N00639.AR.000974
NSA MID SOUTH
5090.3a

RESOURCE CONSERVATION RECOVERY ACT FACILITY INVESTIGATION REPORT ASSEMBLY E FOR SOLID WASTE MANAGEMENT UNITS 2, 9, 14, 38, 59 AND 65

MILLINGTON SUPPACT TN

2/2/1998

ENSAFE INC

RCRA FACILITY INVESTIGATION REPORT
ASSEMBLY E
SWMUs 2, 9, 14, 38, 59, and 65
NAVAL SUPPORT ACTIVITY MEMPHIS
MILLINGTON, TENNESSEE

REVISION 1

CTO-094
Contract No: N62467-89-D-0318

Volume 2
Appendices A through G

Prepared for:

Department of the Navy
Southern Division
Naval Facilities Engineering Command
North Charleston, South Carolina

Prepared by:

EnSafe Inc.
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Memphis, Tennessee 38134
(901) 372-7962

February 2, 1998

Appendix A

Topographic Map — NSA Memphis Southside

Appendix B

DPT Piezocone Soundings and Hydrocone Plots

Table B-1

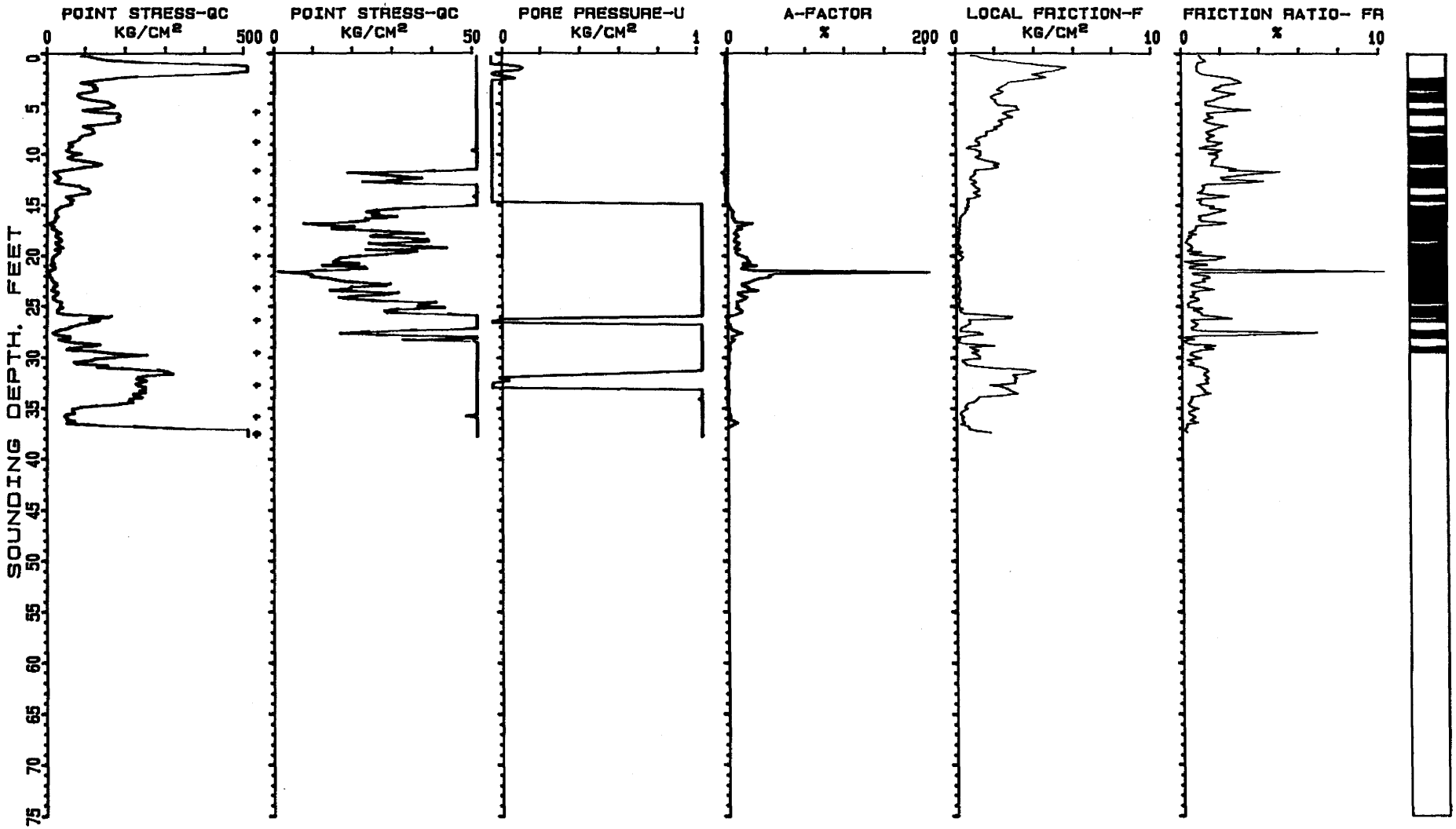
Summary of Horizontal Hydraulic Conductivity Estimates From Hydrocone Data
Assembly E DPT Investigation
NSA Memphis — Millington, Tennessee

Sample ID	Horizontal Hydraulic Conductivity (cm/sec)	Horizontal Hydraulic Conductivity (feet/day)
SWMU 2 Upper Alluvium DPT Points		
002G001327	6.19e-06	0.01
002G001427	1.59e-05	0.04
002G001527	5.05e-06	0.01
002G001627	2.35e-06	< 0.01
002G001725	5.60e-06	0.01
002G001825	3.35e-06	< 0.01
002G001926	1.36e-05	0.03
002G002130	1.07e-06	< 0.01
002G002323	3.36e-06	< 0.01
002G002527	1.92e-06	< 0.01
002G002627	1.10e-07	< 0.01
002G002727	8.58e-07	< 0.01
AVERAGE	***4.95e-06***	***0.01***
SWMU 2 Deeper Alluvium		
002G001337	7.53e-04	2.13
002G001440	7.22e-06	0.02
002G001540	3.25e-05	0.09
002G001639	6.97e-06	0.01
002G001736	9.25e-05	0.26
002G001836	1.49e-04	0.42
002G001939	1.13e-04	0.32
002G002039	7.90e-06	0.02
002G002149	4.99e-04	1.41
002G002249	1.18e-03	3.34
002G002336	2.90e-04	0.82
002G002436	9.87e-07	< 0.01
002G002540	2.36e-04	0.66
002G002643	2.26e-05	0.06
002G002741	8.81e-05	0.24
AVERAGE	***2.32e-04***	***0.65***

SWMU 2

DPT SCREENING INVESTIGATION RESULTS

PIEZOCONE SOUNDING



* PUSH INTERRUPTED TO ADD ROD
PORE PRESSURE DECAY DATA MAY BE AVAILABLE

FILE #..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
SOUNDING # 02-P13
TEST DATE 11-07-1995 13: 13: 49

02-P13 CONTINUED ENSAFE

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES	N'	VERTICAL STRESS	RELATIVE DENSITY	FRICTION ANGLE	YOUNGS MODULUS	UNDRAINED SHEAR ST	SENSITIVITY	COMP.	OCR
31	FINE SAND	121.4	.85	24	24	.966	60%-70%	40-42	267	--	--	--	--
32	FINE SAND	245.6	3.17	49	49	1	>90%	44-46	540	--	--	--	--
33	FINE SAND	237	2.66	47	47	1.033	>90%	44-46	521	--	--	--	--
34	FINE SAND	238.7	2.26	47	47	1.066	>90%	44-46	525	--	--	--	--
35	FINE SAND	182.6	.71	36	36	1.099	70%-80%	42-44	401	--	--	--	--
36	SILTY FINE SAND	64.1	.33	16	16	1.13	40%-50%	38-40	141	--	--	--	--
37	FINE SAND	123.7	.45	24	24	1.163	60%-70%	40-42	272	--	--	--	--

\# N'=POINT STRESS*(.2+.04*FRICTION RATIO)
* NORMALLY CONSOLIDATED SANDS
** FOR OVERCONSOLIDATED SANDS,SLIGHTLY REDUCE ABOVE FRICTION ANGLES
*** FOR OVERCONSOLIDATED SANDS, YOUNG'S MODULUS MAY BE AS MUCH AS 3 TO 6 TIMES HIGHER
**** NK OF 16 USED. FOR OVERCONSOLIDATED CLAYS, AN NK OF 17 IS SUGGESTED

THE ABOVE DATA WAS COMPUTED FOLLOWING 'BASIC' GUIDELINES BY P. K. ROBERTSON AND R. G. CAMPANELLA IN THE HANDBOOK 'GUIDELINES FOR USE AND INTERPERTATION OF THE ELECTRONIC CONE PENETRATION TEST'

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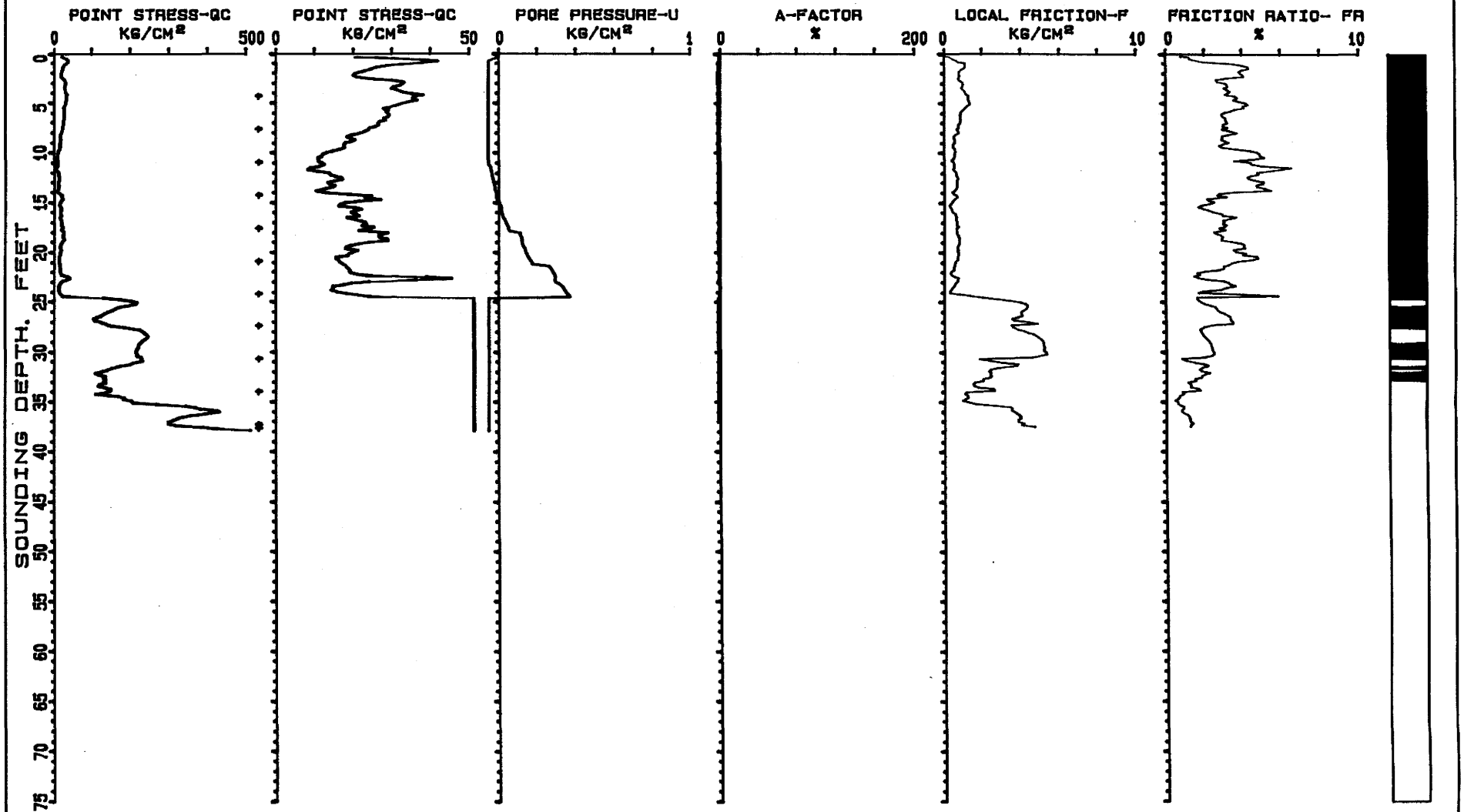
IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE
FOR SOUTHEASTERN UNITED STATES SOILS

JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
FILE NAME..... 02-P20

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES #	N'	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	SILTY FINE SAND	179.6	2.76	44	44	.03	>90%	>48	395	--	--	--	--
2	SILTY FINE SAND	272	4.23	68	68	.061	>90%	>48	598	--	--	--	--
3	SILTY FINE SAND	219.9	4.35	54	54	.092	>90%	>48	483	--	--	--	--
4	SILTY TO CLAYEY F.S.	70	1.28	23	23	.123	70%-80%	>48	154	--	--	--	--
5	SILTY CLAY TO CLAY	28.9	1.28	19	19	.15	--	--	--	1.78	2.2	UD	>6
6	CLAY	22.7	1.76	22	22	.175	--	--	--	1.39	1.2	UD	>6
7	SILTY CLAY TO CLAY	38.3	1.67	25	25	.202	--	--	--	2.36	2.2	UD	>6
8	CLAYEY FINE SAND	55.1	1.52	22	22	.233	60%-70%	44-46	121	--	--	--	--
9	SILTY TO CLAYEY F.S.	64.3	1.12	21	21	.264	70%-80%	44-46	141	--	--	--	--
10	SILTY TO CLAYEY F.S.	52.9	.94	17	17	.294	60%-70%	42-44	116	--	--	--	--
11	SILTY TO CLAYEY F.S.	57.5	.88	19	19	.325	60%-70%	42-44	126	--	--	--	--
12	SILTY TO CLAYEY F.S.	43.4	.53	14	14	.356	50%-60%	40-42	95	--	--	--	--
13	SILTY FINE SAND	51	.44	12	12	.387	60%-70%	42-44	112	--	--	--	--
14	SILTY FINE SAND	56.1	.37	14	14	.418	60%-70%	42-44	123	--	--	--	--
15	SILTY FINE SAND	70.8	.58	17	17	.448	60%-70%	42-44	155	--	--	--	--
16	SILTY FINE SAND	95.3	.72	23	23	.479	70%-80%	42-44	209	--	--	--	--
17	SILTY FINE SAND	62	.26	15	15	.51	50%-60%	40-42	136	--	--	--	--
18	SILTY FINE SAND	52.5	.04	13	13	.541	50%-60%	40-42	115	--	--	--	--
19	SILTY FINE SAND	40.6	.05	10	10	.571	40%-50%	38-40	89	--	--	--	--
20	SILTY FINE SAND	54	.04	13	13	.602	50%-60%	40-42	118	--	--	--	--
21	SILTY FINE SAND	56.8	.18	14	14	.633	50%-60%	40-42	124	--	--	--	--
22	FINE SAND	101	.41	20	20	.666	60%-70%	42-44	222	--	--	--	--
23	FINE SAND	111.2	.45	22	22	.699	70%-80%	42-44	244	--	--	--	--
24	FINE SAND	138.1	.57	27	27	.733	70%-80%	42-44	303	--	--	--	--
25	DENSE OR CEMENTED S.	220.6	.89	36	36	.769	>90%	44-46	485	--	--	--	--
26	FINE SAND	170.9	.42	34	34	.802	80%-90%	44-46	375	--	--	--	--
27	SILTY FINE SAND	74.3	.26	18	18	.833	50%-60%	40-42	163	--	--	--	--
28	FINE SAND	123.4	.24	24	24	.866	70%-80%	42-44	271	--	--	--	--
29	FINE SAND	85.2	.08	17	17	.9	50%-60%	40-42	187	--	--	--	--
30	FINE SAND	104	.33	20	20	.933	60%-70%	40-42	228	--	--	--	--

PIEZOCONE SOUNDING



* PUSH INTERRUPTED TO ADD ROD
PORE PRESSURE DECAY DATA MAY BE AVAILABLE

FILE #..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
SOUNDING # 02-P23
TEST DATE 12-01-1995 10:28:43

J2-P23 CONTINUED ENSAFE

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES	N'	VERTICAL STRESS	RELATIVE DENSITY	FRICTION ANGLE	YOUNGS MODULUS	UNDRAINED SHEAR ST	SENSITIVITY	COMP.	OCR
31	SILTY FINE SAND	222.2	3.92	55	55	.868	>90%	44-46	488	--	--	--	--
32	SILTY FINE SAND	176.1	2.93	44	44	.899	80%-90%	42-44	387	--	--	--	--
33	SILTY FINE SAND	127.5	2.17	31	31	.93	70%-80%	42-44	280	--	--	--	--
34	SILTY FINE SAND	135.1	1.81	33	33	.961	70%-80%	42-44	297	--	--	--	--
35	FINE SAND	169.2	1.19	33	33	.994	70%-80%	42-44	372	--	--	--	--
36	FINE SAND	347.2	3.18	69	69	1.027	>90%	46-48	763	--	--	--	--
37	FINE SAND	350.3	3.93	70	70	1.06	>90%	46-48	770	--	--	--	--

\# N'=POINT STRESS*(.2+.04*FRICTION RATIO)
* NORMALLY CONSOLIDATED SANDS
** FOR OVERCONSOLIDATED SANDS,SLIGHTLY REDUCE ABOVE FRICTION ANGLES
*** FOR OVERCONSOLIDATED SANDS, YOUNG'S MODULUS MAY BE AS MUCH AS 3 TO 6 TIMES HIGHER
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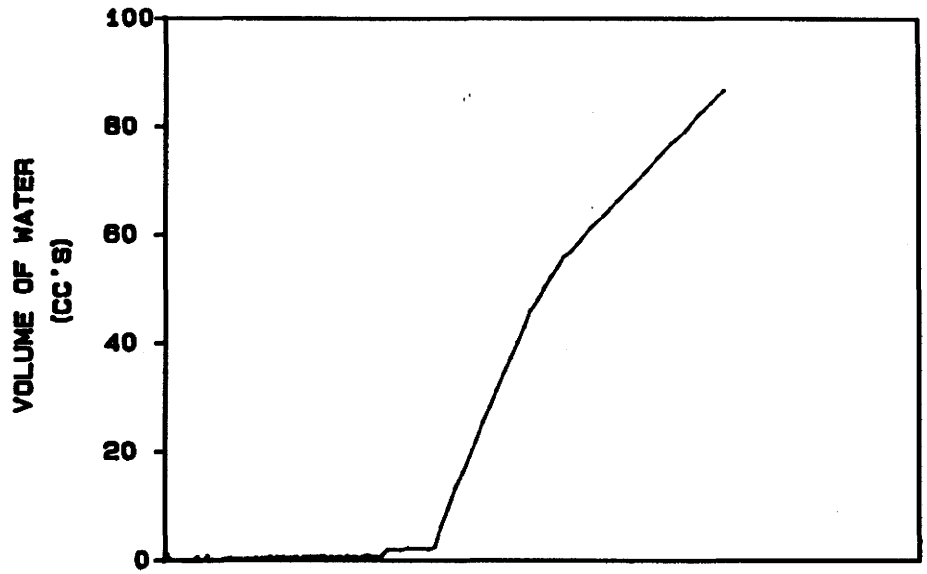
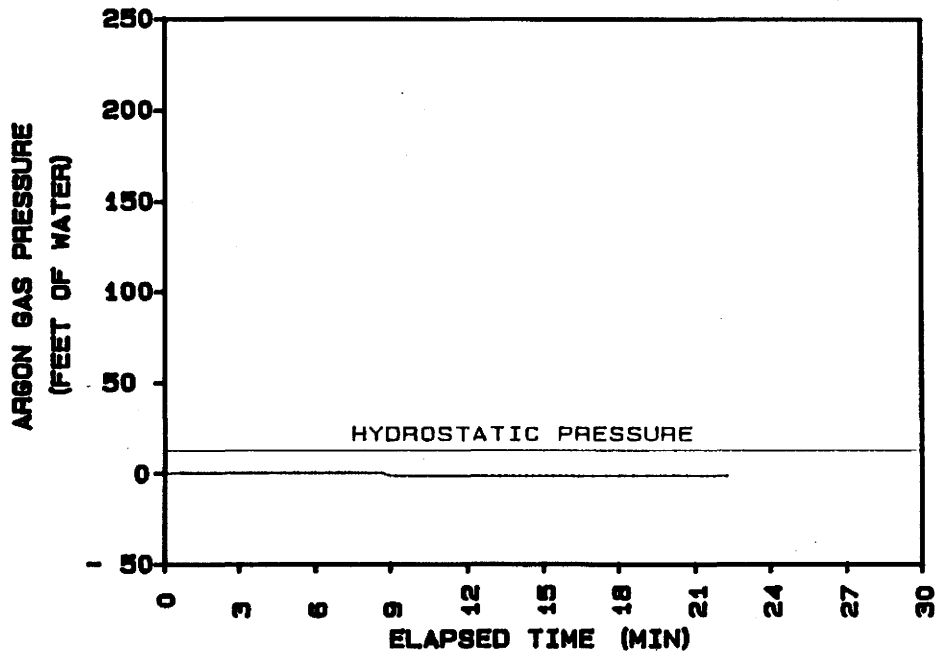
IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE
FOR SOUTHEASTERN UNITED STATES SOILS

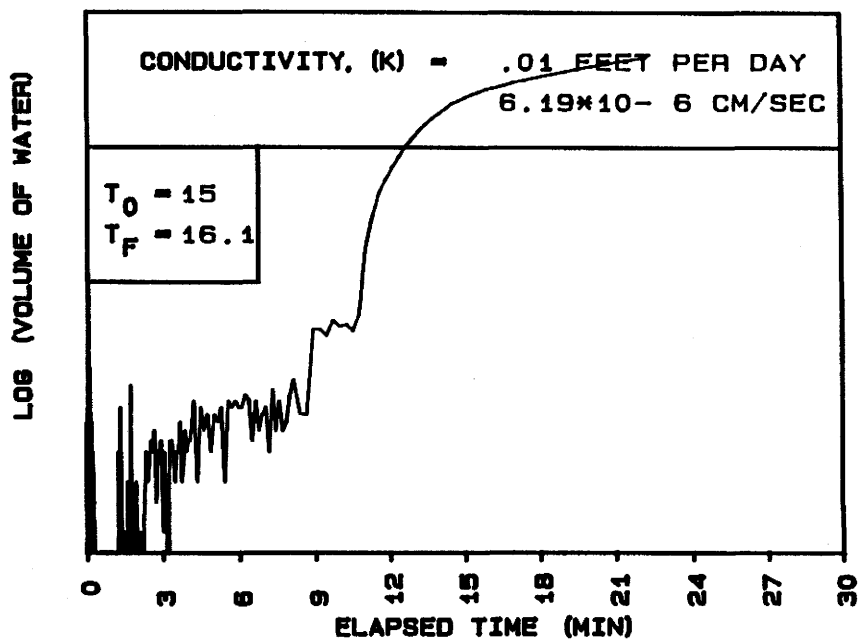
JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
FILE NAME..... 02-P24

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES #	N'	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	SANDY CLAY	15	.45	7	7	.027	--	--	--	.93	3.3	.01	>6
2	SILTY CLAY TO CLAY	34.5	1.52	23	23	.054	--	--	--	2.14	2.2	UD	>6
3	CLAY	38	1.91	38	38	.079	--	--	--	2.36	1.9	UD	>6
4	CLAY	36.6	1.9	36	36	.104	--	--	--	2.27	1.9	UD	>6
5	CLAY	33.5	2.15	33	33	.129	--	--	--	2.07	1.5	UD	>6
6	CLAY	25.3	2.02	25	25	.154	--	--	--	1.56	1.2	UD	>6
7	CLAY	23.3	1.64	23	23	.179	--	--	--	1.43	1.4	UD	>6
8	CLAY	22.8	1.28	22	22	.204	--	--	--	1.39	1.7	UD	>6
9	SILTY CLAY TO CLAY	23.7	.9	15	15	.231	--	--	--	1.44	2.6	UD	>6
10	SANDY CLAY	26.2	.91	13	13	.258	--	--	--	1.6	2.8	.02	>6
11	SANDY CLAY	27.4	.81	13	13	.286	--	--	--	1.67	3.3	.02	>6
12	CLAYEY FINE SAND	29.1	.8	11	11	.316	40%-50%	40-42	64	--	--	--	--
13	CLAY	21.5	1.04	21	21	.341	--	--	--	1.29	2	UD	6
14	CLAY	17.1	.95	17	17	.366	--	--	--	1.01	1.7	.01	6
15	CLAY	12.5	.65	12	12	.391	--	--	--	.72	1.9	.02	6
16	CLAY	11.1	.65	11	11	.416	--	--	--	.63	1.7	.02	6
17	CLAY	11.6	.55	11	11	.441	--	--	--	.66	2	.02	6
18	CLAY	11.3	.49	11	11	.466	--	--	--	.64	2.3	.02	6
19	SILTY CLAY TO CLAY	15.5	.52	10	10	.493	--	--	--	.9	2.9	.01	6
20	SILTY CLAY TO CLAY	14.7	.59	9	9	.521	--	--	--	.84	2.4	.01	6
21	CLAY	6.8	.29	6	6	.545	--	--	--	.35	2.2	.03	3
22	CLAY	9.3	.34	9	9	.57	--	--	--	.5	2.6	.02	3
23	SANDY CLAY	19.1	.51	9	9	.598	--	--	--	1.11	3.7	.01	6
24	SANDY CLAY	11.3	.31	5	5	.625	--	--	--	.62	3.6	.02	3
25	SILTY CLAY TO CLAY	9.7	.29	6	6	.652	--	--	--	.51	3.2	.02	3
26	CLAYEY FINE SAND	23.6	.51	9	9	.683	<40%	34-36	51	--	--	--	--
27	CLAYEY FINE SAND	15.3	.27	6	6	.714	<40%	32-34	33	--	--	--	--
28	SANDY CLAY	15	.3	7	7	.741	--	--	--	.83	4.8	.01	6
29	CLAYEY FINE SAND	22	.42	8	8	.772	<40%	34-36	48	--	--	--	--
30	CLAYEY FINE SAND	31.2	.75	12	12	.803	<40%	36-38	68	--	--	--	--

HYDROCONE TEST







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GROUNDWATER DEPTH (FT) 15

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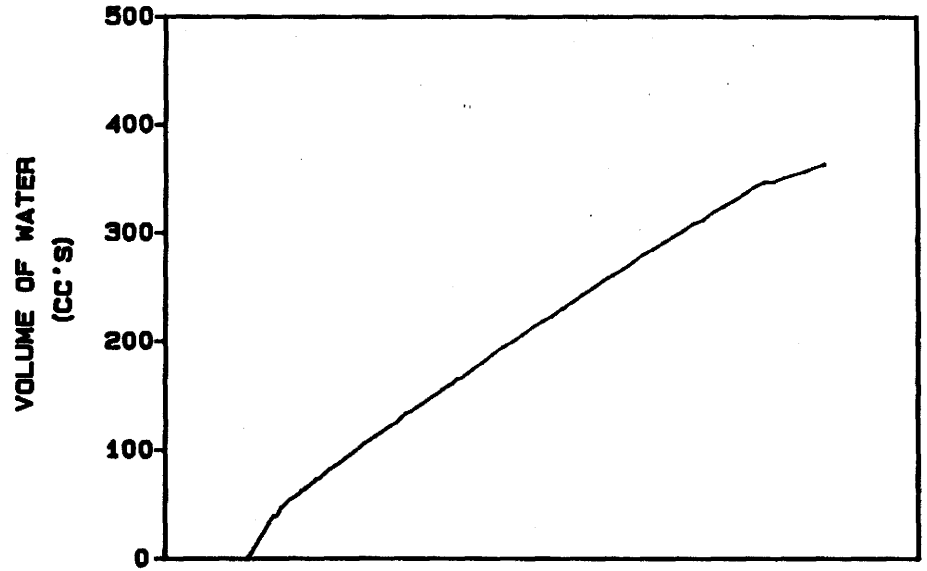

