



engineering and constructing a better tomorrow

May 6, 2011

Mr. Jim Lindquist, Engineer
Marshall Steam Station
Duke Energy Corporation
8320 East NC Highway 150
Terrell, North Carolina 28682

**Subject: Monitoring Well Installation Report
Marshall Steam Station
8320 East NC Highway 150
Terrell, Catawba County, North Carolina
MACTEC Project No.: 6228-10-5284**

Dear Mr. Lindquist:

MACTEC is pleased to provide this report on behalf of our client, AE Drilling, LLC. The purpose of this report is to present the results of monitoring well installation and evaluation activities conducted in December 2010 at the above-referenced site (Figure 1). The well installation and testing was conducted in general accordance with the scope of work outlined in electronic mail correspondence provided by Duke Energy (Duke). The following Figure, Tables and Appendices have been included:

Figure 1:	Monitoring Well Locations
Table 1:	Summary of Well Construction Details
Table 2:	Summary of Slug Test Results
Appendix A:	Soil Boring Logs
Appendix B:	NCDENR Monitoring Well Construction Records
Appendix C:	Photographs of Completed Wells
Appendix D:	Slug Test Data

On December 15 and 16, 2010, two Type II groundwater monitoring wells (MW-6 and MW-7) were installed at the locations shown on Figure 1. The well locations were pre-determined by Duke and marked in the field with survey flagging. Prior to installation, MACTEC met with Mr. Darrell Wolfe of Duke to review both well locations.

The wells were installed using 4.25-inch ID hollow stem augers and Standard Penetration Testing (SPT) and split-spoon sampling was performed at five-foot intervals from the surface to the estimated total depth of each well during installation. Soils observed in the split-spoon samples were logged in the field in accordance with the Unified Soil Classification System (ASTM D2487/D2488). Monitoring well MW-6 was completed at a total depth of 117.5 feet below ground surface (bgs) with 15 feet of 0.010-slot 2-inch diameter PVC well screen and riser set to bracket the water table at the time of installation. Monitoring well MW-7 was completed at a total depth of 54 feet bgs with 15 feet of 0.010-slot 2-inch diameter PVC well screen and riser set to bracket the water table at the time of installation. Filter sand was placed in the annular space between the augers and the casing from the total depth of the well to approximately 2 feet above the screen. A bentonite seal was placed on top of the filter pack and the well was grouted to the surface. Each well was completed with a stand-up well cover that extends approximately 30 inches above-grade and set into a 2-foot by 2-foot concrete pad. Monitoring well ID tags were secured to the outside of the stand-up covers and well numbers were etched into the wet concrete pad. Soil boring logs and well construction records for the two monitoring wells installed during this work have been included as Appendix A and B, respectively.

Subsequent to installation, each well was developed using a submersible or bladder pump to remove fine-grained material. In general, each well was purged until the development water appeared visually clear, at which time, water quality parameters (temperature, pH, conductivity and turbidity) were recorded in 5-gallon increments until turbidity readings were less than or equal to 10 NTUs. Purge water generated during well development was discharged to the ground surface adjacent to each well. Photographs of the completed monitoring wells are included as Appendix C.

Rising head slug tests were performed on well MW-7 on December 23, 2010 and on MW-6 on December 29, 2010. Prior to the tests an In-situ Level Troll pressure transducer and 4-foot long stainless steel slug were placed into the well. The water level in the well was recorded as a "Background" test until the well recharged to within 90% of the original measurement. Subsequent to normalization, the rising head test was started, the slug was removed and the change in head versus time was measured using a Rugged-reader data logger. Slug test data was analyzed using Aqtesolv software to estimate hydraulic conductivity in each well. A summary of slug test data is presented in Table 2. Copies of raw data generated during completion of the rising head slug tests are included in Appendix D. Electronic slug test data is included on the attached compact disc.

*Monitoring Well Installation Report
Marshall Steam Station
Terrell, Catawba County, North Carolina
MACTEC Project 6228-10-5284*

May 6, 2011

Please contact the undersigned at (704) 357-8600, if you have questions or comments concerning this project.

Sincerely,

MACTEC ENGINEERING AND CONSULTING, INC.



