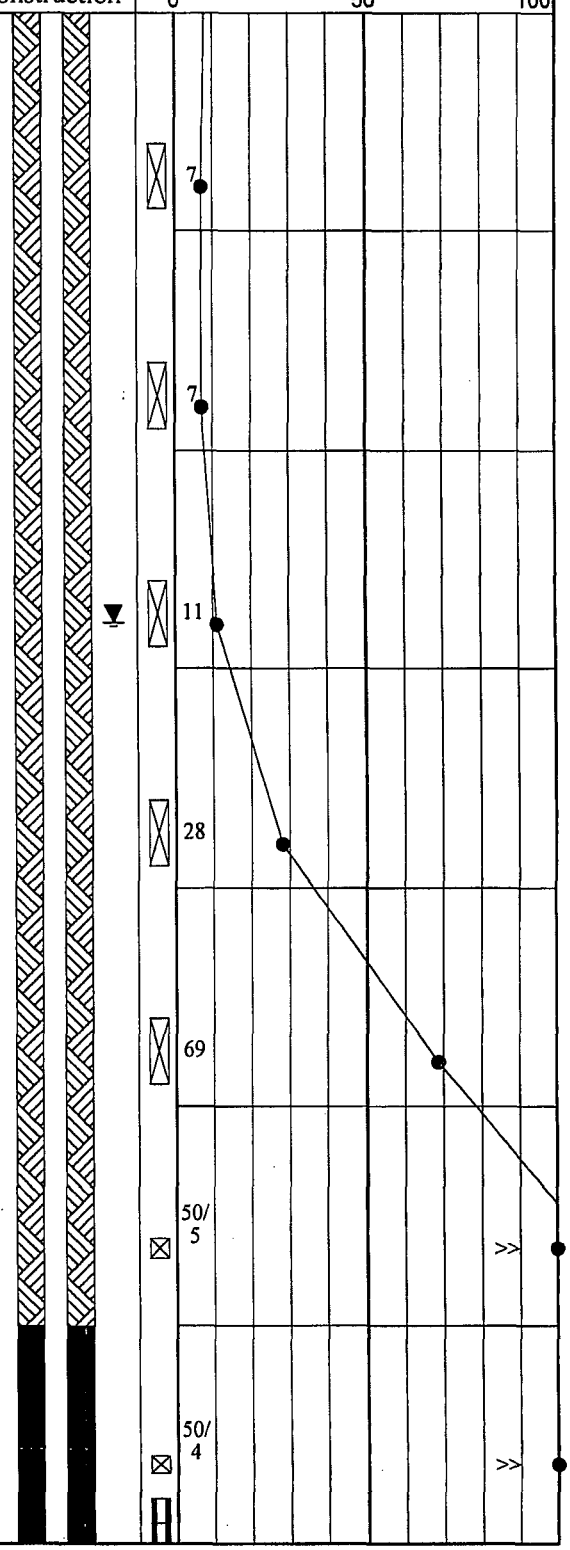
Project: **MNS - Groundwater Protection Project**			**Boring No. M-66R**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 2 of 3
Boring Depth (ft): **89.5**	Elevation (ft): **760.5**	Driller: **Justin Millwood, NC Cert. No. 3439**	Date Drilled: **5/29/07**
Logged By: **Courtney Withers**	Water Level: **Stabilized Water Level at 48.96 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lithology	Material Description
725			
720	40		SOIL/SAPROLITE (M1): Reddish-Brown, Tan, and White, Micaceous, Slightly Clayey, **SILT** With Manganese Staining
715	45		
710	50		SOIL/SAPROLITE (M1): Green, Tan, and White, Micaceous, **SILT** With Manganese Staining
705	55		SOIL/SAPROLITE (M1): Greenish-Black, Brown, Tan, and White, Micaceous, Silty, Medium to Fine **SAND** With Quartz Rock Fragments and Manganese Staining (Granitic)
700	60		
695	65		WEATHRED ROCK (M2): When Sampled Becomes Greenish-Black, Brown, Tan, and White, Micaceous, Silty, Medium to Fine **SAND** Wtih Quartz Rock Fragments and Manganese Staining (Granitic)
			WEATHERED ROCK (M2): When Sampled Becomes Brown, Micaceous, Silty, Medium to Fine **SAND** With Rock Fragments (Schistose)

Well Construction



BORING LOG WITH WELL MNSLOG.GPJ LAGWGN01.GDT 3/26/08

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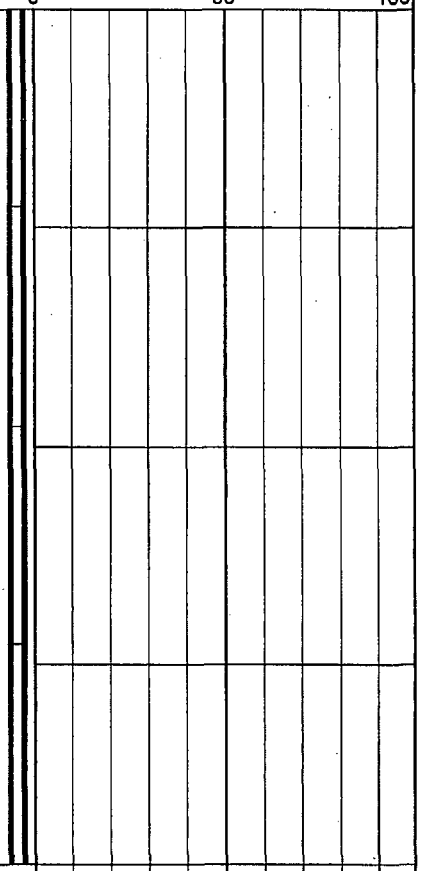
Project: **MNS - Groundwater Protection Project**			**Boring No. M-66R**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 3 of 3
Boring Depth (ft): **89.5**	Elevation (ft): **760.5**	Driller: **Justin Millwood, NC Cert. No. 3439**	Date Drilled: **5/29/07**
Logged By: **Courtney Withers**	Water Level: **Stabilized Water Level at 48.96 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lithology	Material Description
690			**Roller Cone Refusal at 69.00 ft bls**
			PARTIALLY WEATHERED/FRACTURED ROCK (WF): Coarse-Grained **QUARTZ DIORITE**, Intensely Fractured
			SOUND ROCK (D): Coarse-Grained **QUARTZ DIORITE**, Moderately Fractured; Calcite Contained in Fine-Grained Matrix Around 71.54 and 73.84 ft bls
685	75		SOUND ROCK (D): Fine-Grained **META GABBRO**, Moderately Fractured
680	80		
675	85		SOUND ROCK (D): Medium-Grained **QUARTZ DIORITE**, Moderately Fractured
			SOUND ROCK (D): Fine-Grained **META GABBRO**, Moderately Fractured
			Boring Terminated at 89.54 ft bls

Well Construction

Penetration Resistance (Blows/Foot)

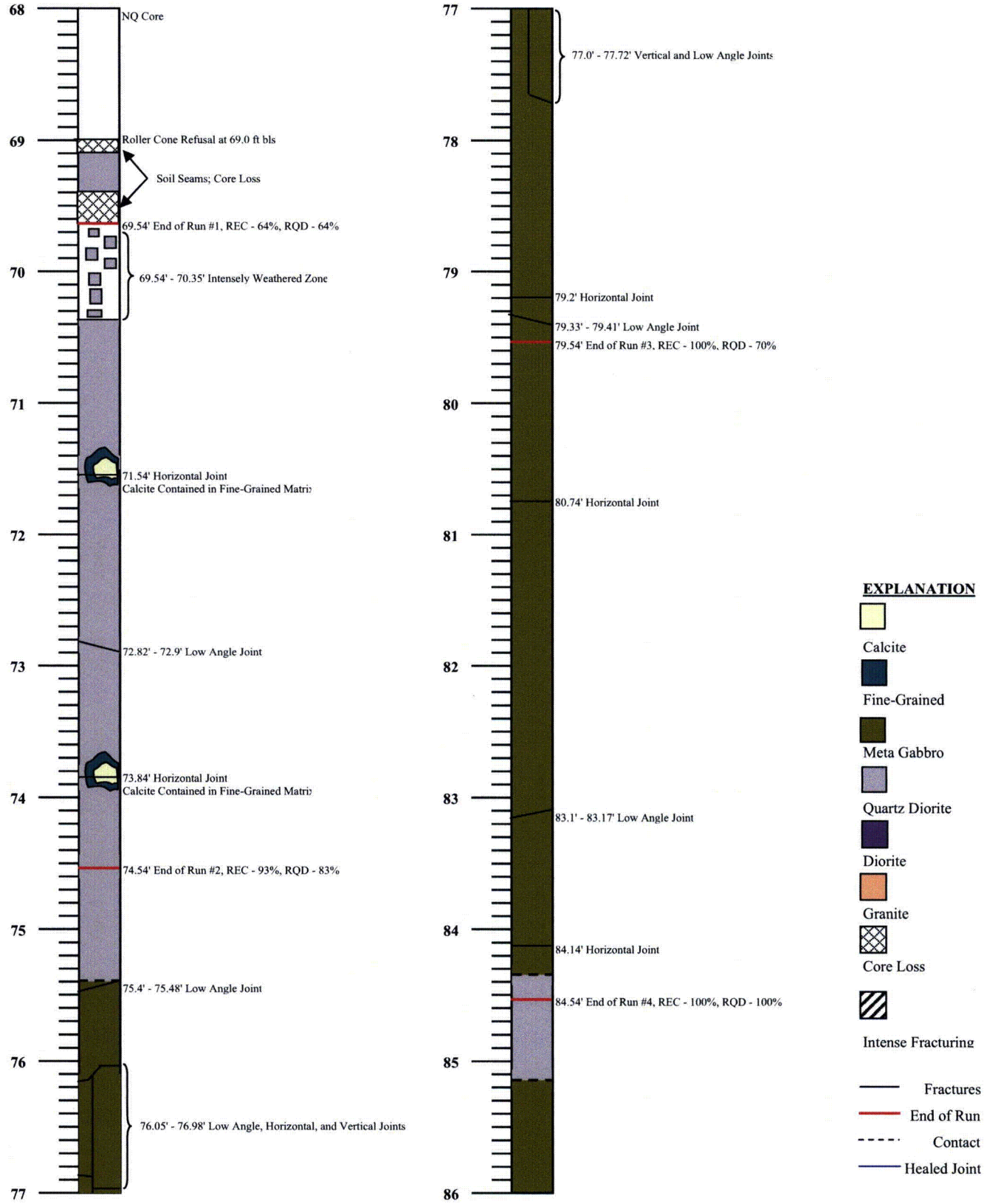


FIELD ROCK CORE LOG

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-66R

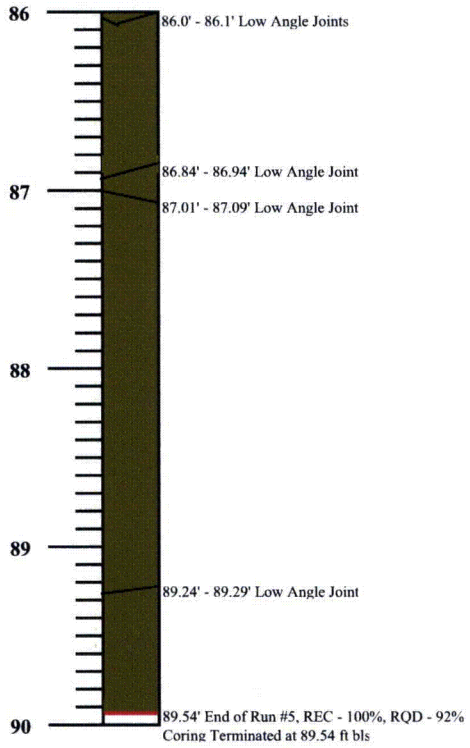


FIELD ROCK CORE LOG

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-66R



EXPLANATION

- Calcite
- Fine-Grained
- Meta Gabbro
- Quartz Diorite
- Diorite
- Granite
- Core Loss
- Intense Fracturing
- Fractures
- End of Run
- Contact
- Healed Joint

COMPLETION REPORT OF WELL No. M-66R

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

WATER LEVEL: **Stabilized Water Level at 48.96 ft bls**
LATITUDE: **35 25 59.98**
LONGITUDE: **80 56 59.38**
TOP OF CASING ELEVATION: **760.12**
DATUM: **MSL**
LOGGED BY: **Courtney Withers**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **Mud Rotary**
DATE DRILLED: **5/29/07**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00		760.47
GRAVEL		0				
FILL (F): Red, Micaceous, Silty, **CLAY** Interlayered With Tan, Micaceous, Fine Sandy, **SILT** With Rock Fragments		5				
		10				
FILL (F): Yellow-Brown and Red, Micaceous, Clayey, **SILT** With Rock Fragments		15				
SOIL/SAPROLITE (M1): Tan, Red, Yellow, and White Mottled, Micaceous, Slightly Clayey, Fine Sandy, **SILT** With Manganese Nodules		20				
SOIL/SAPROLITE (M1): Tan and White, Micaceous, Slightly Clayey, Fine Sandy, **SILT** With Manganese Staining		25				
		30				

WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter: **8"**
Type: **Steel Flush Mount**
Interval: **At Grade**

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 70 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 65 ft bls**

SEAL
Type: **K-Packer + Bentonite**
Interval: **65 to 70.2 ft bls**

FILTERPACK
Type: **N/A**
Interval: **N/A**

SCREEN
Diameter: **2"**
Type: **0.010 Slotted Sch. 40 PVC**
Interval: **70.8 to 75.8 ft bls**

LEGEND
- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

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COMPLETION REPORT OF WELL No. M-66R

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

GROUND SURFACE ELEVATION: **760.5**
LOGGED BY: **Courtney Wither**
CHECKED BY:

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
							(See Page 1)
SOIL/SAPROLITE (M1): Tan and White, Micaceous, Slightly Clayey, Fine Sandy, **SILT** With Manganese Staining *(continued)*		35					
SOIL/SAPROLITE (M1): Reddish-Brown, Tan, and White, Micaceous, Slightly Clayey, **SILT** With Manganese Staining		40 45					
SOIL/SAPROLITE (M1): Green, Tan, and White, Micaceous, **SILT** With Manganese Staining		50					
SOIL/SAPROLITE (M1): Greenish-Black, Brown, Tan, and White, Micaceous, Silty, Medium to Fine **SAND** With Quartz Rock Fragments and Manganese Staining (Granitic)		55 60					
WEATHRED ROCK (M2): When Sampled Becomes Greenish-Black, Brown, Tan, and White, Micaceous, Silty, Medium to Fine **SAND** Wtih Quartz Rock Fragments and Manganese Staining (Granitic)		65 70		65.00 70.00 70.20		695.47 690.47 690.27	
WEATHERED ROCK (M2): When Sampled Becomes Brown, Micaceous, Silty, Medium to Fine **SAND** With Rock Fragments (Schistose)		75		70.80 75.30 75.80		689.67 685.17 684.67	
PARTIALLY WEATHERED/FRACTURED ROCK (WF): Coarse-Grained				77.00		683.47	

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL MNSLOG.GPJ S&ME.GDT 3/26/08

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COMPLETION REPORT OF WELL No. M-66R

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

GROUND SURFACE ELEVATION: **760.5**
LOGGED BY: **Courtney Wither**
CHECKED BY:

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
							(See Page 1)
QUARTZ DIORITE, Intensely Fractured		80					
SOUND ROCK (D): Coarse-Grained **QUARTZ DIORITE**, Moderately Fractured; Calcite Contained in Fine-Grained Matrix Around 71.54 and 73.84 ft bls		85					
SOUND ROCK (D): Fine-Grained **META GABBRO**, Moderately Fractured *(continued)*				89.54		670.93	
SOUND ROCK (D): Medium-Grained **QUARTZ DIORITE**, Moderately Fractured							
SOUND ROCK (D): Fine-Grained **META GABBRO**, Moderately Fractured							

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL MNSLOG.GPJ S&ME.GDT 3/26/08

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COMPLETION REPORT OF WELL No. M-66R

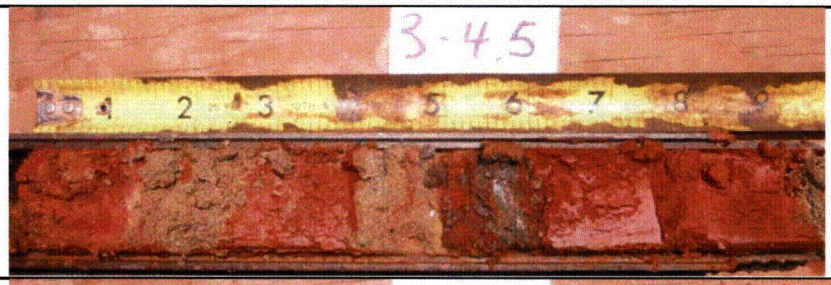
SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Boring Number: M-66R