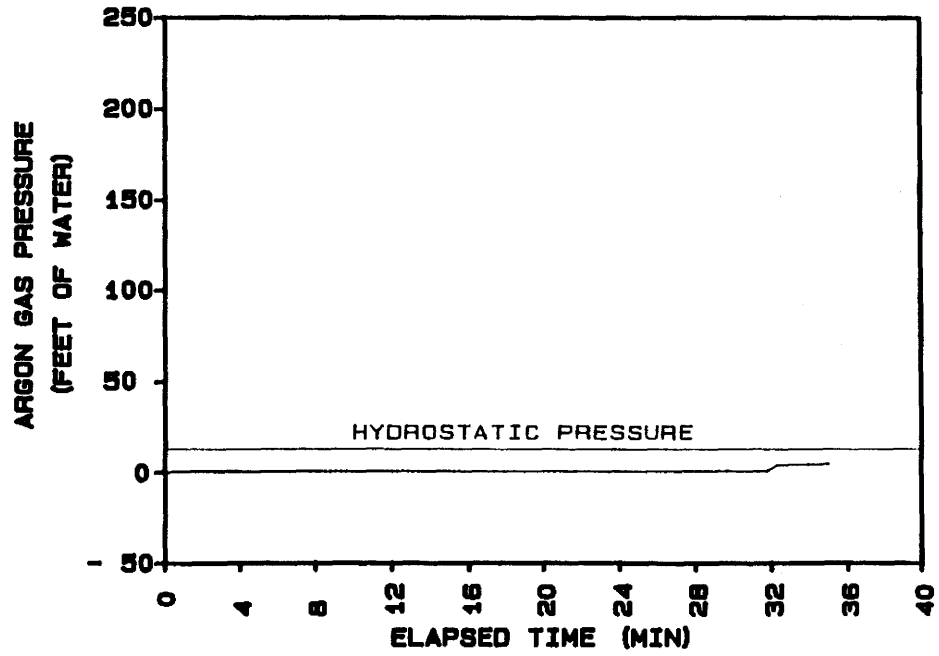

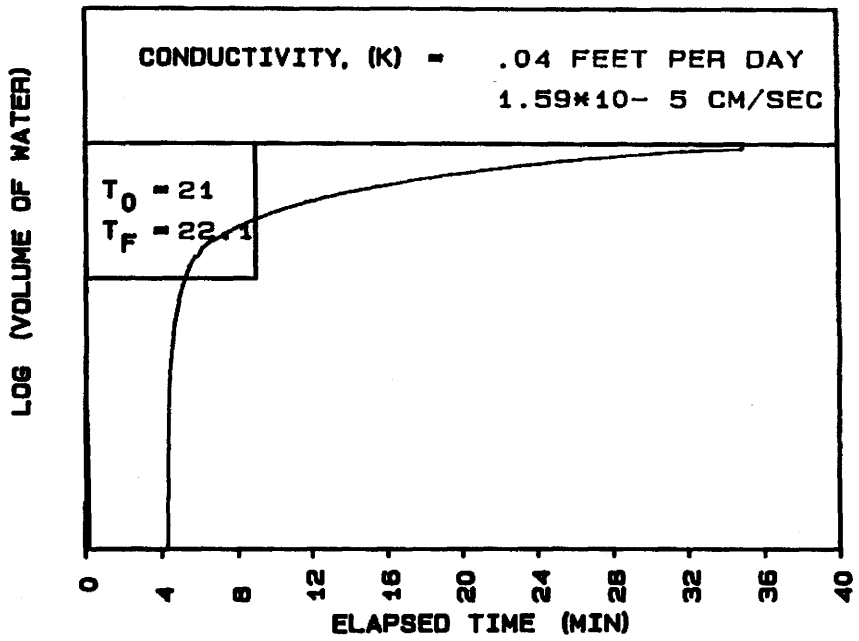

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LOCATION... 02H1427
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GROUNDWATER DEPTH (FT) 15

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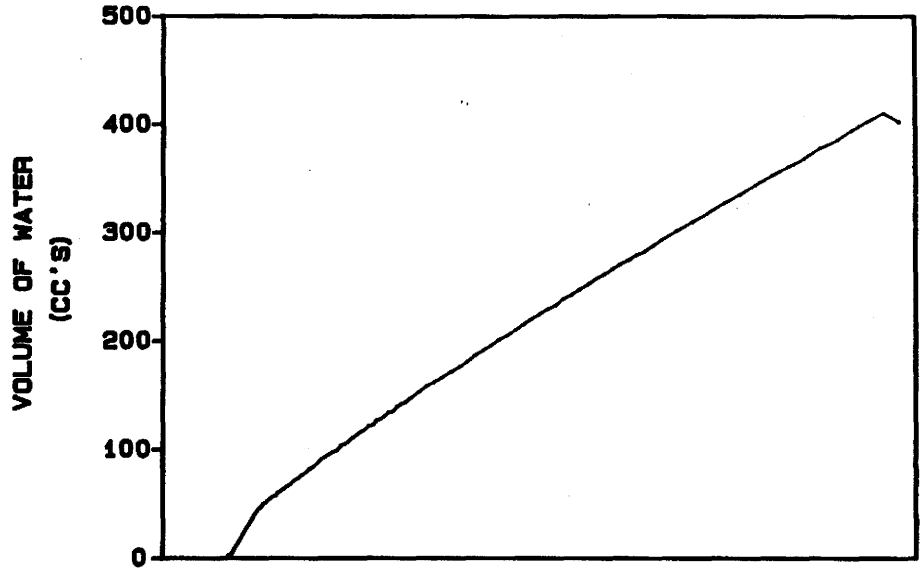

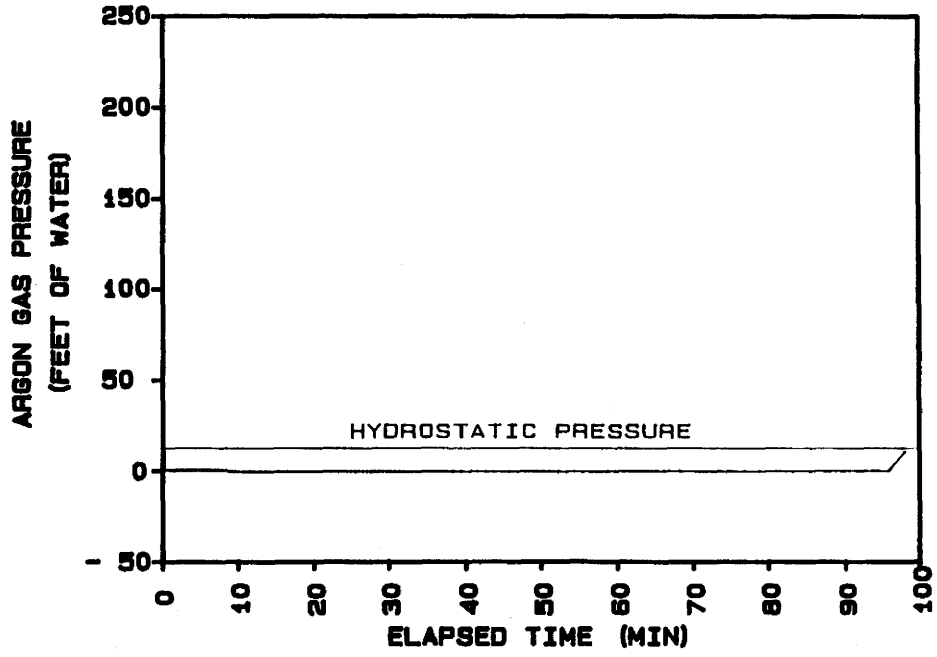

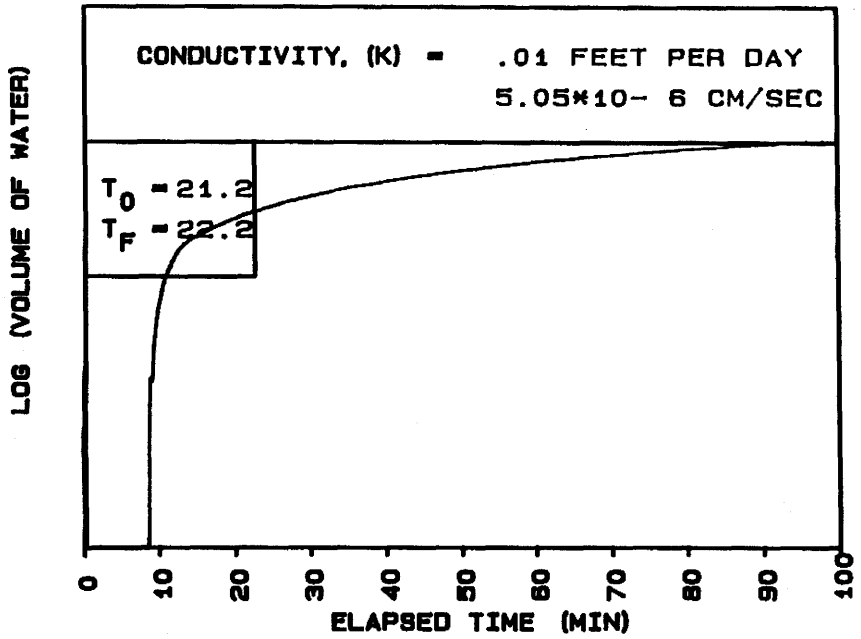

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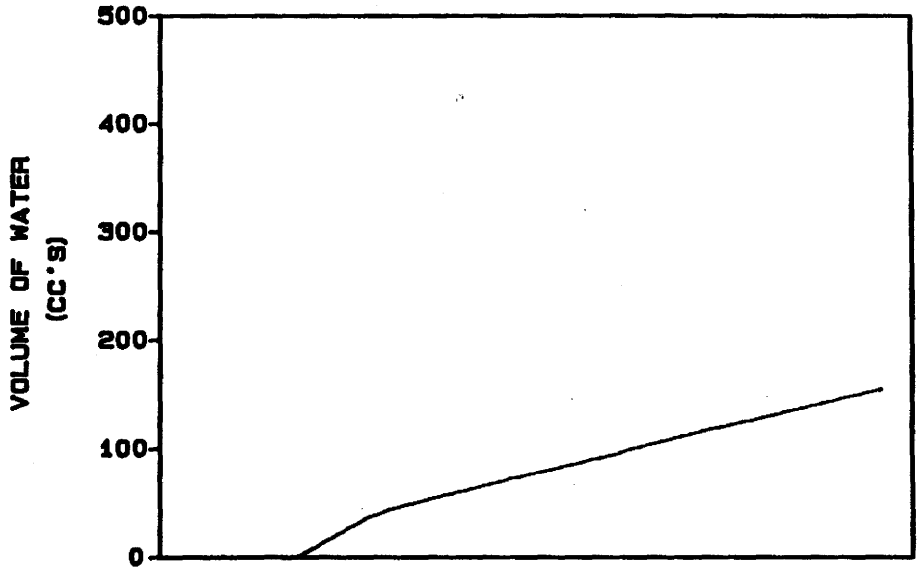

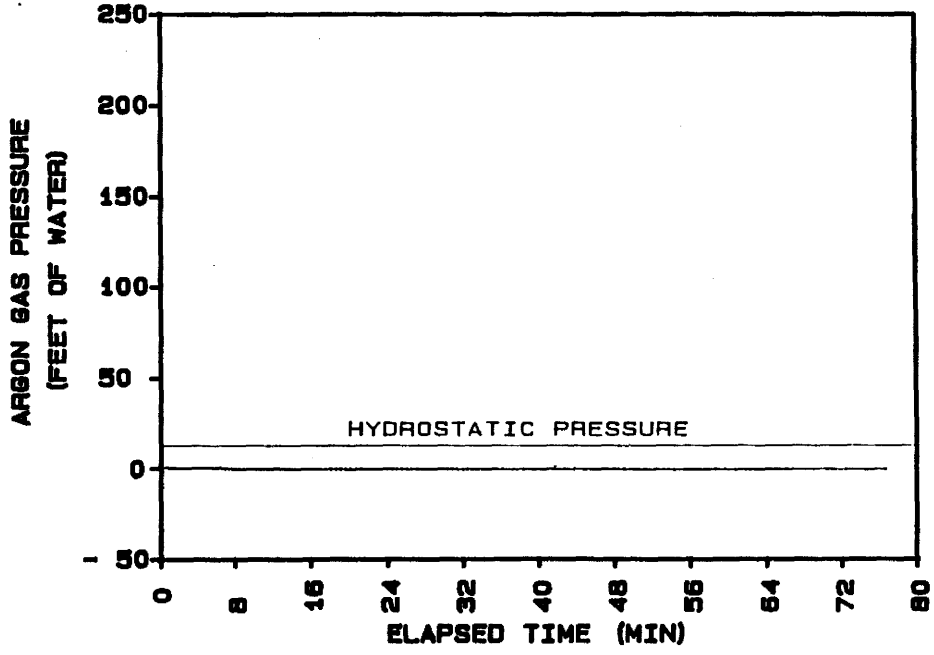

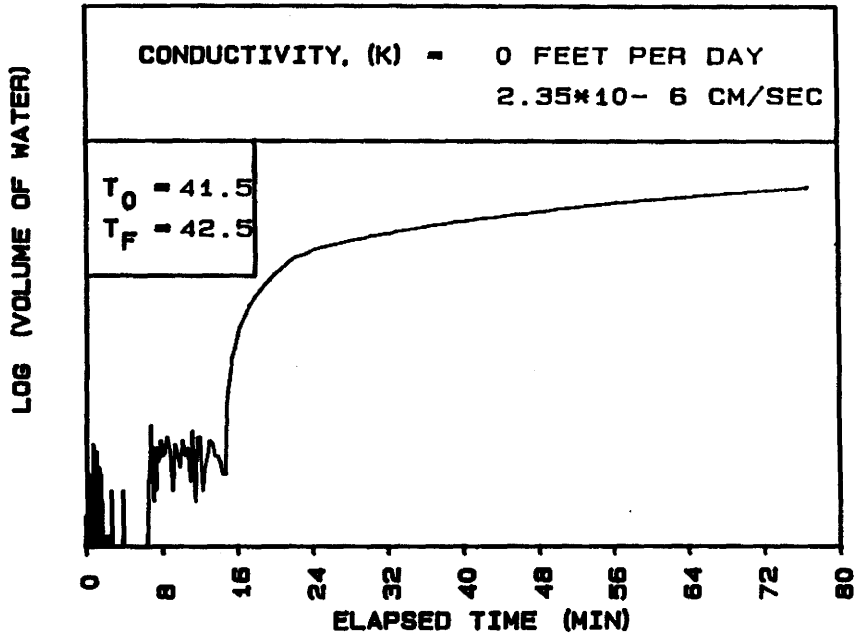

ENSAFE MEMPHIS NSA
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08: 31: 33 12-14-1995

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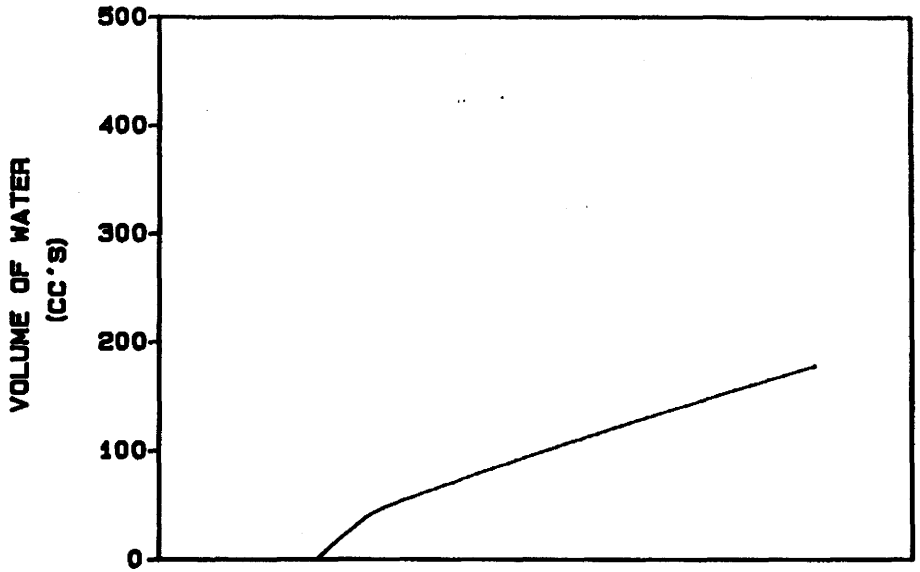

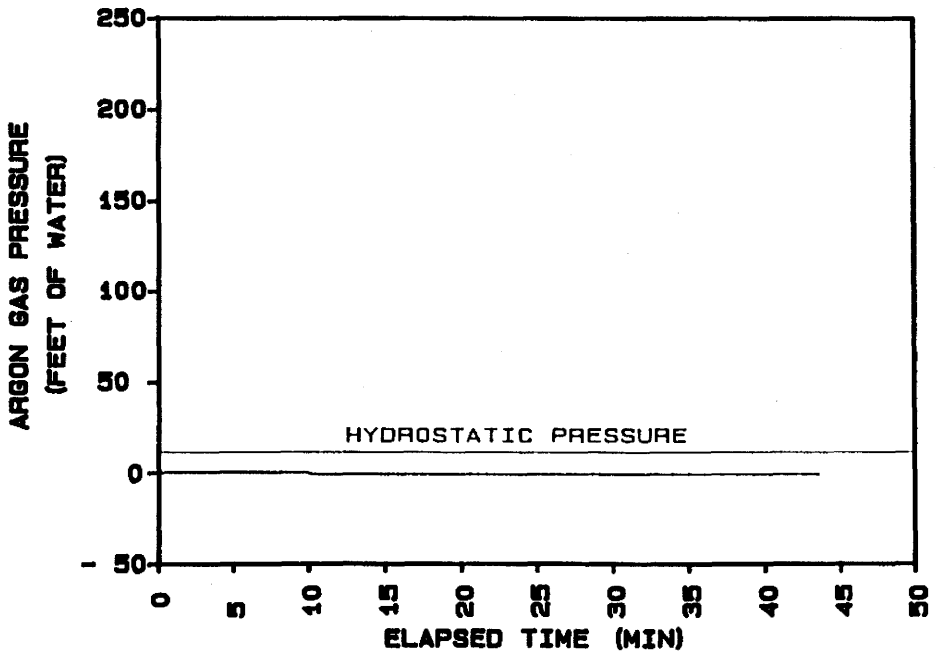

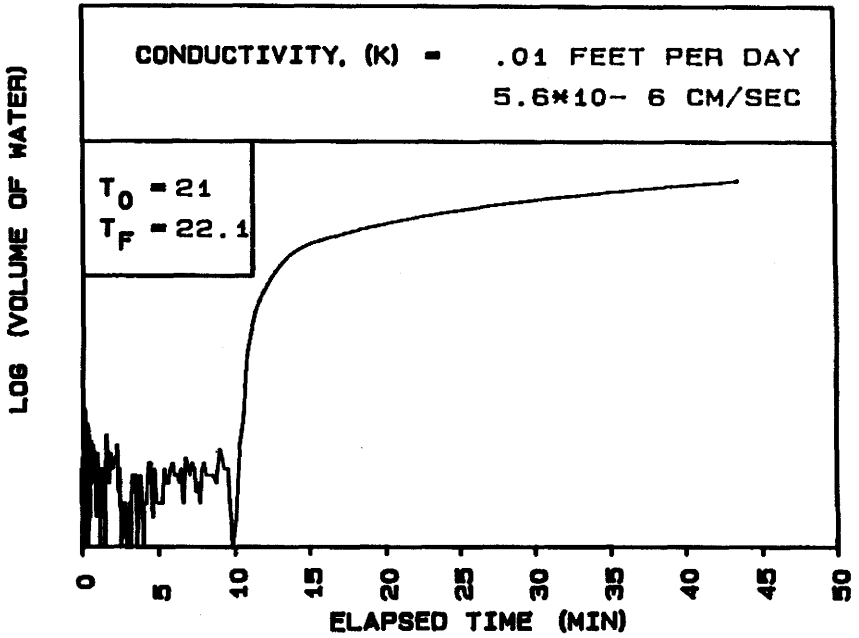

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GROUNDWATER DEPTH (FT) 15

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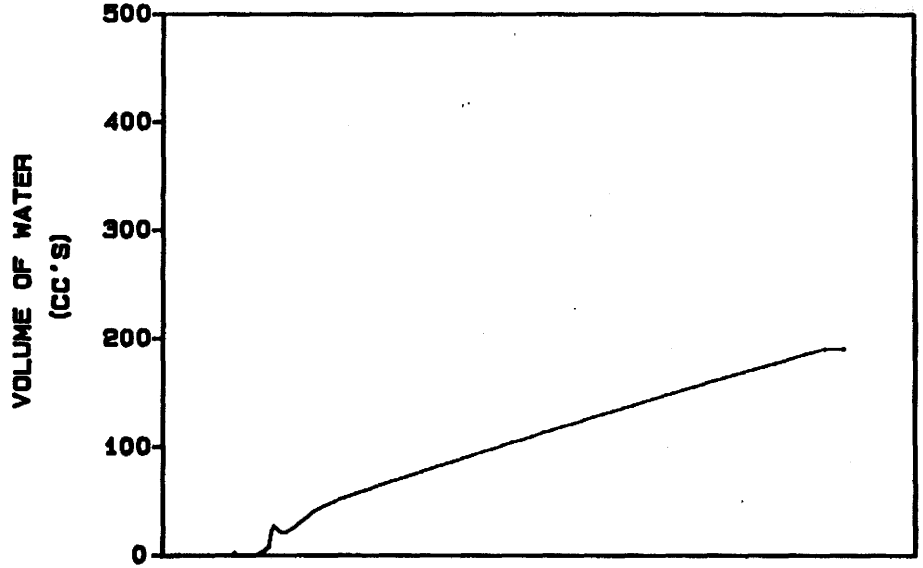
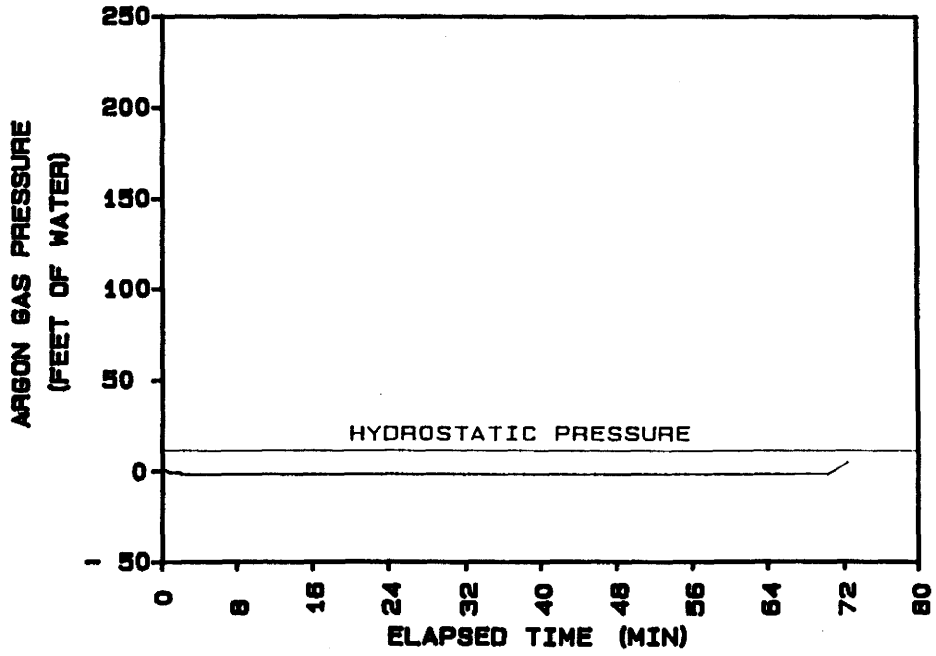
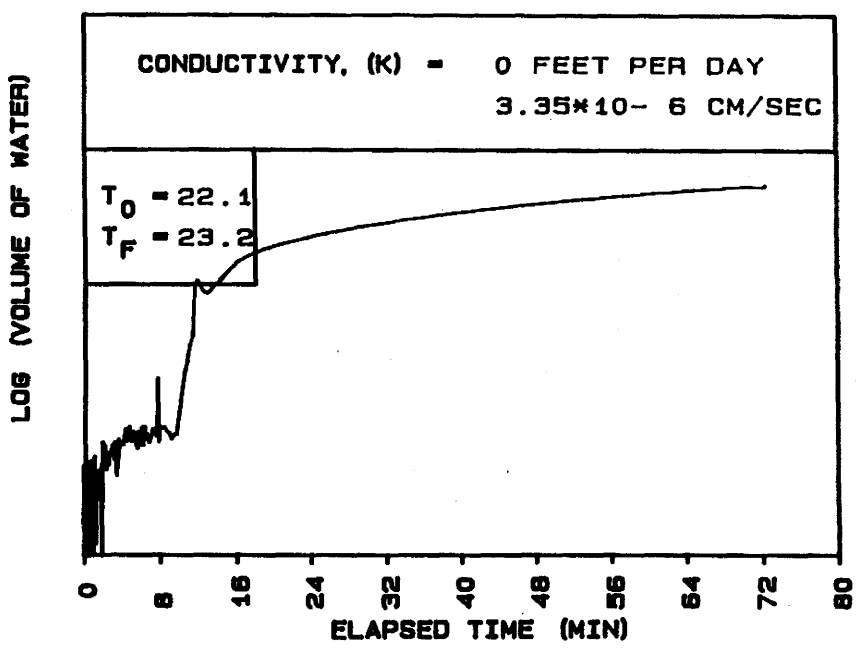


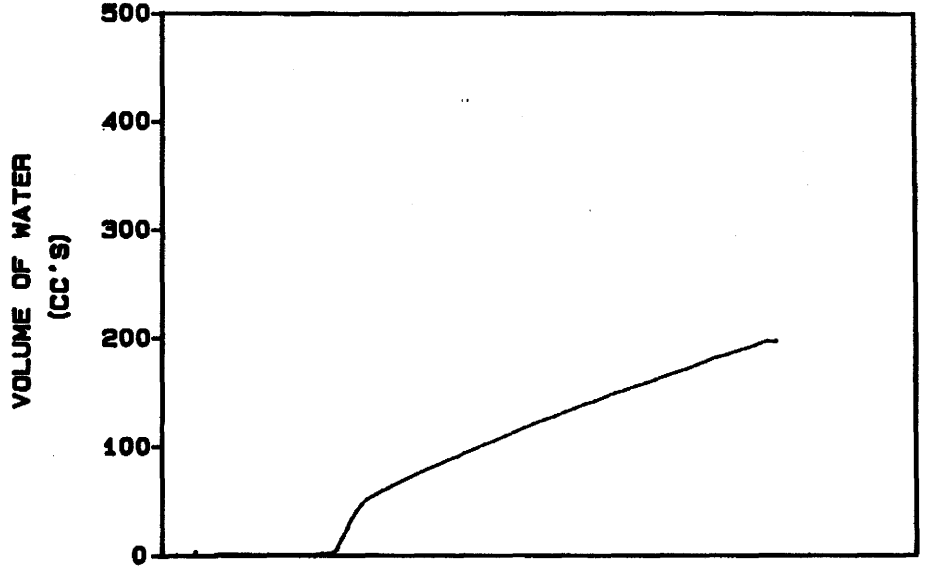


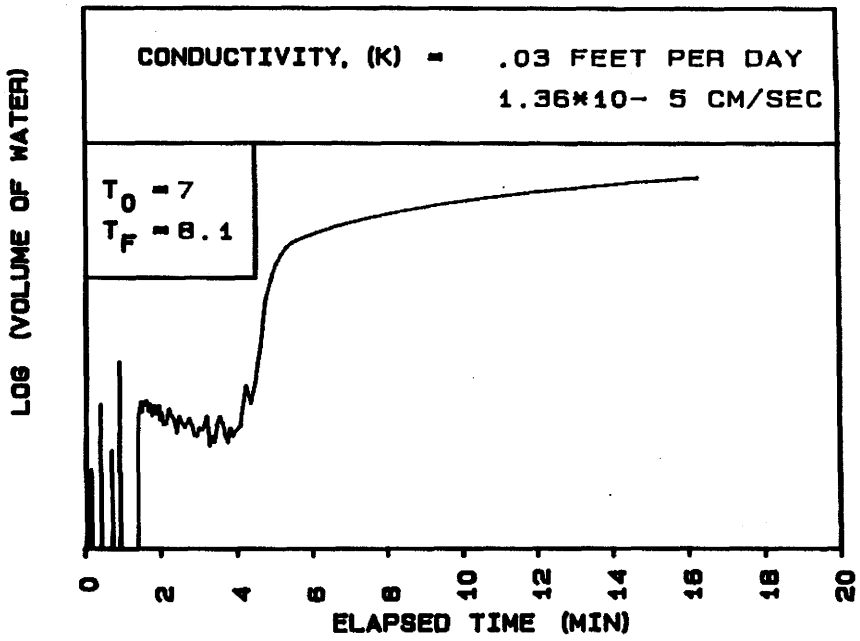


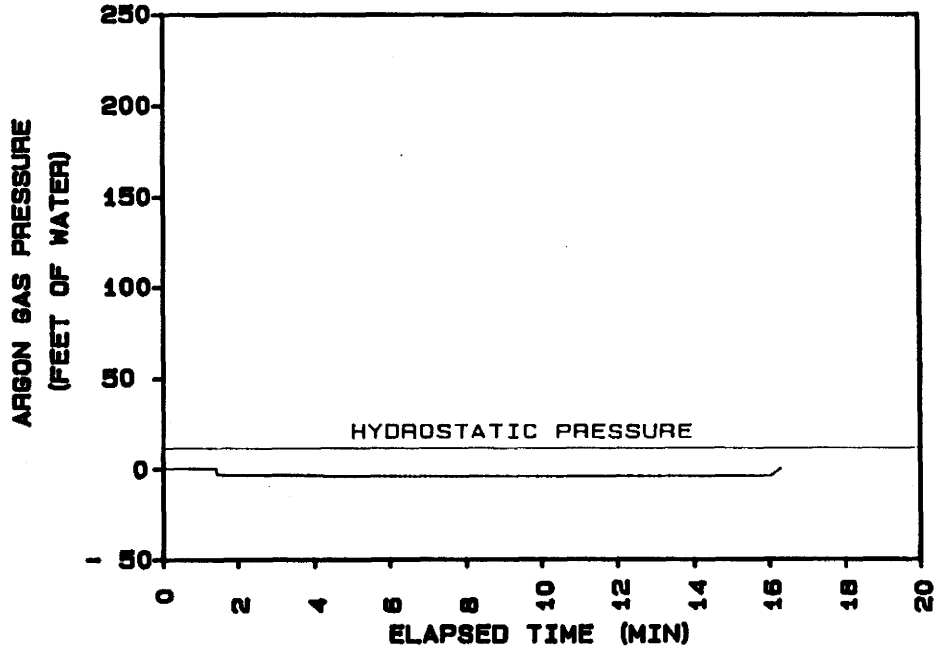
ENSAFE MEMPHIS NSA
LOCATION... 02H1626
TEST DATE
09: 10: 31 12-16-1995