Mark P. Filardi, P.G.
Senior Geologist

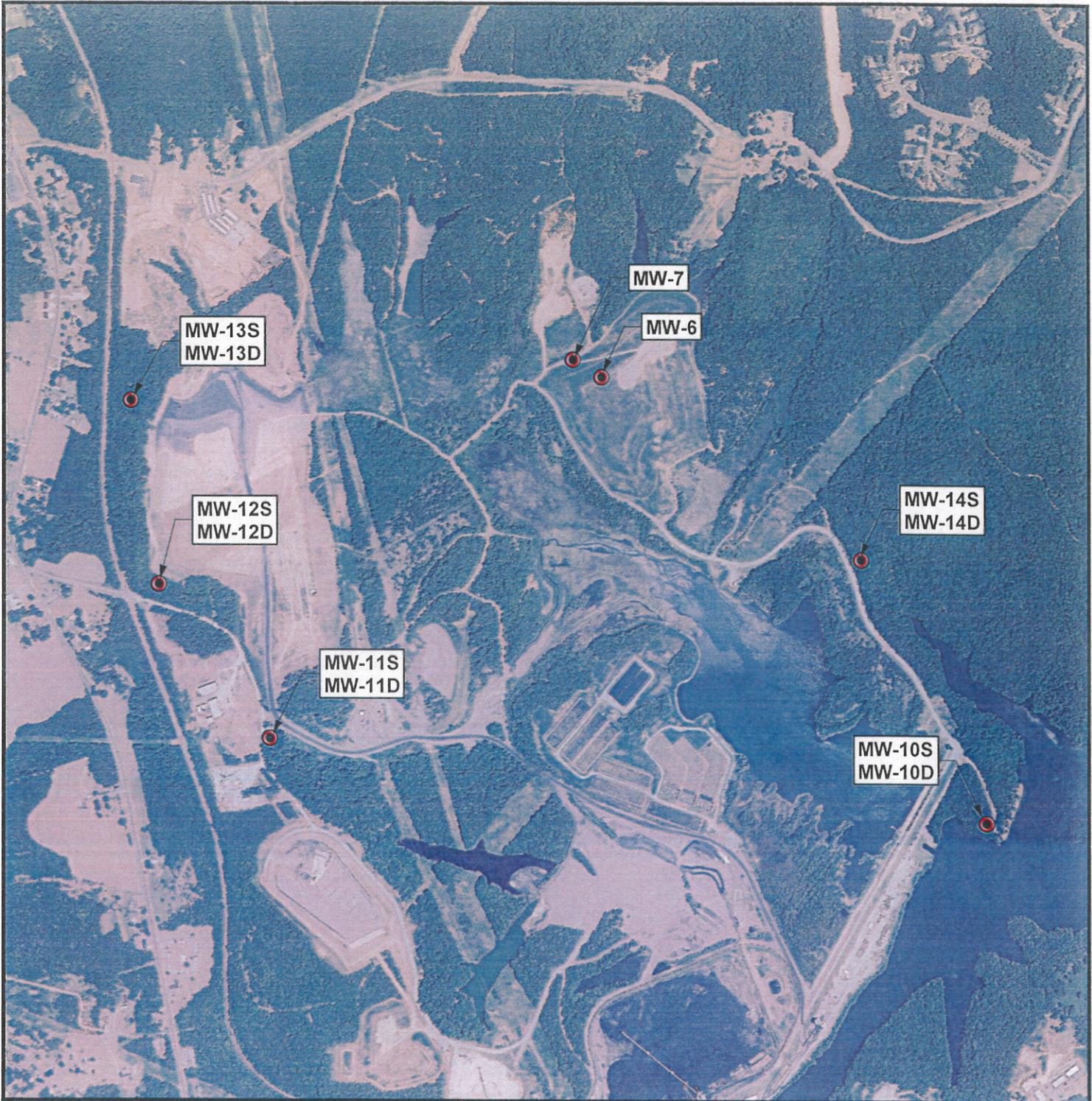


Robert C. Foster, L.G.
Principal

Enclosures

cc: William M. Miller, PE, PLS, Altamont Environmental
Mark Lassiter, P.G., AE Drilling, LLC

FIGURE



Source: Mecklenburg County Geographic Information Systems (GIS), dated 2009.

Site Location

 Monitoring Well Location

0 625 1,250 2,500 3,750 5,000
 Feet



MONITORING WELL LOCATIONS
DUKE ENERGY
MARSHALL STEAM STATION
CATAWBA COUNTY, NORTH CAROLINA

PREPARED BY	DATE	CHECKED BY	DATE	JOB NUMBER	FIGURE
		RUF	2-1-11	6228-10-5284	2

TABLES

Table 1
Summary of Well Construction Details
Marshall Steam Station, Terrell, North Carolina

Well Number	Coordinates		Drilling Method	Construction Details				Measured Details			
	Latitude	Longitude		Well Diameter (I.D. in.)	Borehole Depth (ft bgs)	Well Depth (ft bgs)	Screen Interval (ft bgs)	Top of Casing Elevation (NAVD 88)	Well Depth (ft below TOC)	Depth to Water (ft below TOC)	Height of Water Column (ft)
MW-6	35.616823	-80.969581	HSA	2	119	117.5	102.5 - 117.5	919.65	120.4	109.36	11.04
MW-7	35.617226	-80.970454	HSA	2	54	54	39 - 54	859.16	56.9	46.04	10.86

ft bgs = feet below ground surface
HSA = Hollow-stem Auger

Prepared by Date: chb 2-27-11
Checked by Date: RCF 2-28-11

Table 2
 Summary of Slug Test Data
 Marshall Steam Station, Terrell Creek, North Carolina