Sample No: 1
Depth (ft-bls): 3-4.5
Blow Count: 3 * 3 * 3



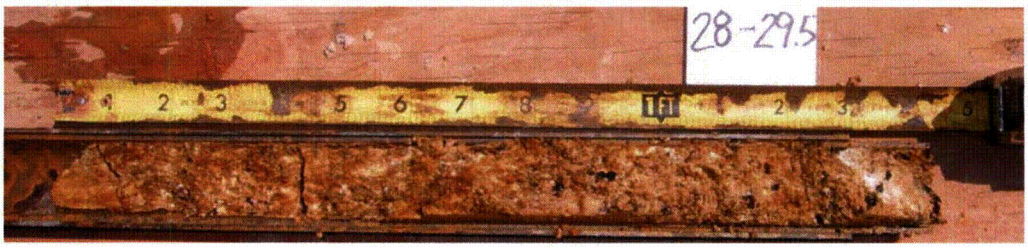
Sample No: 2
Depth (ft-bls): 8-9.5
Blow Count: 3 * 3 * 5

Sample No: 3
Depth (ft-bls): 13-14.5
Blow Count: 1 * 2 * 3

Sample No: 4
Depth (ft-bls): 18-19.5
Blow Count: 2 * 2 * 3

Sample No: 5
Depth (ft-bls): 23-24.5
Blow Count: 2 * 2 * 3

Sample No: 6
Depth (ft-bls): 28-29.5
Blow Count: 2 * 3 * 5



SPLIT SPOON SAMPLE PICTURES

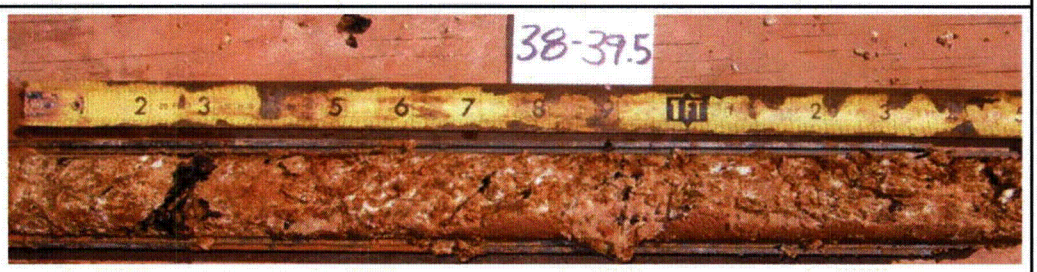
McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Boring Number: M-66R

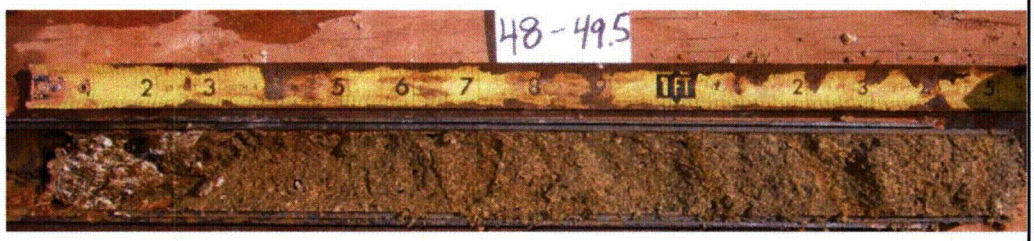
Sample No: 7
Depth (ft-bls): 33-34.5
Blow Count: 2 * 3 * 5

Sample No: 8
Depth (ft-bls): 38-39.5
Blow Count: 3 * 3 * 4



Sample No: 9
Depth (ft-bls): 43-44.5
Blow Count: 2 * 3 * 4

Sample No: 10
Depth (ft-bls): 48-49.5
Blow Count: 2 * 4 * 7



Sample No: 11
Depth (ft-bls): 53-54.5
Blow Count: 12 * 12 * 16

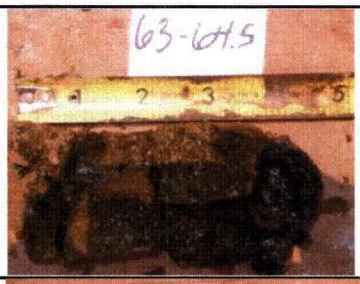
Sample No: 12
Depth (ft-bls): 58-59.5
Blow Count: 17 * 20 * 49

SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Boring Number: M-66R

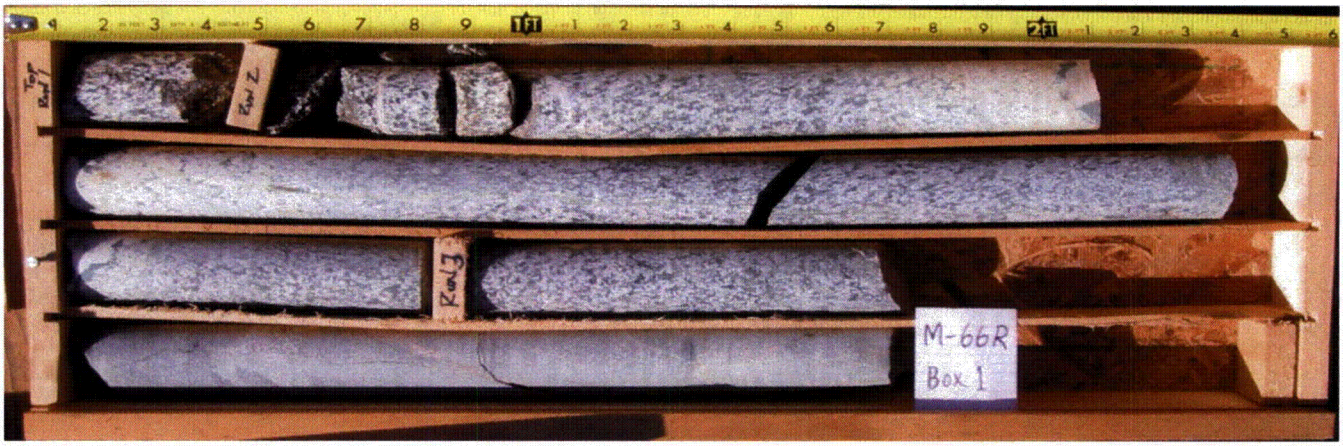
Sample No: 13 **Depth (ft-bls):** 63-64.5 **Blow Count:** 50/5	
Sample No: 14 **Depth (ft-bls):** 68-69.5 **Blow Count:** 50/4	

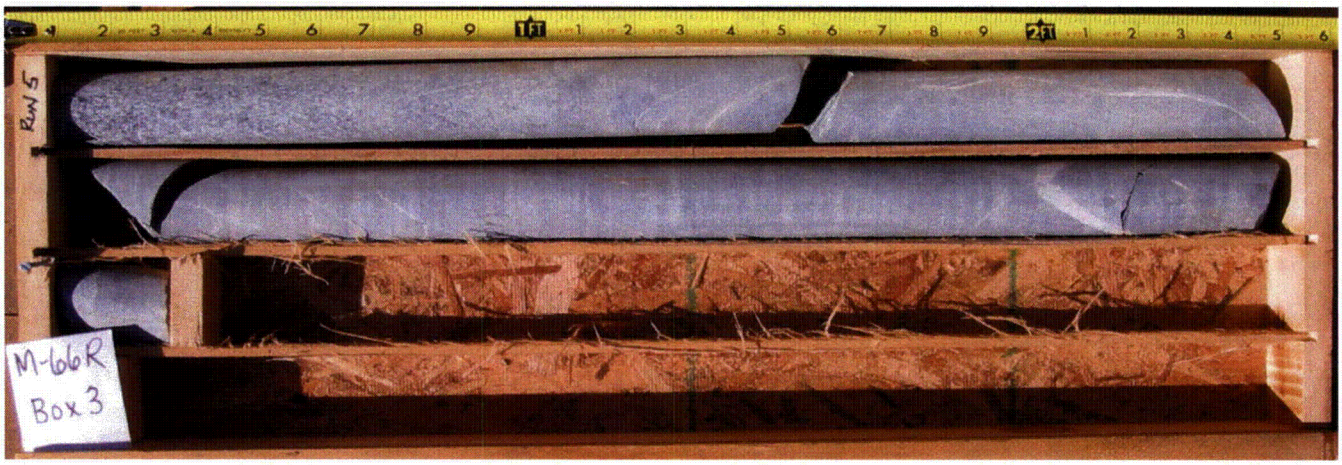
ROCK CORE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-66R





CLASSIFICATION:

68.99' - 75.40': Coarse-Grained Quartz Diorite

75.40' - 84.34': Fine-Grained Meta Gabbro

84.34' - 85.14: Medium-Grained Quartz Diorite

85.14' - 89.54: Fine-Grained Meta Gabbro

CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD
(Open Hole in Uniform Material)

S&ME

Site Name:	MNS - GWPP	
Date:	5/30/2007	
Boring I.D.	M-66R	(Soil/Saprolite)
Test Interval:	48.7' to 51.7'	
Total Depth of Hole:	51.7 ft	1576.21 cm
Length of Open Hole:	3.00 ft	91.46 cm
Transformation Ratio m=	1	
Performed by:	Julie Petersen	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	1626.52	
60	1615.34	2.90E-05
120	1601.49	3.62E-05
180	1584.09	4.59E-05
240	1564.42	5.25E-05
300	1545.12	5.22E-05
360	1527.56	4.81E-05
420	1511.86	4.34E-05
480	1497.80	3.93E-05
540	1485.40	3.50E-05
600	1474.02	3.23E-05
900	1429.76	2.56E-05
1200	1397.84	1.90E-05
1500	1371.83	1.58E-05
1800	1349.15	1.40E-05
2400	1310.40	1.23E-05
3000	1275.64	1.13E-05
3600	1246.46	9.73E-06

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

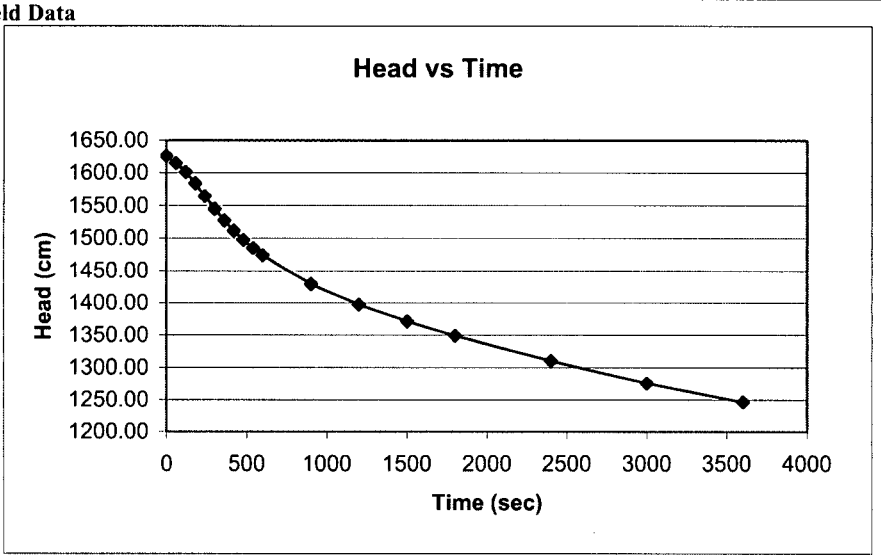
K_h	is the Horizontal Coefficient of Permeability (cm/sec)
H_1	is the Piezometric Head for time; $t = t_1$ (cm)
H_2	is the Piezometric Head for time; $t = t_2$ (cm)
D	is the Diameter of the Standpipe (cm)
d	is the diameter of the Open Length (cm),
m	is the Transformation Ratio, Where
	$m = \sqrt{K_h / K_v}$ — K_h is the Horizontal Permeability; K_v is the Vertical Permeability
L	is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

3.07E-05

Graph of Field Data



CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD
(Open Hole in Uniform Material)

S&ME

Site Name:	MNS - GWPP		
Date:	5/31/2007		
Boring I.D.	M-66R		
Test Interval:	69.54' to 74.54'	(Sound Rock)	
Total Depth of Hole:	74.54 ft		2272.56 cm
Length of Open Hole:	5.0 ft		152.44 cm
Transformation Ratio m=	1		
Performed by:	Julie Petersen		

Time (sec)	Head (cm)	Permeability (cm/sec)
0	2168.08	
60	2041.01	1.77E-04
120	1980.43	8.82E-05
180	1953.51	4.01E-05

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

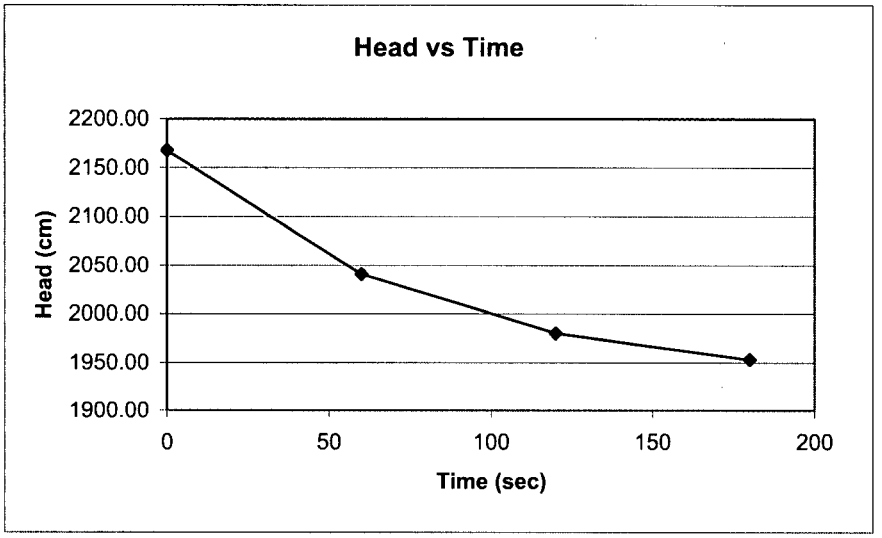
- K_h is the Horizontal Coefficient of Permeability (cm/sec)
- H_1 is the Piezometric Head for time; $t = t_1$ (cm)
- H_2 is the Piezometric Head for time; $t = t_2$ (cm)
- D is the Diameter of the Standpipe (cm)
- d is the diameter of the Open Length (cm),
- m is the Transformation Ratio, Where $m = \sqrt{K_h / K_v}$ — K_h is the Horizontal Permeability, K_v is the Vertical Permeability
- L is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

1.02E-04

Graph of Field Data



CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD
(Open Hole in Uniform Material)

S&ME

Site Name:	MNS - GWPP		
Date:	5/31/2007		
Boring I.D.	M-66R		
Test Interval:	69.54' to 79.54'	(Sound Rock)	
Total Depth of Hole:	79.54 ft		2425 cm
Length of Open Hole:	10 ft		304.88 cm
Transformation Ratio m=	1		
Performed by:	Julie Petersen		

Time (sec)	Head (cm)	Permeability (cm/sec)
0	2204.21	
60	2168.60	2.83E-05
120	2137.56	2.51E-05
180	2109.63	2.29E-05
240	2083.96	2.13E-05
300	2060.34	1.98E-05
360	2038.48	1.85E-05
420	2018.14	1.74E-05
480	1999.18	1.64E-05
540	1985.49	1.19E-05
600	1969.05	1.45E-05
900	1901.52	1.21E-05

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

K_h	is the Horizontal Coefficient of Permeability (cm/sec)
H_1	is the Piezometric Head for time; $t = t_1$ (cm)
H_2	is the Piezometric Head for time; $t = t_2$ (cm)
D	is the Diameter of the Standpipe (cm)
d	is the diameter of the Open Length (cm),
m	is the Transformation Ratio, Where

$m = \sqrt{K_h / K_v}$ K_h is the Horizontal Permeability; K_v is the Vertical Permeability

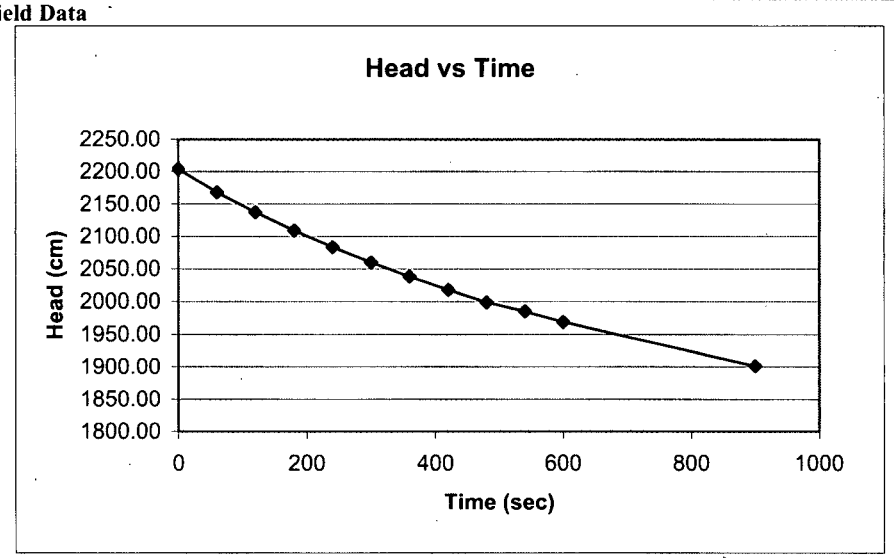
L	is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