SAMPLE DEPTH (FT) 26
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



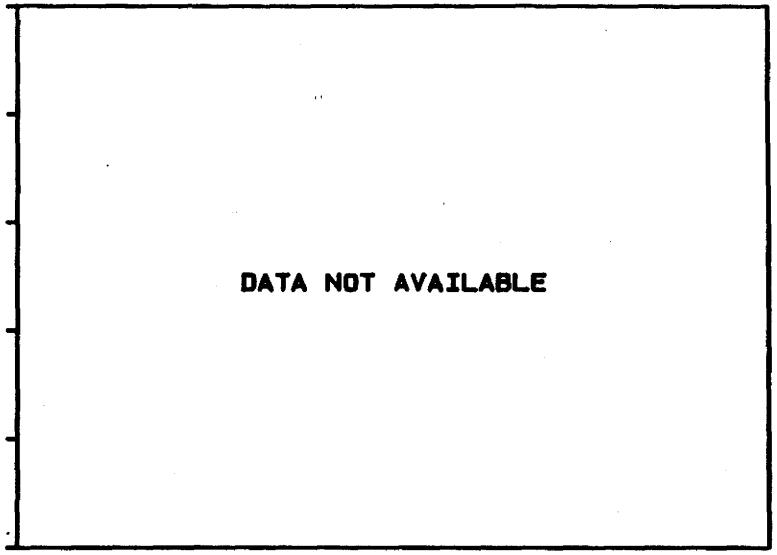


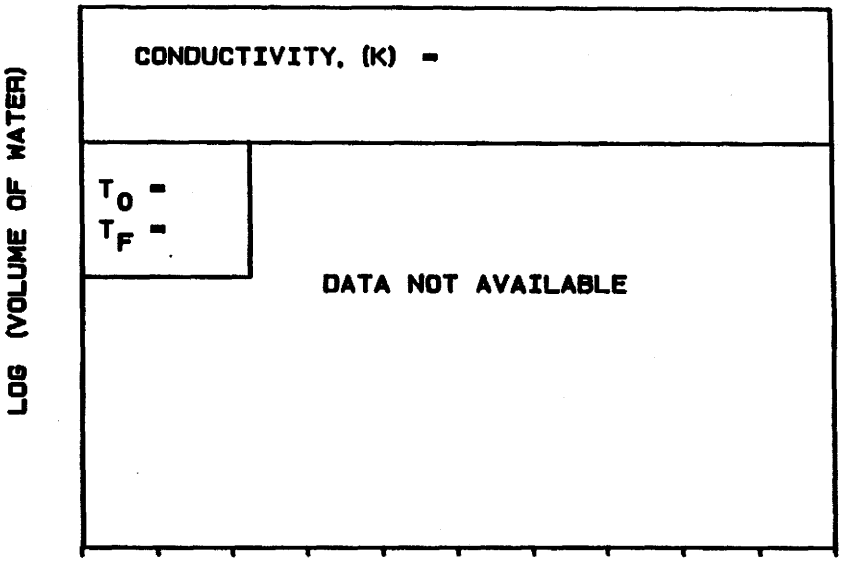


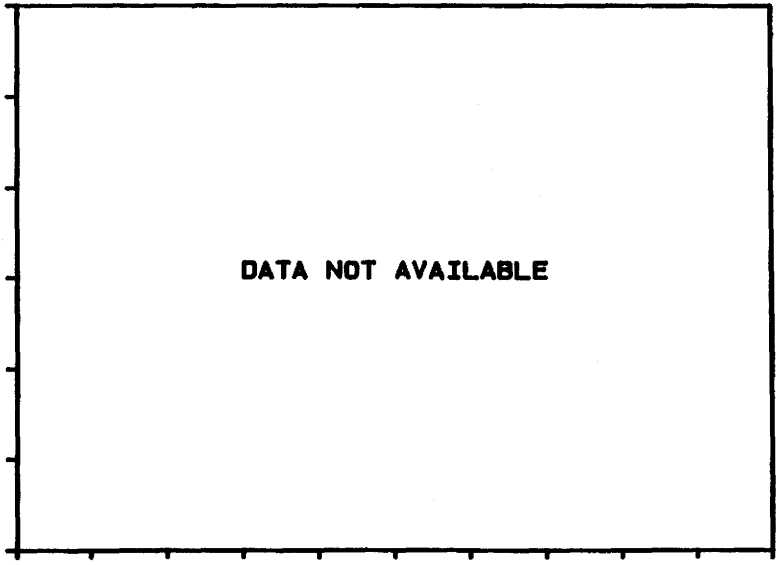
ENSAFE MEMPHIS NSA
LOCATION... 02H1926
TEST DATE
13: 14: 16 12-16-1995

SAMPLE DEPTH (FT) 26
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



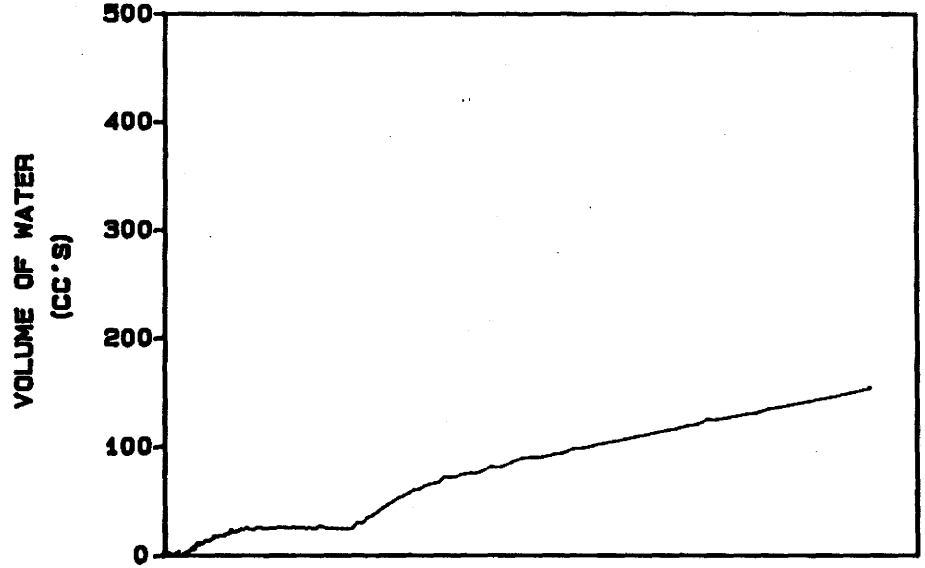


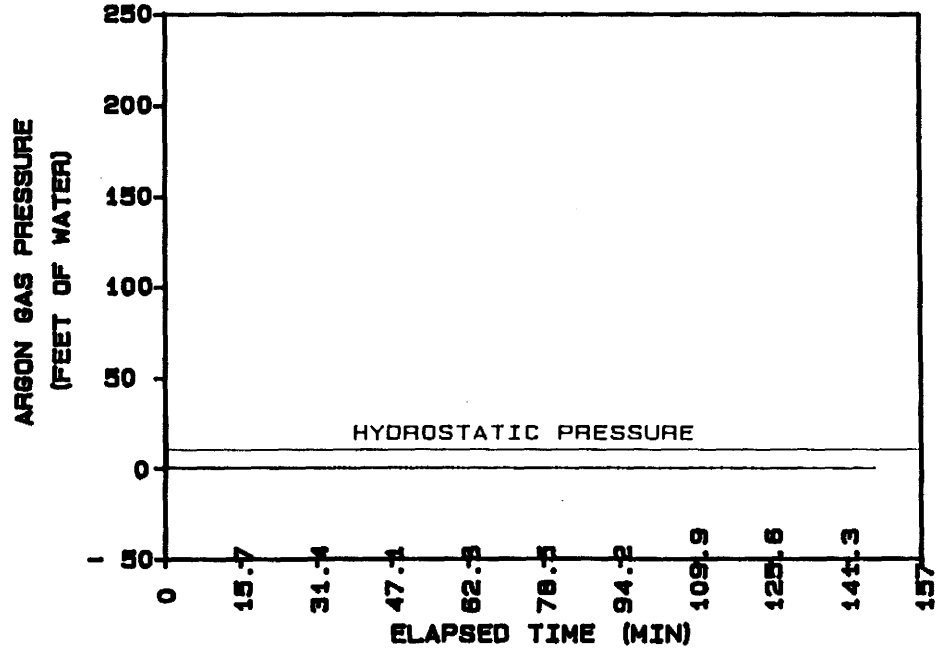


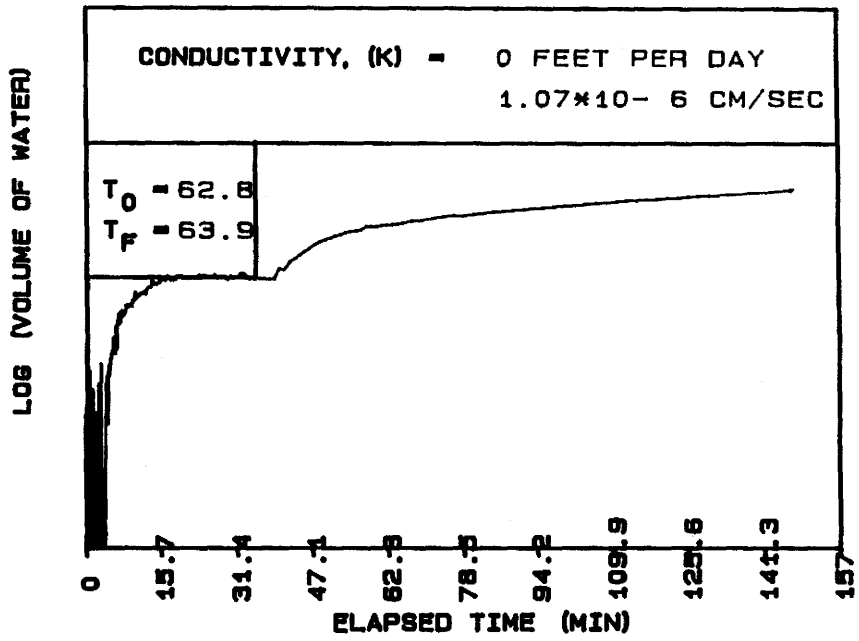
ENSAFE MEMPHIS NSA
LOCATION... 02H2022

DATA NOT AVAILABLE

HYDROCONE TEST







ENSAFE MEMPHIS NSA
LOCATION... 02H2130
TEST DATE
14: 55: 42 12-05-1995

SAMPLE DEPTH (FT) 30
GROUNDWATER DEPTH (FT) 20

HYDROCONE TEST

VOLUME OF WATER (CC'S)

DATA NOT AVAILABLE

LOG (VOLUME OF WATER)

CONDUCTIVITY, (K) =

T_0 =

T_F =

DATA NOT AVAILABLE

ELAPSED TIME (MIN)

ARGON GAS PRESSURE (FEET OF WATER)

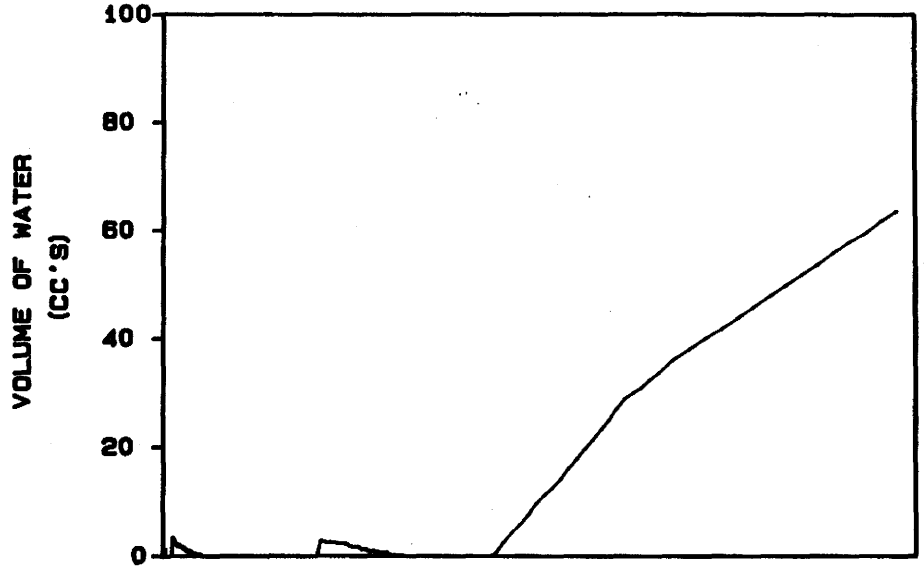
DATA NOT AVAILABLE

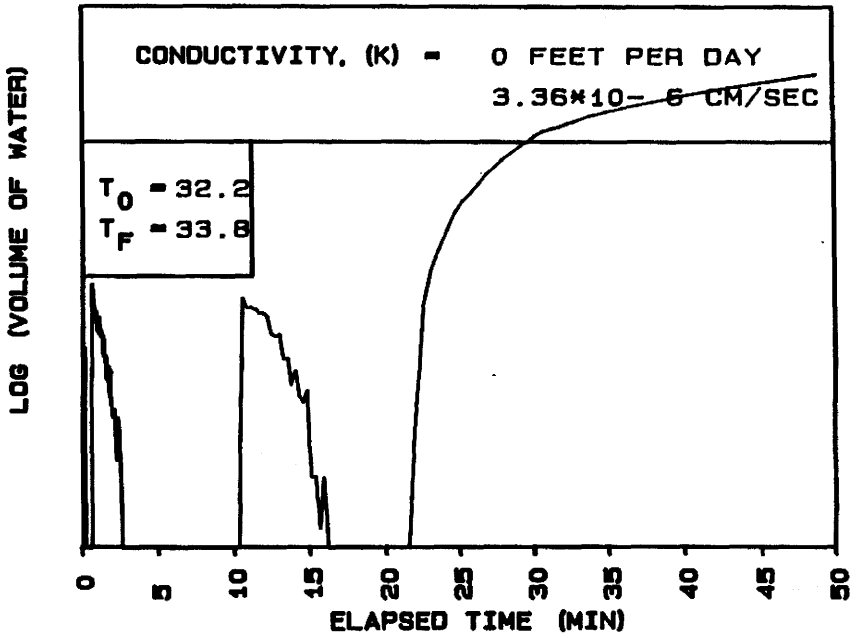
ELAPSED TIME (MIN)

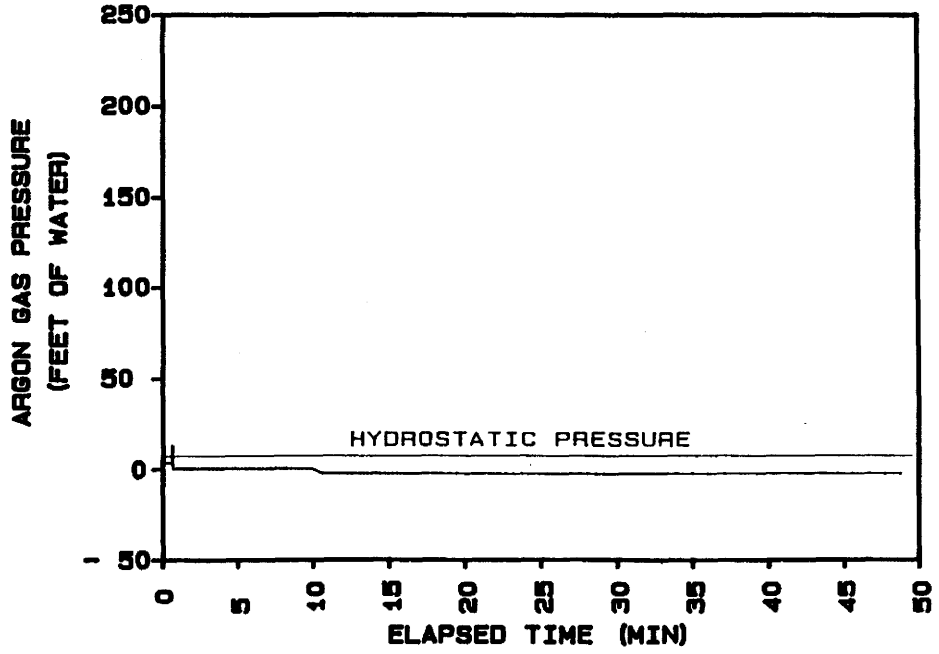
ENSAFE MEMPHIS NSA
LOCATION... 02H2229

DATA NOT AVAILABLE

HYDROCONE TEST



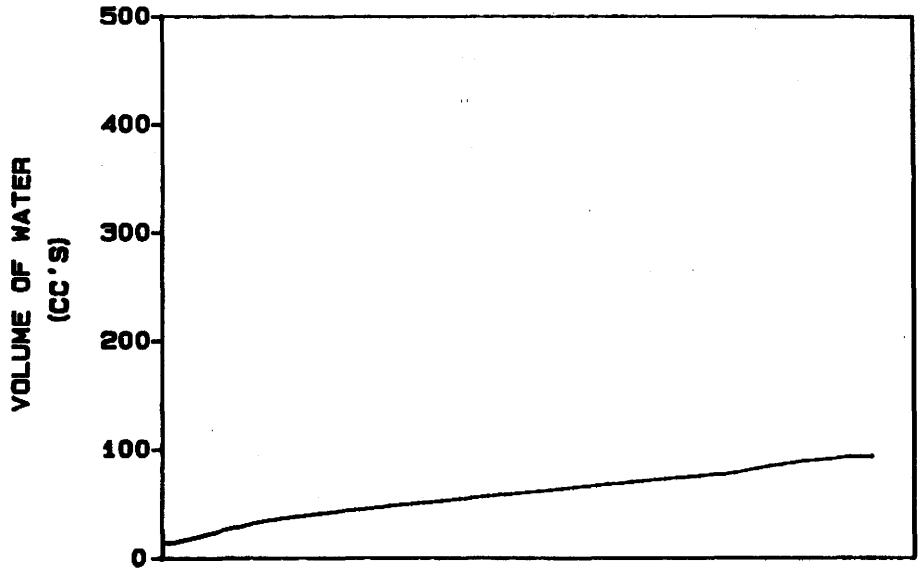


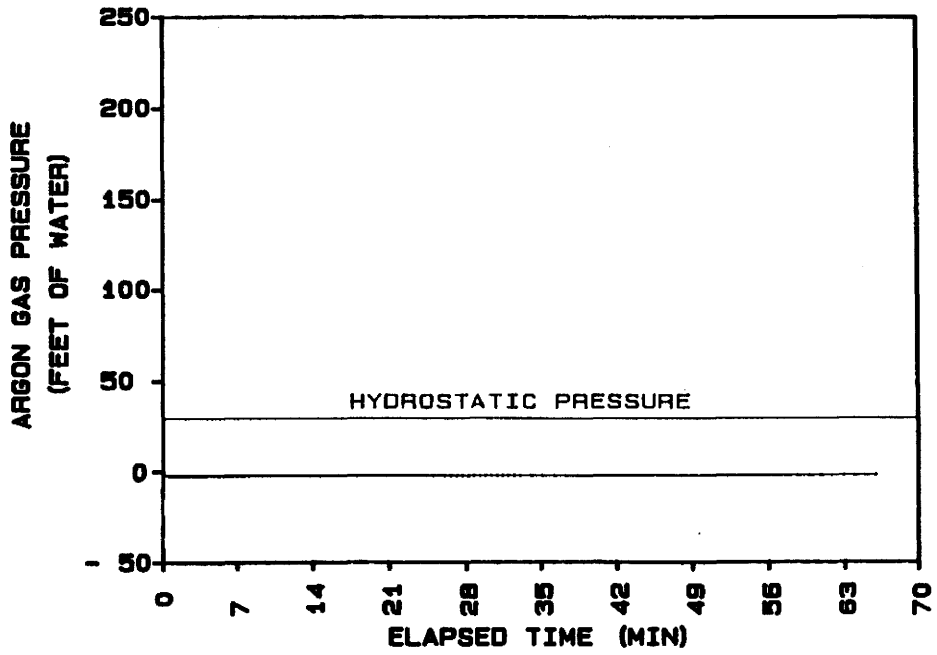


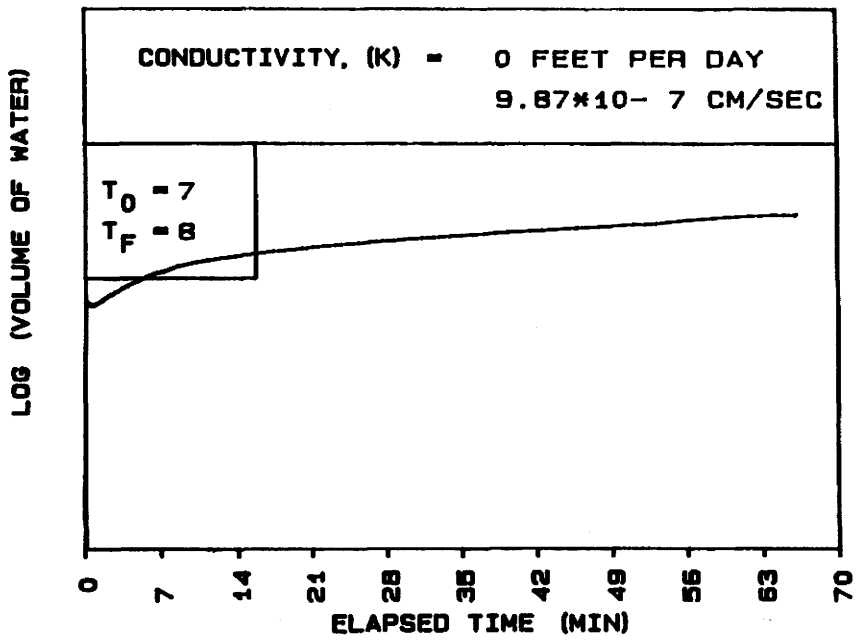
ENSAFE MEMPHIS NSA
LOCATION... 02H2323
TEST DATE
13: 25: 32 12-01-1995

SAMPLE DEPTH (FT) 23
GROUNDWATER DEPTH (FT) 16

HYDROCONE TEST



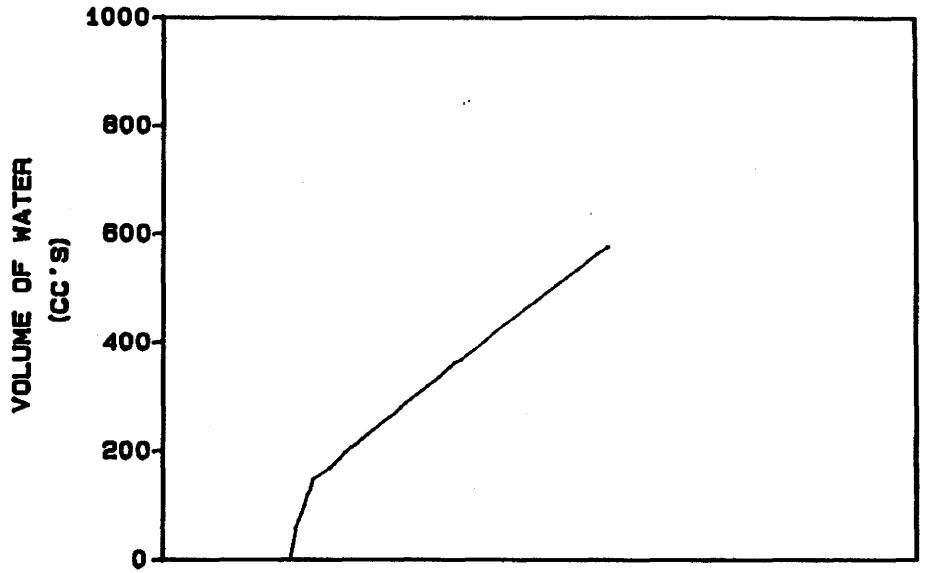


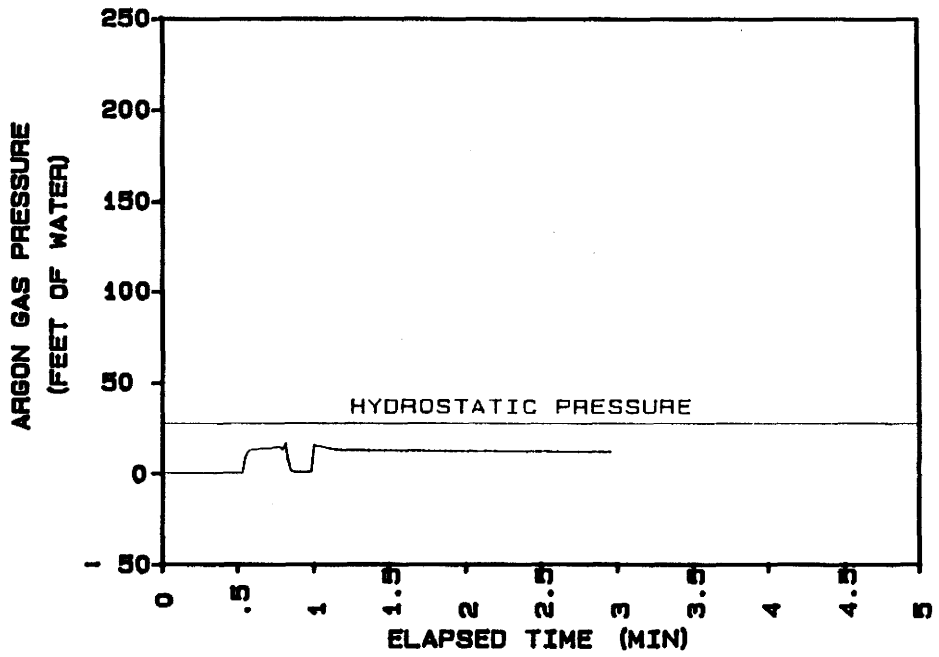


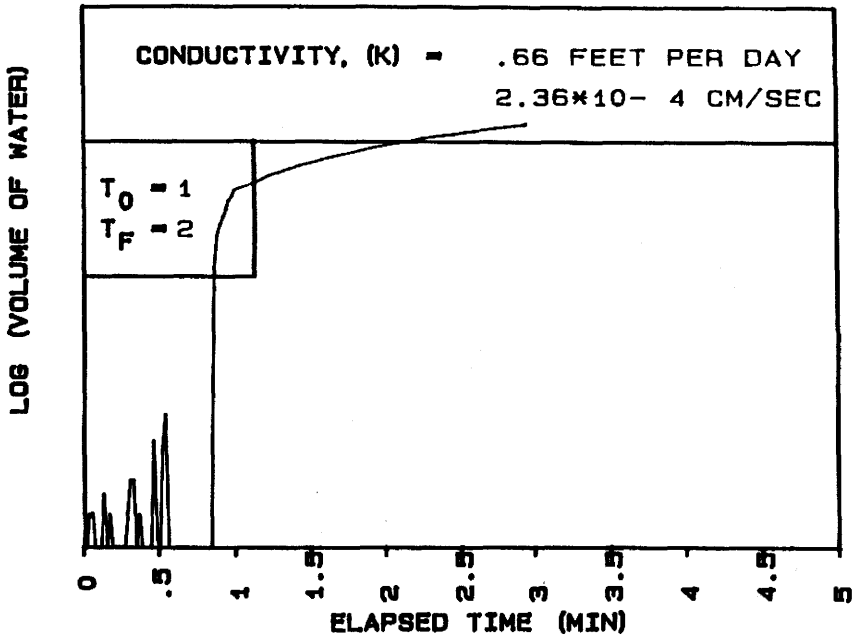
ENSAFE MEMPHIS NSA
LOCATION... 02H2436
TEST DATE
10: 23: 14 12-02-1995