WELL ID	Test Date	Aquifer Model	Rising Head Test		Borehole Depth (ft bgs)	Well Depth (ft bgs)	Screen Interval (ft bgs)	Well Diameter (I.D. in.)
			Solution Method	K-value (cm/sec)				
MW-6	12/29/2010	unconfined	Bouwer-Rice	1.30E-03	119	117.5	102.5 - 117.5	2
MW-7	12/20/2010	unconfined	Bouwer-Rice	1.51E-03	54	54	39 - 54	2

Prepared By Date:

chb 2-27-11

Checked By Date:

RCF 2-28-11

APPENDICES

**APPENDIX A
SOIL BORING LOGS**

DEPTH (ft)	SOIL CLASSIFICATION SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES			REMARKS		
				IDENT	TYPE	N-COUNT			
						1st 6"		2nd 6"	3rd 6"
0	Dark bluish gray (Gley 2 4/1 10B) coal ash, firm to hard								
5				SS-1	X	2-8-10			
10				SS-2	X	9-12-14			
15				SS-3	X	9-12-20			
20				SS-4	X	4-4-7			
25				SS-5	X	8-11-10			
30				SS-6	X	7-9-13			
35				SS-7	X	8-8-8			
40				SS-8	X	4-9-12			
45				SS-9	X	5-6-17			

SOIL BORING LOGS.GPJ 2/1/11

DRILLER: Dan Bergman/AE Drilling
 EQUIPMENT: CME-750
 METHOD: 4.25" (ID) HSA
 HOLE DIA.: 8"
 REMARKS:

SOIL TEST BORING RECORD

PROJECT: Duke Energy Marshall Steam Station
WELL ID: MW-6
 December 16, 2010
PROJ. NO.: 6228-10-5284 PAGE 1 OF 3

THIS RECORD IS A REASONABLE INTERPRETATION
 OF SUBSURFACE CONDITIONS AT THE EXPLORATION
 LOCATION. SUBSURFACE CONDITIONS AT OTHER
 LOCATIONS AND AT OTHER TIMES MAY DIFFER.
 INTERFACES BETWEEN STRATA ARE APPROXIMATE.
 TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.