1.89E-05

Graph of Field Data

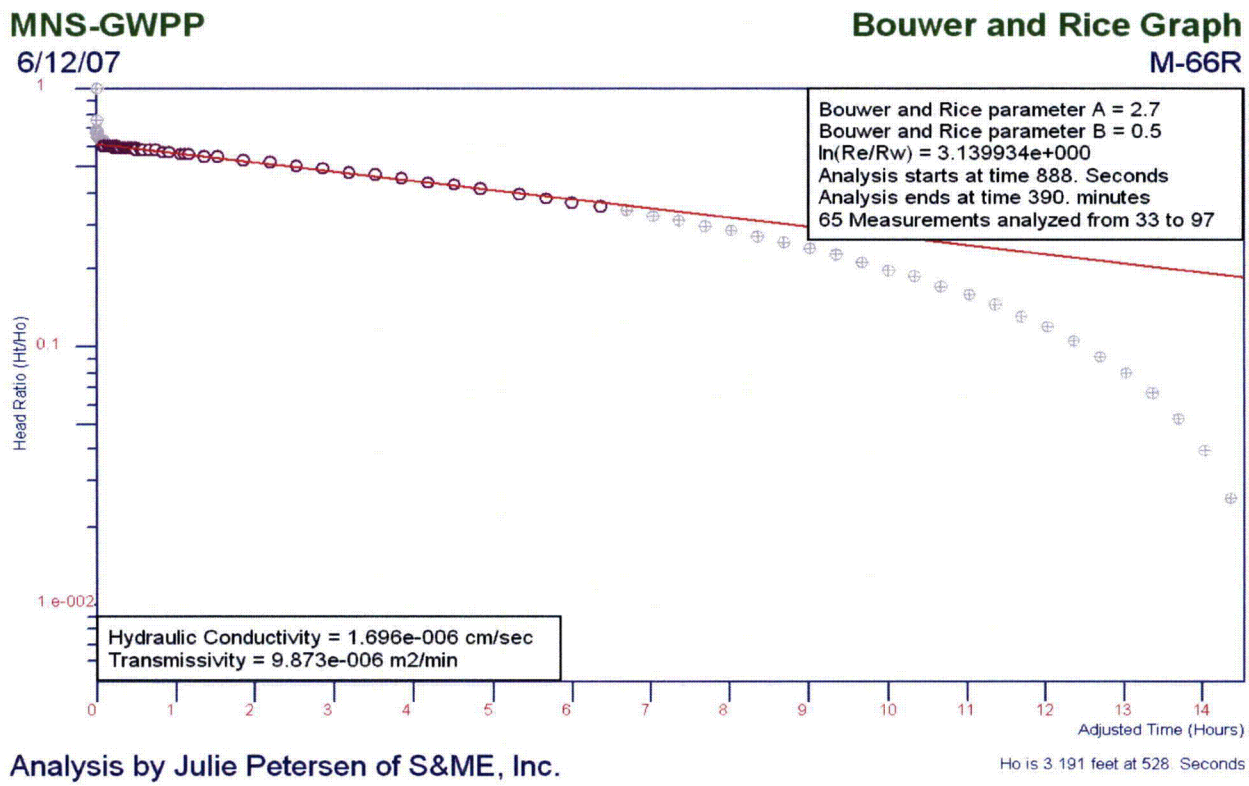


Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	MNS-GWPP
Test Date:	6/12/2007
Well Label:	M-66R
Aquifer Thickness:	31.84 feet
Screen Length:	5. feet
Casing Radius:	1. Inches
Effective Radius:	1.5 Inches
Static Water Level:	48.96 feet
Water Table to Screen Bottom:	26.84 feet
Anisotropy Ratio:	1

Time Adjustment: 528. Seconds
Test starts with trial 0
There are 121 time and drawdown measurements
Maximum head is 3.191 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



Analysis by Julie Petersen of S&ME, Inc.

PERMEABILITY

1.70E-06 cm/sec

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S&ME, Inc.
9751 Southern Pine Blvd.
Charlotte, North Carolina
Telephone: 704-523-4726
Fax: 704-525-3953

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.

Project: **MNS - Groundwater Protection Project**			**Boring No. M-70**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 1 of 1
Boring Depth (ft): **21.0**	Elevation (ft): **760.4**	Driller: **Justin Millwood, NC Cert. No. 3439**	Date Drilled: **6/19/07**
Logged By: **Courtney Withers**	Water Level: **Stabilized Water Level at 11.45 ft bls**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Lithology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
760			**ASPHALT**		
			FILL (F): Red and Yellow, Micaceous, Slightly Sandy, Clayey, **SILT** With Manganese Staining		
755	5				
			SOIL/SAPROLITE (M1): Red, White, and Yellow, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Staining		
750	10				
			SOIL/SAPROLITE (M1): Red, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Nodules		
745	15		SOIL/SAPROLITE (M1): Yellowish-Tan, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Staining		
			SOIL/SAPROLITE (M1): Red, Yellowish-Tan, and White, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Staining		
740	20				
			Boring Terminated at 21.00 ft bls **Lithologic Descriptions Obtained From M-70DR**		

COMPLETION REPORT OF WELL No. M-70

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

WATER LEVEL: **Stabilized Water Level at 11.45 ft bls**

LATITUDE: **35 26 01.23**
LONGITUDE: **80 56 57.16**
TOP OF CASING ELEVATION: **760.18**
DATUM: **MSL**
LOGGED BY: **Courtney Withers**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **4¼" H.S.A.**
DATE DRILLED: **6/19/07**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00		760.44
ASPHALT		0		1.50		758.94
FILL (F): Red and Yellow, Micaceous, Slightly Sandy, Clayey, **SILT** With Manganese Staining		5		4.00		756.44
SOIL/SAPROLITE (M1): Red, White, and Yellow, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Staining		10				
SOIL/SAPROLITE (M1): Red, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Nodules		15				
SOIL/SAPROLITE (M1): Yellowish-Tan, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Staining		20		20.50		739.94
SOIL/SAPROLITE (M1): Red, Yellowish-Tan, and White, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Staining				21.00		739.44

WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter: **8"**
Type: **Steel Flush Mount**
Interval: **At Grade**

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 6 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 1.5 ft bls**

SEAL
Type: **Bentonite**
Interval: **1.5 to 4 ft bls**

FILTERPACK
Type: **#1 Filter Sand**
Interval: **4 to 21 ft bls**

SCREEN
Diameter: **2"**
Type: **0.010 Slotted Sch. 40 PVC**
Interval: **6 to 21 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL MNSLOG.GPJ S&ME.GDT 3/26/08

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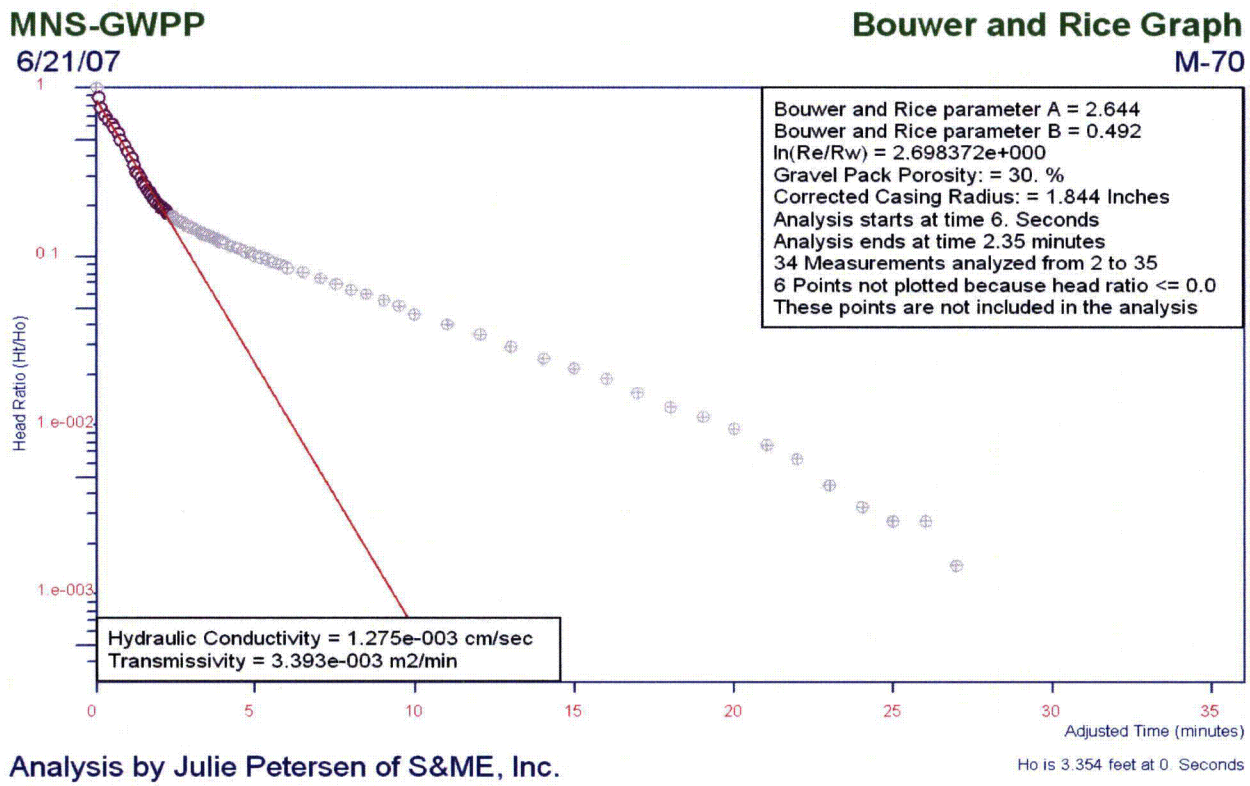
COMPLETION REPORT OF WELL No. M-70

Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	MNS-GWPP
Test Date:	6/21/2007
Well Label:	M-70
Aquifer Thickness:	14.55 feet
Screen Length:	15. feet
Casing Radius:	1. Inches
Effective Radius:	3. Inches
Gravel Pack Porosity:	30.00%
Corrected Casing Radius:	1.844 Inches
Static Water Level:	11.45 feet
Water Table to Screen Bottom:	9.55 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 119 time and drawdown measurements
Maximum head is 3.354 feet
Minimum head is -1.2e-002 feet

Calculation by Bouwer and Rice Graphical Method



Analysis by Julie Petersen of S&ME, Inc.

PERMEABILITY

1.28E-03 cm/sec

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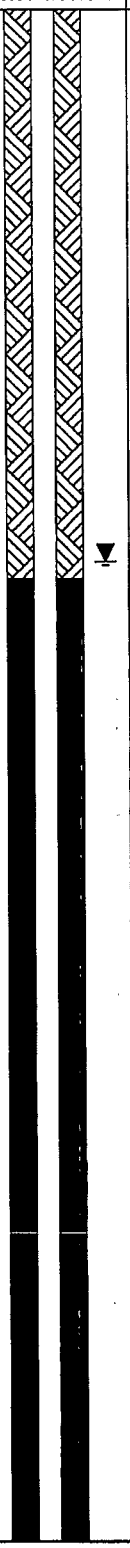
1. BORING AND SAMPLING IS IN ACCORDANCE WITH ASTM D-1586.
2. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

Project: **MNS - Groundwater Protection Project**			**Boring No. M-70R**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 1 of 2
Boring Depth (ft): **65.5**	Elevation (ft): **760.4**	Driller: **Justin Millwood, NC Cert. No. 3439**	Date Drilled: **6/18/07**
Logged By: **Courtney Withers**	Water Level: **Stabilized Water Level at 12.63 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Material Description
760		**ASPHALT**
		FILL (F): Red and Yellow, Micaceous, Slightly Sandy, Clayey, **SILT** With Manganese Staining
755	5	
		SOIL/SAPROLITE (M1): Red, White, and Yellow, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Staining
750	10	
		SOIL/SAPROLITE (M1): Red, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Nodules
745	15	SOIL/SAPROLITE (M1): Yellowish-Tan, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Staining
		SOIL/SAPROLITE (M1): Red, Yellowish-Tan, and White, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Staining
740	20	
735	25	
		SOIL/SAPROLITE (M1): Tan and White, Coarse **SAND** Lense
		SOIL/SAPROLITE (M1): Brown, Micaceous, Slightly Clayey, Fine Sandy, **SILT** With Manganese Staining
730	30	
		SOIL/SAPROLITE (M1): Brownish-Orange and White, Micaceous, Fine Sandy, **SILT** With Manganese Staining

Well Construction



Penetration Resistance (Blows/Foot)
0 50 100

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Project: **MNS - Groundwater Protection Project**			**Boring No. M-70R**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 2 of 2
Boring Depth (ft): **65.5**	Elevation (ft): **760.4**	Driller: **Justin Millwood, NC Cert. No. 3439**	Date Drilled: **6/18/07**
Logged By: **Courtney Withers**	Water Level: **Stabilized Water Level at 12.63 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
725					
720	40				
715	45				
710	50		WEATHERED ROCK (M2): When Sampled Becomes Tan and White, Micaceous, Fine Sandy, **SILT** With Manganese Staining		
			WEATHERED ROCK (M2): When Sampled Becomes Brownish-Orange and White, Micaceous, Silty, Medium to Fine **SAND** With Manganese Staining		
705	55		WEATHERED ROCK (M2): When Sampled Becomes Tan, White, and Black, Micaceous, Silty, Medium to Fine **SAND**		
700	60				
695	65		WEATHERED ROCK (M2): When Sampled Becomes Orange, Tan, Black, and White, Micaceous, Silty, Medium to Fine **SAND** With Manganese Staining		
			Roller Cone Refusal at 65.45 ft bls **Lithologic Descriptions Obtained From M-70DR**		

COMPLETION REPORT OF WELL No. M-70R

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

WATER LEVEL: **Stabilized Water Level at 12.63 ft bls**
LATITUDE: **35 26 01.23**
LONGITUDE: **80 56 57.10**
TOP OF CASING ELEVATION: **760.22**
DATUM: **MSL**
LOGGED BY: **Courtney Withers**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **Mud Rotary**
DATE DRILLED: **6/18/07**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00		760.44
ASPHALT		0				
FILL (F): Red and Yellow, Micaceous, Slightly Sandy, Clayey, **SILT** With Manganese Staining		5				
SOIL/SAPROLITE (M1): Red, White, and Yellow, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Staining		10		13.00		747.44
SOIL/SAPROLITE (M1): Red, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Nodules		15				
SOIL/SAPROLITE (M1): Yellowish-Tan, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Staining		20				
SOIL/SAPROLITE (M1): Red, Yellowish-Tan, and White, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Staining		25				
SOIL/SAPROLITE (M1): Tan and White, Coarse **SAND** Lense		30				
SOIL/SAPROLITE (M1): Brown, Micaceous, Slightly Clayey, Fine Sandy, **SILT** With						

WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter: **8"**
Type: **Steel Flush Mount**
Interval: **At Grade**

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 55.45 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 13 ft bls**

SEAL
Type: **Bentonite**
Interval: **13 to 53.5 ft bls**

FILTERPACK
Type: **#1 Filter Sand**
Interval: **53.5 to 65.45 ft bls**

SCREEN
Diameter: **2"**
Type: **0.010 Slotted Sch. 40 PVC**
Interval: **55.45 to 65.45 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

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COMPLETION REPORT OF WELL No. M-70R

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

GROUND SURFACE ELEVATION: **760.4**
LOGGED BY: **Courtney Wither**
CHECKED BY:

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
							(See Page 1)
Manganese Staining SOIL/SAPROLITE (M1): Brownish-Orange and White, Micaceous, Fine Sandy, **SILT** With Manganese Staining *(continued)*		35, 40, 45					
WEATHERED ROCK (M2): When Sampled Becomes Tan and White, Micaceous, Fine Sandy, **SILT** With Manganese Staining		50					
WEATHERED ROCK (M2): When Sampled Becomes Brownish-Orange and White, Micaceous, Silty, Medium to Fine **SAND** With Manganese Staining		55		53.50		706.94	
WEATHERED ROCK (M2): When Sampled Becomes Tan, White, and Black, Micaceous, Silty, Medium to Fine **SAND**		60					
WEATHERED ROCK (M2): When Sampled Becomes Orange, Tan, Black, and White, Micaceous, Silty, Medium to Fine **SAND** With Manganese Staining		65		65.00 65.45		695.44 694.99	

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

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COMPLETION REPORT OF WELL No. M-70R

MONITORING WELL MNSLOG.GPJ S&ME.GDT 3/26/08

CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD
(Open Hole in Uniform Material)

S&ME

Site Name:	MNS - GWPP	
Date:	6/15/2007	
Boring I.D.	M-70R	
Test Interval:	49.2' to 52.2'	(Weathered Rock)
Total Depth of Hole:	52.2 ft	1591.46 cm
Length of Open Hole:	3 ft	91.46 cm
Transformation Ratio m=	1	
Performed by:	Julie Petersen	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	1618.81	
60	1618.29	1.35E-06
120	1618.05	6.34E-07
180	1617.74	7.92E-07
240	1617.41	8.72E-07
300	1617.07	8.72E-07
360	1616.71	9.51E-07
420	1616.37	8.72E-07
480	1616.01	9.52E-07
540	1615.61	1.03E-06
600	1615.21	1.03E-06
900	1613.45	9.21E-07
1200	1611.46	1.03E-06
1500	1609.24	1.16E-06
1800	1606.86	1.24E-06
2400	1602.26	1.21E-06
3000	1597.50	1.25E-06
3600	1592.68	1.27E-06