SAMPLE DEPTH (FT) 37
GROUNDWATER DEPTH (FT) 8

HYDROCONE TEST



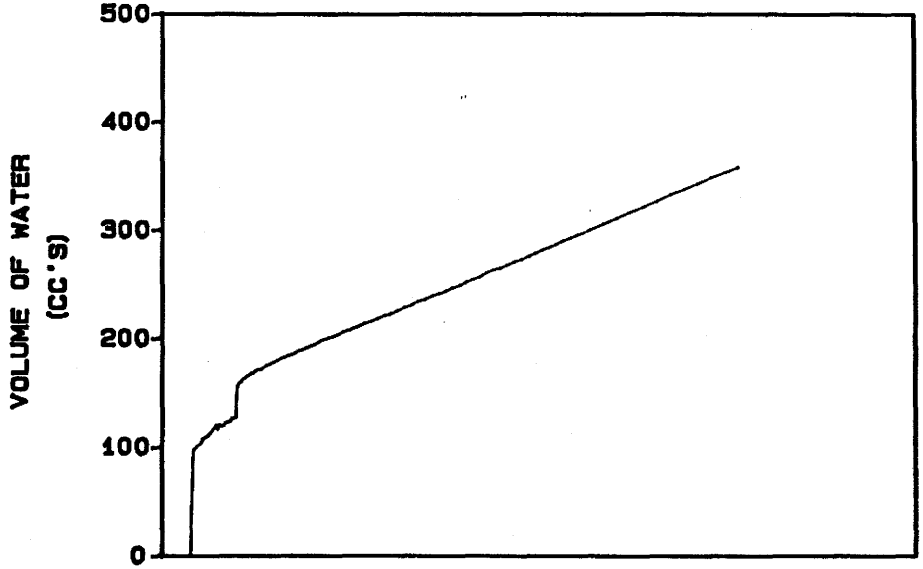


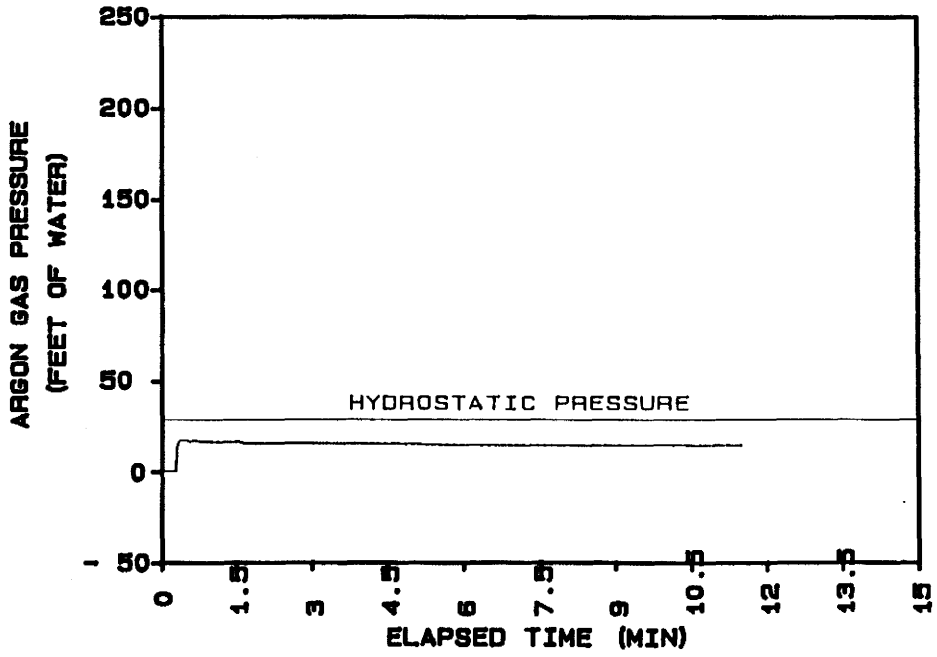


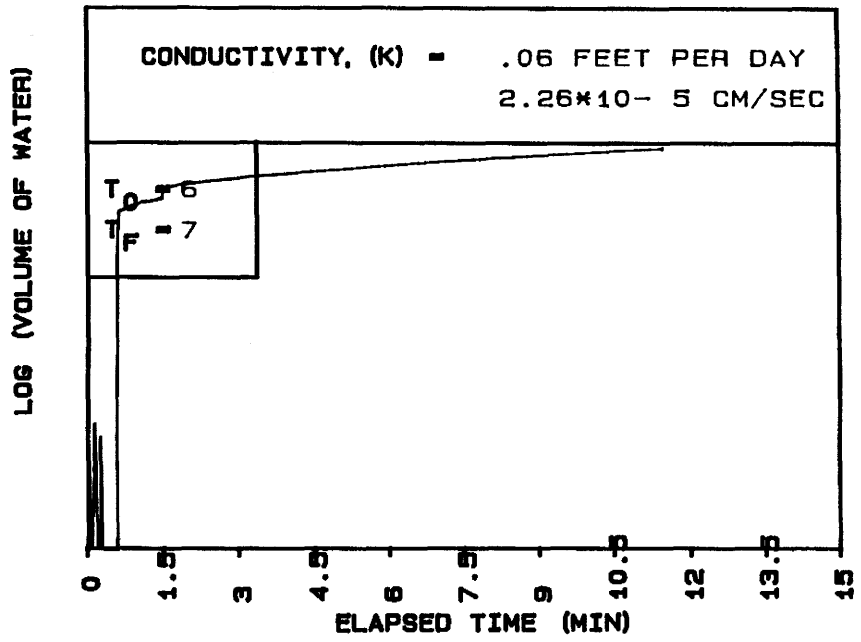
ENSAFE MEMPHIS NSA
LOCATION... 02H2540
TEST DATE
12: 47: 38 12-05-1995

SAMPLE DEPTH (FT) 40
GROUNDWATER DEPTH (FT) 13

HYDROCONE TEST



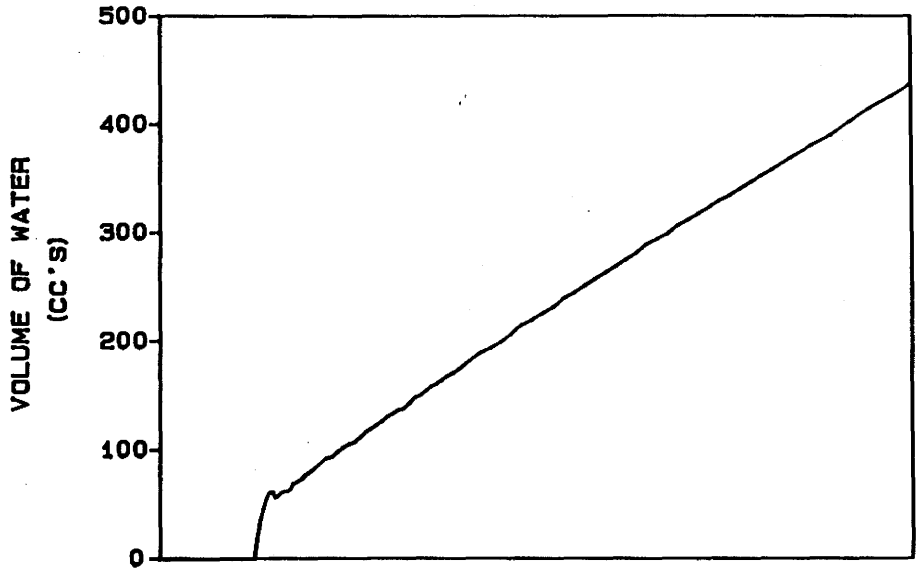


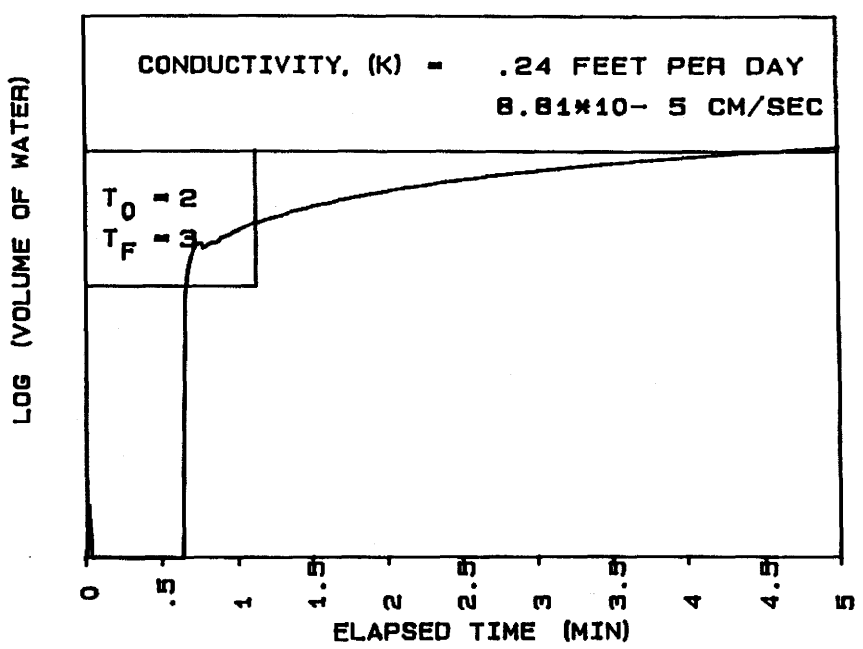


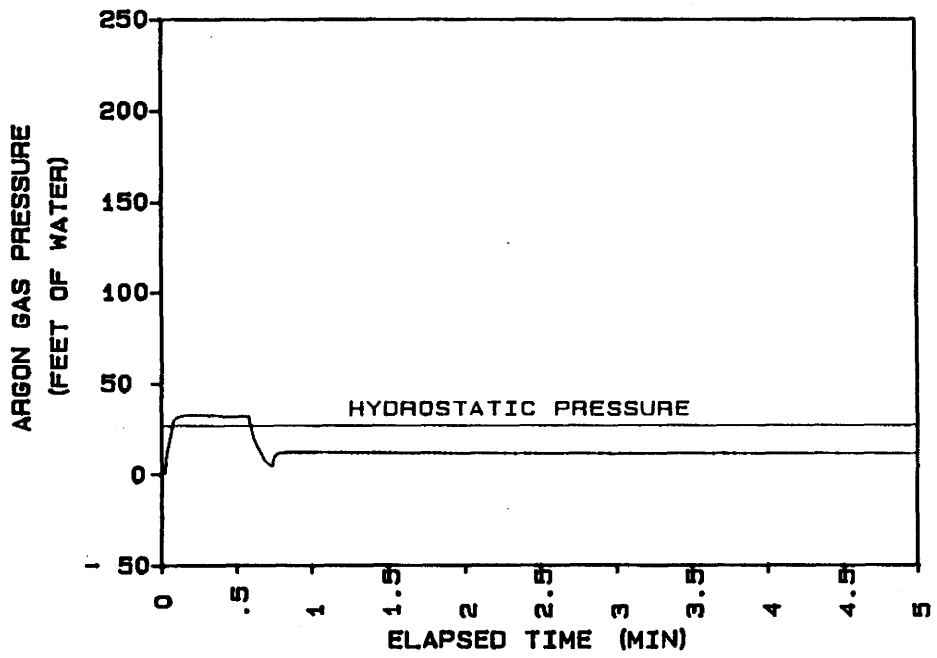
ENSAFE MEMPHIS NSA
LOCATION... 02H2643
TEST DATE
14: 44: 15 12-03-1995

SAMPLE DEPTH (FT) 43
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST







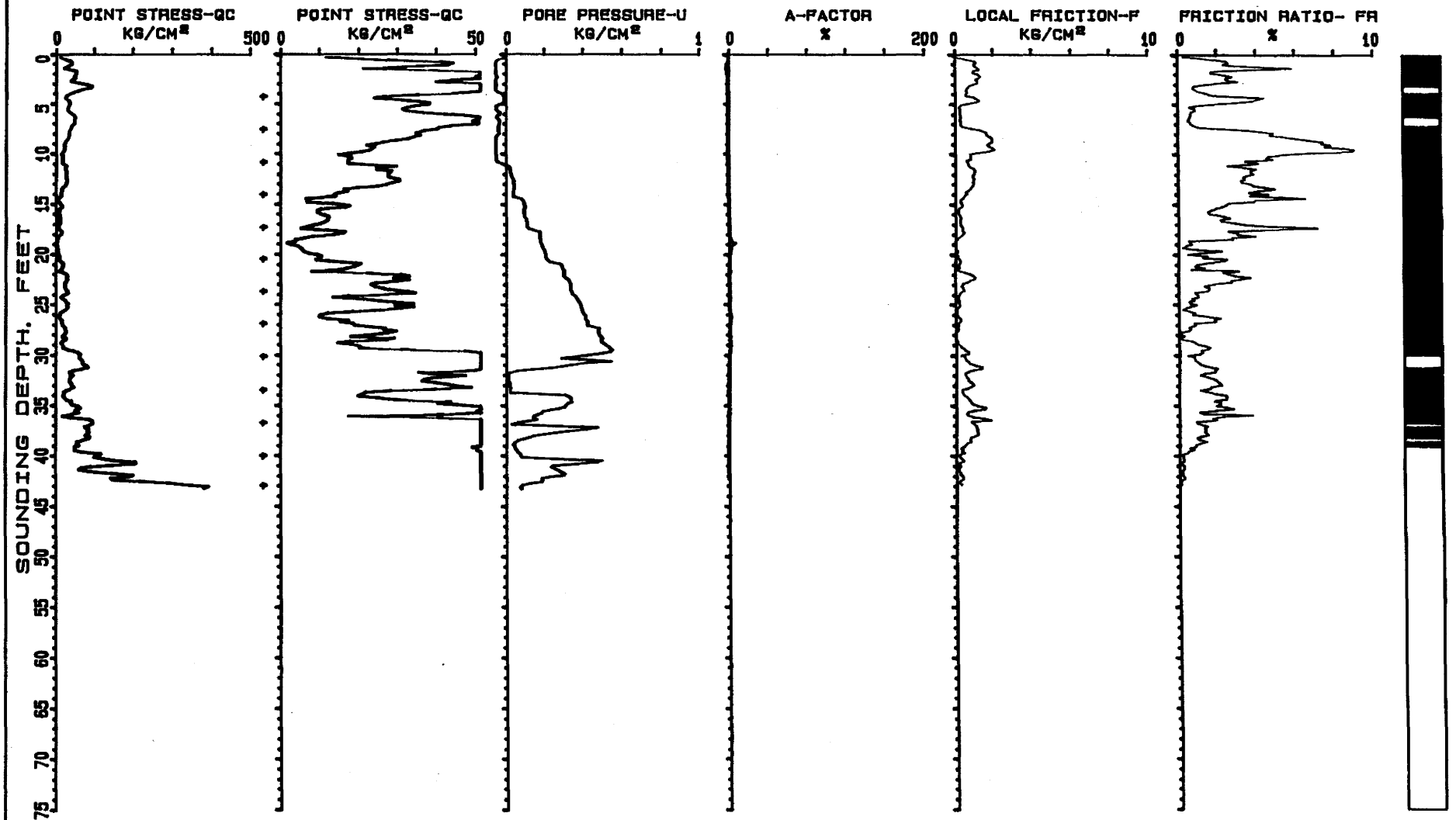
ENSAFE MEMPHIS NSA
LOCATION... 02H2741
TEST DATE
18: 07: 39 12-04-1995

SAMPLE DEPTH (FT) 41
GROUNDWATER DEPTH (FT) 15

SWMU 9

DPT SCREENING INVESTIGATION RESULTS

PIEZOCONE SOUNDING



* PUSH INTERRUPTED TO ADD ROD
PORE PRESSURE DECAY DATA MAY BE AVAILABLE

FILE #..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
SOUNDING # 09-P09
TEST DATE 12-17-1995 13: 49: 14

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES	N'	VERTICAL STRESS	RELATIVE DENSITY	FRICTION ANGLE	YOUNGS MODULUS	UNDRAINED SHEAR ST	SENSITIVITY	COMP.	OCR
31	SILTY FINE SAND	69.5	.74	17	17	.896	40%-50%	38-40	152	--	--	--	--
32	SILTY TO CLAYEY F.S.	58.4	.84	19	19	.927	40%-50%	38-40	128	--	--	--	--
33	CLAYEY FINE SAND	40.8	.76	16	16	.958	<40%	36-38	89	--	--	--	--
34	SILTY TO CLAYEY F.S.	33.9	.47	11	11	.988	<40%	34-36	74	--	--	--	--
35	CLAYEY FINE SAND	35.5	.88	14	14	1.019	<40%	34-36	78	--	--	--	--
36	SILTY TO CLAYEY F.S.	50.3	.95	16	16	1.05	<40%	36-38	110	--	--	--	--
37	SILTY TO CLAYEY F.S.	72.9	1.16	24	24	1.081	40%-50%	38-40	160	--	--	--	--
38	SILTY FINE SAND	84.8	1.11	21	21	1.111	50%-60%	38-40	186	--	--	--	--
39	SILTY FINE SAND	71.7	.68	17	17	1.142	40%-50%	38-40	157	--	--	--	--
40	SILTY FINE SAND	73.3	.3	18	18	1.173	40%-50%	38-40	161	--	--	--	--
41	FINE SAND	155.1	.25	31	31	1.206	70%-80%	42-44	341	--	--	--	--
42	FINE SAND	123.9	.22	24	24	1.239	60%-70%	40-42	272	--	--	--	--

\# N'=POINT STRESS*(.2+.04*FRICTION RATIO)
* NORMALLY CONSOLIDATED SANDS
** FOR OVERCONSOLIDATED SANDS,SLIGHTLY REDUCE ABOVE FRICTION ANGLES
*** FOR OVERCONSOLIDATED SANDS, YOUNG'S MODULUS MAY BE AS MUCH AS 3 TO 6 TIMES HIGHER
**** NK OF 16 USED. FOR OVERCONSOLIDATED CLAYS, AN NK OF 17 IS SUGGESTED

THE ABOVE DATA WAS COMPUTED FOLLOWING 'BASIC' GUIDELINES BY P. K. ROBERTSON AND R. G. CAMPANELLA IN THE HANDBOOK 'GUIDELINES FOR USE AND INTERPERTATION OF THE ELECTRONIC CONE PENETRATION TEST'

ADDITIONAL LOCAL CORRELATIONS DEVELOPED BY IN-SITU TECHNOLOGY HAVE ALSO BEEN USED IN COMPUTING THE ABOVE DATA. IT IS THE POLICY OF IN-SITU TECHNOLOGY TO CONTINUALLY UPGRADE AND MODIFY C.P.T CORRELATIONS AS PUBLISHED RESEARCH AND LOCAL EXPERIENCE GROWS.

IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE
FOR SOUTHEASTERN UNITED STATES SOILS

JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
FILE NAME..... 09-P14

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES #	N' #	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	CLAY	46.4	2.37	46	46	.024	--	--	--	2.89	1.9	UD	>6
2	SILTY TO CLAYEY F.S.	134.8	3.94	44	44	.055	>90%	>48	296	--	--	--	--
3	SILTY TO CLAYEY F.S.	128.2	3.79	42	42	.086	>90%	>48	282	--	--	--	--
4	CLAYEY FINE SAND	67.2	2.54	26	26	.117	70%-80%	>48	147	--	--	--	--
5	CLAY	45.8	2.48	45	45	.142	--	--	--	2.84	1.8	UD	>6
6	CLAY	27	1.61	27	27	.167	--	--	--	1.66	1.6	UD	>6
7	SOFT CLAY	8.7	1.04	8	8	.183	--	--	--	.51	.8	UD	6
8	SOFT CLAY	1.4	.73	1	1	.199	--	--	--	.05	.1	UD	1-1.5
9	CLAY	6.7	.5	6	6	.224	--	--	--	.38	1.3	.03	6
10	SOFT CLAY	2.6	.87	2	2	.24	--	--	--	.12	.3	UD	1-1.5
11	SOFT CLAY	1.3	1.25	1	1	.256	--	--	--	.04	.1	UD	1
12	SOFT CLAY	.4	1.39	0	0	.272	--	--	--	-.02	0	UD	<1
13	SOFT CLAY	3.5	1.35	3	3	.288	--	--	--	.17	.2	UD	3
14	SOFT CLAY	2.1	1.21	2	2	.304	--	--	--	.08	.1	UD	1-1.5
15	SOFT CLAY	.2	1.01	0	0	.32	--	--	--	-.04	0	UD	<1
16	SOFT CLAY	2.2	.9	2	2	.336	--	--	--	.08	.2	UD	1

\# N'=POINT STRESS*(.2+.04*FRICTION RATIO)
* NORMALLY CONSOLIDATED SANDS
** FOR OVERCONSOLIDATED SANDS,SLIGHTLY REDUCE ABOVE FRICTION ANGLES
*** FOR OVERCONSOLIDATED SANDS, YOUNG'S MODULUS MAY BE AS MUCH AS 3 TO 6 TIMES HIGHER
**** NK OF 16 USED. FOR OVERCONSOLIDATED CLAYS, AN NK OF 17 IS SUGGESTED

THE ABOVE DATA WAS COMPUTED FOLLOWING 'BASIC' GUIDELINES BY P. K. ROBERTSON AND R. G. CAMPANELLA IN THE HANDBOOK 'GUIDELINES FOR USE AND INTERPERTATION OF THE ELECTRONIC CONE PENETRATION TEST'

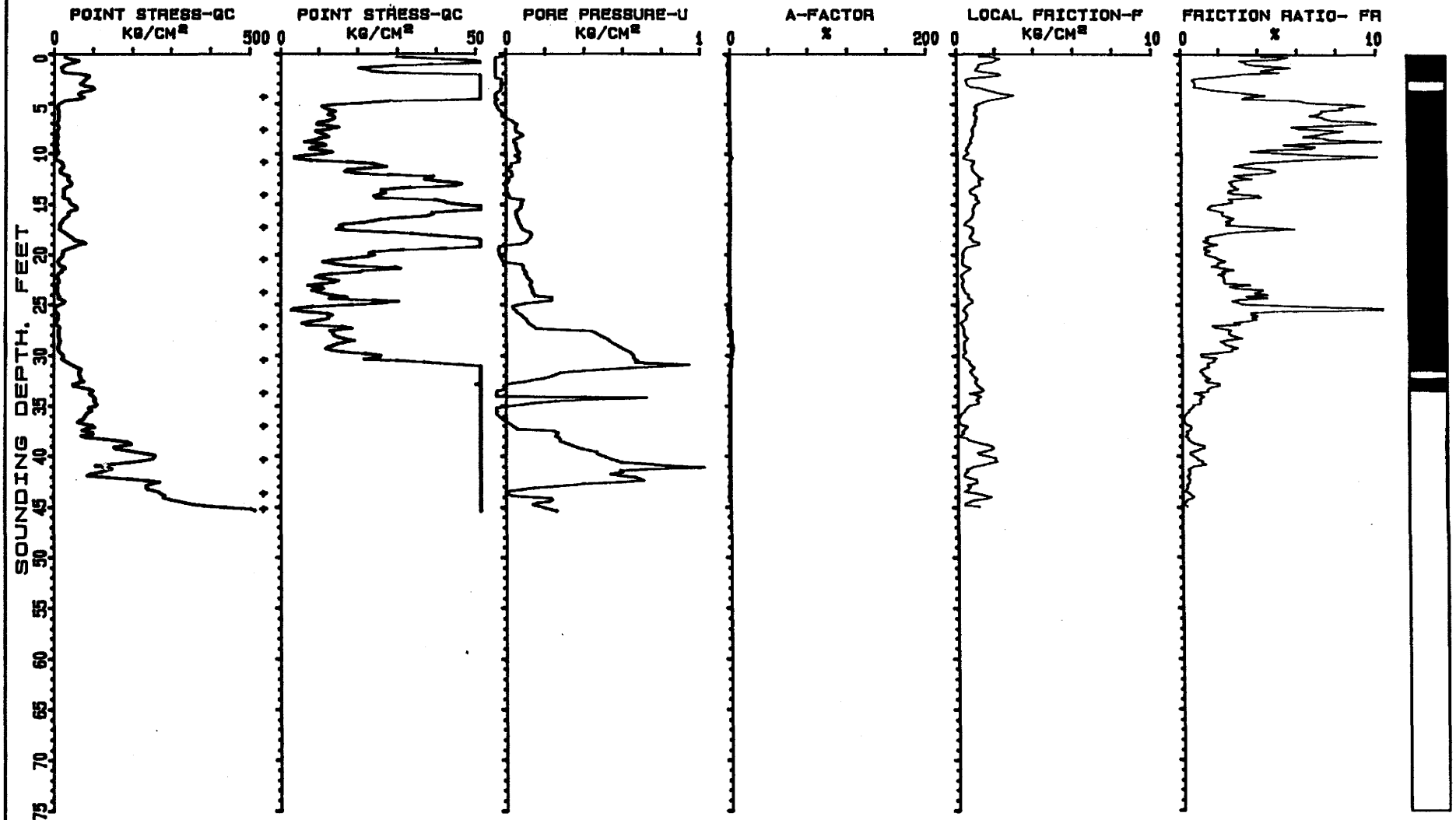
ADDITIONAL LOCAL CORRELATIONS DEVELOPED BY IN-SITU TECHNOLOGY HAVE ALSO BEEN USED IN COMPUTING THE ABOVE DATA. IT IS THE POLICY OF IN-SITU TECHNOLOGY TO CONTINUALLY UPGRADE AND MODIFY C.P.T CORRELATIONS AS PUBLISHED RESEARCH AND LOCAL EXPERIENCE GROWS.

IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE
FOR SOUTHEASTERN UNITED STATES SOILS

JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
FILE NAME..... 09-P14A

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES #	N'	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	CLAYEY FINE SAND	66.7	2.15	26	26	.03	70%-80%	>48	146	--	--	--	--
2	SILTY TO CLAYEY F.S.	114.3	3.04	38	38	.061	>90%	>48	251	--	--	--	--
3	CLAYEY FINE SAND	121.5	3.73	48	48	.092	>90%	>48	267	--	--	--	--
4	CLAYEY FINE SAND	90	2.74	36	36	.123	70%-80%	>48	198	--	--	--	--
5	CLAYEY FINE SAND	55.4	1.91	22	22	.153	60%-70%	46-48	121	--	--	--	--
6	SANDY CLAY	47.1	1.66	23	23	.181	--	--	--	2.92	2.8	.01	>6
7	CLAY	24.9	1.38	24	24	.206	--	--	--	1.53	1.7	UD	>6
8	CLAY	12	1.27	12	12	.23	--	--	--	.72	.9	.02	6
9	SOFT CLAY	6.5	1.26	6	6	.247	--	--	--	.37	.5	UD	6
10	SOFT CLAY	8	1.36	8	8	.263	--	--	--	.46	.5	UD	6
11	SOFT CLAY	12.2	1.44	12	12	.279	--	--	--	.72	.8	UD	6
12	CLAY	14.8	1.59	14	14	.304	--	--	--	.88	.9	.01	6
13	SOFT CLAY	14.4	1.71	14	14	.32	--	--	--	.85	.8	UD	6
14	CLAY	14.1	1.39	14	14	.345	--	--	--	.83	1	.01	6
15	CLAY	13.9	1.26	13	13	.37	--	--	--	.81	1	.01	6
16	CLAY	13.3	1.11	13	13	.395	--	--	--	.77	1.1	.01	6
17	SOFT CLAY	9.6	1.06	9	9	.411	--	--	--	.54	.9	UD	6
18	SOFT CLAY	9.4	1.1	9	9	.427	--	--	--	.52	.8	UD	6
19	SOFT CLAY	3.1	.99	3	3	.443	--	--	--	.12	.3	UD	1-1.5
20	SOFT CLAY	1.4	1.03	1	1	.459	--	--	--	.02	.1	UD	<1
21	SOFT CLAY	2.3	1.16	2	2	.475	--	--	--	.07	.2	UD	1
22	SOFT CLAY	1.9	1.01	1	1	.491	--	--	--	.04	.1	UD	<1
23	SOFT CLAY	3.1	1	3	3	.507	--	--	--	.11	.3	UD	1
24	SOFT CLAY	5.8	1.08	5	5	.524	--	--	--	.28	.5	UD	3
25	CLAY	10.5	.91	10	10	.548	--	--	--	.57	1.1	.02	6
26	CLAY	12	.87	12	12	.573	--	--	--	.66	1.3	.02	6
27	CLAY	11	.77	11	11	.598	--	--	--	.59	1.4	.02	3
28	SOFT CLAY	7.3	.76	7	7	.614	--	--	--	.36	.9	UD	3
29	SOFT CLAY	4.9	.74	4	4	.63	--	--	--	.21	.6	UD	1-1.5
30	SOFT CLAY	6.1	.7	6	6	.647	--	--	--	.28	.8	UD	1-1.5

PIEZOCONE SOUNDING



* PUSH INTERRUPTED TO ADD ROD
PORE PRESSURE DECAY DATA MAY BE AVAILABLE

FILE #..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
SOUNDING # 09-P17
TEST DATE 12-17-1995 09: 18: 17

J9-P17 CONTINUED ENSAFE

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES	N'	VERTICAL STRESS	RELATIVE DENSITY	FRICTION ANGLE	YOUNGS MODULUS	UNDRAINED SHEAR ST	SENSITIVITY	COMP.	OCR
31	CLAYEY FINE SAND	34.1	.55	13	13	.87	<40%	36-38	75	--	--	--	--
32	SILTY TO CLAYEY F.S.	65	.75	21	21	.901	40%-50%	38-40	143	--	--	--	--
33	SILTY TO CLAYEY F.S.	64.9	.97	21	21	.931	40%-50%	38-40	142	--	--	--	--
34	SILTY FINE SAND	86	1.09	21	21	.962	50%-60%	40-42	189	--	--	--	--
35	FINE SAND	105.7	.9	21	21	.995	60%-70%	40-42	232	--	--	--	--
36	FINE SAND	91	.27	18	18	1.028	50%-60%	40-42	200	--	--	--	--
37	FINE SAND	77.5	.15	15	15	1.062	40%-50%	38-40	170	--	--	--	--
38	FINE SAND	90.4	.28	18	18	1.095	50%-60%	40-42	198	--	--	--	--
39	FINE SAND	145.3	.9	29	29	1.128	70%-80%	42-44	319	--	--	--	--
40	FINE SAND	199.2	1.47	39	39	1.161	80%-90%	42-44	438	--	--	--	--
41	FINE SAND	207.1	1.59	41	41	1.195	80%-90%	42-44	455	--	--	--	--
42	FINE SAND	118.3	.48	23	23	1.228	60%-70%	40-42	260	--	--	--	--
43	DENSE OR CEMENTED S.	220.1	.73	36	36	1.264	80%-90%	42-44	484	--	--	--	--
44	DENSE OR CEMENTED S.	262.9	.96	43	43	1.301	>90%	44-46	578	--	--	--	--

\# N'=POINT STRESS*(.2+.04*FRICTION RATIO)

* NORMALLY CONSOLIDATED SANDS

** FOR OVERCONSOLIDATED SANDS,SLIGHTLY REDUCE ABOVE FRICTION ANGLES

** FOR OVERCONSOLIDATED SANDS, YOUNG'S MODULUS MAY BE AS MUCH AS 3 TO 6 TIMES HIGHER

**** NK OF 16 USED. FOR OVERCONSOLIDATED CLAYS, AN NK OF 17 IS SUGGESTED

THE ABOVE DATA WAS COMPUTED FOLLOWING 'BASIC' GUIDELINES BY P. K. ROBERTSON AND R. G. CAMPANELLA IN THE HANDBOOK 'GUIDELINES FOR USE AND INTERPERTATION OF THE ELECTRONIC CONE PENETRATION TEST'

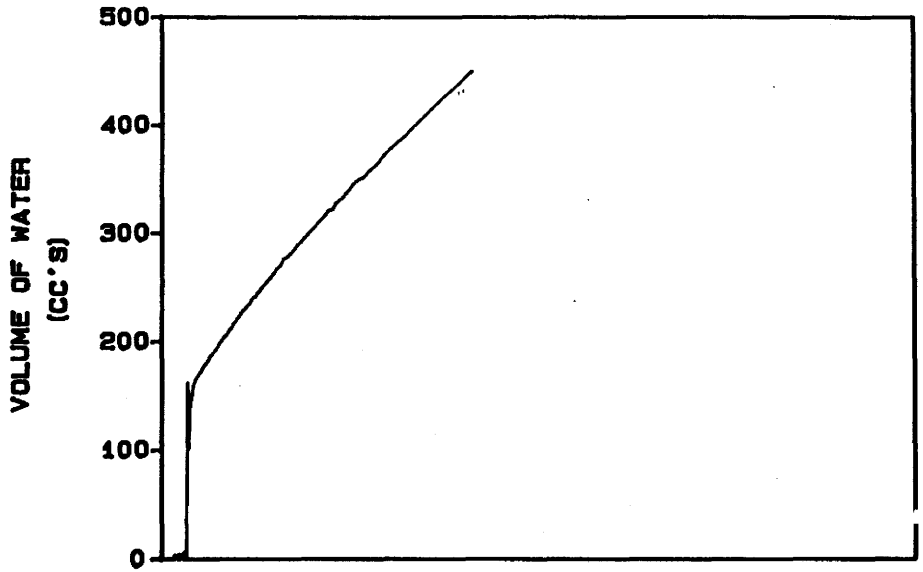
ADDITIONAL LOCAL CORRELATIONS DEVELOPED BY IN-SITU TECHNOLOGY HAVE ALSO BEEN USED IN COMPUTING THE ABOVE DATA. IT IS THE POLICY OF IN-SITU TECHNOLOGY TO CONTINUALLY UPGRADE AND MODIFY C.P.T CORRELATIONS AS PUBLISHED RESEARCH AND LOCAL EXPERIENCE GROWS.

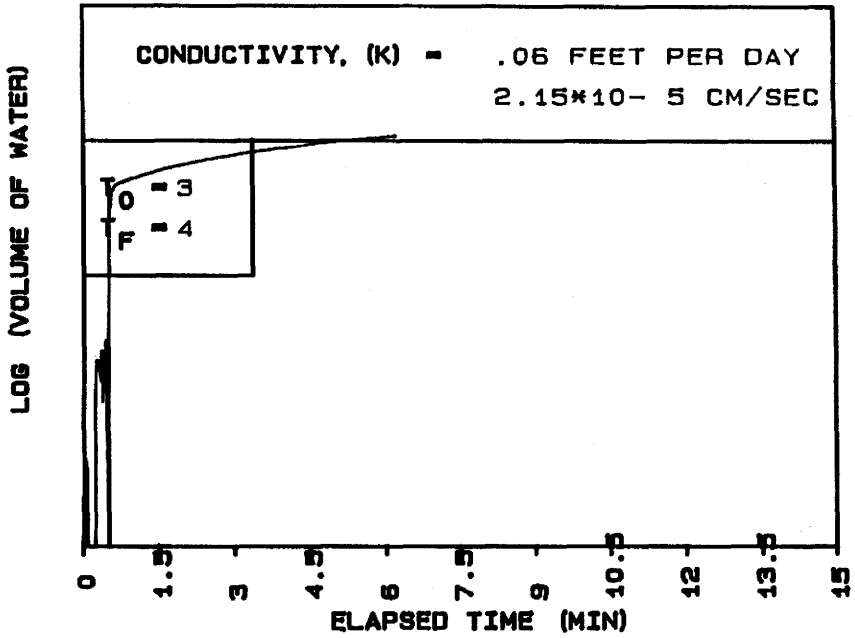
IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE FOR SOUTHEASTERN UNITED STATES SOILS

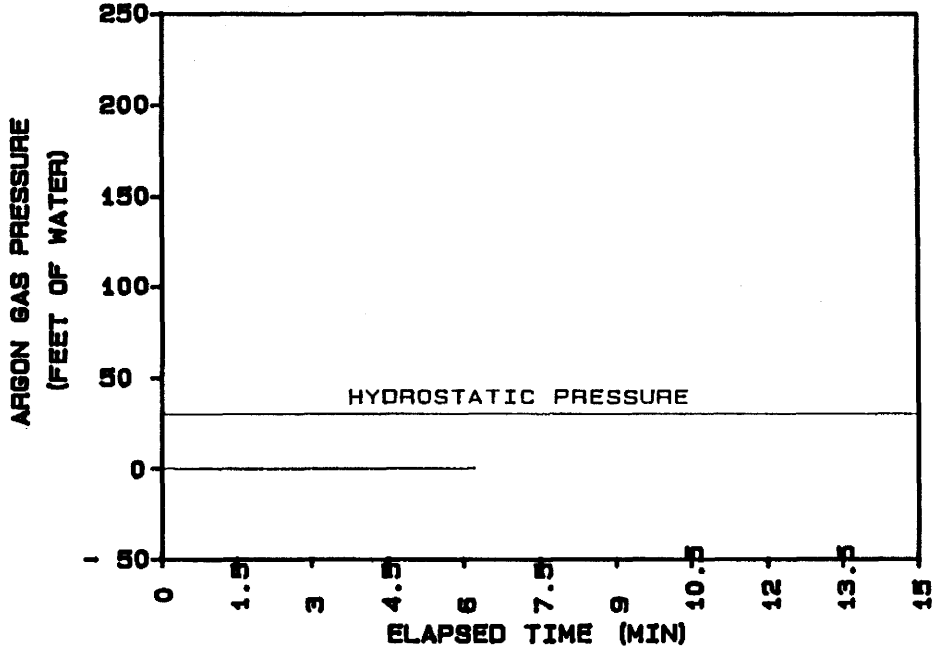
JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
FILE NAME..... 09-P21

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES #	N'	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	SILTY TO CLAYEY F.S.	56.1	.89	18	18	.03	70%-80%	>48	123	--	--	--	--
2	SILTY TO CLAYEY F.S.	54.8	.88	18	18	.061	70%-80%	>48	120	--	--	--	--
3	SILTY TO CLAYEY F.S.	69	1.23	23	23	.092	70%-80%	>48	151	--	--	--	--
4	SILTY TO CLAYEY F.S.	72.7	.98	24	24	.123	70%-80%	>48	159	--	--	--	--
5	SILTY TO CLAYEY F.S.	73.5	1.17	24	24	.153	70%-80%	46-48	161	--	--	--	--
6	CLAYEY FINE SAND	56.7	1.28	22	22	.184	60%-70%	44-46	124	--	--	--	--
7	SILTY TO CLAYEY F.S.	65.9	1.28	21	21	.215	70%-80%	44-46	144	--	--	--	--
8	SILTY TO CLAYEY F.S.	47.2	.93	15	15	.246	60%-70%	42-44	103	--	--	--	--
9	CLAYEY FINE SAND	33.5	.64	13	13	.276	50%-60%	40-42	73	--	--	--	--
10	CLAYEY FINE SAND	24.6	.34	9	9	.307	40%-50%	38-40	54	--	--	--	--
11	CLAYEY FINE SAND	21.7	.27	8	8	.338	<40%	38-40	47	--	--	--	--
12	CLAYEY FINE SAND	27	.61	10	10	.369	40%-50%	38-40	59	--	--	--	--
13	CLAYEY FINE SAND	32.8	.54	13	13	.399	40%-50%	40-42	72	--	--	--	--
14	SILTY TO CLAYEY F.S.	30	.4	10	10	.43	40%-50%	38-40	66	--	--	--	--
15	CLAYEY FINE SAND	18.2	.12	7	7	.461	<40%	36-38	40	--	--	--	--
16	SANDY CLAY	7.5	.09	3	3	.488	--	--	--	.4	7.7	.03	3
17	SANDY CLAY	6.4	.1	3	3	.516	--	--	--	.33	5.8	.02	3
18	SENSITIVE FINE GRAIN	7.9	.04	3	3	.538	--	--	--	.42	17.1	.02	3
19	CLAYEY FINE SAND	16.3	.26	6	6	.568	<40%	34-36	35	--	--	--	--
20	SILTY TO CLAYEY F.S.	21.4	.15	7	7	.599	<40%	34-36	47	--	--	--	--
21	CLAYEY FINE SAND	21.3	.26	8	8	.63	<40%	34-36	46	--	--	--	--
22	CLAYEY FINE SAND	18.3	.17	7	7	.661	<40%	34-36	40	--	--	--	--
23	CLAYEY FINE SAND	28.7	.59	11	11	.692	<40%	36-38	63	--	--	--	--
24	SILTY TO CLAYEY F.S.	40.5	.5	13	13	.722	<40%	38-40	89	--	--	--	--
25	SILTY TO CLAYEY F.S.	30.4	.11	10	10	.753	<40%	36-38	66	--	--	--	--
26	SILTY TO CLAYEY F.S.	21.7	.01	7	7	.784	<40%	34-36	47	--	--	--	--
27	CLAYEY FINE SAND	14.5	.04	5	5	.815	<40%	30-32	31	--	--	--	--
28	SILTY TO CLAYEY F.S.	28.1	.07	9	9	.845	<40%	34-36	61	--	--	--	--
29	SILTY TO CLAYEY F.S.	28.5	.09	9	9	.876	<40%	34-36	62	--	--	--	--
30	SILTY TO CLAYEY F.S.	34.2	.21	11	11	.907	<40%	36-38	75	--	--	--	--

HYDROCONE TEST



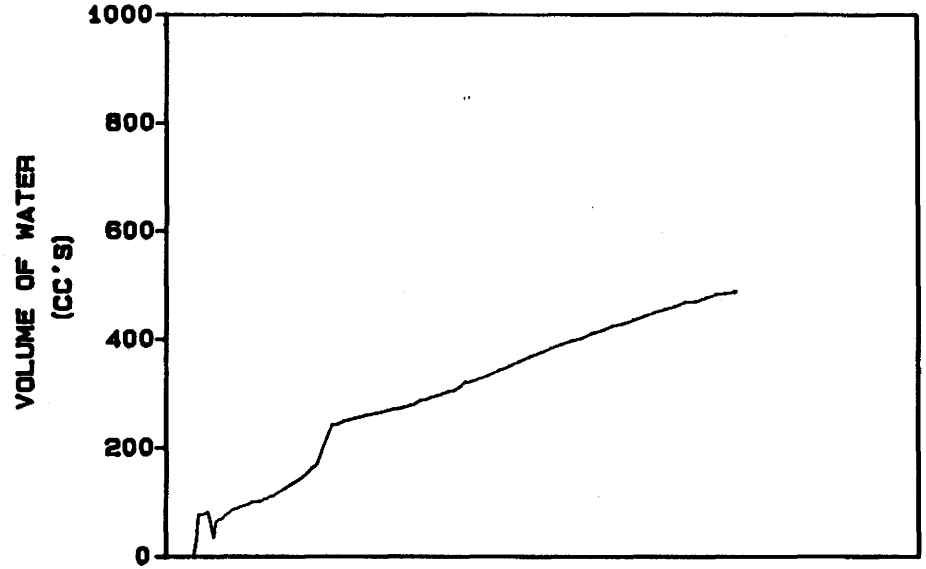


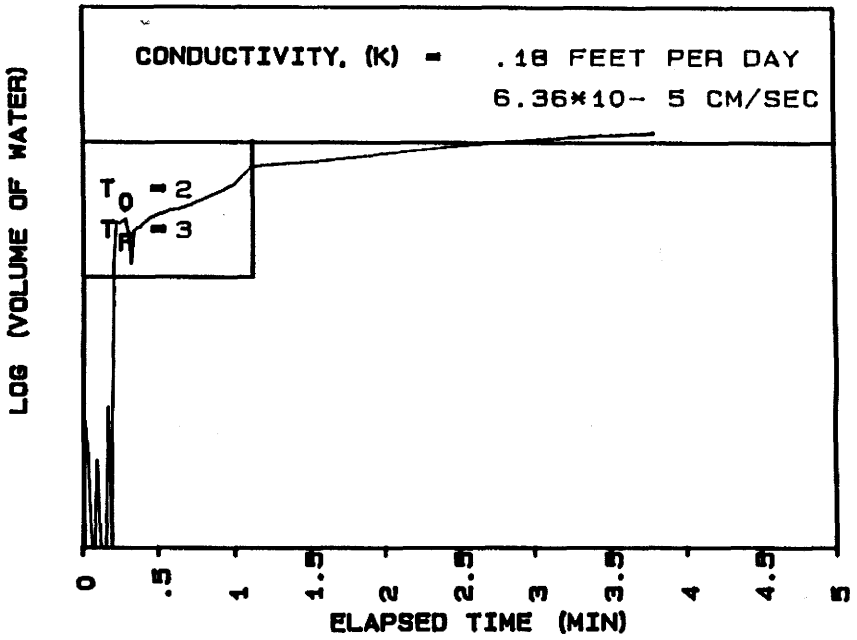


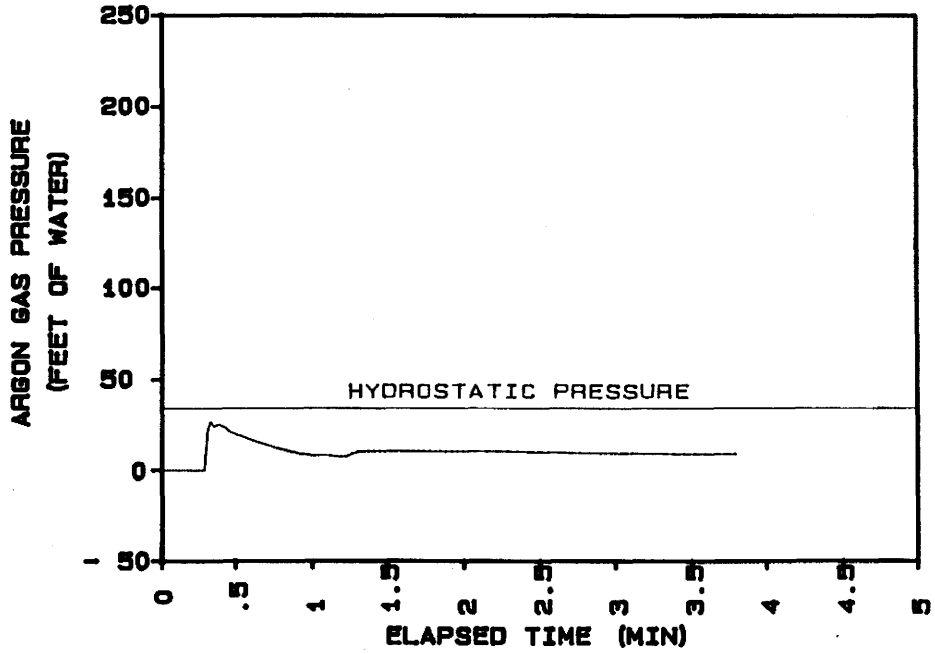
ENSAFE MEMPHIS NSA
LOCATION... 09H0946
TEST DATE
20: 37: 54 12-01-1995

SAMPLE DEPTH (FT) 45
GROUNDWATER DEPTH (FT) 16

HYDROCONE TEST



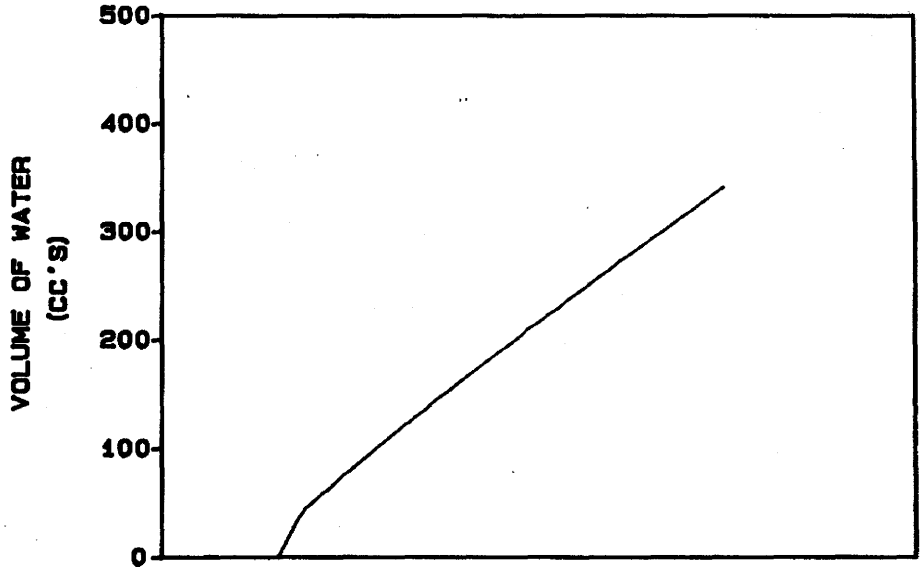


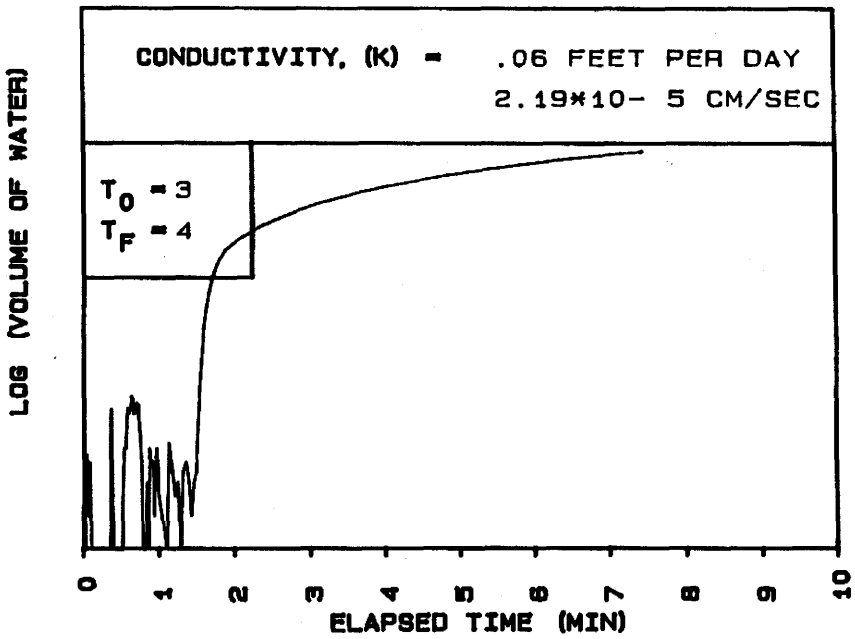


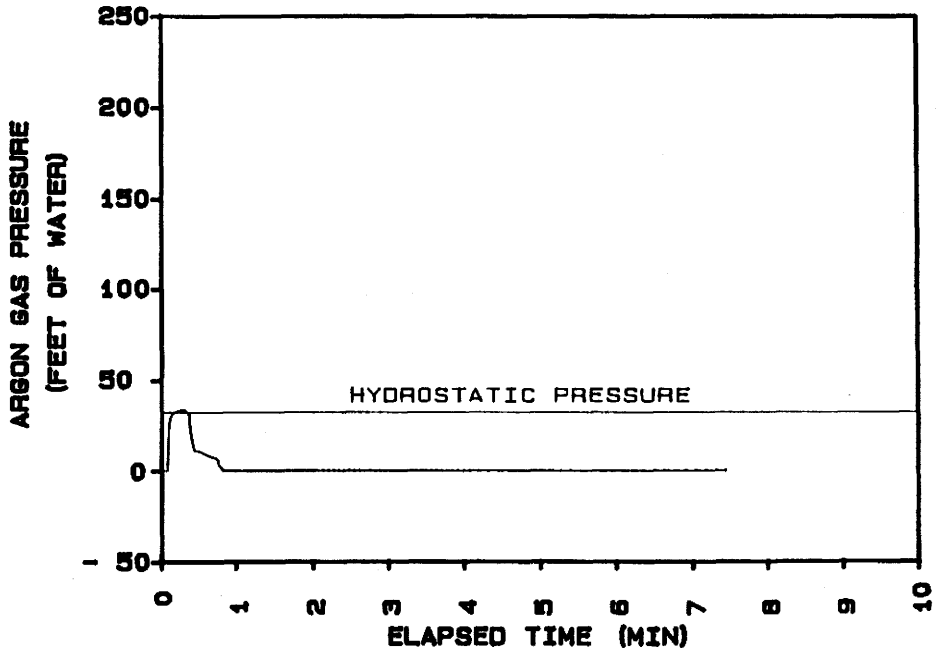
ENSAFE MEMPHIS NSA
LOCATION... 09H1150
TEST DATE
15: 38: 51 12-02-1995

SAMPLE DEPTH (FT) 50
GROUNDWATER DEPTH (FT) 16

HYDROCONE TEST



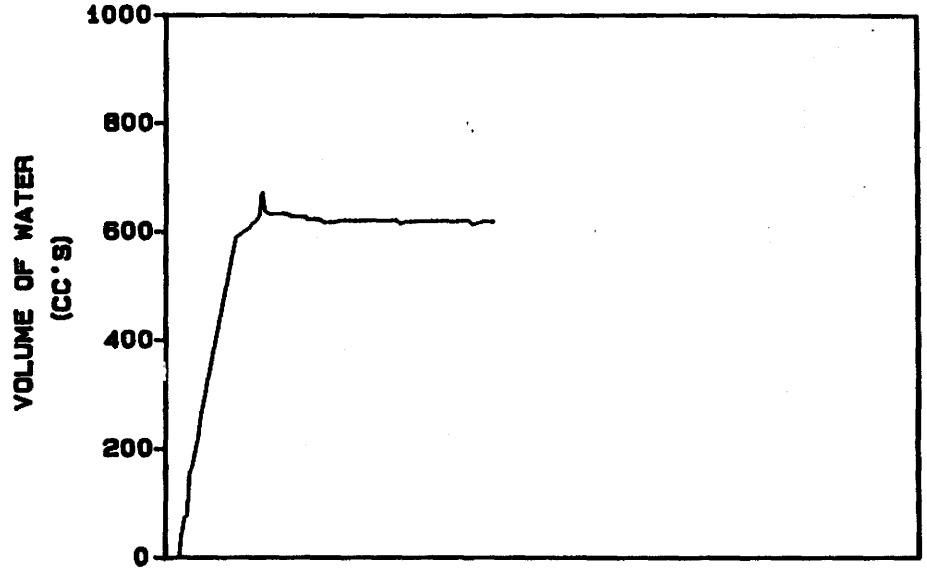


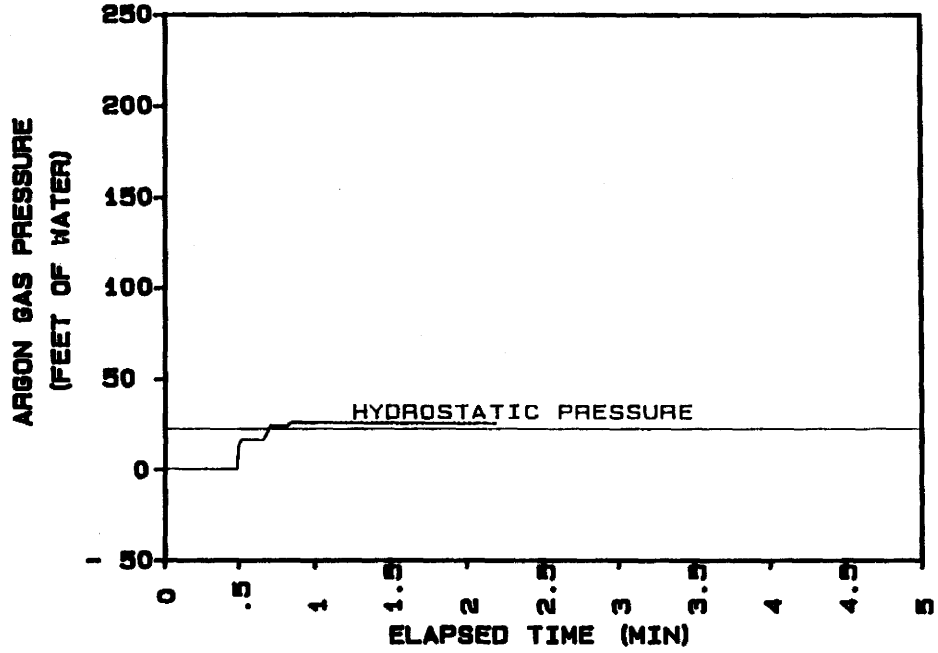


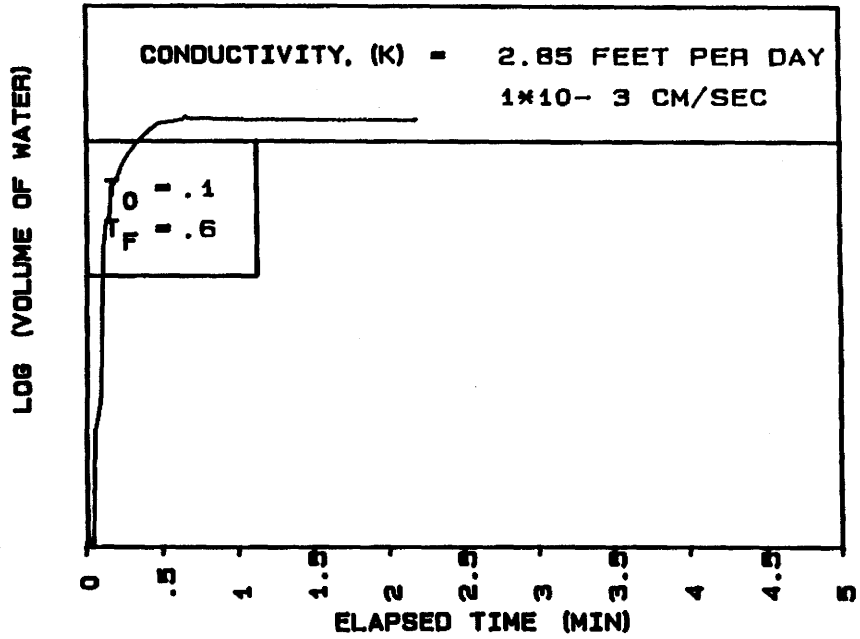
ENSAFE MEMPHIS NSA
LOCATION... 09H1348
TEST DATE
18: 44: 13 12-02-1995