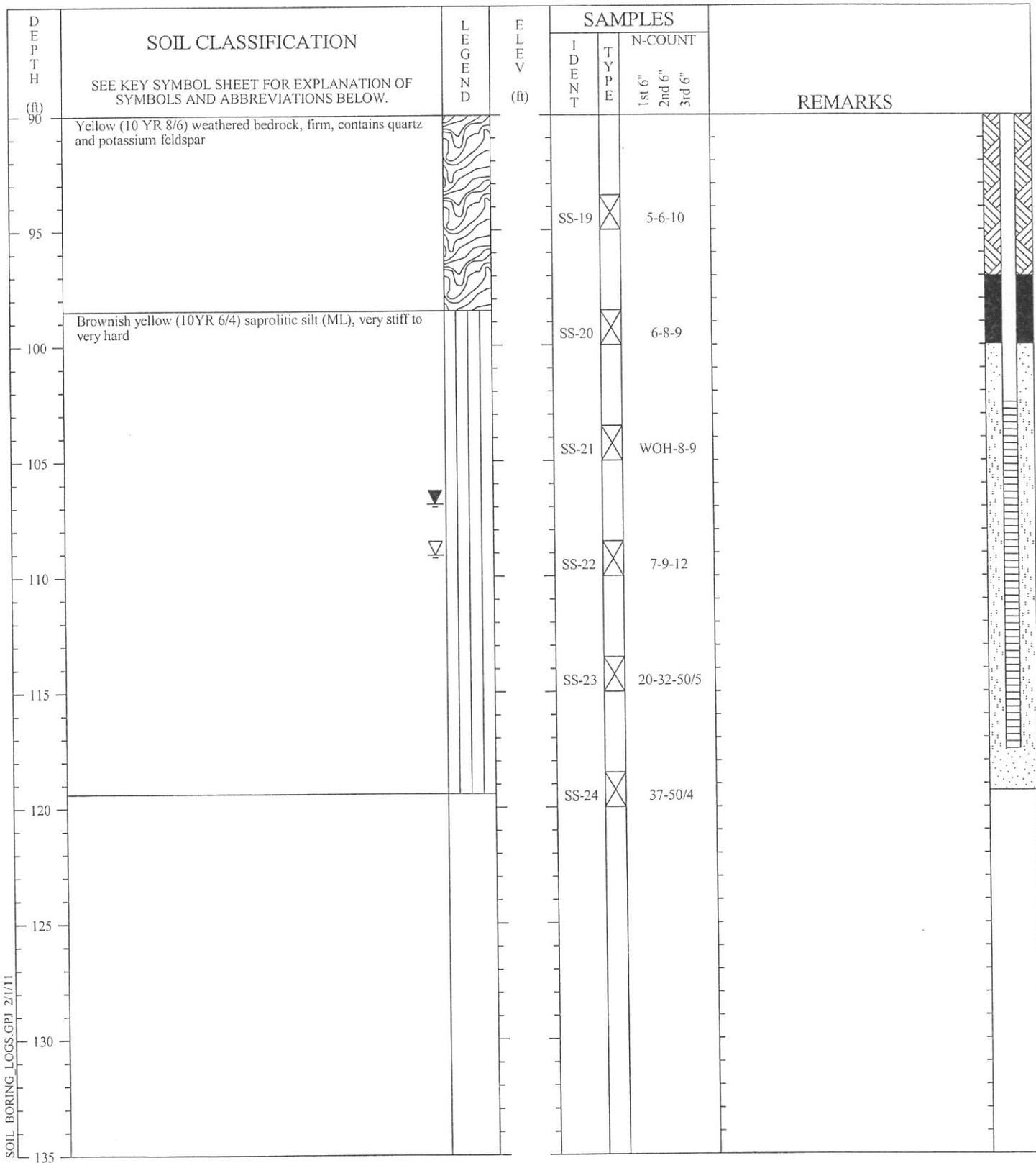
DEPTH (ft)	SOIL CLASSIFICATION SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES			REMARKS		
				IDENT	TYPE	N-COUNT			
						1st 6"		2nd 6"	3rd 6"
45	Dark bluish gray (Gley 2 4/1 10B) coal ash, firm to hard								
50			SS-10	X		4-3-4			
55			SS-11	X		4-3-4			
60			SS-12	X		8-10-13			
65			SS-13	X		4-5-28			
70			SS-14	X		12-12-11			
75			SS-15	X		5-6-6			
80			SS-16	X		10-13-11			
85			SS-17	X		8-10-13			
90	Yellow (10 YR 8/6) weathered bedrock, firm, contains quartz and potassium feldspar		SS-18	X		7-8-9			

SOIL BORING LOGS.GPJ 2/1/11

DRILLER: Dan Bergman/AE Drilling
 EQUIPMENT: CME-750
 METHOD: 4.25" (ID) HSA
 HOLE DIA.: 8"
 REMARKS:

SOIL TEST BORING RECORD	
PROJECT:	Duke Energy Marshall Steam Station
WELL ID:	MW-6
	December 16, 2010
PROJ. NO.:	6228-10-5284
	PAGE 2 OF 3

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.