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

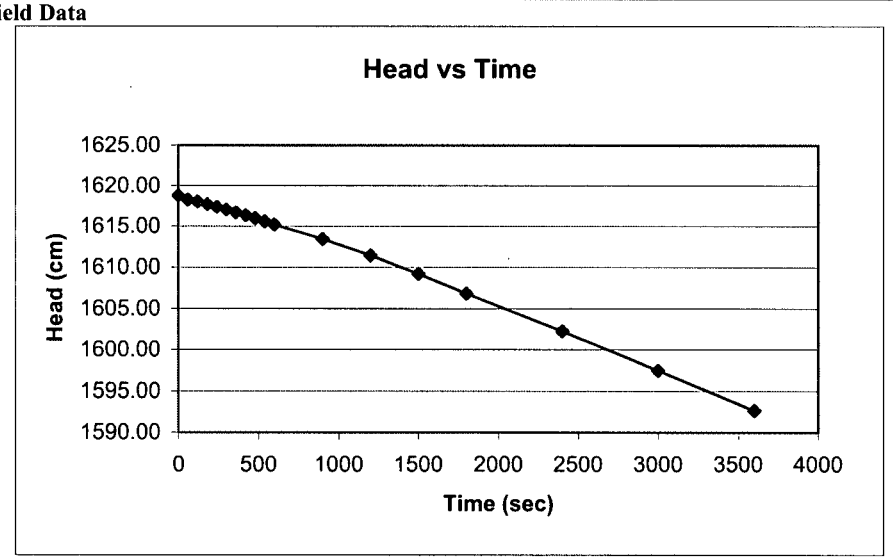
K_h	is the Horizontal Coefficient of Permeability (cm/sec)
H_1	is the Piezometric Head for time; $t = t_1$ (cm)
H_2	is the Piezometric Head for time; $t = t_2$ (cm)
D	is the Diameter of the Standpipe (cm)
d	is the diameter of the Open Length (cm),
m	is the Transformation Ratio, Where
	$m = \sqrt{K_h / K_v}$ K_h is the Horizontal Permeability, K_v is the Vertical Permeability
L	is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

1.03E-06

Graph of Field Data

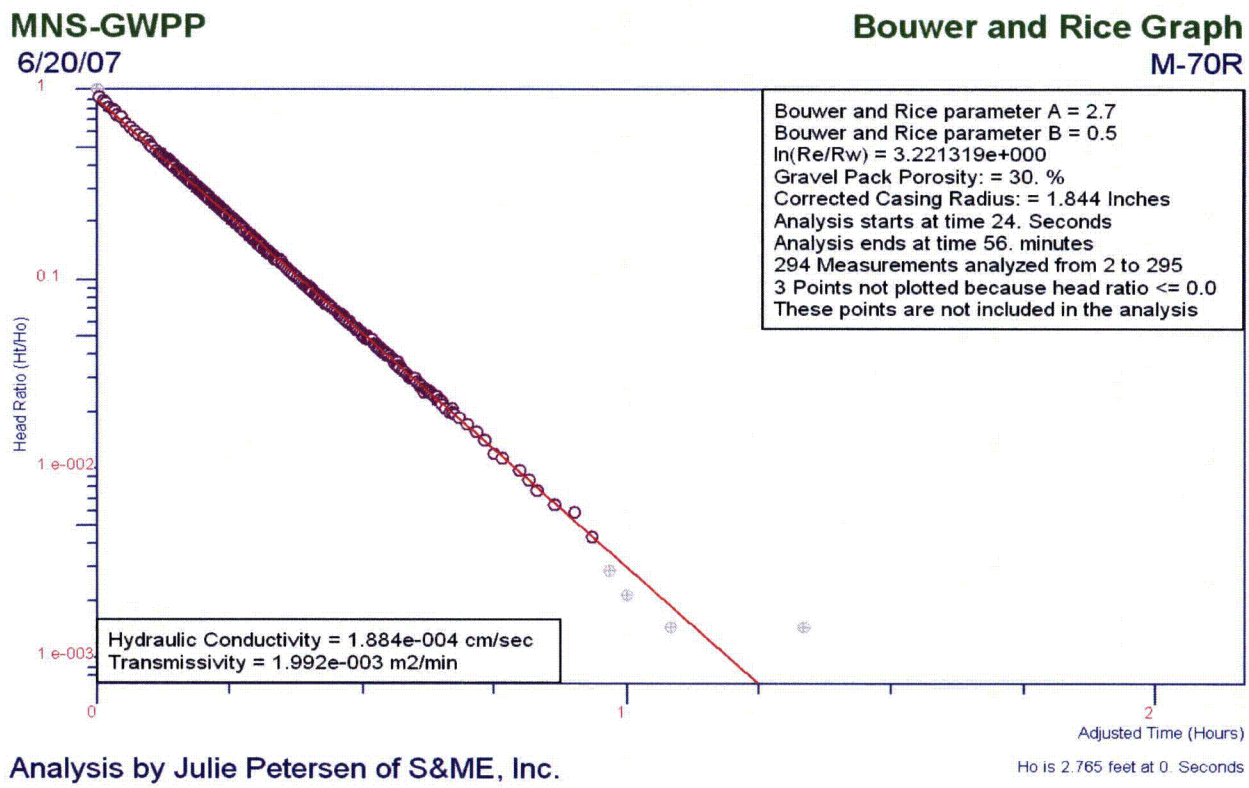


Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	MNS-GWPP
Test Date:	6/20/2007
Well Label:	M-70R
Aquifer Thickness:	57.82 feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	3. Inches
Gravel Pack Porosity:	30.00%
Corrected Casing Radius:	1.844 Inches
Static Water Level:	12.63 feet
Water Table to Screen Bottom:	52.82 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 302 time and drawdown measurements
Maximum head is 2.765 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



Analysis by Julie Petersen of S&ME, Inc.

PERMEABILITY

1.88E-04 cm/sec

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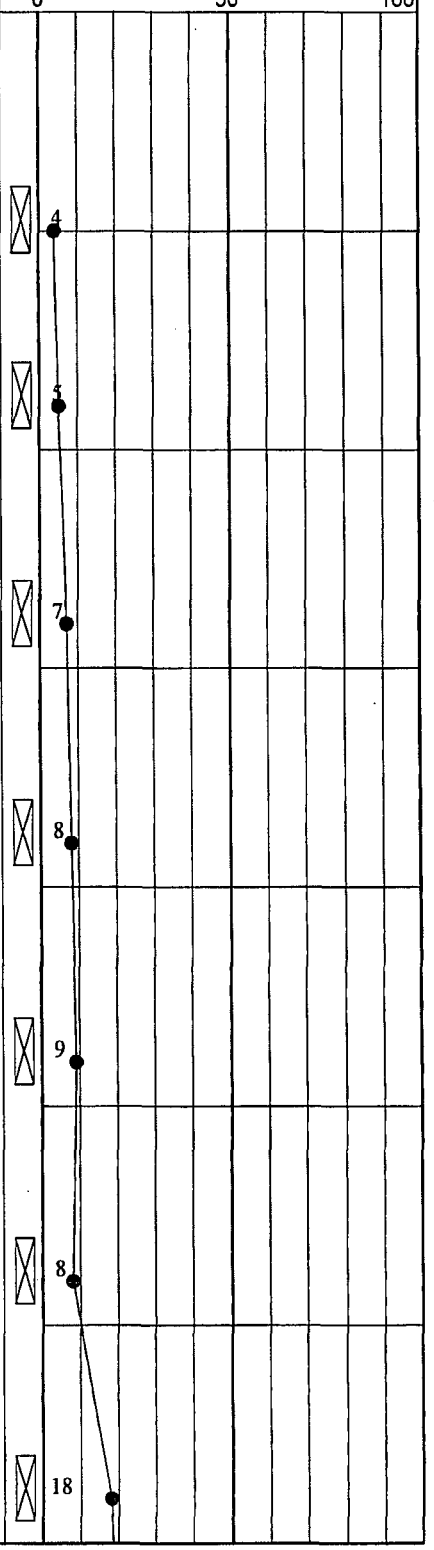
Project: **MNS - Groundwater Protection Project**			**Boring No. M-70DR**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 1 of 3
Boring Depth (ft): **94.5**	Elevation (ft): **760.4**	Driller: **Justin Millwood, NC Cert. No. 3439**	Date Drilled: **6/6/07**
Logged By: **Courtney Withers**	Water Level: **Stabilized Water Level at 13.20 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lithology	Material Description
760			**ASPHALT**
			GRAVEL
755	5		FILL (F): Red and Yellow, Micaceous, Slightly Sandy, Clayey, **SILT** With Manganese Staining
750	10		SOIL/SAPROLITE (M1): Red, White, and Yellow, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Staining
745	15		SOIL/SAPROLITE (M1): Red, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Nodules
			SOIL/SAPROLITE (M1): Yellowish-Tan, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Staining
740	20		SOIL/SAPROLITE (M1): Red, Yellowish-Tan, and White, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Staining
735	25		
			SOIL/SAPROLITE (M1): Tan and White, Coarse **SAND** Lense
730	30		SOIL/SAPROLITE (M1): Brown, Micaceous, Slightly Clayey, Fine Sandy, **SILT** With Manganese Staining
			SOIL/SAPROLITE (M1): Brownish-Orange and White, Micaceous, Fine Sandy, **SILT** With Manganese Staining

Well Construction

Penetration Resistance (Blows/Foot)



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Project: **MNS - Groundwater Protection Project**			**Boring No. M-70DR**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 2 of 3
Boring Depth (ft): **94.5**	Elevation (ft): **760.4**	Driller: **Justin Millwood, NC Cert. No. 3439**	Date Drilled: **6/6/07**
Logged By: **Courtney Withers**	Water Level: **Stabilized Water Level at 13.20 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
725					
	40				21
720					
					19
	45				
715					
			WEATHERED ROCK (M2): When Sampled Becomes Tan and White, Micaceous, Fine Sandy, **SILT** With Manganese Staining		50/5 >>
	50				
710			WEATHERED ROCK (M2): When Sampled Becomes Brownish-Orange and White, Micaceous, Silty, Medium to Fine **SAND** With Manganese Staining		
			WEATHERED ROCK (M2): When Sampled Becomes Tan, White, and Black, Micaceous, Silty, Medium to Fine **SAND**		50/5 >>
	55				
705					50/3 >>
	60				
700					50/4 >>
			WEATHERED ROCK (M2): When Sampled Becomes Orange, Tan, Black, and White, Micaceous, Silty, Medium to Fine **SAND** With Manganese Staining		
	65		**Roller Cone Refusal at 65.55 ft bls**		
695			PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **META GABBRO** With Intermittent Fine and Coarse-Grained **META GABBRO** and Soil Seams, Very Intensely Fractured		

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Project: **MNS - Groundwater Protection Project**			**Boring No. M-70DR**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 3 of 3
Boring Depth (ft): **94.5**	Elevation (ft): **760.4**	Driller: **Justin Millwood, NC Cert. No. 3439**	Date Drilled: **6/6/07**
Logged By: **Courtney Withers**	Water Level: **Stabilized Water Level at 13.20 ft bls**		Drilling Method: **Mud Rotary**

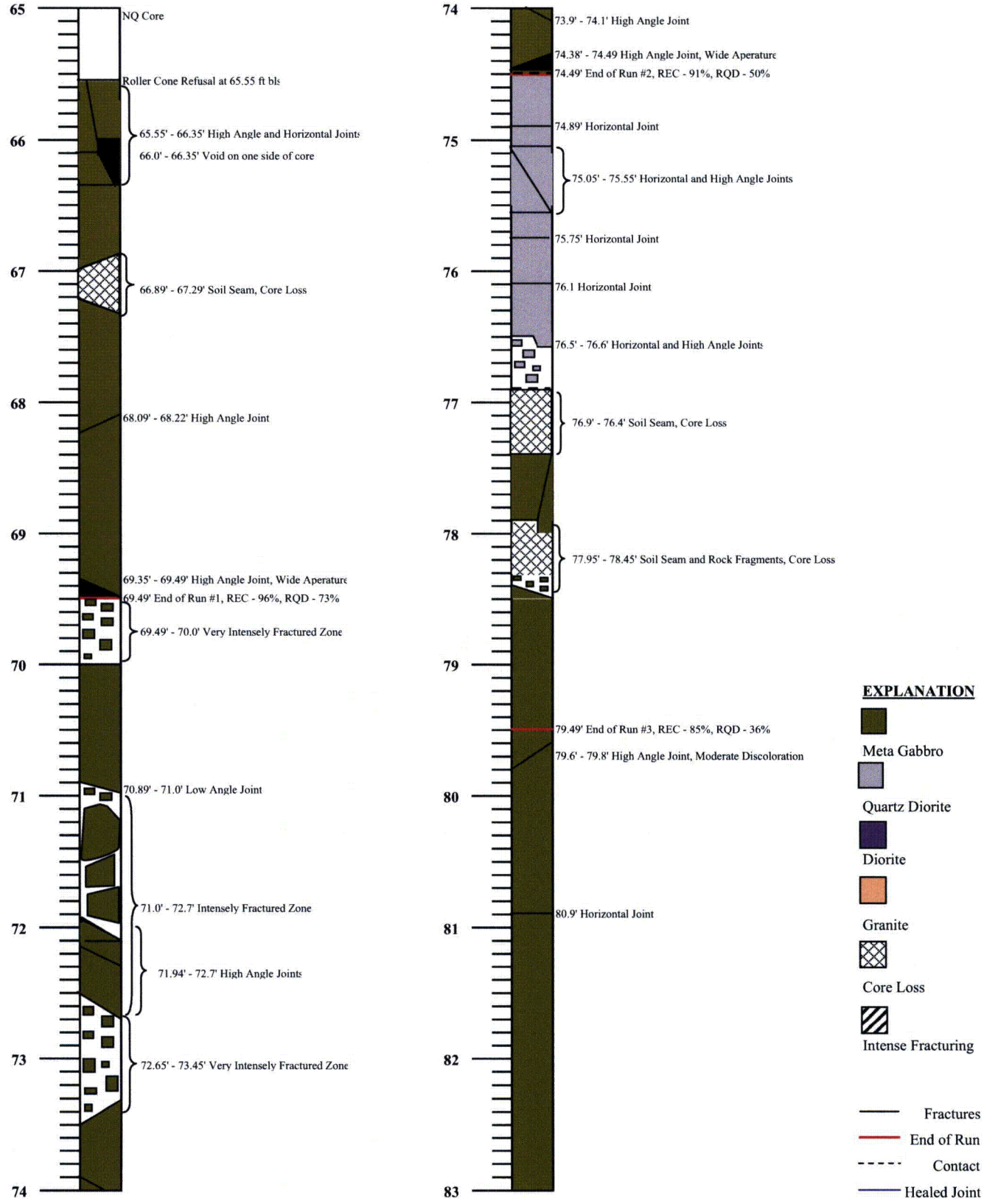
Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
690					
685	75		SOUND ROCK (D): Medium-Grained **QUARTZ DIORITE**, Moderately Fractured		
			PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **META GABBRO** With Intermittent Soil Seams and Quartz Veins, Very Intensely Fractured		
680	80		SOUND ROCK (D): Medium-Grained **META GABBRO**, Slightly Fractured		
675	85				
670	90		SOUND ROCK (D): Fine and Medium-Grained **QUARTZ DIORITE** With Intermittent Medium-Grained **META GABBRO**, Slightly Fractured		
			Boring Terminated at 94.49 ft bls		