SAMPLE DEPTH (FT) 48
GROUNDWATER DEPTH (FT) 16

HYDROCONE TEST



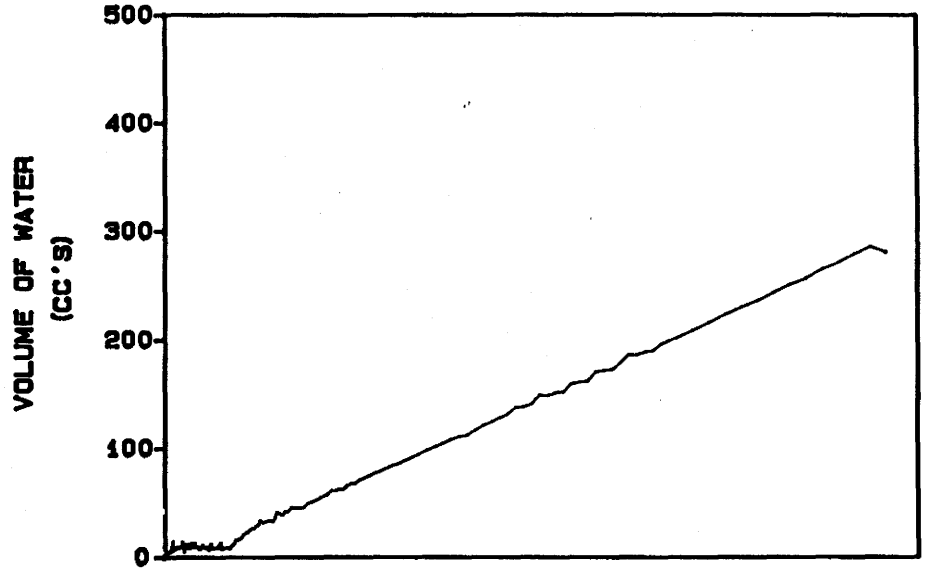


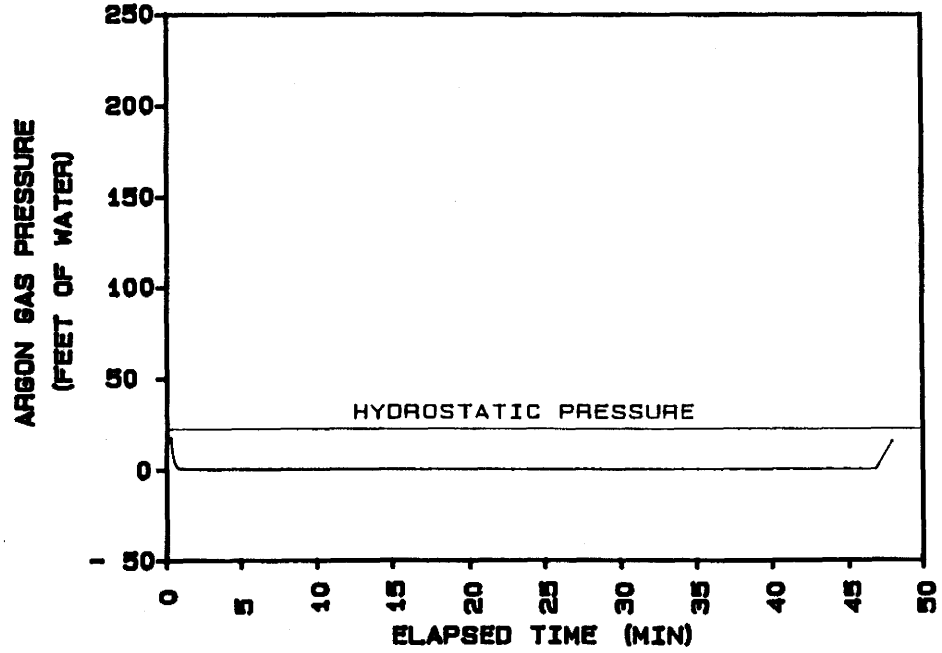


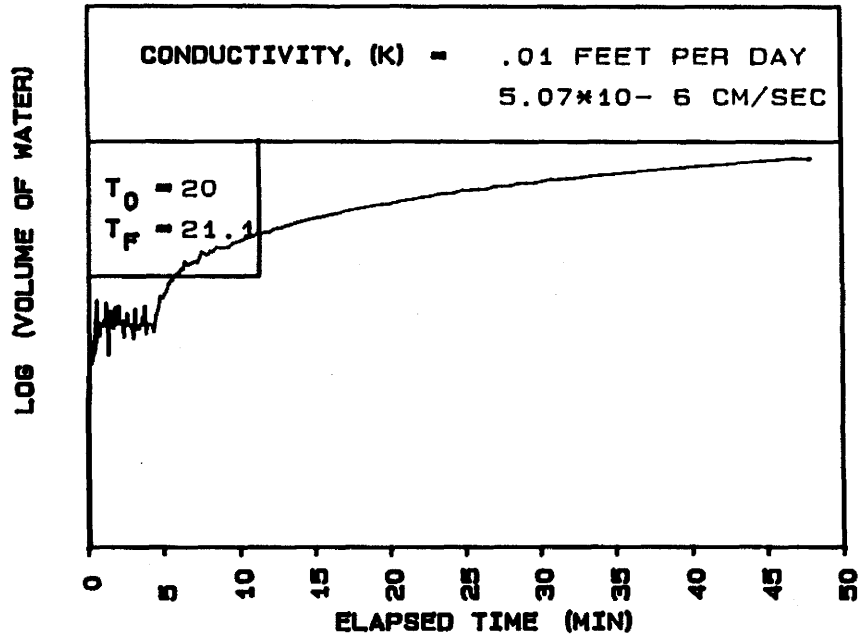
ENSAFE MEMPHIS NSA
LOCATION... 09H1547
TEST DATE
10: 49: 26 11-28-1995

SAMPLE DEPTH (FT) 47
GROUNDWATER DEPTH (FT) 25

HYDROCONE TEST







ENSAFE MEMPHIS NSA
LOCATION... 09H1747
TEST DATE
17: 19: 10 11-29-1995

SAMPLE DEPTH (FT) 47
GROUNDWATER DEPTH (FT) 25

HYDROCONE TEST

VOLUME OF WATER (CC'S)

DATA NOT AVAILABLE

LOG (VOLUME OF WATER)

CONDUCTIVITY, (K) =

T_O =

T_F =

DATA NOT AVAILABLE

ELAPSED TIME (MIN)

ARGON GAS PRESSURE (FEET OF WATER)

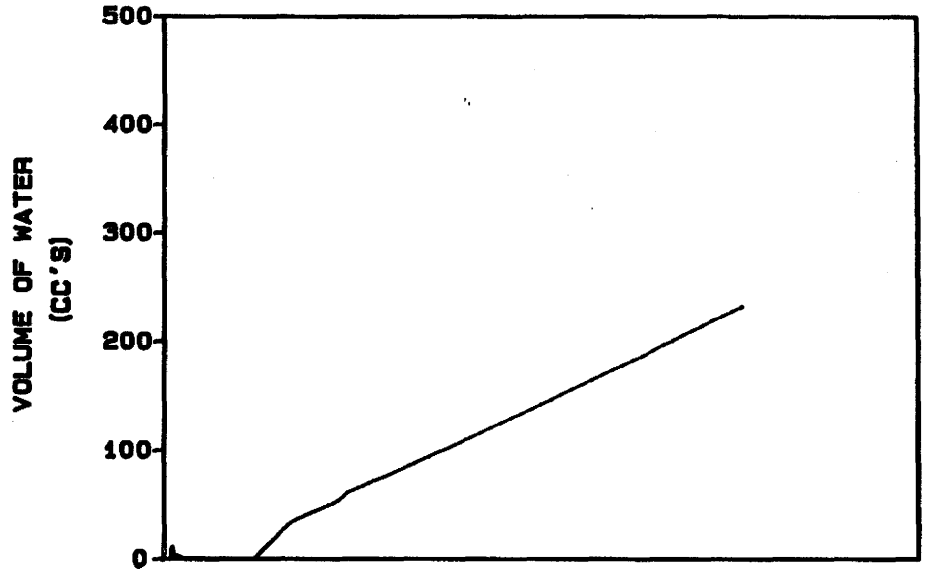
DATA NOT AVAILABLE

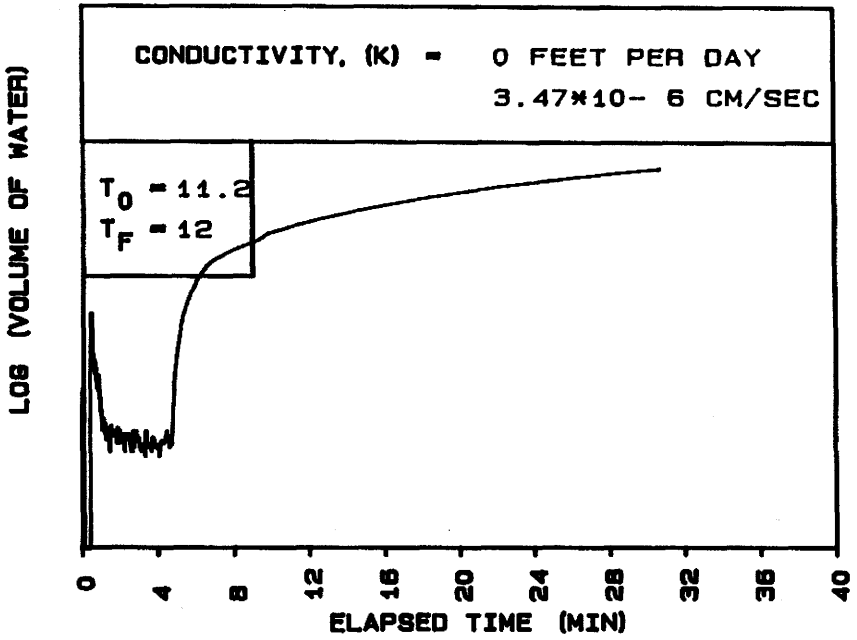
ELAPSED TIME (MIN)

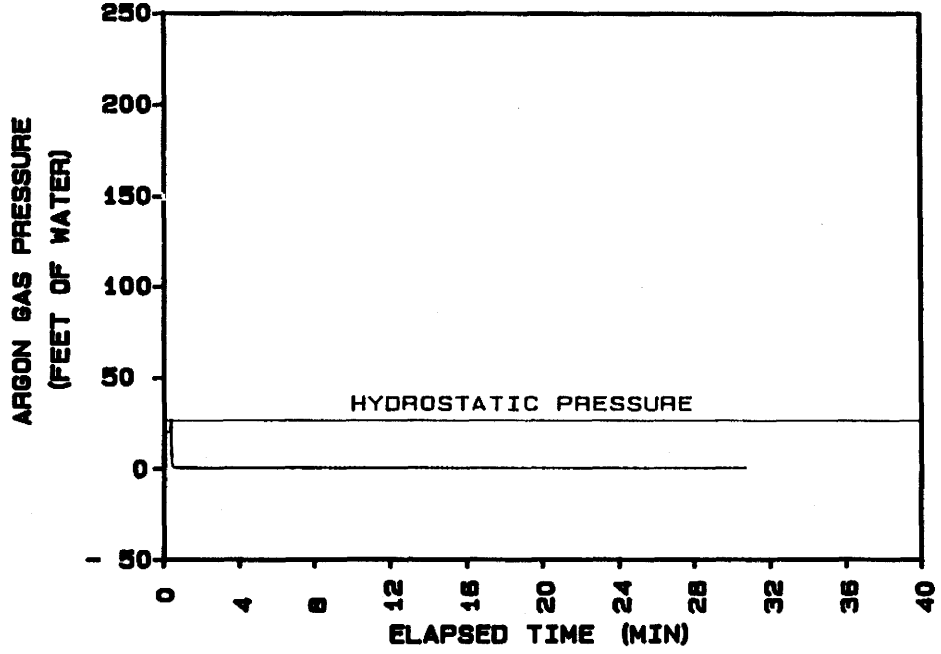
ENSAFE MEMPHIS NSA
LOCATION... 09H1946

DATA NOT AVAILABLE

HYDROCONE TEST



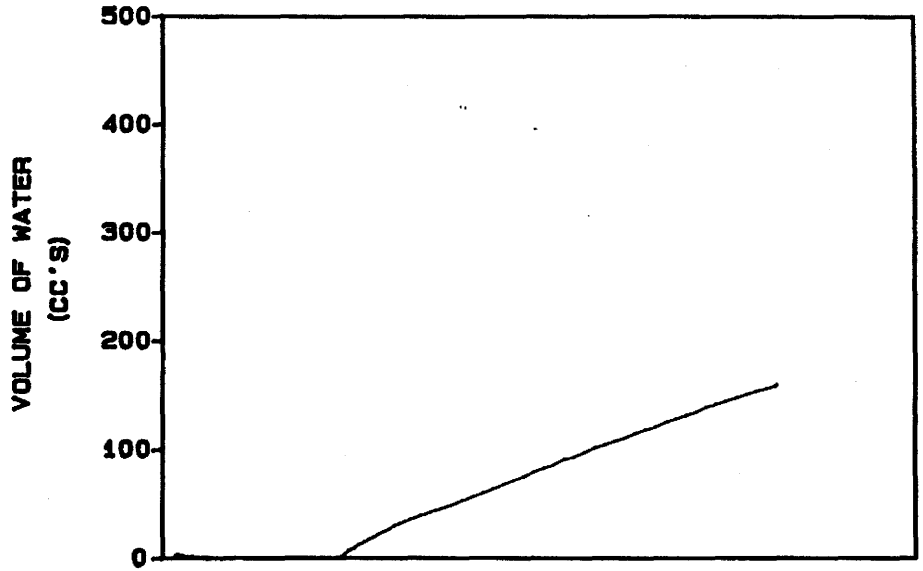


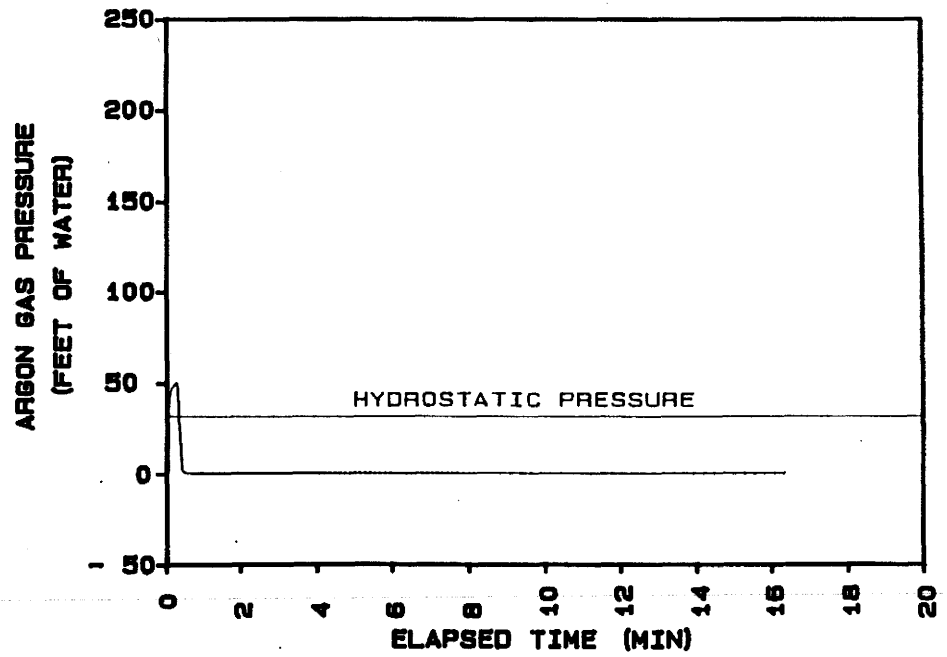


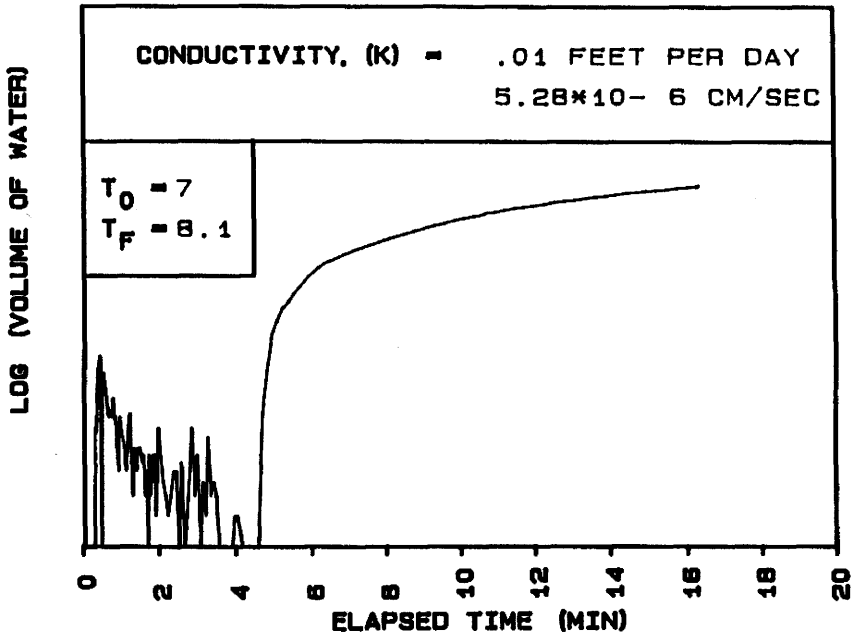
ENSAFE MEMPHIS NSA
LOCATION... 09H2142
TEST DATE
16: 30: 33 11-30-1995

SAMPLE DEPTH (FT) 42
GROUNDWATER DEPTH (FT) 16

HYDROCONE TEST







ENSAFE MEMPHIS NSA
LOCATION... 09H2347
TEST DATE
17: 35: 56 12-01-1995

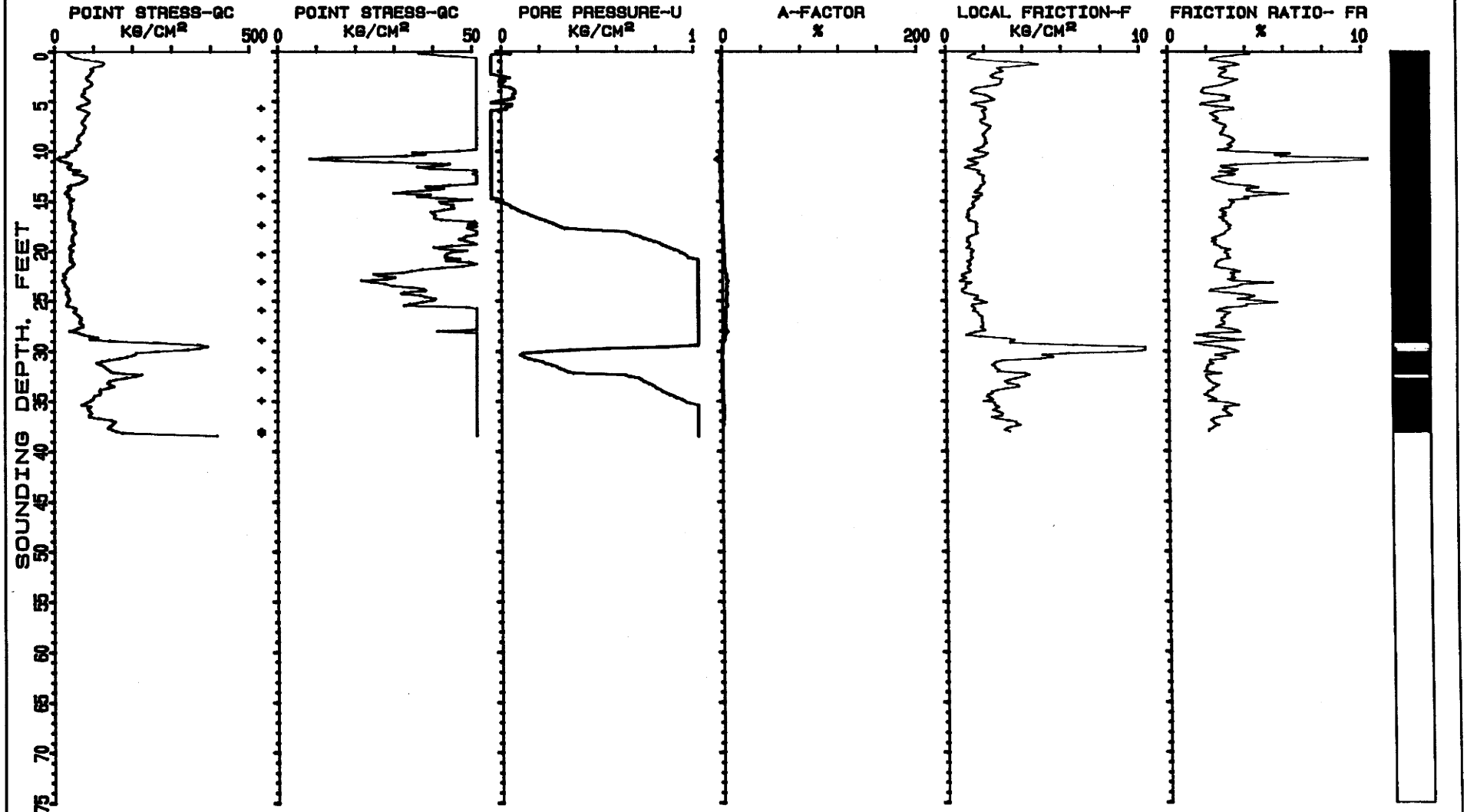
SAMPLE DEPTH (FT) 47
GROUNDWATER DEPTH (FT) 16

IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE
FOR SOUTHEASTERN UNITED STATES SOILS

JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
FILE NAME..... 14-P05

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES #	N'	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	SILTY FINE SAND	175.2	2.9	43	43	.03	>90%	>48	385	--	--	--	--
2	DENSE OR CEMENTED S.	246	1.23	41	41	.067	>90%	>48	541	--	--	--	--
3	SILTY FINE SAND	96.1	1.38	24	24	.098	80%-90%	>48	211	--	--	--	--
4	CLAYEY FINE SAND	70.2	1.8	28	28	.128	70%-80%	>48	154	--	--	--	--
5	CLAYEY FINE SAND	57.1	1.35	22	22	.159	60%-70%	46-48	125	--	--	--	--
6	CLAYEY FINE SAND	44.4	1.07	17	17	.19	60%-70%	44-46	97	--	--	--	--
7	CLAYEY FINE SAND	44.2	.9	17	17	.221	60%-70%	42-44	97	--	--	--	--
8	CLAYEY FINE SAND	38.5	.68	15	15	.251	50%-60%	42-44	84	--	--	--	--
9	SILTY TO CLAYEY F.S.	36	.49	12	12	.282	50%-60%	42-44	79	--	--	--	--
10	SILTY TO CLAYEY F.S.	39.1	.56	13	13	.313	50%-60%	40-42	86	--	--	--	--
11	CLAYEY FINE SAND	36.7	.77	14	14	.344	50%-60%	40-42	80	--	--	--	--
12	SILTY TO CLAYEY F.S.	45.9	.92	15	15	.375	50%-60%	40-42	100	--	--	--	--
13	CLAYEY FINE SAND	55.9	1.42	22	22	.405	60%-70%	42-44	122	--	--	--	--
14	SILTY TO CLAYEY F.S.	77	1.9	25	25	.436	70%-80%	42-44	169	--	--	--	--
15	SILTY TO CLAYEY F.S.	67.8	1.41	22	22	.467	60%-70%	42-44	149	--	--	--	--
16	SILTY TO CLAYEY F.S.	50.4	.79	16	16	.498	50%-60%	40-42	110	--	--	--	--
17	SILTY TO CLAYEY F.S.	46	.62	15	15	.528	40%-50%	40-42	101	--	--	--	--
18	SILTY TO CLAYEY F.S.	44.6	.47	14	14	.559	40%-50%	38-40	98	--	--	--	--
19	SILTY TO CLAYEY F.S.	42.9	.3	14	14	.59	40%-50%	38-40	94	--	--	--	--
20	SILTY TO CLAYEY F.S.	42.4	.47	14	14	.621	40%-50%	38-40	93	--	--	--	--
21	SILTY TO CLAYEY F.S.	44.6	.49	14	14	.651	40%-50%	38-40	98	--	--	--	--
22	SILTY TO CLAYEY F.S.	35	.4	11	11	.682	<40%	36-38	77	--	--	--	--
23	SILTY TO CLAYEY F.S.	44.9	.72	14	14	.713	40%-50%	38-40	98	--	--	--	--
24	SILTY TO CLAYEY F.S.	32.1	.31	10	10	.744	<40%	36-38	70	--	--	--	--
25	CLAYEY FINE SAND	44.4	.89	17	17	.775	<40%	38-40	97	--	--	--	--
26	CLAYEY FINE SAND	31.2	.69	12	12	.805	<40%	36-38	68	--	--	--	--
27	CLAYEY FINE SAND	34.1	.91	13	13	.836	<40%	36-38	75	--	--	--	--
28	SILTY FINE SAND	31	0	7	7	.867	<40%	34-36	68	--	--	--	--
29	SILTY FINE SAND	51.9	0	12	12	.898	<40%	38-40	114	--	--	--	--
30	SILTY TO CLAYEY F.S.	148.4	3.21	49	49	.928	70%-80%	42-44	326	--	--	--	--

PIEZOCONE SOUNDING



◆ PUSH INTERRUPTED TO ADD ROD
PORE PRESSURE DECAY DATA MAY BE AVAILABLE

FILE #..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
SOUNDING # 14-P06
TEST DATE 11-07-1995 17: 29: 26

14-P06 CONTINUED ENSAFE

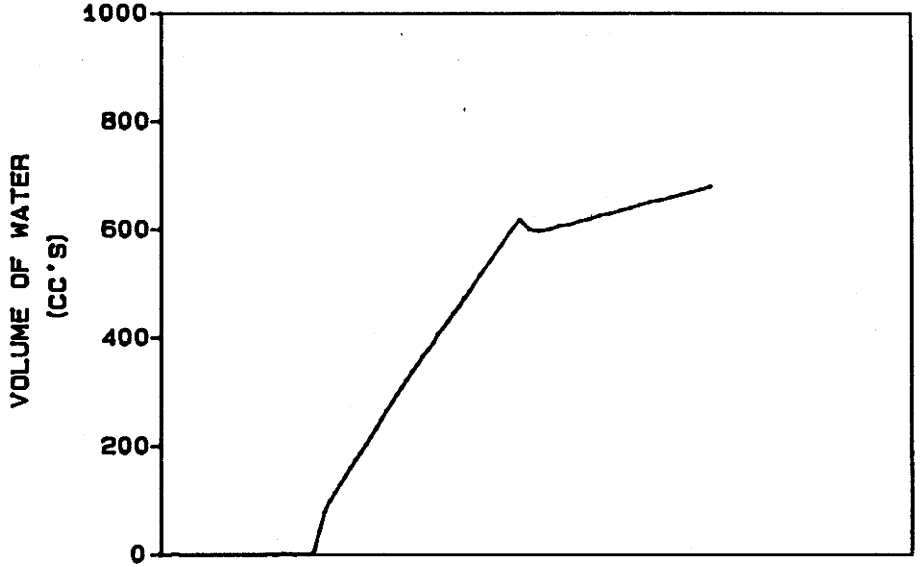
DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES	N'	VERTICAL STRESS	RELATIVE DENSITY	FRICTION ANGLE	YOUNGS MODULUS	UNDRAINED SHEAR ST	SENSITIVITY	COMP.	OCR
31	SILTY TO CLAYEY F.S.	218.4	5.26	72	72	.929	>90%	44-46	480	--	--	--	--
32	SILTY TO CLAYEY F.S.	127.3	2.56	42	42	.96	60%-70%	42-44	280	--	--	--	--
33	SILTY TO CLAYEY F.S.	170.6	3.54	56	56	.991	70%-80%	42-44	375	--	--	--	--
34	SILTY TO CLAYEY F.S.	136.6	3.05	45	45	1.022	70%-80%	42-44	300	--	--	--	--
35	SILTY TO CLAYEY F.S.	107.8	2.25	35	35	1.052	60%-70%	40-42	237	--	--	--	--
36	CLAYEY FINE SAND	86.1	2.56	34	34	1.083	50%-60%	38-40	189	--	--	--	--
37	CLAYEY FINE SAND	102.2	2.88	40	40	1.114	50%-60%	40-42	224	--	--	--	--
38	SILTY TO CLAYEY F.S.	148.4	3.41	49	49	1.145	70%-80%	42-44	326	--	--	--	--