SOIL BORING LOGS.GPJ 2/1/11

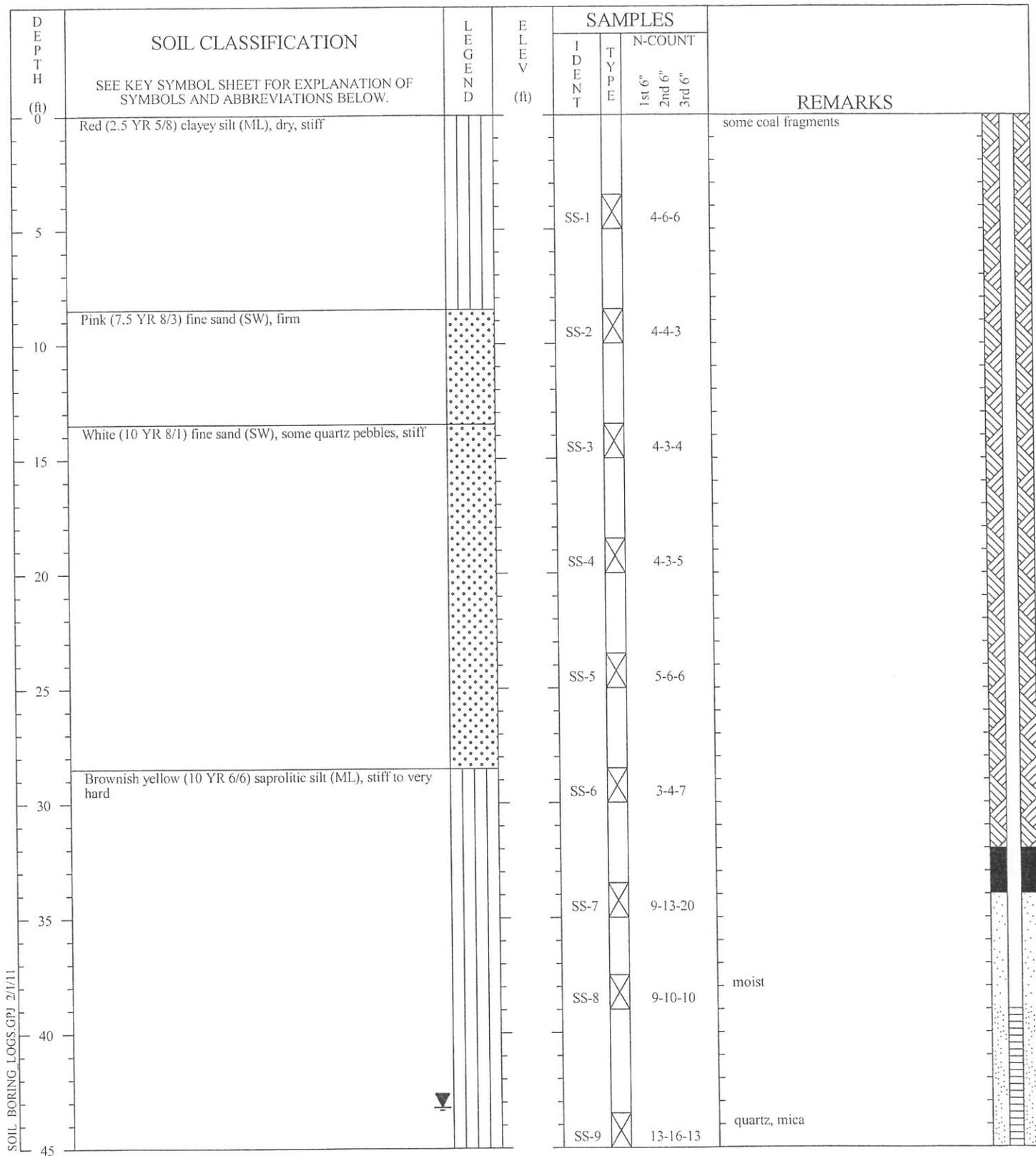
DRILLER: Dan Bergman/AE Drilling
 EQUIPMENT: CME-750
 METHOD: 4.25" (ID) HSA
 HOLE DIA.: 8"
 REMARKS:

SOIL TEST BORING RECORD

PROJECT: Duke Energy Marshall Steam Station
WELL ID: MW-6
 December 16, 2010
PROJ. NO.: 6228-10-5284

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.





SOIL BORING LOGS.GPJ 2/1/11

DRILLER: Dan Bergman/AE Drilling
 EQUIPMENT: CME-750
 METHOD: 4.25" (ID) HSA
 HOLE DIA.: 8"
 REMARKS:

SOIL TEST BORING RECORD

PROJECT: Duke Energy Marshall Steam Station
WELL ID: MW-7
 December 15, 2010
PROJ. NO.: 6228-10-5284 **PAGE 1 OF 2**

THIS RECORD IS A REASONABLE INTERPRETATION
 OF SUBSURFACE CONDITIONS AT THE EXPLORATION
 LOCATION. SUBSURFACE CONDITIONS AT OTHER
 LOCATIONS AND AT OTHER TIMES MAY DIFFER.
 INTERFACES BETWEEN STRATA ARE APPROXIMATE.
 TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.



DEPTH (ft)	SOIL CLASSIFICATION SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES			REMARKS		
				IDENT	TYPE	N-COUNT			
						1st 6"		2nd 6"	3rd 6"
45	Brownish yellow (10 YR 6/6) saprolitic silt (ML), stiff to very hard								
50				SS-10		20-22-28	spoon wet		
55				SS-11		50/3			
60									
65									
70									
75									
80									
85									
90									

SOIL BORING LOGS.GPJ 2/1/11

DRILLER: Dan Bergman/AE Drilling
 EQUIPMENT: CME-750
 METHOD: 4.25" (ID) HSA
 HOLE DIA.: 8"
 REMARKS:

SOIL TEST BORING RECORD

PROJECT: Duke Energy Marshall Steam Station
WELL ID: MW-7
 December 15, 2010
PROJ. NO.: 6228-10-5284 **PAGE 2 OF 2**

THIS RECORD IS A REASONABLE INTERPRETATION
 OF SUBSURFACE CONDITIONS AT THE EXPLORATION
 LOCATION. SUBSURFACE CONDITIONS AT OTHER
 LOCATIONS AND AT OTHER TIMES MAY DIFFER.
 INTERFACES BETWEEN STRATA ARE APPROXIMATE.
 TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.