FIELD ROCK CORE LOG

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-70DR

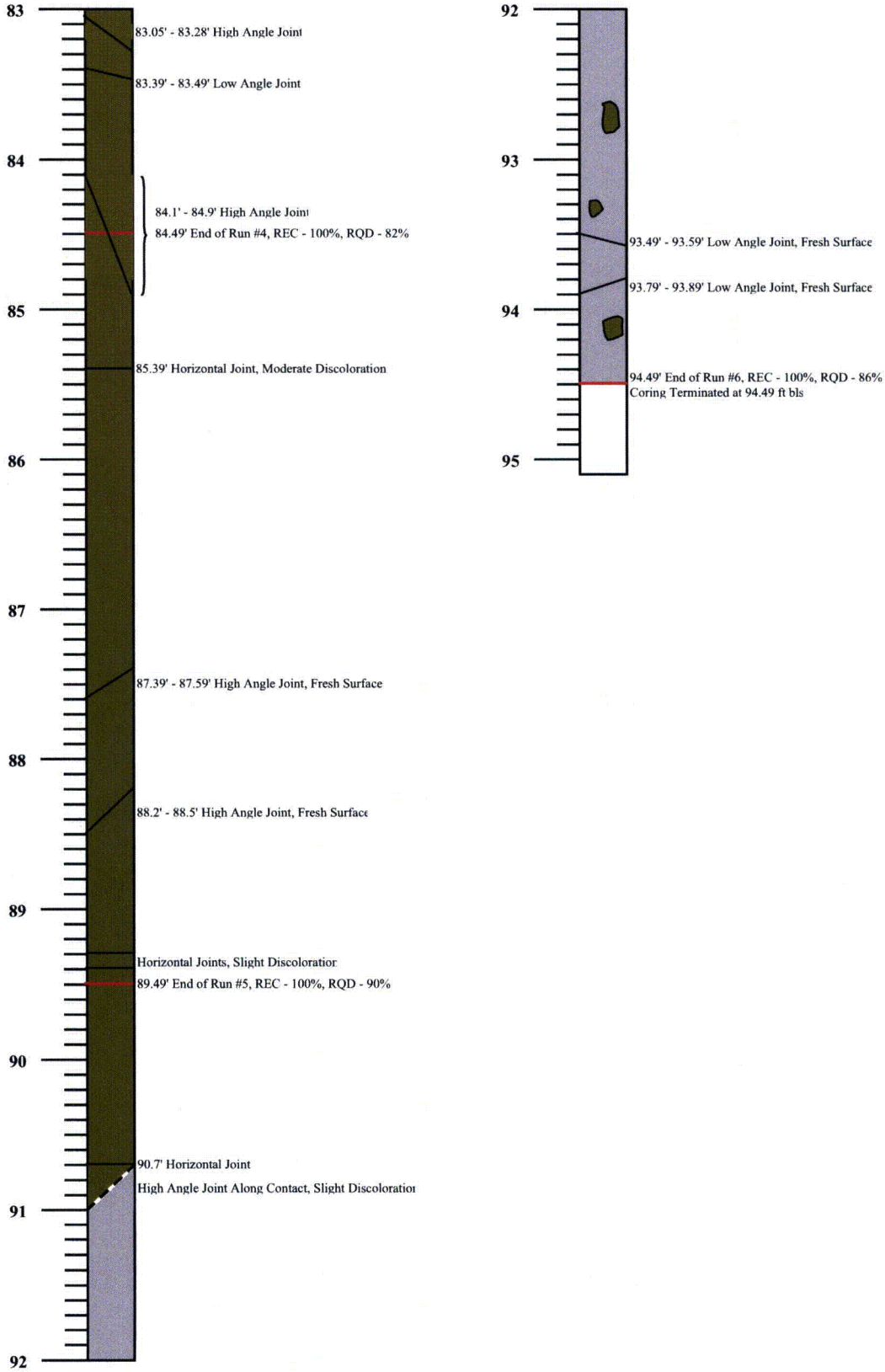


FIELD ROCK CORE LOG

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-70DR



EXPLANATION

- Meta Gabbro
- Quartz Diorite
- Diorite
- Granite
- Core Loss
- Intense Fracturing

- Fractures
- End of Run
- Contact
- Healed Joint

COMPLETION REPORT OF WELL No. M-70DR

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

WATER LEVEL: **Stabilized Water Level at 13.20 ft bls**

LATITUDE: **35 26 01.21**
LONGITUDE: **80 56 57.05**
TOP OF CASING ELEVATION: **760.19**
DATUM: **MSL**
LOGGED BY: **Courtney Withers**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **Mud Rotary**
DATE DRILLED: **6/6/07**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00		760.42
ASPHALT		0				
GRAVEL						
FILL (F): Red and Yellow, Micaceous, Slightly Sandy, Clayey, **SILT** With Manganese Staining		5		7.00		753.42
SOIL/SAPROLITE (M1): Red, White, and Yellow, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Staining		10				
SOIL/SAPROLITE (M1): Red, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Nodules		15				
SOIL/SAPROLITE (M1): Yellowish-Tan, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Staining		20				
SOIL/SAPROLITE (M1): Red, Yellowish-Tan, and White, Micaceous, Slightly Clayey, Medium to Fine Sandy, **SILT** With Manganese Staining		25				
SOIL/SAPROLITE (M1): Tan and White, Coarse **SAND** Lense		30				
SOIL/SAPROLITE (M1): Brown, Micaceous, Slightly Clayey, Fine Sandy,						

WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter: **8"**
Type: **Steel Flush Mount**
Interval: **At Grade**

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 72.4 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 7 ft bls**

SEAL
Type: **K-Packer + Bentonite**
Interval: **7 to 71.8 ft bls**

FILTERPACK
Type: **N/A**
Interval: **N/A**

SCREEN
Diameter: **2"**
Type: **0.010 Slotted Sch. 40 PVC**
Interval: **72.4 to 77.4 ft bls**

LEGEND
- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

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COMPLETION REPORT OF WELL No. M-70DR

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

GROUND SURFACE ELEVATION:
LOGGED BY: **760.4**
CHECKED BY: **Courtney Wither**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
							(See Page 1)
SILT With Manganese Staining		35					
SOIL/SAPROLITE (M1): Brownish-Orange and White, Micaceous, Fine Sandy, **SILT** With Manganese Staining *(continued)*		40 45					
WEATHERED ROCK (M2): When Sampled Becomes Tan and White, Micaceous, Fine Sandy, **SILT** With Manganese Staining		50					
WEATHERED ROCK (M2): When Sampled Becomes Brownish-Orange and White, Micaceous, Silty, Medium to Fine **SAND** With Manganese Staining		55					
WEATHERED ROCK (M2): When Sampled Becomes Tan, White, and Black, Micaceous, Silty, Medium to Fine **SAND**		60					
WEATHERED ROCK (M2): When Sampled Becomes Orange, Tan, Black, and White, Micaceous, Silty, Medium to Fine **SAND** With Manganese Staining		65					
PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **META GABBRO** With Intermittent Fine and Coarse-Grained **META GABBRO** and Soil Seams, Very Intensely Fractured		70 75		71.60 71.80 72.40 76.90		688.82 688.62 688.02 683.52	
SOUND ROCK (D): Medium-Grained				77.40 77.80		683.02 682.62	

LEGEND

	FILTER PACK	TOC	TOP OF CASING
	BENTONITE	GS	GROUND SURFACE
	CEMENT GROUT	BS	BENTONITE SEAL
	CUTTINGS / BACKFILL	FP	FILTER PACK
	STATIC WATER LEVEL	TSC	TOP OF SCREEN
		BSC	BOTTOM OF SCREEN
		TD	TOTAL DEPTH
		CG	CEMENT GROUT

MONITORING WELL MNSLOG.GPJ S&ME.GDT 3/26/08

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COMPLETION REPORT OF WELL No. M-70DR

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

GROUND SURFACE ELEVATION:
LOGGED BY: **760.4**
CHECKED BY: **Courtney Wither**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
							(See Page 1)
QUARTZ DIORITE, Moderately Fractured		80		78.00		682.42	
PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **META GABBRO** With Intermittent Soil Seams and Quartz Veins, Very Intensely Fractured		85					
SOUND ROCK (D): Medium-Grained **META GABBRO,** Slightly Fractured *(continued)*		90					
SOUND ROCK (D): Fine and Medium-Grained **QUARTZ DIORITE** With Intermittent Medium-Grained **META GABBRO,** Slightly Fractured				94.49		665.93	

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL MNSLOG.GPJ S&ME.GDT 3/26/08

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COMPLETION REPORT OF WELL No. M-70DR

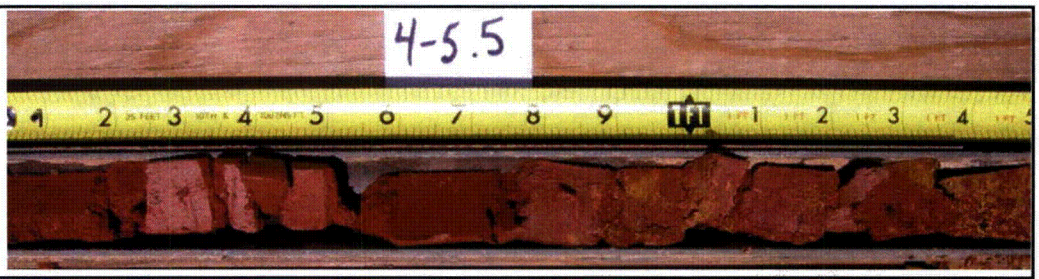
SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Boring Number: M-70DR

Sample No: 1
Depth (ft-bls): 4-5.5
Blow Count: 2 * 2 * 2



Sample No: 2
Depth (ft-bls): 8-9.5
Blow Count: 3 * 2 * 3

Sample No: 3
Depth (ft-bls): 13-14.5
Blow Count: 2 * 3 * 4

Sample No: 4
Depth (ft-bls): 18-19.5
Blow Count: 2 * 3 * 5

Sample No: 5
Depth (ft-bls): 23-24.5
Blow Count: 2 * 3 * 6

Sample No: 6
Depth (ft-bls): 28-29.5
Blow Count: 3 * 4 * 4

SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Boring Number: M-70DR

Sample No: 7
Depth (ft-bls): 33-34.5
Blow Count: 4 * 7 * 11

Sample No: 8
Depth (ft-bls): 38-39.5
Blow Count: 5 * 9 * 12

Sample No: 9
Depth (ft-bls): 43-44.5
Blow Count: 4 * 7 * 12

Sample No: 10
Depth (ft-bls): 48-49.5
Blow Count: 9 * 17 * 50/5

Sample No: 11
Depth (ft-bls): 53-54.5
Blow Count: 50/5

Sample No: 12
Depth (ft-bls): 58-59.5
Blow Count: 50/3

SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Boring Number: **M-70DR**

Sample No: 13

Depth (ft-bls): 63-64.5

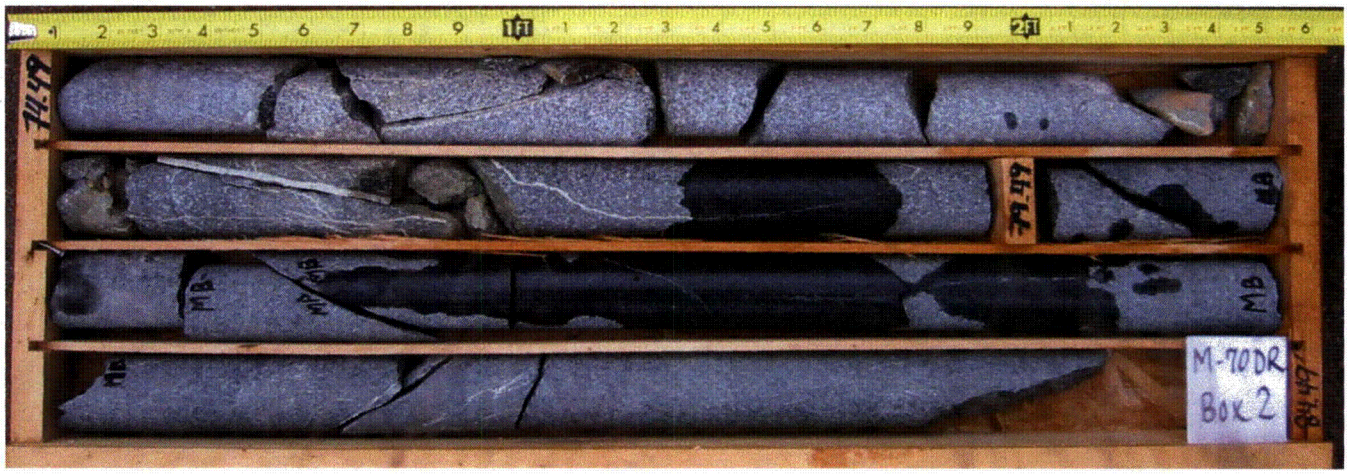
Blow Count: 50/4

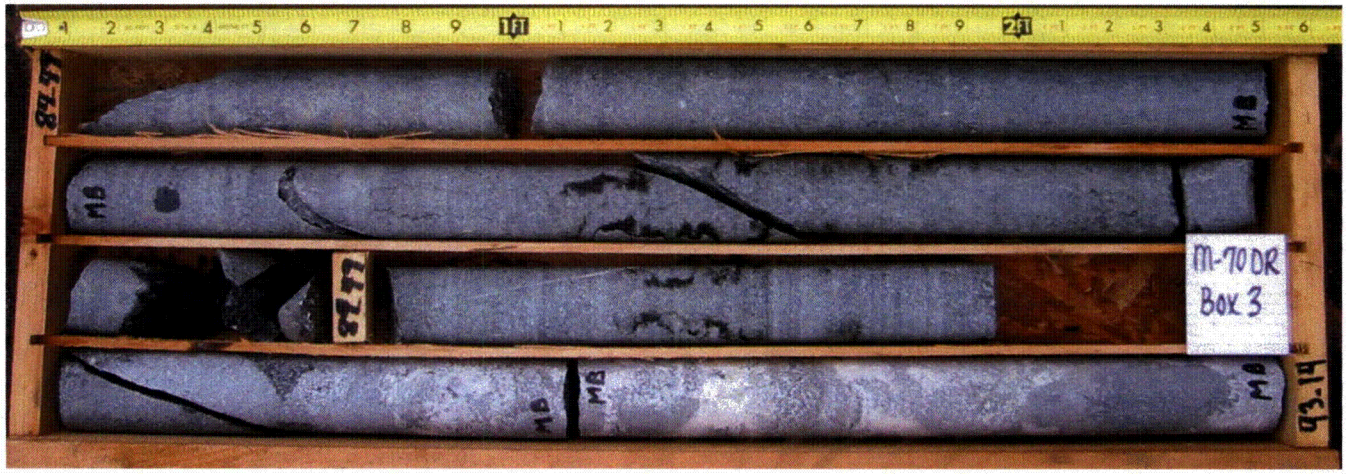
ROCK CORE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-70DR





ROCK CORE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-70DR

CLASSIFICATION:

65.59' - 74.49': Medium-Grained Meta Gabbro With Intermittent Fine and Coarse-Grained Meta Gabbro and Intermittent Soil Seams

74.49' - 76.89': Medium-Grained Quartz Diorite

76.89' - 78.49': Medium-Grained Meta Gabbro With Intermittent Soil Seams and Quartz Veins

78.49' - 90.84': Medium-Grained Meta Gabbro

90.84' - 94.49': Fine and Medium-Grained Quartz Diorite With Intermittent Medium-Grained Meta Gabbro

CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD
(Open Hole in Uniform Material)

S&ME

Site Name:	MNS - GWPP	
Date:	6/11/2007	
Boring I.D.	M-70DR	
Test Interval:	65.59' to 69.49'	(PWR/Sound Rock)
Total Depth of Hole:	69.49 ft	2118.6 cm
Length of Open Hole:	3.9 ft	118.9 cm
Transformation Ratio m=	1	
Performed by:	Julie Petersen	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	2141.10	
60	2137.80	5.39E-06
120	2133.69	6.75E-06
180	2129.02	7.66E-06
240	2124.70	7.13E-06
300	2120.49	6.94E-06
360	2116.46	6.65E-06
420	2112.44	6.66E-06
480	2108.69	6.22E-06
540	2104.91	6.28E-06
600	2101.04	6.45E-06
900	2081.34	6.59E-06
1200	2062.56	6.35E-06
1500	2046.25	5.56E-06
1800	2032.10	4.86E-06
2400	2006.68	4.41E-06
3000	1984.21	3.94E-06
3600	1964.51	3.49E-06

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

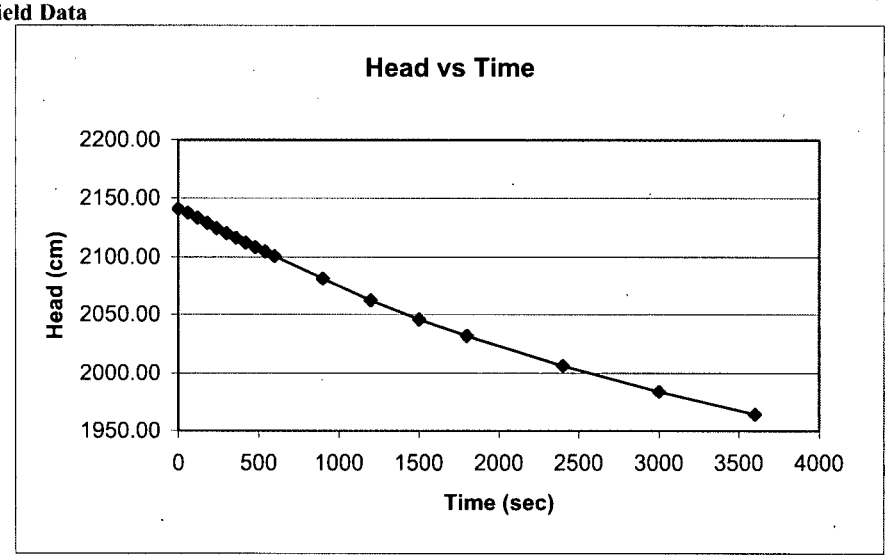
K_h	is the Horizontal Coefficient of Permeability (cm/sec)
H_1	is the Piezometric Head for time; $t = t_1$ (cm)
H_2	is the Piezometric Head for time; $t = t_2$ (cm)
D	is the Diameter of the Standpipe (cm)
d	is the diameter of the Open Length (cm),
m	is the Transformation Ratio, Where
	$m = \sqrt{K_h / K_v}$ — K_h is the Horizontal Permeability; K_v is the Vertical Permeability
L	is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

5.96E-06

Graph of Field Data



CALCULATION OF PERMEABILITY BY THE FALLING HEAD METHOD
(Open Hole in Uniform Material)

S&ME

Site Name:	MNS - GWPP	
Date:	6/11/2007	
Boring I.D.	M-70DR	
Test Interval:	65.59' to 74.49'	(PWR/Sound Rock)
Total Depth of Hole:	74.49 ft	2271.04 cm
Length of Open Hole:	8.9 ft	271.34 cm
Transformation Ratio m=	1	
Performed by:	Julie Petersen	