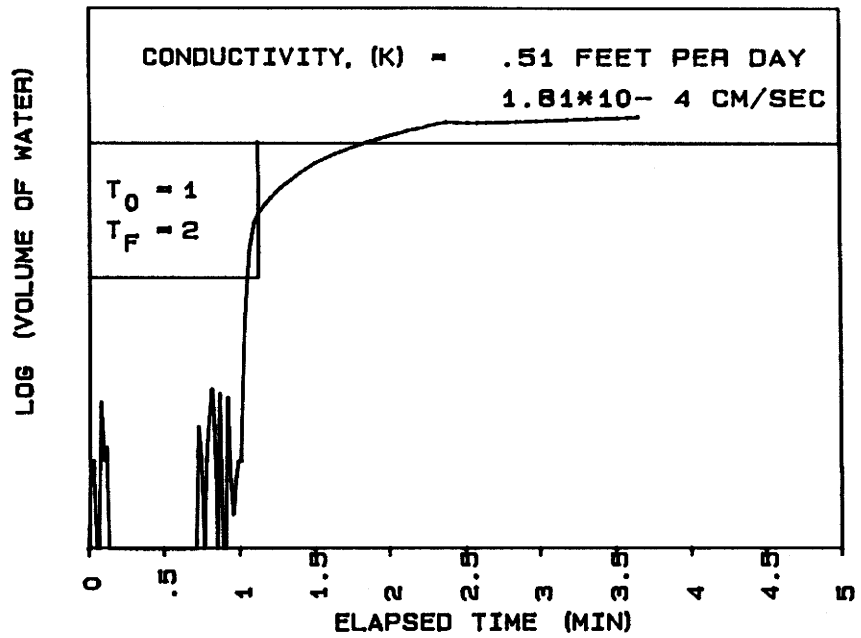
\# N'=POINT STRESS*(.2+.04*FRICTION RATIO)
* NORMALLY CONSOLIDATED SANDS
** FOR OVERCONSOLIDATED SANDS,SLIGHTLY REDUCE ABOVE FRICTION ANGLES
*** FOR OVERCONSOLIDATED SANDS, YOUNG'S MODULUS MAY BE AS MUCH AS 3 TO 6 TIMES HIGHER
**** NK OF 16 USED. FOR OVERCONSOLIDATED CLAYS, AN NK OF 17 IS SUGGESTED

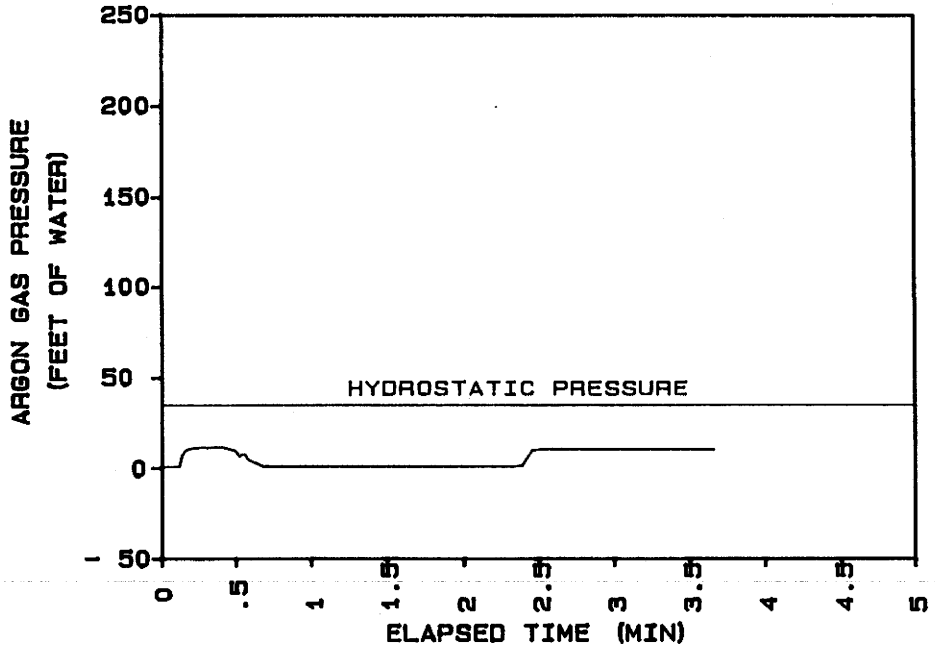
THE ABOVE DATA WAS COMPUTED FOLLOWING 'BASIC' GUIDELINES BY P. K. ROBERTSON AND R. G. CAMPANELLA IN THE HANDBOOK 'GUIDELINES FOR USE AND INTERPERTATION OF THE ELECTRONIC CONE PENETRATION TEST'

ADDITIONAL LOCAL CORRELATIONS DEVELOPED BY IN-SITU TECHNOLOGY HAVE ALSO BEEN USED IN COMPUTING THE ABOVE DATA. IT IS THE POLICY OF IN-SITU TECHNOLOGY TO CONTINUALLY UPGRADE AND MODIFY C.P.T CORRELATIONS AS PUBLISHED RESEARCH AND LOCAL EXPERIENCE GROWS.

HYDROCONE TEST



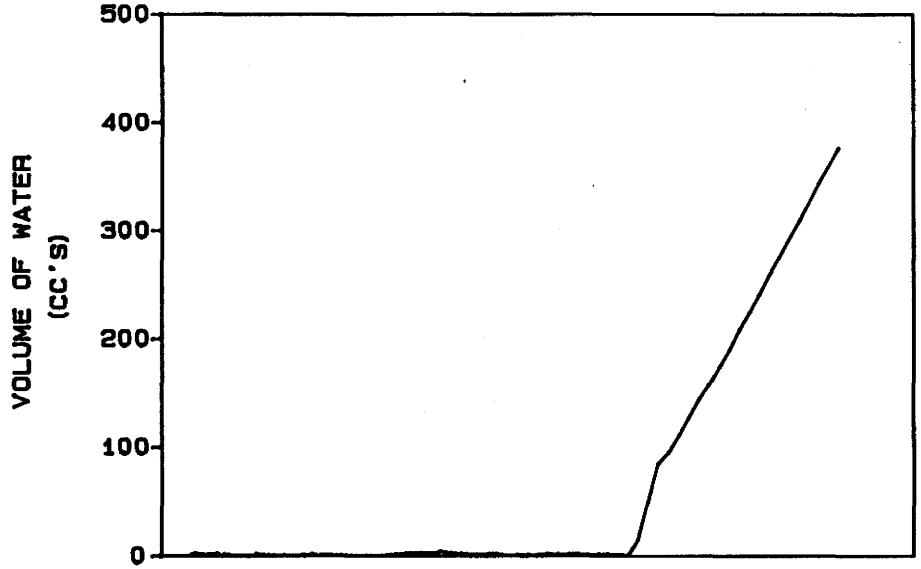


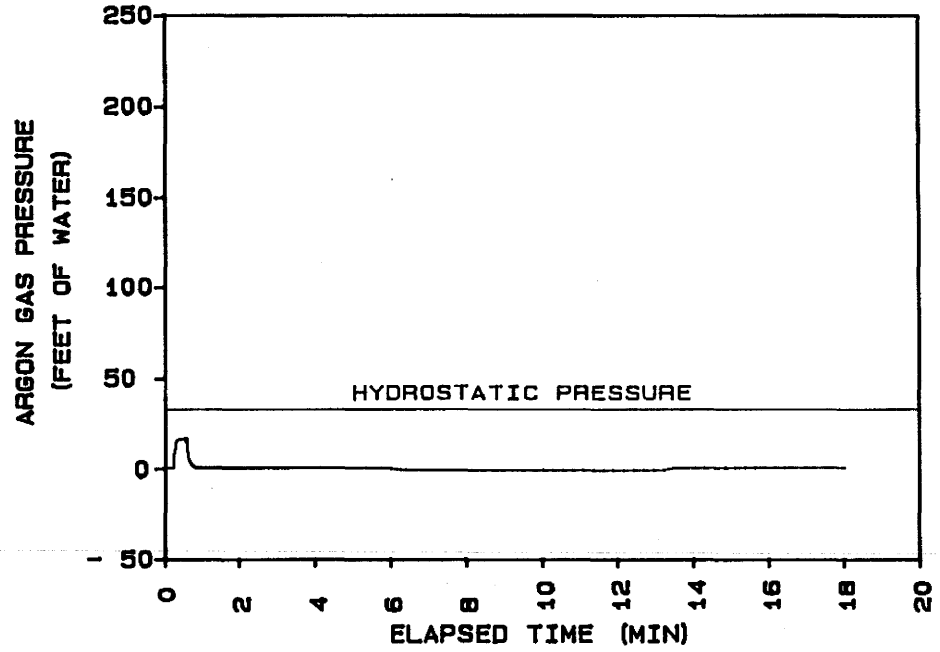


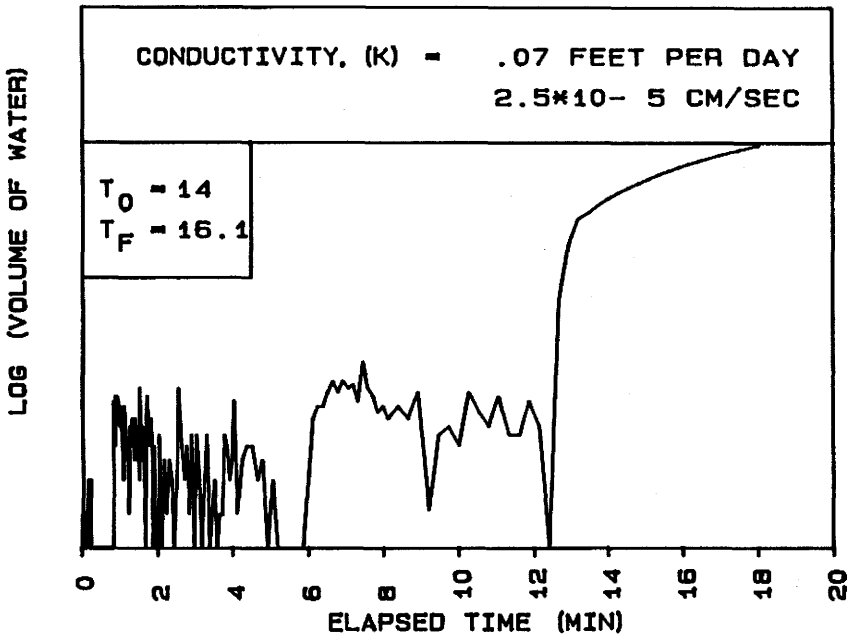
ENSAFE MEMPHIS NSA
LOCATION... 14H0545
TEST DATE
16: 41: 24 11-13-1995

SAMPLE DEPTH (FT) 45
GROUNDWATER DEPTH (FT) 11

HYDROCONE TEST



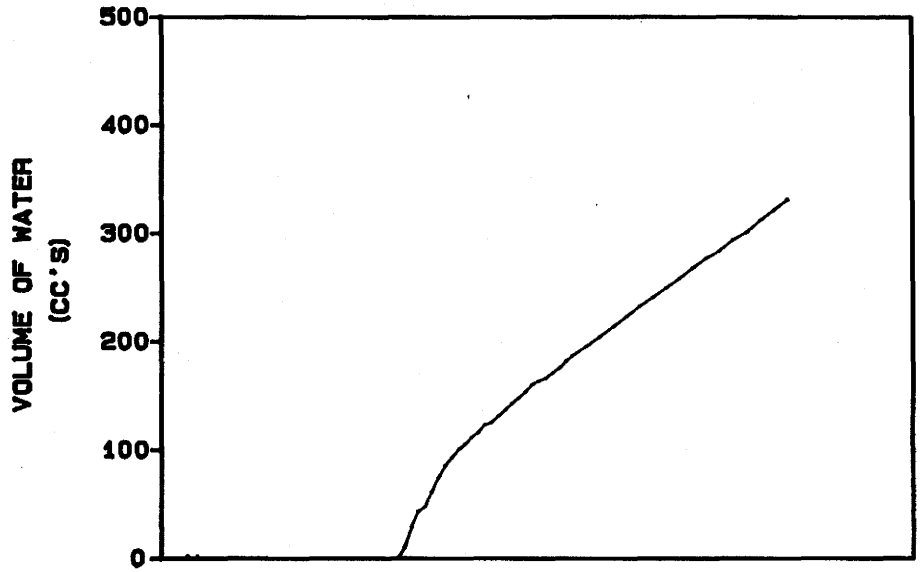


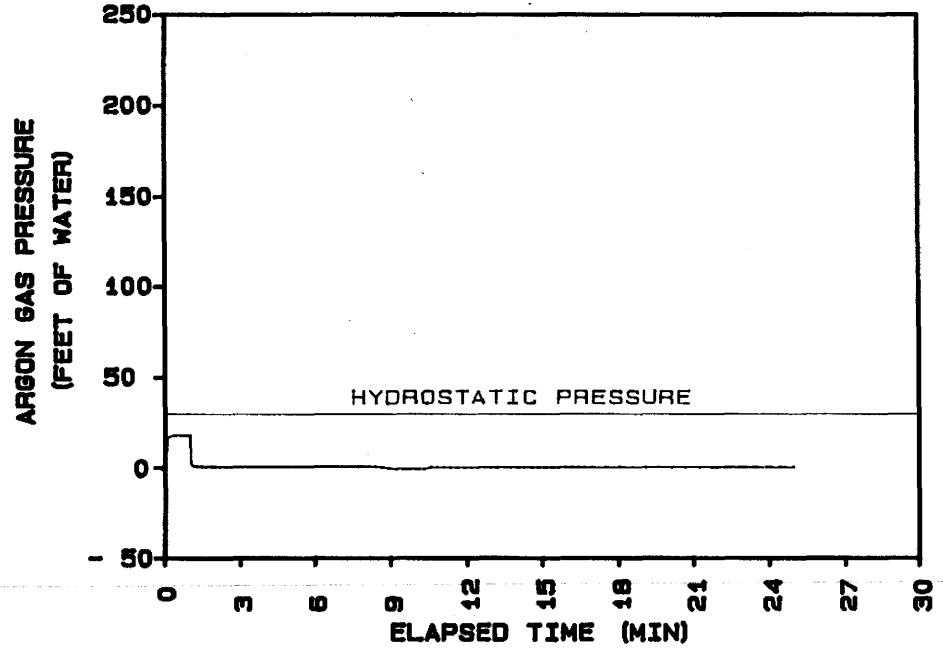


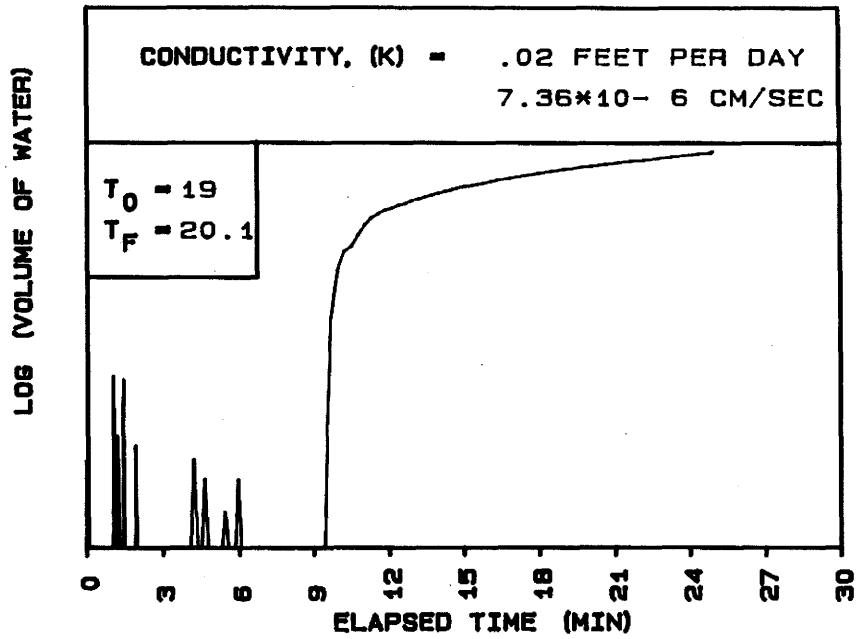
ENSAFE MEMPHIS NSA
LOCATION... 14H0743
TEST DATE
17: 39: 31 11-14-1995

SAMPLE DEPTH (FT) 43
GROUNDWATER DEPTH (FT) 11

HYDROCONE TEST



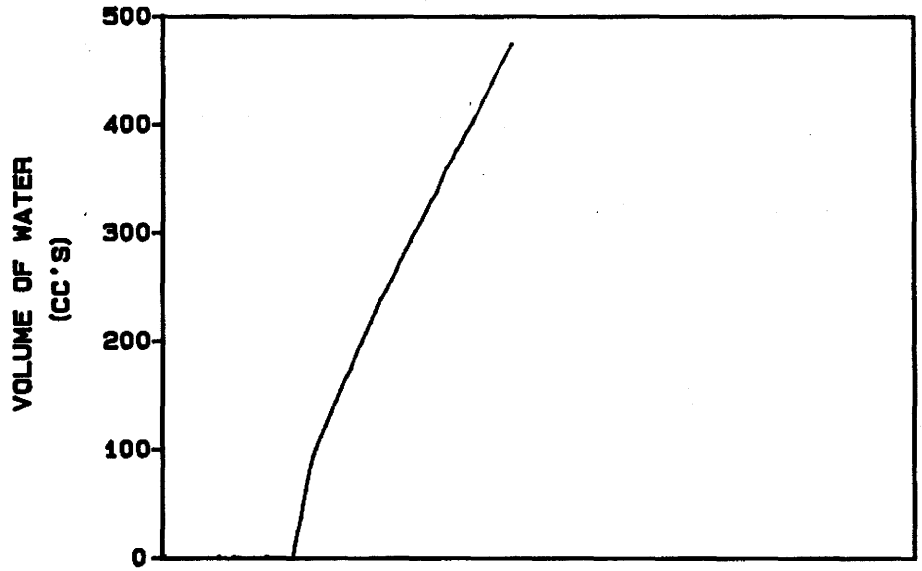


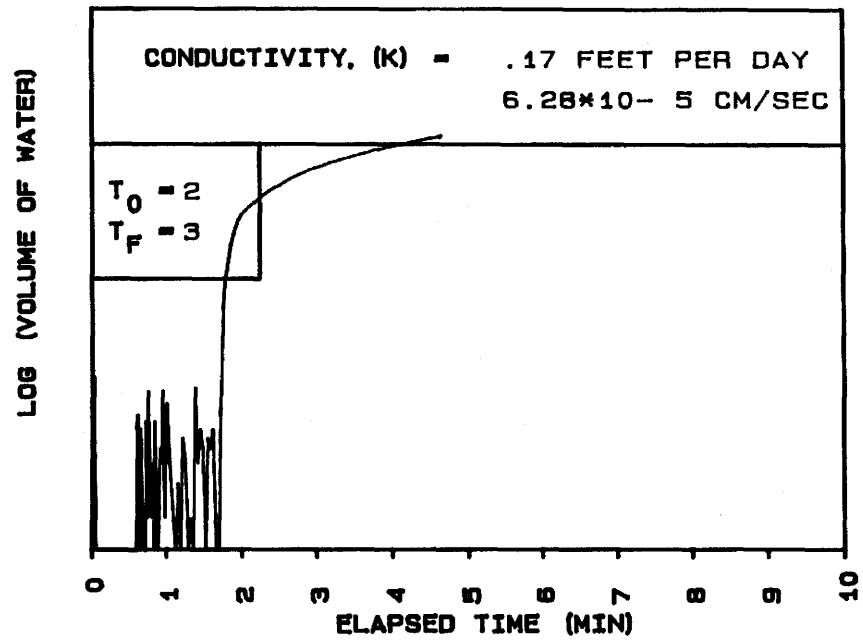


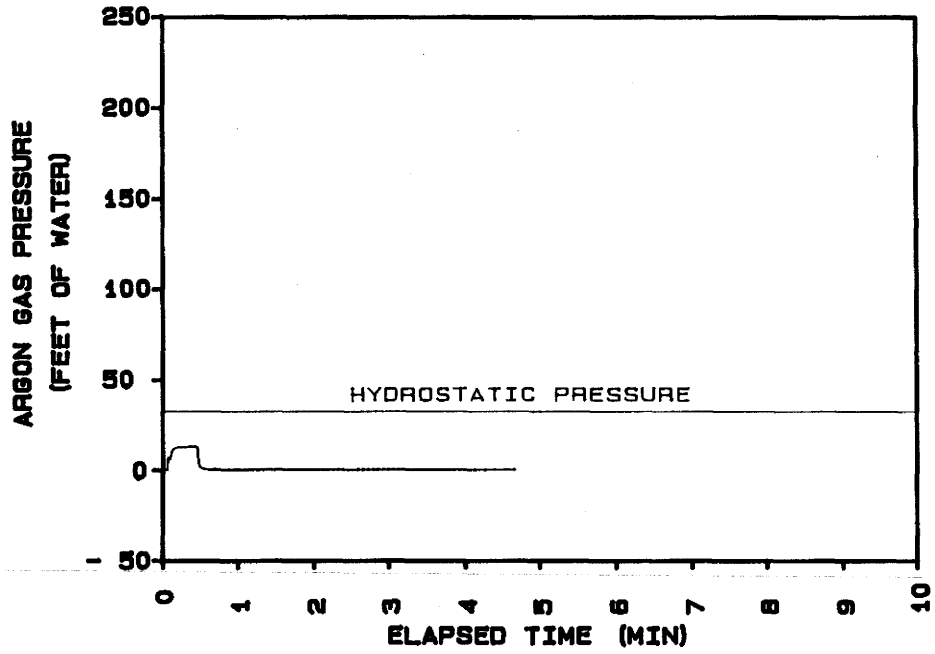
ENSAFE MEMPHIS NSA
LOCATION... 14H0840
TEST DATE
12: 44: 58 11-15-1995

SAMPLE DEPTH (FT) 40
GROUNDWATER DEPTH (FT) 11

HYDROCONE TEST



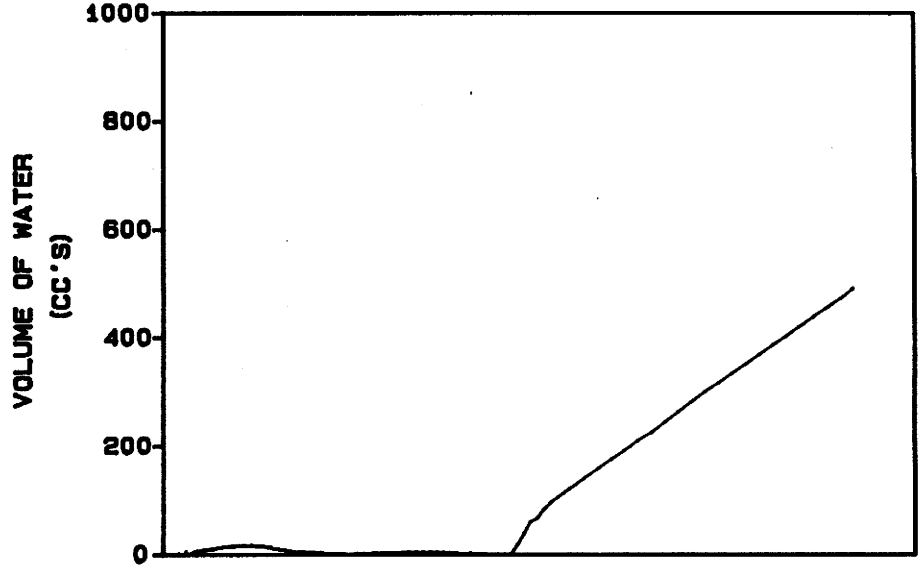


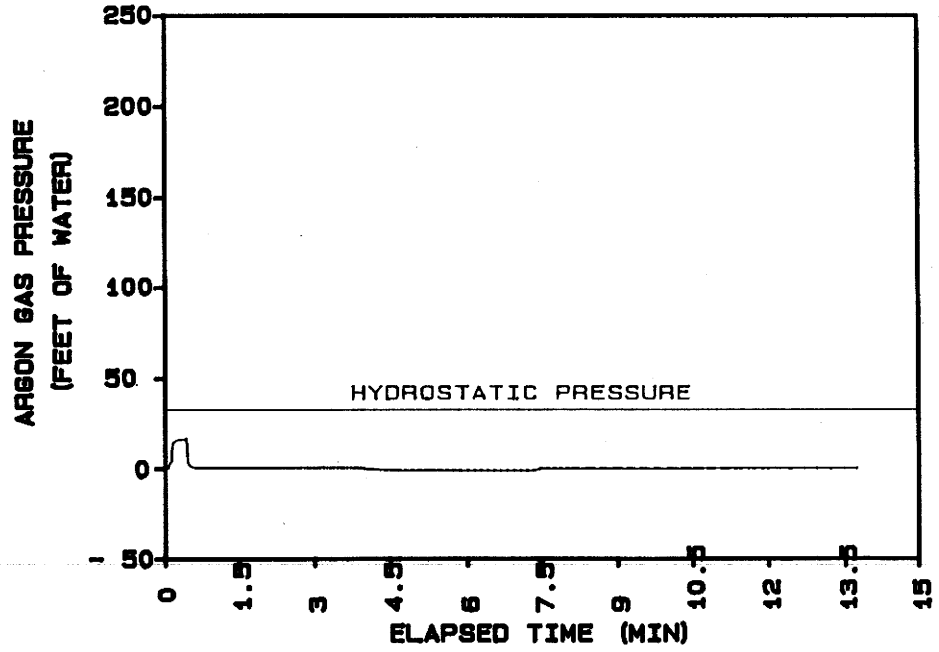


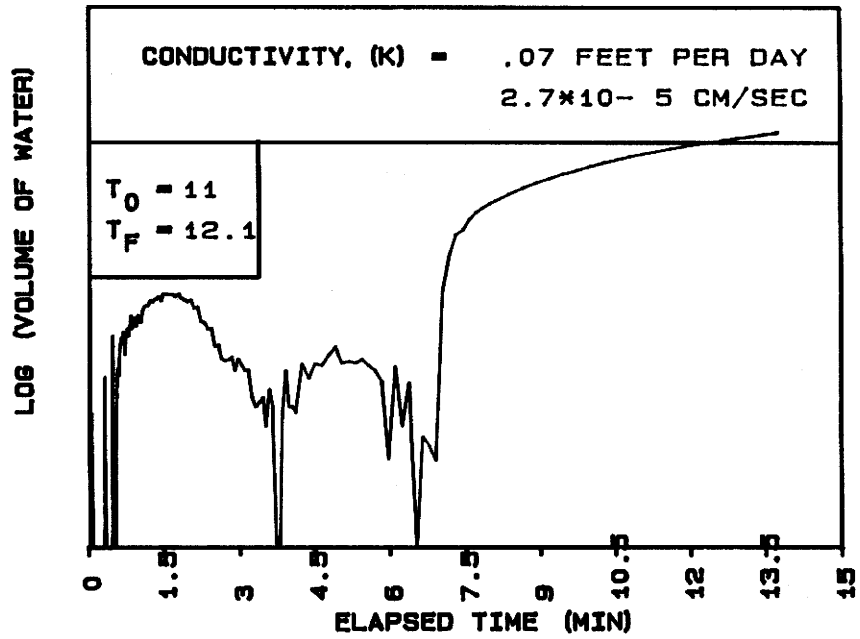
ENSAFE MEMPHIS NSA
LOCATION... 14H0943
TEST DATE
17: 08: 48 11-15-1995