**APPENDIX B
NCDENR MONITORING WELL CONSTRUCTION RECORDS**



NON RESIDENTIAL WELL CONSTRUCTION RECORD

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 3455-A

1. WELL CONTRACTOR:

Well Contractor (Individual) Name
A E DRILLING SERVICES, LLC
 Well Contractor Company Name
Two United Way
 Street Address
Greenville SC 29607
 City or Town State Zip Code
 (864) 288-1986
 Area code Phone number

2. WELL INFORMATION:

WELL CONSTRUCTION PERMIT# _____
 OTHER ASSOCIATED PERMIT#(if applicable) _____
 SITE WELL ID #(if applicable) MW-6

3. WELL USE (Check One Box) Monitoring Municipal/Public

Industrial/Commercial Agricultural Recovery Injection
 Irrigation Other (list use) _____

DATE DRILLED 12/17/10

4. WELL LOCATION:

8320 E. NC Highway 150
 (Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

CITY: Terrell COUNTY Satawba

TOPOGRAPHIC / LAND SETTING: (check appropriate box)

Slope Valley Flat Ridge Other _____

LATITUDE 35.616823

LONGITUDE -80.969581

Latitude/longitude source: GPS Topographic map
 (location of well must be shown on a USGS topo map and attached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)

Marshall Steam Station
 Facility Name Facility ID# (if applicable)

8320 E. NC Highway 150
 Street Address

Terrell NC 28687
 City or Town State Zip Code

Jim Lindquist
 Contact Name

SAME
 Mailing Address

City or Town State Zip Code

(828) 478-7622
 Area code Phone number

6. WELL DETAILS:

- a. TOTAL DEPTH: 117.5
 b. DOES WELL REPLACE EXISTING WELL? YES NO
 c. WATER LEVEL Below Top of Casing: 109.36 FT.
 (Use "+" if Above Top of Casing)

d. TOP OF CASING IS +25 FT. Above Land Surface*
 *Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. YIELD (gpm): N/A METHOD OF TEST _____

f. DISINFECTION: Type N/A Amount _____

g. WATER ZONES (depth):
 Top _____ Bottom _____ Top _____ Bottom _____
 Top _____ Bottom _____ Top _____ Bottom _____
 Top _____ Bottom _____ Top _____ Bottom _____

7. CASING: Depth	Diameter	Weight	Material
Top <u>52.5</u> Bottom <u>102.5</u> Ft.	<u>2"</u>	<u>scr 40</u>	<u>PVC</u>
Top _____ Bottom _____ Ft.	_____	_____	_____
Top _____ Bottom _____ Ft.	_____	_____	_____

8. GROUT: Depth	Material	Method
Top <u>0</u> Bottom <u>97</u> Ft.	<u>cement/bentonite</u>	<u>pressure</u>
Top _____ Bottom _____ Ft.	_____	_____
Top _____ Bottom _____ Ft.	_____	_____

9. SCREEN: Depth	Diameter	Slot Size	Material
Top <u>102.5</u> Bottom <u>117.5</u> Ft.	<u>2 in.</u>	<u>.010 in.</u>	<u>PVC</u>
Top _____ Bottom _____ Ft.	_____	_____	_____
Top _____ Bottom _____ Ft.	_____	_____	_____

10. SAND/GRAVEL PACK: Depth	Size	Material
Top <u>100</u> Bottom <u>117.5</u> Ft.	<u>#1</u>	<u>silica sand</u>
Top _____ Bottom _____ Ft.	_____	_____
Top _____ Bottom _____ Ft.	_____	_____

11. DRILLING LOG	Formation Description
Top <u>0</u> Bottom <u>88</u>	<u>coal ash</u>
<u>88</u> / <u>119.5</u>	<u>weathered bedrock</u>
_____ / _____	_____
_____ / _____	_____
_____ / _____	_____
_____ / _____	_____
_____ / _____	_____
_____ / _____	_____
_____ / _____	_____

12. REMARKS:

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Gay Winbourn 12/29/10
 SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE

Gary Winbourn
 PRINTED NAME OF PERSON CONSTRUCTING THE WELL



NON RESIDENTIAL WELL CONSTRUCTION RECORD

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 3455-A

1. WELL CONTRACTOR:

Gary Winbourn
 Well Contractor (Individual) Name
A E DRILLING SERVICES, LLC
 Well Contractor Company Name
Two United Way
 Street Address
Greenville SC 29607
 City or Town State Zip Code
(864) 288-1986
 Area code Phone number

2. WELL INFORMATION:

WELL CONSTRUCTION PERMIT# _____
 OTHER ASSOCIATED PERMIT#(if applicable) _____
 SITE WELL ID #(if applicable) MW-7