Time (sec)	Head (cm)	Permeability (cm/sec)
0	2133.45	
60	2101.89	2.83E-05
120	2075.00	2.45E-05
180	2051.01	2.21E-05
240	2029.48	2.01E-05
300	2010.55	1.78E-05
360	1992.65	1.70E-05
420	1976.04	1.59E-05
480	1960.79	1.47E-05
540	1946.49	1.39E-05
600	1933.29	1.29E-05
900	1879.54	1.07E-05

Calculations

$$K_h = \frac{d^2 \cdot \ln\left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \cdot \ln\frac{H_1}{H_2}$$

for $\frac{mL}{D} > 4$

Where:

K_h	is the Horizontal Coefficient of Permeability (cm/sec)
H_1	is the Piezometric Head for time; $t = t_1$ (cm)
H_2	is the Piezometric Head for time; $t = t_2$ (cm)
D	is the Diameter of the Standpipe (cm)
d	is the diameter of the Open Length (cm),
m	is the Transformation Ratio, Where

$$m = \sqrt{K_h / K_v}$$

K_h is the Horizontal Permeability
K_v is the Vertical Permeability

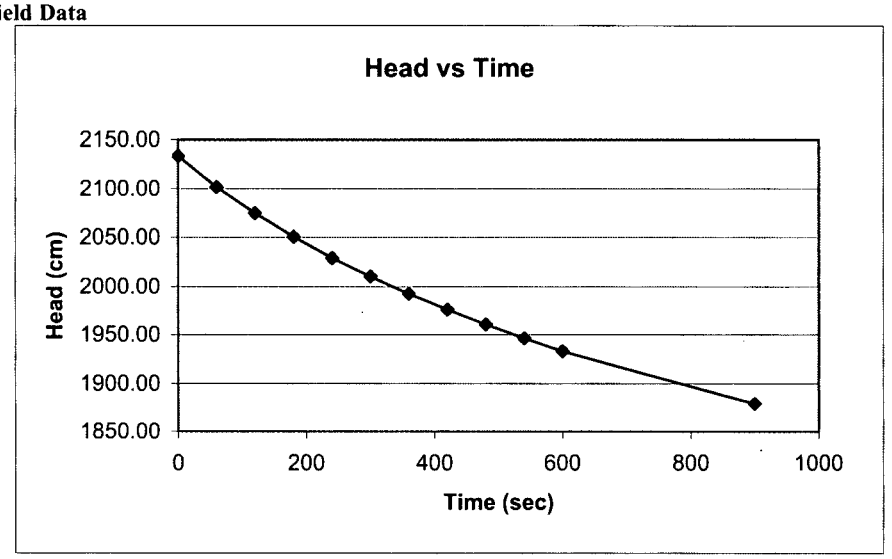
L	is the Open Length of Hole (cm)

Spreadsheet assumes 3" ID Pipe; NQ Hole, OD = 3"

MEAN PERMEABILITY (cm/sec)

1.80E-05

Graph of Field Data

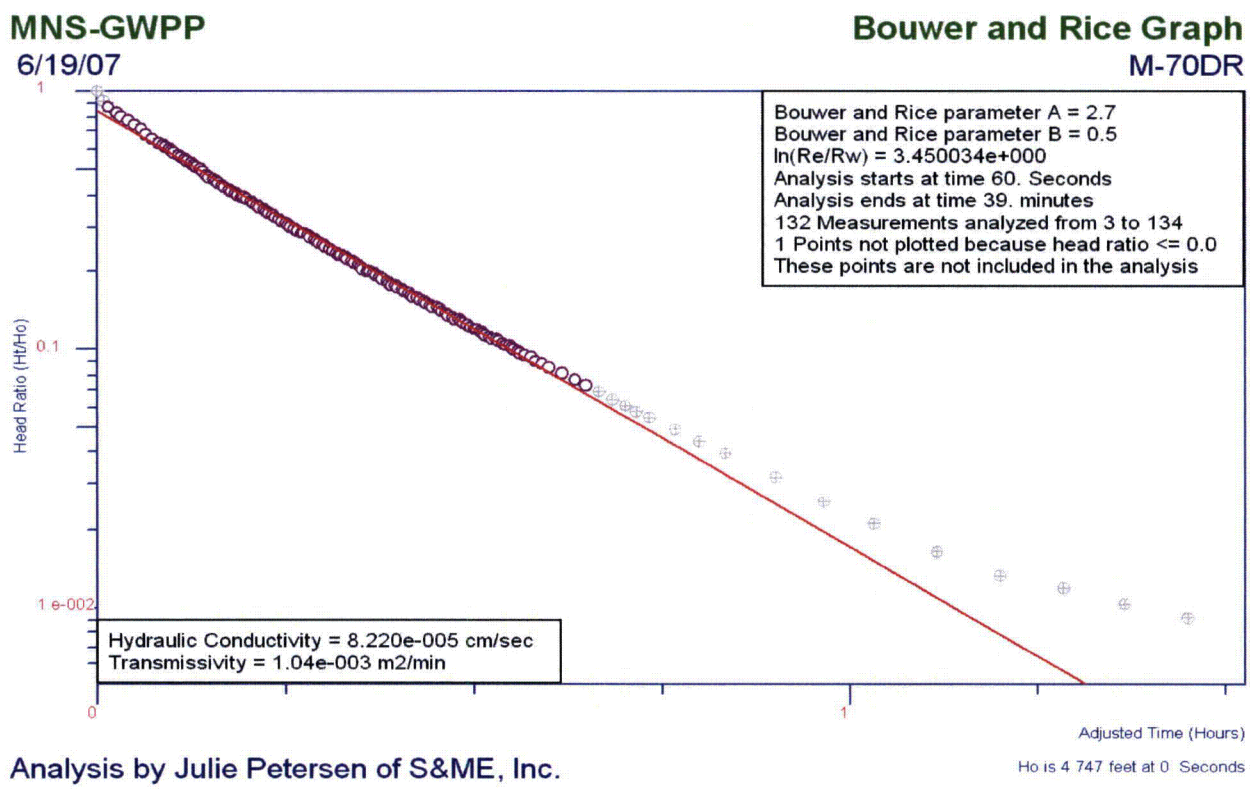


Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	MNS-GWPP
Test Date:	6/19/2007
Well Label:	M-70DR
Aquifer Thickness:	69.2 feet
Screen Length:	5. feet
Casing Radius:	1. Inches
Effective Radius:	1.5 Inches
Static Water Level:	13.2 feet
Water Table to Screen Bottom:	64.2 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 151 time and drawdown measurements
Maximum head is 4.747 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



Analysis by Julie Petersen of S&ME, Inc.

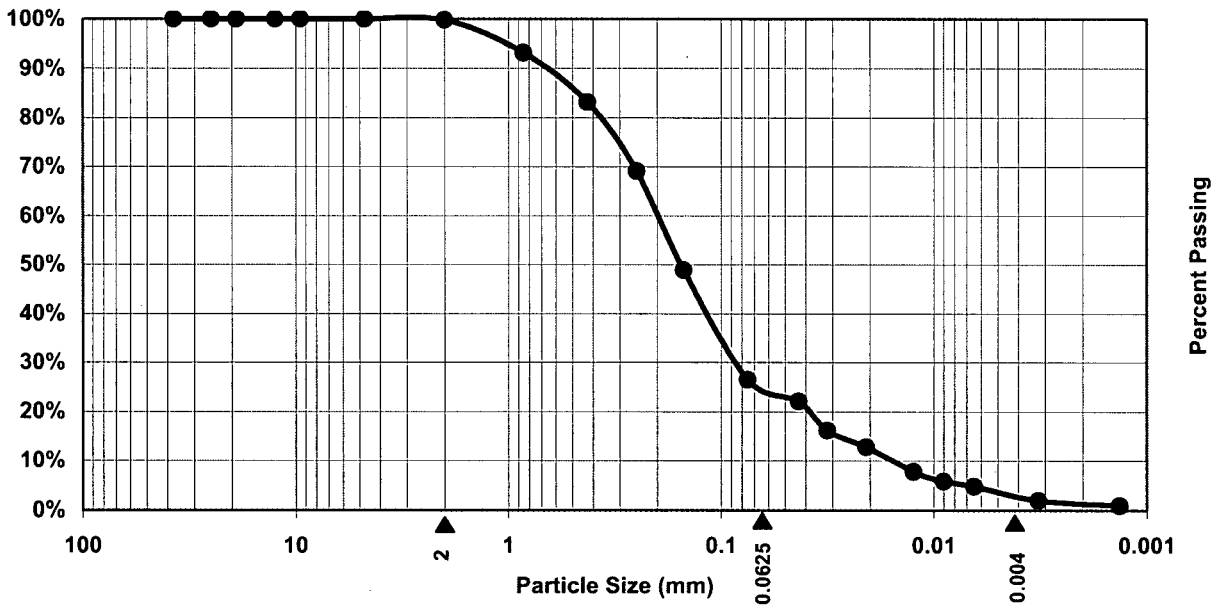
PERMEABILITY

8.22E-05 cm/sec

PARTICLE SIZE ANALYSIS OF SOILS
FOR USE IN FETTER AND BEAR DIAGRAMS

Boring No.:	**Sample No.:**	**Depth:**
M-70DR	SS-11 & SS-12	53.0-54.5 and 58.0-59.5 ft bls

Sample Description:
Tan, White, and Black, Silty, Fine to Medium Sand With Mica



	> 2 mm	2 mm - 0.0625 mm	0.0625 mm - 0.004 mm	<0.004 mm
From Graph:	% Gravel 0.2%	% Sand 74.7%	% Silt 22.4%	% Clay 2.7%
Adjusted for Calculations	**0%**	**75%**	**22%**	**3%**

Notes:
Grain size distribution taken from grain size with hydrometer data located in Appendix II.
Gravel, sand, silt and clay sizes based on Wentworth Scale.

S&ME Project:
McGuire Nuclear Station - GWPP

S&ME Project No.:
1264-06-724

S&ME

FETTER AND BEAR DIAGRAMS

S&ME PROJECT: McGuire Nuclear Station - GWPP
S&ME PROJECT NO.: 1264-06-724

Boring No. M-70DR

Boring Depth: 53.0 to 54.5 & 58.0 to 59.5 ft bls

% Sand: 75%

% Silt: 22%

% Clay: 3%

Estimated Specific Yield: 28%

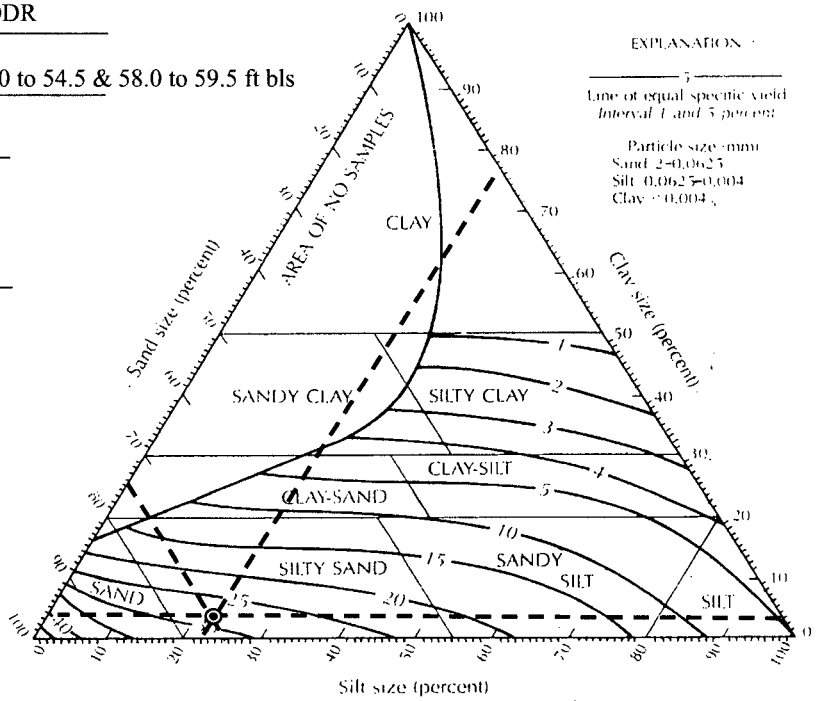
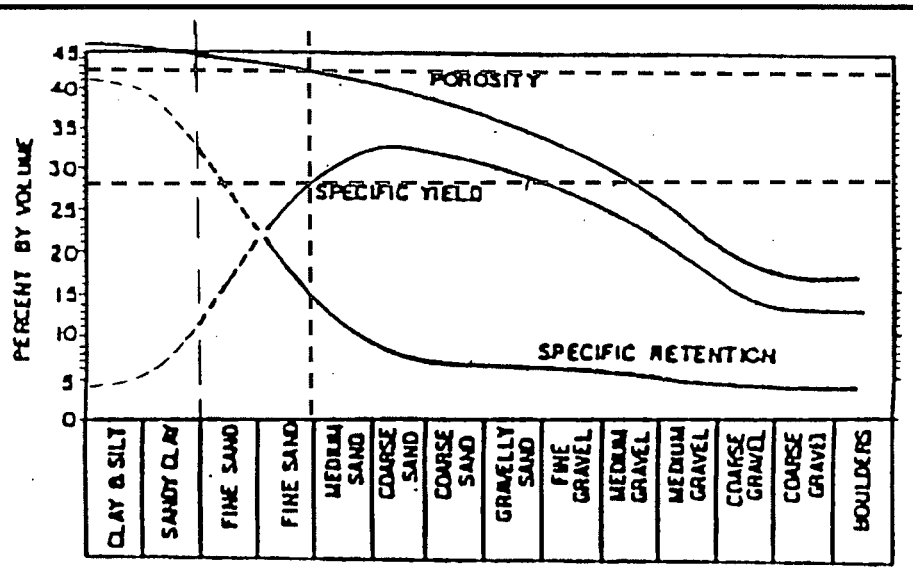


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.



Estimated Porosity: 42.5%

Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)

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Fax: 704-525-3953

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.

Project: **MNS - Groundwater Protection Project**			**Boring No. M-80**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 1 of 2
Boring Depth (ft): **50.6**	Elevation (ft): **737.2**	Driller: **Justin Millwood, NC Cert. No. 3439**	Date Drilled: **4/3/07**
Logged By: **Courtney Withers**	Water Level: **Water Table Not Encountered**		Drilling Method: **4¼" H.S.A.**

Elev. (Feet)	Depth (Feet)	Material Description	Penetration Resistance (Blows/Foot)
735		SOIL/SAPROLITE (M1): Red, Medium to Fine Sandy, Silty, **CLAY**	
	5	SOIL/SAPROLITE (M1): Red, Micaceous, Silty, Clayey, Medium to Fine **SAND** With a Black and White Fine Sand Lense	18
730		SOIL/SAPROLITE (M1): Brownish-Red, Silty, **CLAY** (High Plasticity) With Manganese Staining	19
	10	WEATHERED ROCK (M2): When Sampled Becomes White and Black, Silty, Medium to Fine **SAND** With Rock Fragments (Granitic)	
725		SOIL/SAPROLITE (M1): White, Tan, and Orange, Silty, Medium to Fine **SAND** With Manganese Staining (Granitic)	
	15	WEATHERED ROCK (M2): When Sampled Becomes White, Black, and Orange, Silty, Coarse to Fine **SAND** With Rock Fragments and Iron Staining (Granitic)	50/5 >>
720		**Auger Refusal at 18.89 ft bls**	50/0 >>
	20	SOUND ROCK (D): Medium-Grained **GRANITE**, Slightly Fractured	
715		PARTIALLY WEATHERED/FRACTURED ROCK (WF): Medium-Grained **GRANITE** With Orbicuals, Intensely Fractured	
	25	SOUND ROCK (D): Medium-Grained **GRANITE** With Orbicuals, Moderately Fractured	
710			
	30	SOUND ROCK (D): Medium-Grained **GRANITE** With Orbicuals, Slightly Fractured	
705			

Well Construction

Penetration Resistance (Blows/Foot): 0 — 50 — 100

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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.