3. WELL USE (Check One Box) Monitoring Municipal/Public
 Industrial/Commercial Agricultural Recovery Injection
 Irrigation Other (list use) _____
 DATE DRILLED 12/16/10

4. WELL LOCATION:

8320 E. NC Highway 150
 (Street Name, Numbers, Community, Subdivision, Lot No., Parcel/Zip Code)
 CITY: Terrell COUNTY Catawba
 TOPOGRAPHIC / LAND SETTING: (check appropriate box)
 Slope Valley Flat Ridge Other _____
 LATITUDE 35.617226
 LONGITUDE -80.970454
 Latitude/longitude source: GPS Topographic map
 (location of well must be shown on a USGS topo map and attached to this form if not using GPS)

5. FACILITY (Name of the business where the well is located.)

Marshall Steam Station
 Facility Name Facility ID# (if applicable) _____
8320 E. NC Highway 150
 Street Address
Terrell NC 28682
 City or Town State Zip Code
Jim Lindquist
 Contact Name
SAME
 Mailing Address
 City or Town State Zip Code

(818) 478-7622
 Area code Phone number

6. WELL DETAILS:

- a. TOTAL DEPTH: 54
 b. DOES WELL REPLACE EXISTING WELL? YES NO
 c. WATER LEVEL Below Top of Casing: 46.04 FT.
 (Use "+" if Above Top of Casing)

d. TOP OF CASING IS 2.5 FT. Above Land Surface*
 *Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. YIELD (gpm): N/A METHOD OF TEST _____

f. DISINFECTION: Type N/A Amount _____

g. WATER ZONES (depth):
 Top _____ Bottom _____ Top _____ Bottom _____
 Top _____ Bottom _____ Top _____ Bottom _____
 Top _____ Bottom _____ Top _____ Bottom _____

7. CASING: Depth		Diameter	Thickness/ Weight	Material
Top <u>39</u>	Bottom <u>39</u>	Ft. <u>2"</u>	<u>5.2x40</u>	<u>PVC</u>
Top _____	Bottom _____	Ft. _____	_____	_____
Top _____	Bottom _____	Ft. _____	_____	_____

8. GROUT: Depth		Material	Method
Top <u>0</u>	Bottom <u>32</u>	Ft. <u>cement/bentonite</u>	<u>pressure</u>
Top _____	Bottom _____	Ft. _____	_____
Top _____	Bottom _____	Ft. _____	_____

9. SCREEN: Depth		Diameter	Slot Size	Material
Top <u>39</u>	Bottom <u>54</u>	Ft. <u>2</u> in.	<u>1/4</u> in.	<u>PVC</u>
Top _____	Bottom _____	Ft. _____	_____	_____
Top _____	Bottom _____	Ft. _____	_____	_____

10. SAND/GRAVEL PACK:		Depth	Size	Material
Top <u>34</u>	Bottom <u>54</u>	Ft. <u>#1</u>	<u>Silica Sand</u>	
Top _____	Bottom _____	Ft. _____	_____	_____
Top _____	Bottom _____	Ft. _____	_____	_____

11. DRILLING LOG		Formation Description
Top <u>0</u>	Bottom <u>54</u>	<u>silt and sand</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

12. REMARKS:

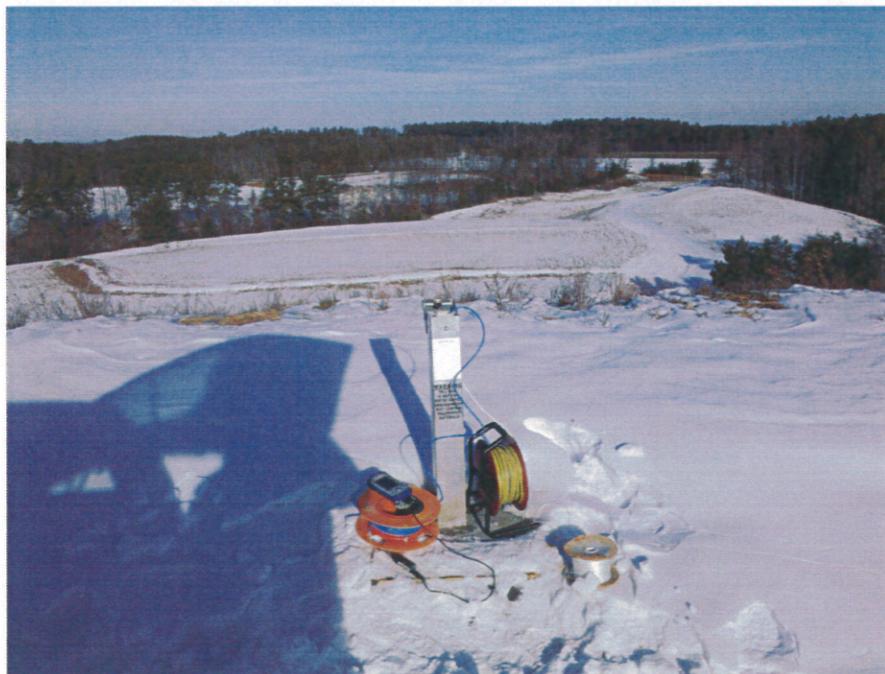
I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Gary Winbourn 12/20/10
 SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE
Gary Winbourn
 PRINTED NAME OF PERSON CONSTRUCTING THE WELL

**APPENDIX C
PHOTOGRAPHS OF COMPLETED WELLS**

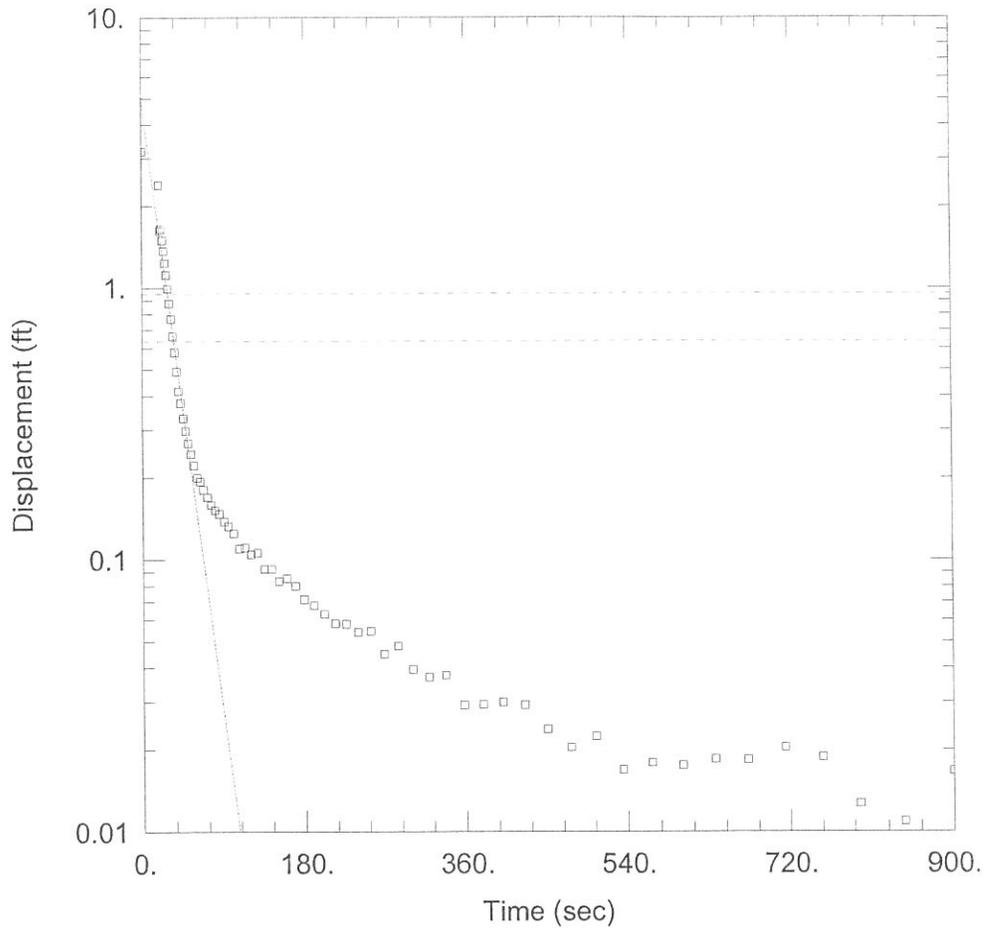


Photograph 1: Monitoring well MW-7.



Photograph 2: Monitoring well MW-6.

**APPENDIX D
SLUG TEST DATA**



MW-7 RISING HEAD TEST

PROJECT INFORMATION

Company: MACTEC
 Client: Duke Energy
 Project: 6228-09-4964
 Location: Marshall Steam Station
 Test Well: MW-7
 Test Date: 12/20/10

AQUIFER DATA

Saturated Thickness: 10.86 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-7)

Initial Displacement: 3.185 ft Static Water Column Height: 10.86 ft
 Total Well Penetration Depth: 15. ft Screen Length: 15. ft
 Casing Radius: 0.086 ft Well Radius: 0.34 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bower-Rice
 K = 0.001512 cm/sec $y_0 =$ 5.172 ft