Project: **MNS - Groundwater Protection Project**			**Boring No. M-80**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 2 of 2
Boring Depth (ft): **50.6**	Elevation (ft): **737.2**	Driller: **Justin Millwood, NC Cert. No. 3439**	Date Drilled: **4/3/07**
Logged By: **Courtney Withers**	Water Level: **Water Table Not Encountered**		Drilling Method: **4¼" H.S.A.**

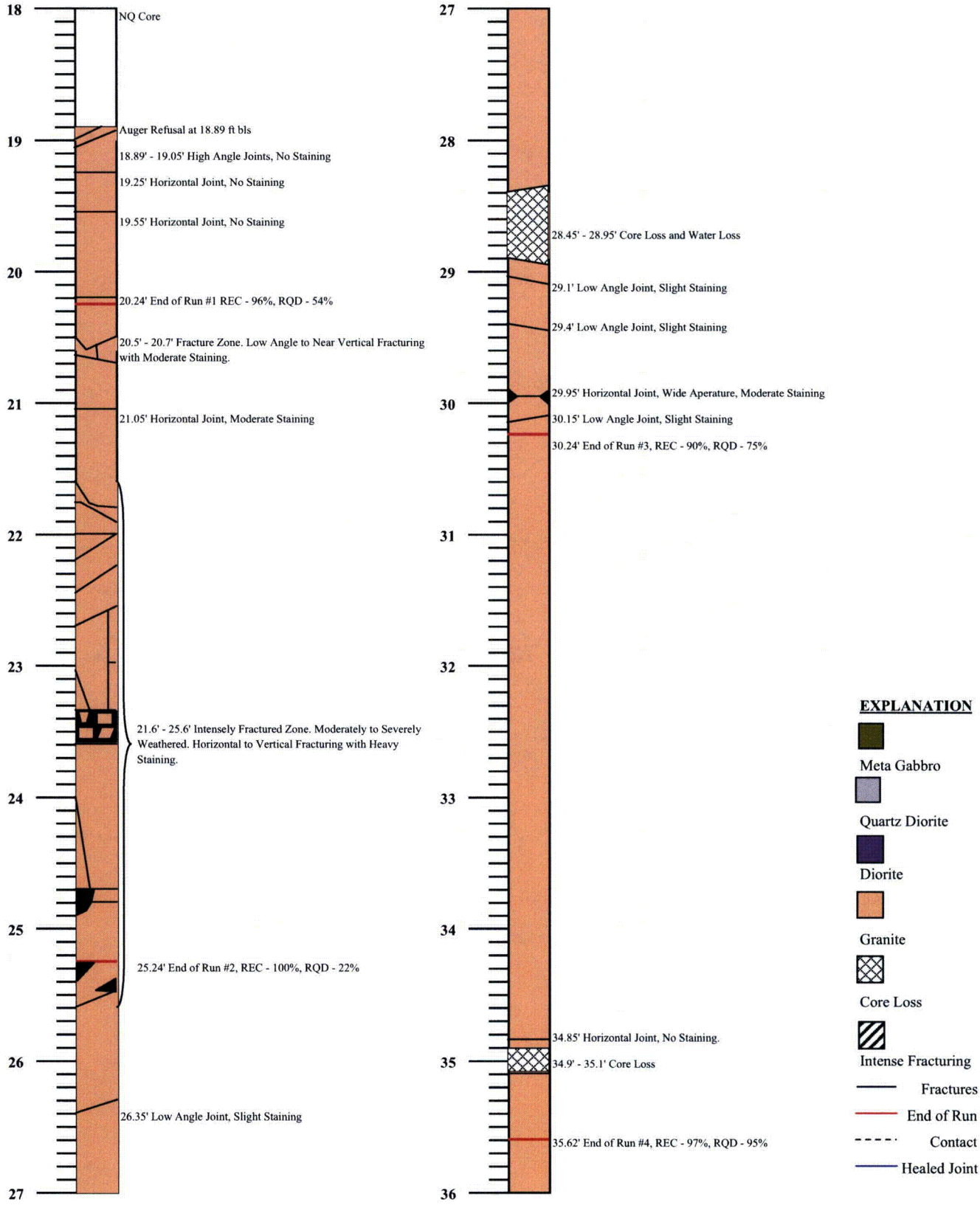
Elev. (Feet)	Depth (Feet)	Lith-ology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
			SOUND ROCK (D): Medium-Grained **GRANITE** With Orbicuals, Non-Fractured		
700					
	40				
695					
	45				
690					
	50		SOUND ROCK (D): Medium-Granined **GRANITE**, Slightly Fractured		
			Boring Terminated at 50.62 ft bls **Boring Was Abandoned Due to Absence of Water**		

FIELD ROCK CORE LOG

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-80

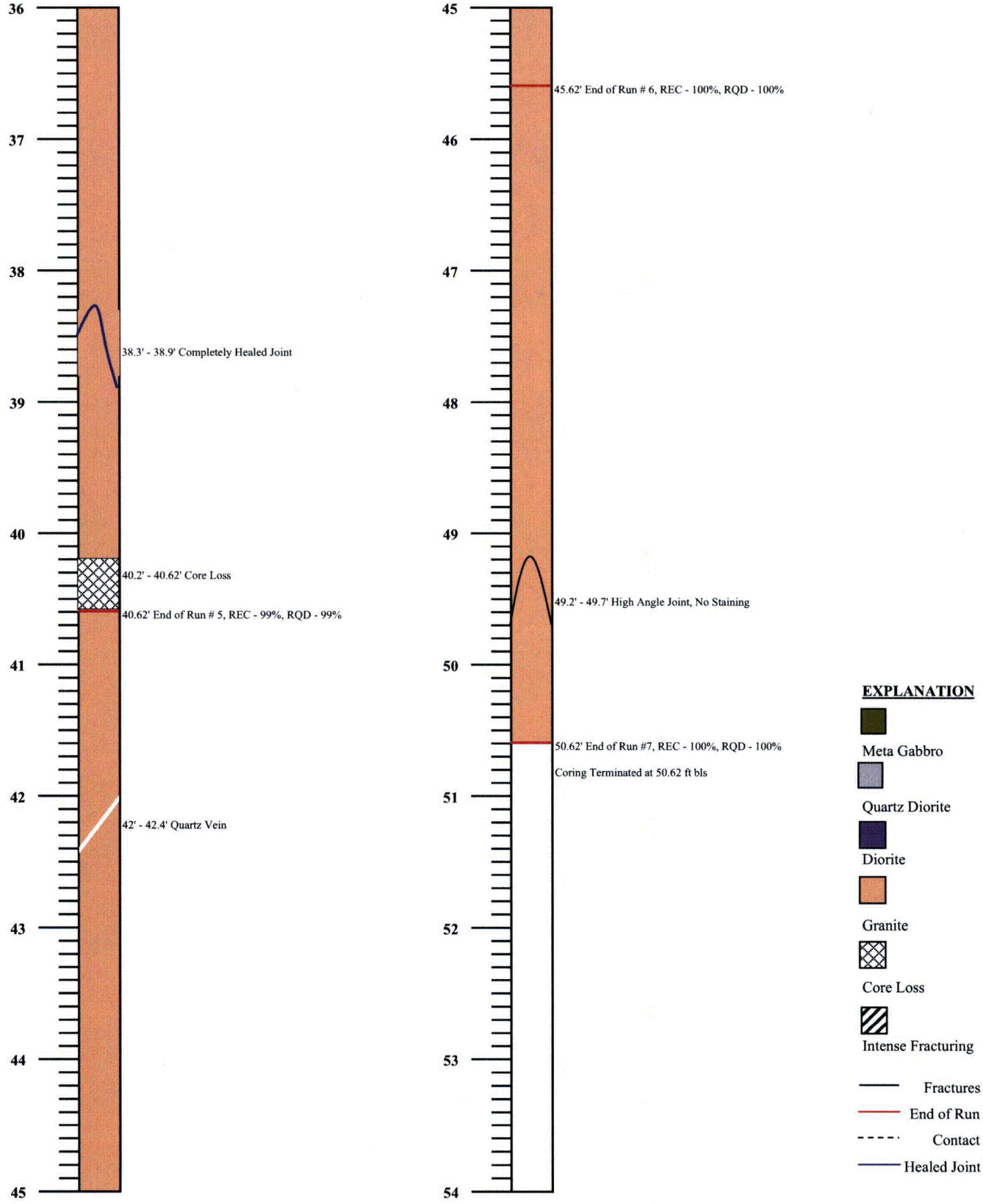


FIELD ROCK CORE LOG

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-80



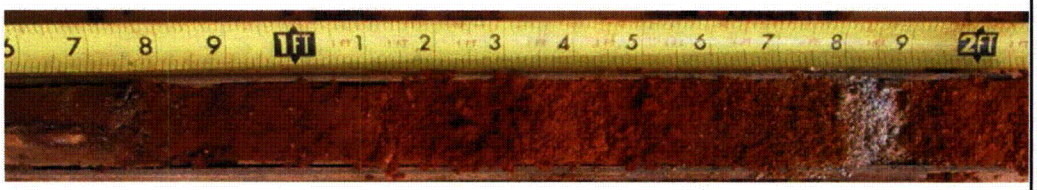
SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

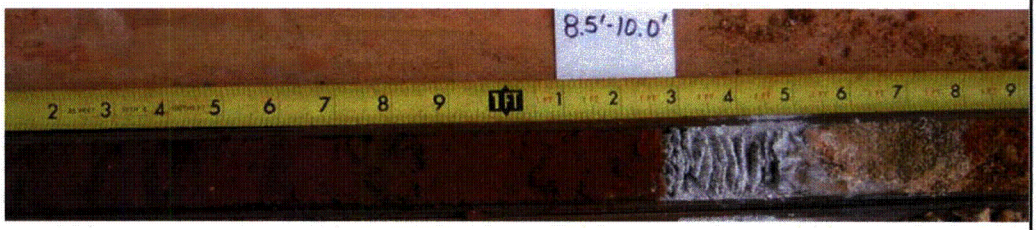
S&ME Project No: 1264-06-724

Boring Number: M-80

Sample No: 1
Depth (ft-bls): 3.5 - 5
Blow Count: 5 * 6 * 12



Sample No: 2
Depth (ft-bls): 8.5 - 10
Blow Count: 14 * 9 * 10



Sample No: 3
Depth (ft-bls): 13.5 - 15
Blow Count: 17 * 32 * 50/5

Sample No: 4
Depth (ft-bls): 18.5 - 20
Blow Count: 50/0

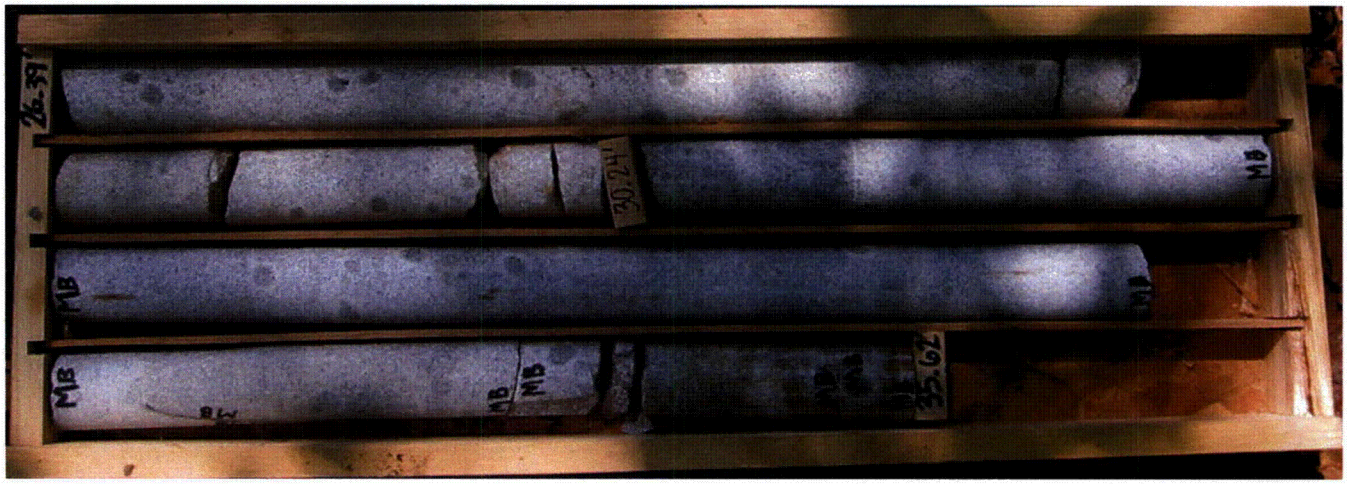
No Recovery

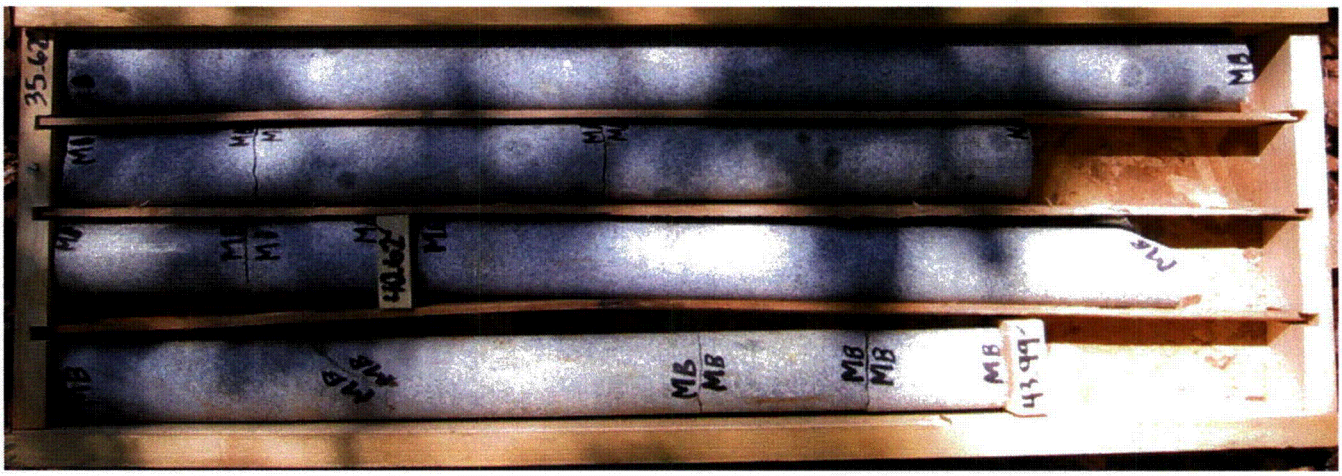
ROCK CORE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-80



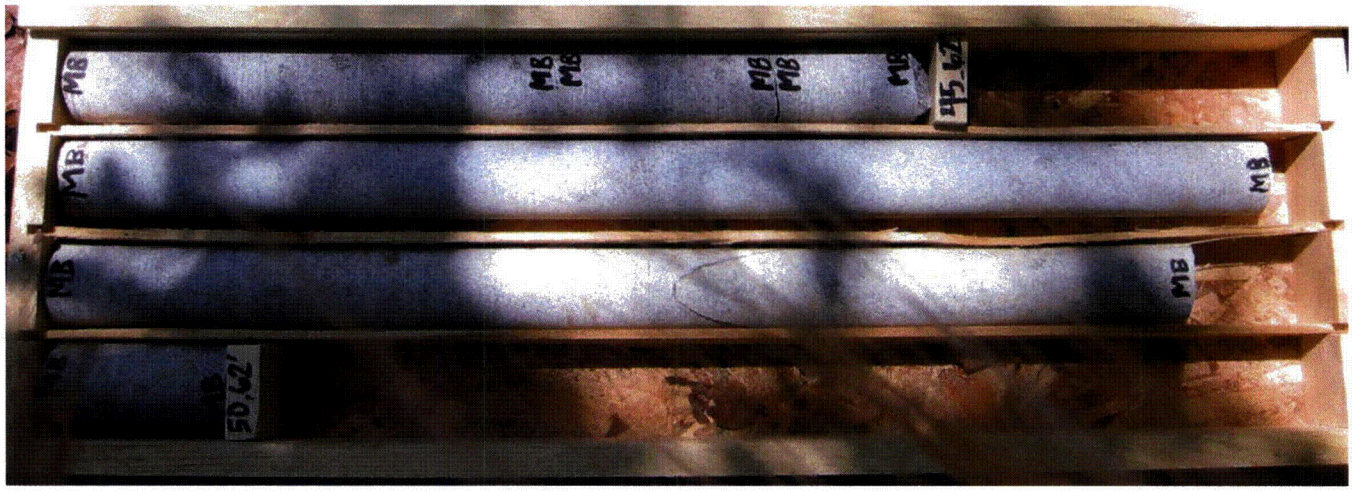


ROCK CORE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Core Location: M-80



CLASSIFICATION:

18.89' - 50.62' Medium Grained Granite with Orbicuals

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9751 Southern Pine Blvd.
Charlotte, North Carolina
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Fax: 704-525-3953

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.

Project: **MNS - Groundwater Protection Project**			**Boring No. M-82**
Location: **Huntersville, North Carolina**		Number: **1264-06-724**	Sheet No. 1 of 1
Boring Depth (ft): **34.6**	Elevation (ft): **675.2**	Driller: **Justin Millwood, NC Cert. No. 3439**	Date Drilled: **3/21/07**
Logged By: **Courtney Withers**	Water Level: **Stabilized Water Level at 25.45 ft bls**		Drilling Method: **Mud Rotary**

Elev. (Feet)	Depth (Feet)	Lithology	Material Description	Well Construction	Penetration Resistance (Blows/Foot) 0 50 100
675			SOIL/SAPROLITE (M1): Red, Micaceous, Slightly Clayey, Fine Sandy, **SILT**		11
670	5				
			SOIL/SAPROLITE (M1): Brown, Black, and White, Micaceous, Silty, Medium to Fine **SAND** (Granitic)		7
665	10				
			SOIL/SAPROLITE (M1): White and Tan, Micaceous, Medium to Fine **SAND** With Red Clay Seam at 13.8 ft bls (Granitic)		14
660	15				14
655	20		SOIL/SAPROLITE (M1): Reddish-Brown, **SILT** With Manganese Staining		
			SOIL/SAPROLITE (M1): Tan and White, Micaceous, Silty, Fine **SAND** With Manganese Staining (Granitic)		11
650	25				
			SOIL/SAPROLITE (M1): Orange and Brown, Micaceous, Medium to Fine Sandy, **SILT** With Manganese Staining		16
645	30				
			WEATHERED ROCK (M2): When Sampled Becomes Brown, Black, and White, Micaceous, Silty, Medium to Fine **SAND** (Granitic)		50/4 >>
			Roller Cone Refusal at 34.60 ft bls		

BORING LOG WITH WELL MNSLOG.GPJ LAGWGN01.GDT 3/26/08

COMPLETION REPORT OF WELL No. M-82

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

WATER LEVEL: **Stabilized Water Level at 25.45 ft bls**
LATITUDE: **35 25 48.15**
LONGITUDE: **80 57 16.62**
TOP OF CASING ELEVATION: **678.36**
DATUM: **MSL**
LOGGED BY: **Courtney Withers**

DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **Mud Rotary**
DATE DRILLED: **3/21/07**

STRATA DESCRIPTION	SYMBOL	DEPTH (ft.)	WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)
				0.00		675.23
SOIL/SAPROLITE (M1): Red, Micaceous, Slightly Clayey, Fine Sandy, **SILT**		0, 5				
SOIL/SAPROLITE (M1): Brown, Black, and White, Micaceous, Silty, Medium to Fine **SAND** (Granitic)		10				
SOIL/SAPROLITE (M1): White and Tan, Micaceous, Medium to Fine **SAND** With Red Clay Seam at 13.8 ft bls (Granitic)		15				
				19.80		655.43
SOIL/SAPROLITE (M1): Reddish-Brown, **SILT** With Manganese Staining		20		22.05		653.18
SOIL/SAPROLITE (M1): Tan and White, Micaceous, Silty, Fine **SAND** With Manganese Staining (Granitic)		25				
SOIL/SAPROLITE (M1): Orange and Brown, Micaceous, Medium to Fine Sandy, **SILT** With Manganese Staining		30				
WEATHERED ROCK (M2): When Sampled Becomes Brown,				34.10		641.13
				34.60		640.63

WELL CONSTRUCTION DETAILS

PROTECTIVE CASING
Diameter: **4" X 4"**
Type: **Lockable Steel**
Interval: **Above Grade**

RISER CASING
Diameter: **2"**
Type: **Sch. 40 PVC**
Interval: **0 to 24.60 ft bls**

GROUT
Type: **Neat Cement**
Interval: **0 to 19.80 ft bls**

SEAL
Type: **Bentonite**
Interval: **19.80 to 22.05 ft bls**

FILTERPACK
Type: **#1 Filter Sand**
Interval: **22.05 to 34.60 ft bls**

SCREEN
Diameter: **2"**
Type: **0.010 Slotted Sch. 40 PVC**
Interval: **24.60 to 34.60 ft bls**

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL MNSLOG.GPJ S&ME.GDT 3/26/08

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9751 Southern Pine Blvd.
Charlotte, North Carolina

COMPLETION REPORT OF WELL No. M-82

PROJECT: **MNS - Groundwater Protection Project**
PROJECT NO: **1264-06-724**
PROJECT LOCATION: **Huntersville, North Carolina**

GROUND SURFACE ELEVATION:
LOGGED BY: **675.2**
CHECKED BY: **Courtney Withe**

STRATA			WELL DETAILS	DEPTH (ft.)	LEGEND	ELEVATION (ft.)	WELL CONSTRUCTION DETAILS
DESCRIPTION	SYMBOL	DEPTH (ft.)					
							(See Page 1)
Black, and White, Micaceous, Silty, Medium to Fine **SAND** (Granitic)							

LEGEND

- FILTER PACK
- BENTONITE
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL

TOC	TOP OF CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
CG	CEMENT GROUT

MONITORING WELL MNSLOG.GPJ S&ME.GDT 3/26/08

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COMPLETION REPORT OF WELL No. M-82

SPLIT SPOON SAMPLE PICTURES

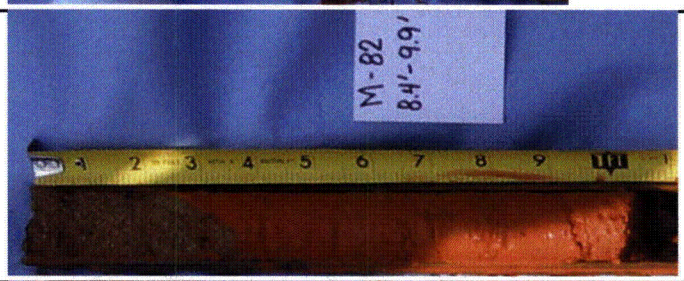
McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

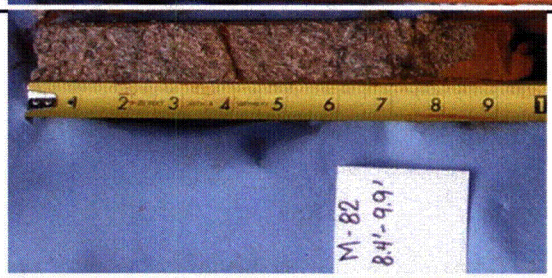
Boring Number: M-82

Sample No: 1
Depth (ft-bls): 3.4 - 4.9
Blow Count: 3 * 4 * 7

Sample No: 2
Depth (ft-bls): 8.4 - 9.9
Blow Count: 4 * 3 * 4



Sample No: 3
Depth (ft-bls): 13.4 - 14.9
Blow Count: 4 * 5 * 9



Sample No: 4
Depth (ft-bls): 18.4 - 19.9
Blow Count: 5 * 6 * 8

Sample No: 5
Depth (ft-bls): 23.4 - 24.9
Blow Count: 4 * 5 * 6

Sample No: 6
Depth (ft-bls): 28.4 - 29.9
Blow Count: 4 * 5 * 11

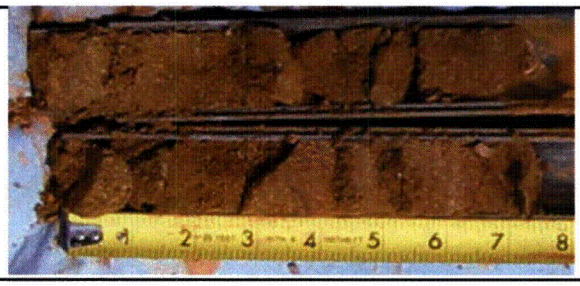
SPLIT SPOON SAMPLE PICTURES

McGuire Nuclear Station - Groundwater Protection Project

S&ME Project No: 1264-06-724

Boring Number: M-82

Sample No: 7
Depth (ft-bls): 33.4 - 34.9
Blow Count: 19 * 50/4

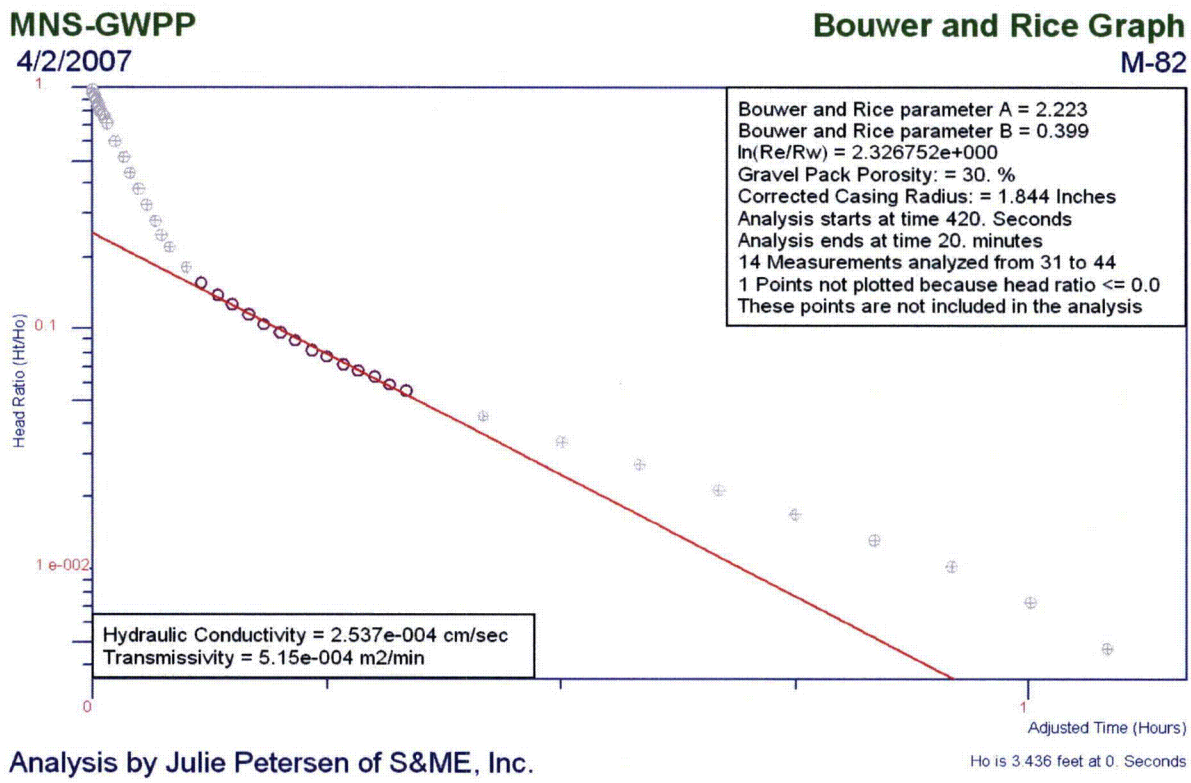


Calculation of Permeability By The Rising Head Method (Slug Test)

Site Name:	MNS-GWPP
Test Date:	4/2/2007
Well Label:	M-82
Aquifer Thickness:	11.1 feet
Screen Length:	10. feet
Casing Radius:	1. Inches
Effective Radius:	3. Inches
Gravel Pack Porosity:	30.00%
Corrected Casing Radius:	1.844 Inches
Static Water Level:	28.5 feet
Water Table to Screen Bottom:	6.1 feet
Anisotropy Ratio:	1

Time Adjustment: 0. Seconds
Test starts with trial 0
There are 54 time and drawdown measurements
Maximum head is 3.436 feet
Minimum head is 0. feet

Calculation by Bouwer and Rice Graphical Method



Analysis by Julie Petersen of S&ME, Inc.

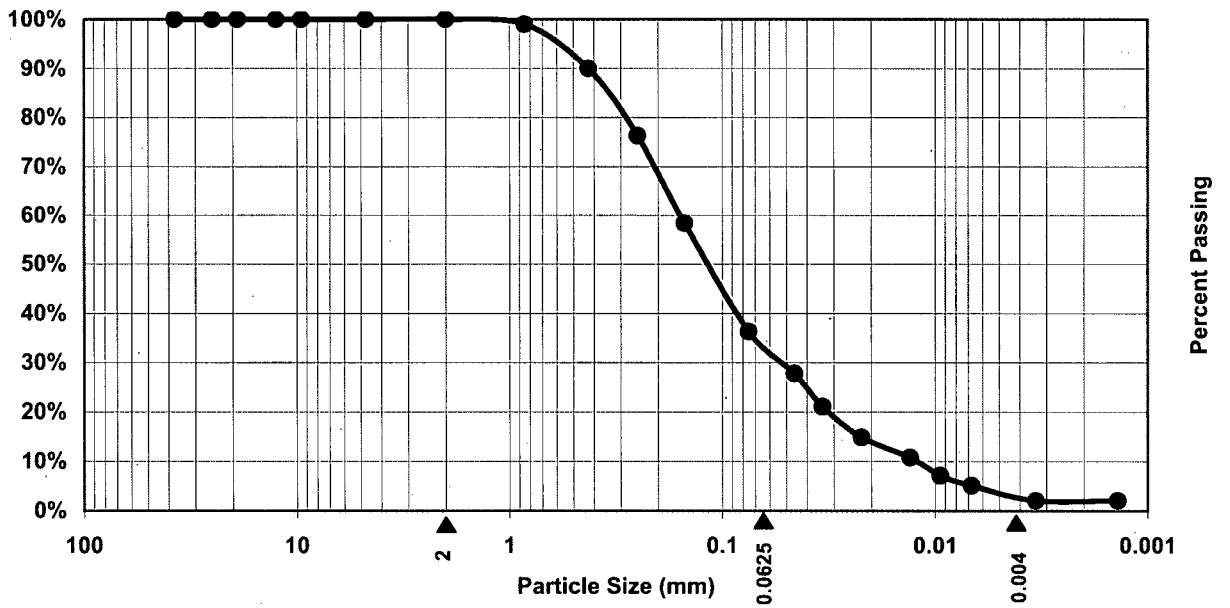
PERMEABILITY

2.54E-04 cm/sec

PARTICLE SIZE ANALYSIS OF SOILS
FOR USE IN FETTER AND BEAR DIAGRAMS

Boring No.:	**Sample No.:**	**Depth:**
M-82	SS-7	33.4 to 34.9 ft bls

Sample Description:
Brown, Black, and White, Silty, Fine to Medium Sand With Mica



	> 2 mm	2 mm - 0.0625 mm	0.0625 mm - 0.004 mm	<0.004 mm
From Graph:	% Gravel 0.0%	% Sand 66.6%	% Silt 30.7%	% Clay 2.7%
Adjusted for Calculations	**0%**	**67%**	**31%**	**3%**

Notes:
Grain size distribution taken from grain size with hydrometer data located in Appendix II.
Gravel, sand, silt and clay sizes based on Wentworth Scale.

S&ME Project:
McGuire Nuclear Station - GWPP

S&ME Project No.:
1264-06-724

S&ME

FETTER AND BEAR DIAGRAMS

S&ME PROJECT: McGuire Nuclear Station - GWPP
S&ME PROJECT NO.: 1264-06-724

Boring No. M-82

Boring Depth: 33.4 to 34.9 ft bls

% Sand: 67%

% Silt: 31%

% Clay: 3%

Estimated Specific Yield: 26%

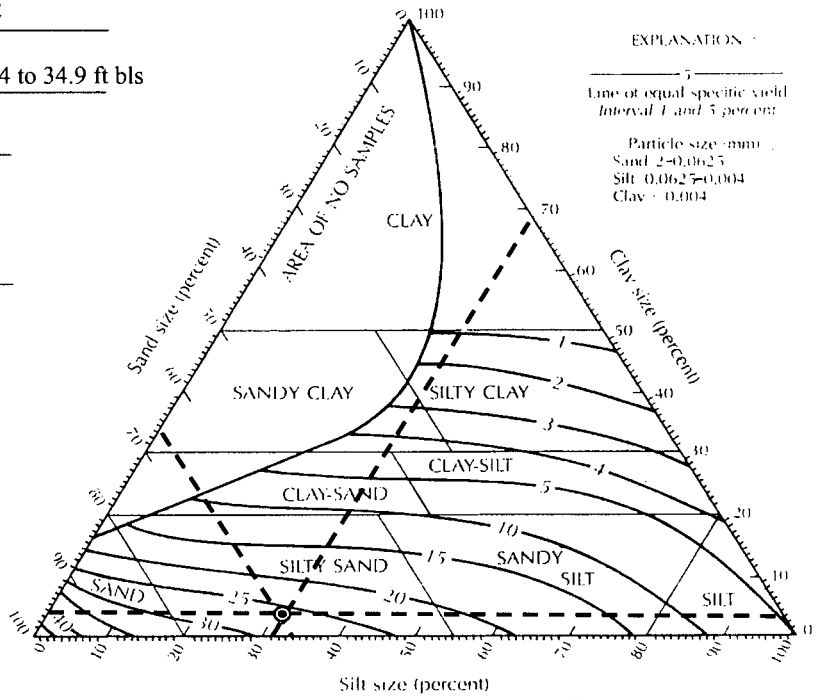
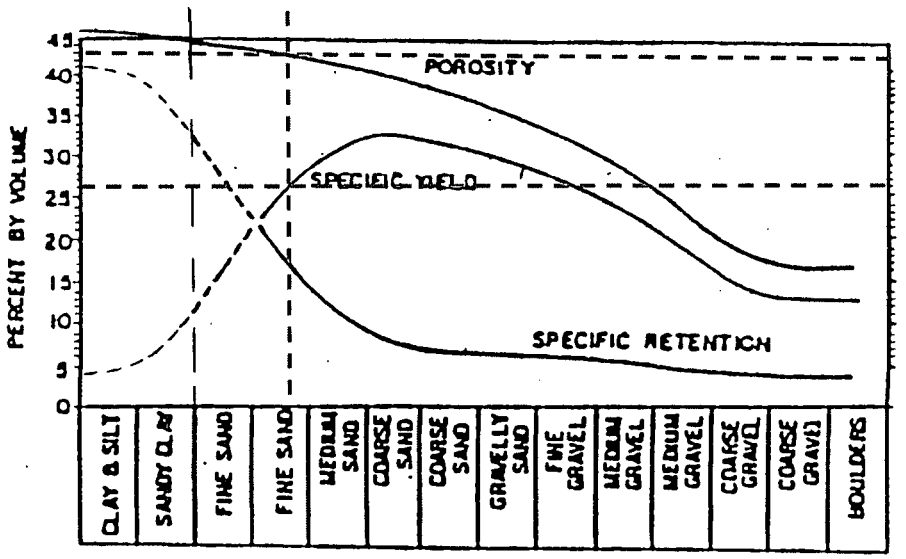


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A. I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.



Estimated Porosity: 43%

Variation of Porosity, Specific Yield, and Specific Retention with Grain Size (after Bear, 1972)