SAMPLE DEPTH (FT) 43
GROUNDWATER DEPTH (FT) 11

HYDROCONE TEST



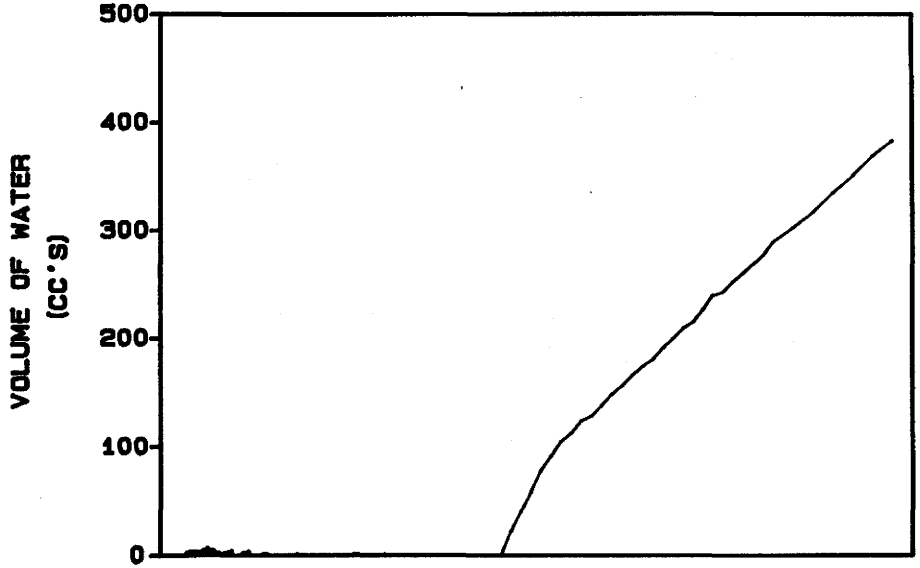


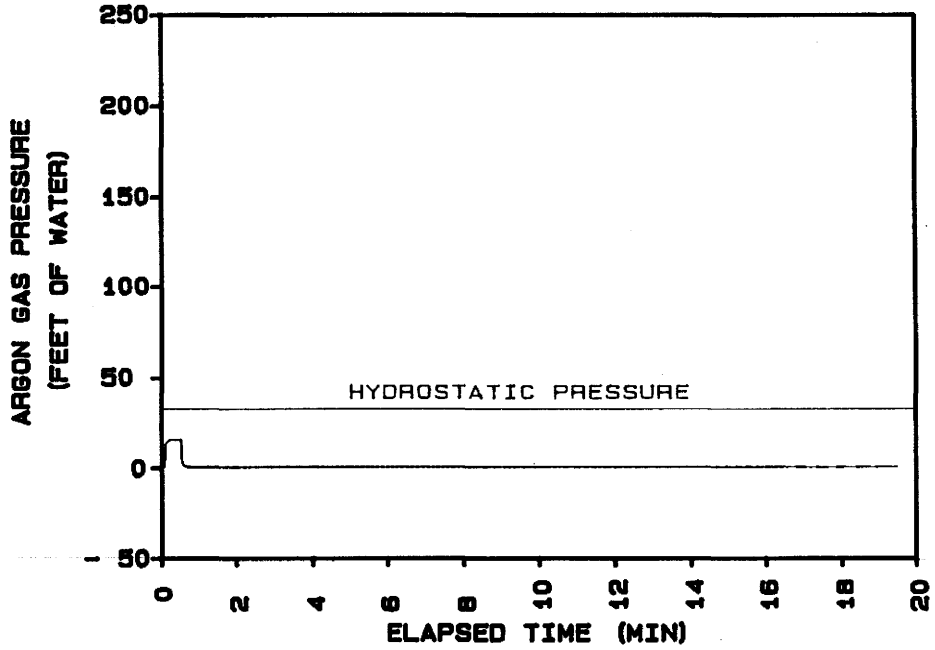


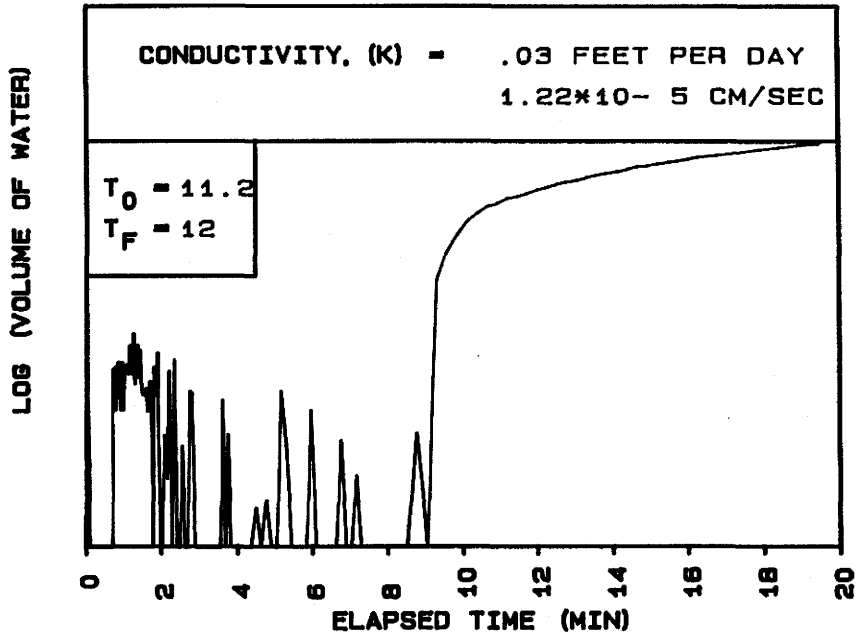
ENSAFE MEMPHIS NSA
LOCATION... 14H1043
TEST DATE
11: 23: 29 11-16-1995

SAMPLE DEPTH (FT) 43
GROUNDWATER DEPTH (FT) 11

HYDROCONE TEST



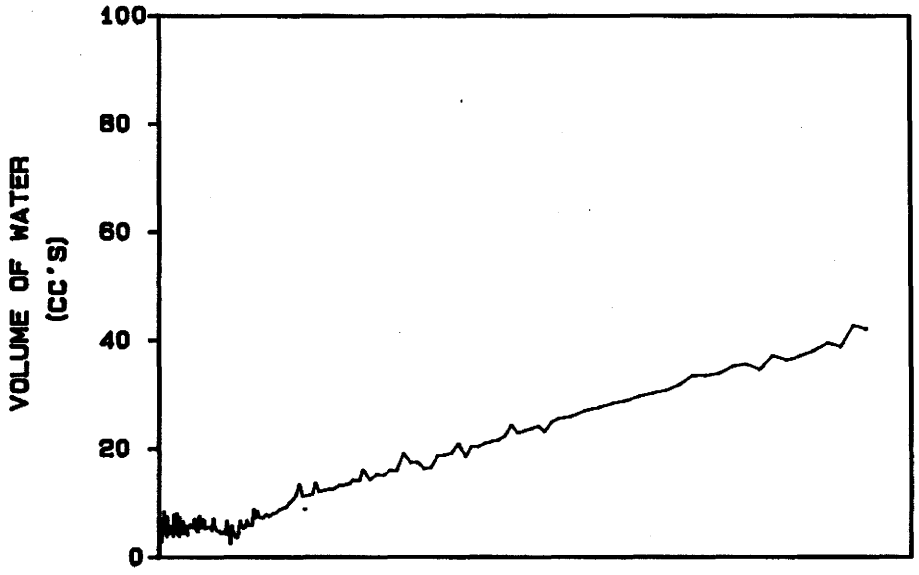


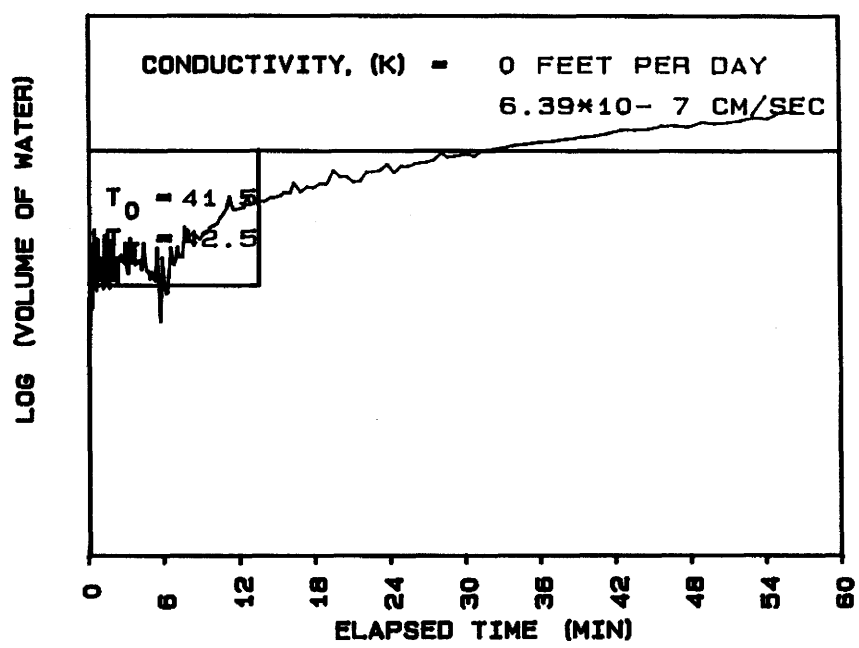


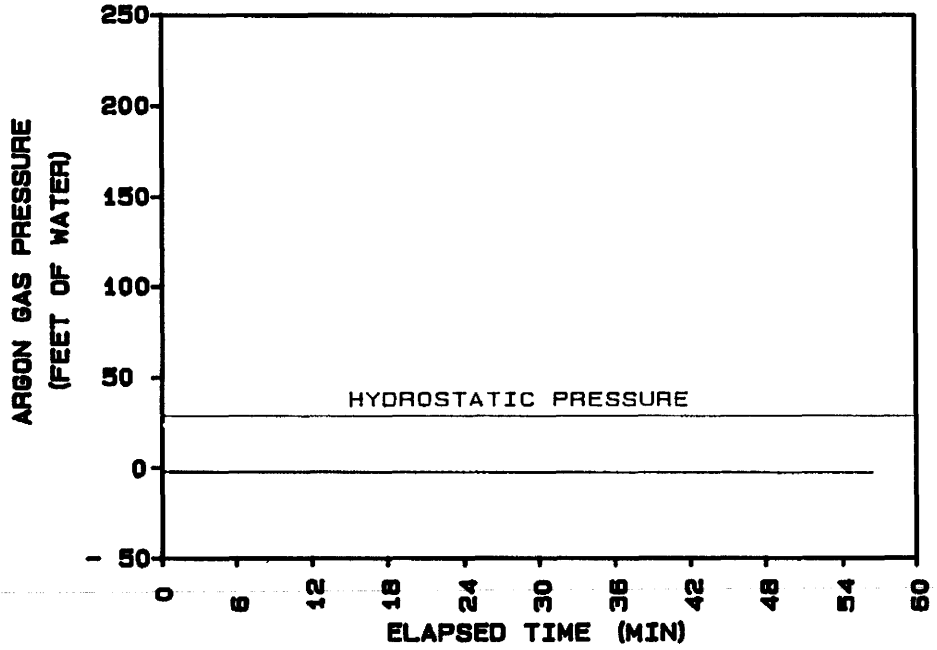
ENSAFE MEMPHIS NSA
LOCATION... 14H1143
TEST DATE
16: 15: 32 11-16-1995

SAMPLE DEPTH (FT) 43
GROUNDWATER DEPTH (FT) 11

HYDROCONE TEST



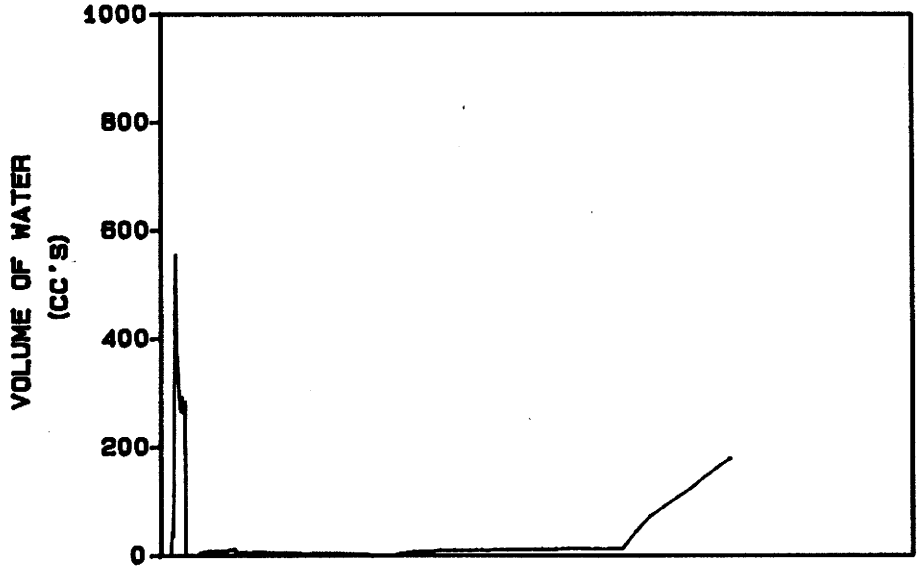


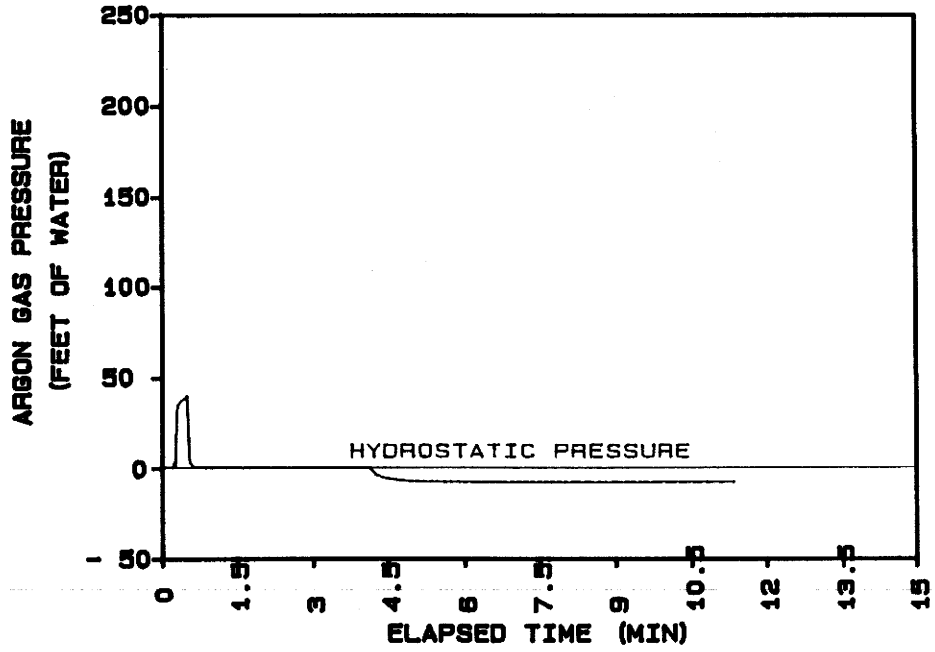


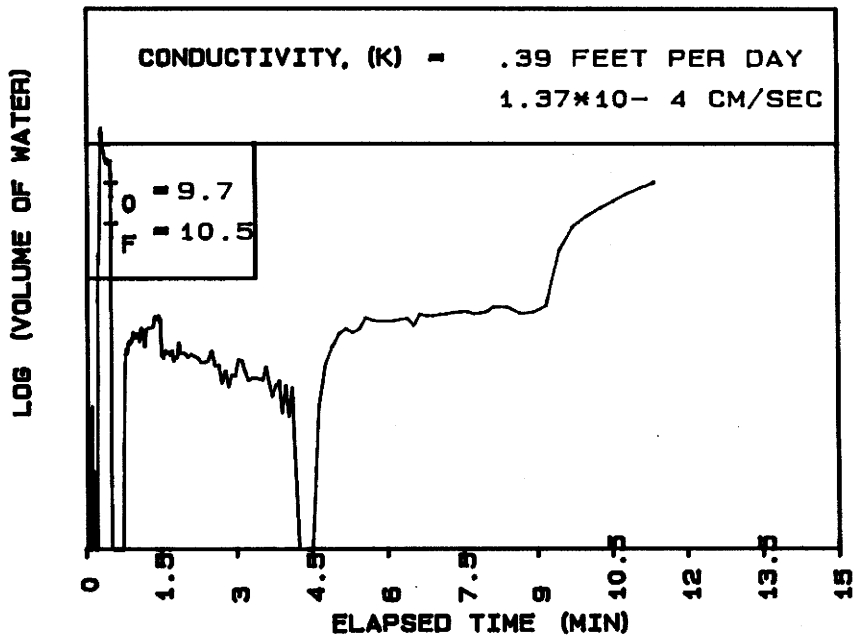
ENSAFE MEMPHIS NSA
LOCATION... 14H1239
TEST DATE
10: 28: 03 11-17-1995

SAMPLE DEPTH (FT) 39
GROUNDWATER DEPTH (FT) 11

HYDROCONE TEST







ENSAFE MEMPHIS NSA
LOCATION... 14H1411
TEST DATE
15: 30: 41 11-17-1995

SAMPLE DEPTH (FT) 11
GROUNDWATER DEPTH (FT) 11

HYDROCONE TEST

VOLUME OF WATER (CC'S)

DATA NOT AVAILABLE

LOG (VOLUME OF WATER)

CONDUCTIVITY, (K) =

T_0 =

T_F =

DATA NOT AVAILABLE

ELAPSED TIME (MIN)

ARGON GAS PRESSURE (FEET OF WATER)

DATA NOT AVAILABLE

ELAPSED TIME (MIN)

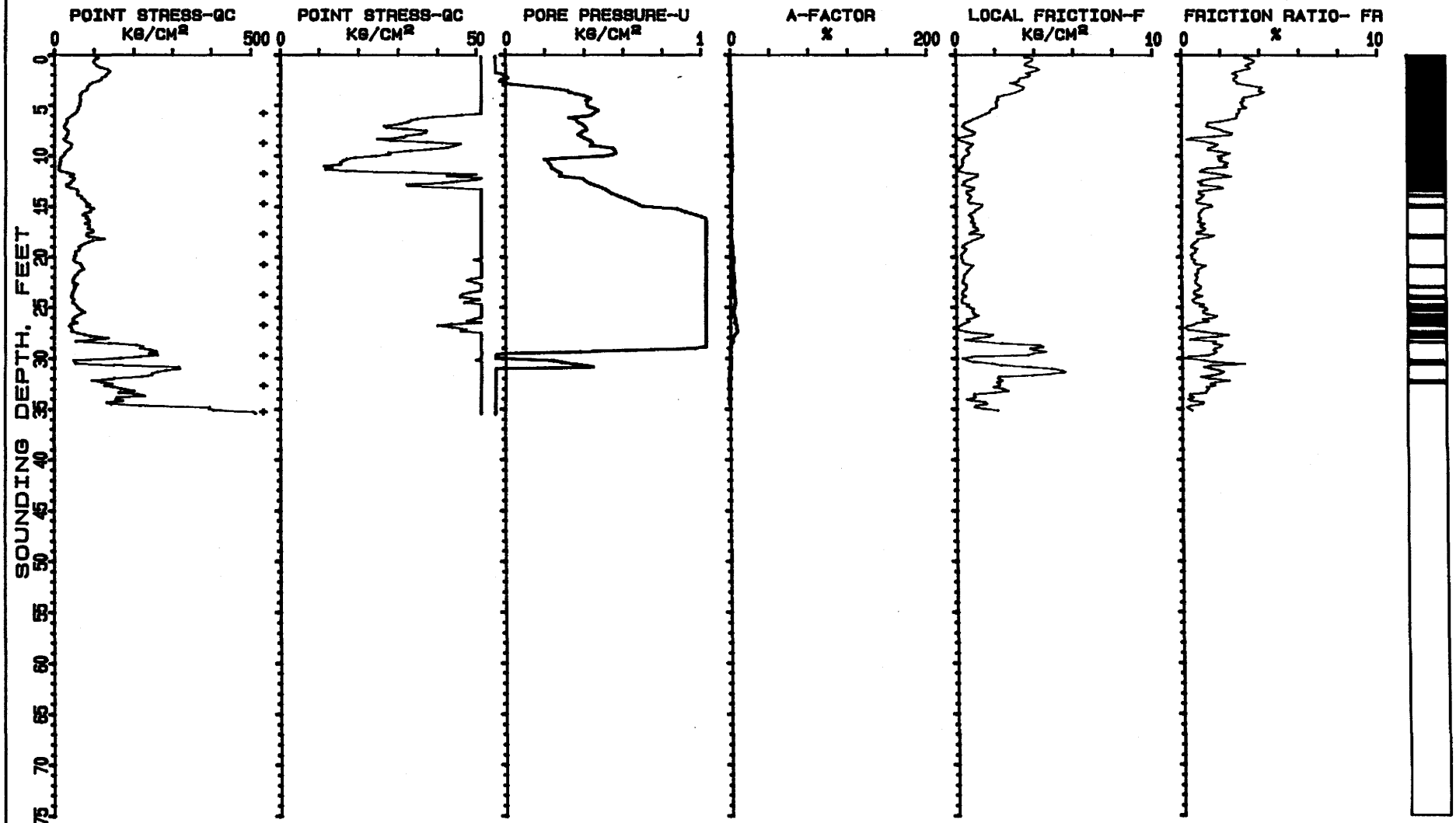
ENSAFE MEMPHIS NSA
LOCATION... 14H1513

DATA NOT AVAILABLE

SWMU 65

DPT SCREENING INVESTIGATION RESULTS

PIEZOCONE SOUNDING



◆ PUSH INTERRUPTED TO ADD ROD
PORE PRESSURE DECAY DATA MAY BE AVAILABLE

FILE #..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
SOUNDING # 65-P01
TEST DATE 11-08-1995 11:28:58

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES	N'	VERTICAL STRESS	RELATIVE DENSITY	FRICTION ANGLE	YOUNGS MODULUS	UNDRAINED SHEAR ST	SENSITIVITY	COMP.	OCR
31	SILTY FINE SAND	159.3	2.76	39	39	.956	70%-80%	42-44	350	--	--	--	--
32	SILTY FINE SAND	248.2	3.77	62	62	.986	>90%	44-46	546	--	--	--	--
33	SILTY FINE SAND	137.3	2.22	34	34	1.017	70%-80%	42-44	302	--	--	--	--
34	FINE SAND	183.6	1.22	36	36	1.05	80%-90%	42-44	403	--	--	--	--

\# N'=POINT STRESS*(.2+.04*FRICTION RATIO)
* NORMALLY CONSOLIDATED SANDS
** FOR OVERCONSOLIDATED SANDS,SLIGHTLY REDUCE ABOVE FRICTION ANGLES
*** FOR OVERCONSOLIDATED SANDS, YOUNG'S MODULUS MAY BE AS MUCH AS 3 TO 6 TIMES HIGHER
**** NK OF 16 USED. FOR OVERCONSOLIDATED CLAYS, AN NK OF 17 IS SUGGESTED

THE ABOVE DATA WAS COMPUTED FOLLOWING 'BASIC' GUIDELINES BY P. K. ROBERTSON AND R. G. CAMPANELLA IN THE HANDBOOK 'GUIDELINES FOR USE AND INTERPERTATION OF THE ELECTRONIC CONE PENETRATION TEST'

ADDITIONAL LOCAL CORRELATIONS DEVELOPED BY IN-SITU TECHNOLOGY HAVE ALSO BEEN USED IN COMPUTING THE ABOVE DATA. IT IS THE POLICY OF IN-SITU TECHNOLOGY TO CONTINUALLY UPGRADE AND MODIFY C.P.T CORRELATIONS AS PUBLISHED RESEARCH AND LOCAL EXPERIENCE GROWS.

IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE
FOR SOUTHEASTERN UNITED STATES SOILS

JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
FILE NAME..... 65-P06

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES #	N'	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	SILTY CLAY TO CLAY	39.5	1.74	26	26	.027	--	--	--	2.46	2.2	UD	>6
2	CLAY	49.9	2.97	49	49	.052	--	--	--	3.11	1.6	UD	>6
3	SANDY CLAY	68.4	2.77	34	34	.079	--	--	--	4.26	2.4	0	>6
4	SANDY CLAY	44.9	1.55	22	22	.106	--	--	--	2.79	2.8	.01	>6
5	SILTY TO CLAYEY F.S.	35	.29	11	11	.137	60%-70%	44-46	77	--	--	--	--
6	SILTY TO CLAYEY F.S.	44.5	.8	14	14	.168	60%-70%	44-46	97	--	--	--	--
7	SILTY TO CLAYEY F.S.	40.6	.57	13	13	.199	60%-70%	44-46	89	--	--	--	--
8	SILTY TO CLAYEY F.S.	37.5	.2	12	12	.23	50%-60%	42-44	82	--	--	--	--
9	SILTY FINE SAND	36	.05	9	9	.26	50%-60%	42-44	79	--	--	--	--
10	SILTY FINE SAND	37.6	.04	9	9	.291	50%-60%	42-44	82	--	--	--	--
11	SILTY FINE SAND	39.1	.11	9	9	.322	50%-60%	40-42	86	--	--	--	--
12	SILTY FINE SAND	42	.03	10	10	.353	50%-60%	40-42	92	--	--	--	--
13	SILTY FINE SAND	60.9	.26	15	15	.383	60%-70%	42-44	133	--	--	--	--
14	SILTY FINE SAND	64.3	.3	16	16	.414	60%-70%	42-44	141	--	--	--	--
15	SILTY FINE SAND	76.1	.67	19	19	.445	70%-80%	42-44	167	--	--	--	--
16	SILTY FINE SAND	63	.44	15	15	.476	60%-70%	42-44	138	--	--	--	--
17	SILTY TO CLAYEY F.S.	92	1.39	30	30	.506	60%-70%	42-44	202	--	--	--	--
18	SILTY FINE SAND	66.4	.45	16	16	.537	50%-60%	40-42	146	--	--	--	--
19	SILTY FINE SAND	46.9	.15	11	11	.568	40%-50%	40-42	103	--	--	--	--
20	SILTY TO CLAYEY F.S.	32.1	.17	10	10	.599	<40%	36-38	70	--	--	--	--
21	SILTY TO CLAYEY F.S.	33.2	.15	11	11	.629	<40%	36-38	73	--	--	--	--
22	SILTY FINE SAND	43.7	.02	10	10	.66	40%-50%	38-40	96	--	--	--	--
23	SILTY FINE SAND	94.7	1.03	23	23	.691	60%-70%	42-44	208	--	--	--	--
24	FINE SAND	191.2	2.28	38	38	.724	80%-90%	44-46	420	--	--	--	--
25	SILTY FINE SAND	181.1	2.97	45	45	.755	80%-90%	44-46	398	--	--	--	--
26	SILTY TO CLAYEY F.S.	240.2	6.24	80	80	.786	>90%	44-46	528	--	--	--	--
27	FINE SAND	468.2	7.43	93	93	.819	>90%	>48	1030	--	--	--	--
28	FINE SAND	435.9	5.27	87	87	.852	>90%	46-48	958	--	--	--	--
29	FINE SAND	486.7	6.91	97	97	.885	>90%	>48	1070	--	--	--	--
30	DENSE OR CEMENTED S.	399.6	2.76	66	66	.922	>90%	46-48	879	--	--	--	--

Appendix C

Soil Boring/Monitoring Well Logs
Geophysical Logs
Geotechnical Analyses

SWMU 2

SOIL BORING/MONITORING WELL LOGS
AND
GEOTECHNICAL LABORATORY RESULTS

EnSafe/Allen & Hoshall

Boring 002S0029

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Geologist: *D. Ladd, W. Parks*
Started at *0750 on 2-6-96*	Surface Elevation: *266.60 feet msl*
Completed at *0915 on 2-6-96*	Drilling Method: *Rotasonic*
Total Depth: *55.0 feet*	Drilling Company: *Alliance Environmental, Inc.*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
					BG		OL	(0-35') Upper Alluvium (see descriptions below).	
					BG		OL	(0-3.5') Soil and roots.	
			1	56					263.1
					BG		ML	(3.5-16') Silt (see descriptions below).	
5					BG		ML	(3.5-6') Silt, moderate yellowish-brown mottled with light olive gray, with considerable iron staining.	
					BG		ML	(6-16') Silt, olive gray to light olive gray mottled with moderate yellowish-brown.	
					BG		ML		
10							ML		
			2	70	BG		ML	Moist from 12' to 16'.	
					BG		ML	Contains iron-manganese nodules from 13' to 16'.	
15					BG		ML	Mottled with dark yellowish-orange near 16'.	
									250.6
			3	100	BG			No description available, collected Shelby tube from 16' to 19' for geotechnical analysis.	
					BG				247.6
20					BG		ML	(19-30') Silt (see descriptions below).	
					BG		ML	(19-26') Silt, olive gray to greenish-gray, with a very few snail fragments, moist.	
					BG		ML	With very fine sand below 22'.	
			4	100	BG		ML	Contains roots below 23'.	
					BG		ML	Contains iron-manganese nodules from 24' to 26'.	
25					BG		ML		
					BG		ML	(26-30') Silt, sandy (very fine-grained), olive gray to greenish-gray becoming light olive gray near 30', contains snail shell fragments, moist.	
					BG		ML	Large piece of wood at 28'.	
					BG		ML	Percentage of sand increases near 30'.	
30							SM		236.6

EnSafe/Allen & Hoshall

Boring 002S0030

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Geologist: *D. Ladd, W. Parks*
Started at *1015 on 2-1-96*	Surface Elevation: *265.60 feet msl*
Completed at *1150 on 2-1-96*	Drilling Method: *Rotasonic*
Total Depth: *50.0 feet*	Drilling Company: *Alliance Environmental, Inc.*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
					9		OL GW	(0-24') Upper Alluvium (see descriptions below).	
								(0-4') Soil, gravel, and asphalt.	
			1	40	6				261.6
5					6			(4-15') Silt, moderate yellowish-brown mottled with light olive gray and olive gray.	
					6			(4-10') Silt, moderate yellowish-brown mottled with light olive gray, with iron-manganese nodules.	
					6		ML		
10			2	70	6			(10-15') Clayey silt, moderate yellowish-brown mottled with olive gray, becoming moist near 15'.	
					6				
					6				
15					6				250.6
								No recovery from 15 to 16'.	
			3	100				No description available, collected Shelby tube sample from 16' to 19'	
					7				246.6
20					6		CL ML	(19-24') Clay and silt, olive gray to greenish-gray, wet.	
			4	67	6				
									241.6
					6		SW ML	(24-48') Deeper Alluvium (see descriptions below).	
25								(24-25') Sand, fine to medium-grained, and silt, olive gray to greenish-gray, with snail shell fragments, wet.	240.6
					7		ML SP	(25-26') Silt and sand, very fine-grained, olive-gray to greenish- gray, with snail shell fragments, moist.	
					6				
30									

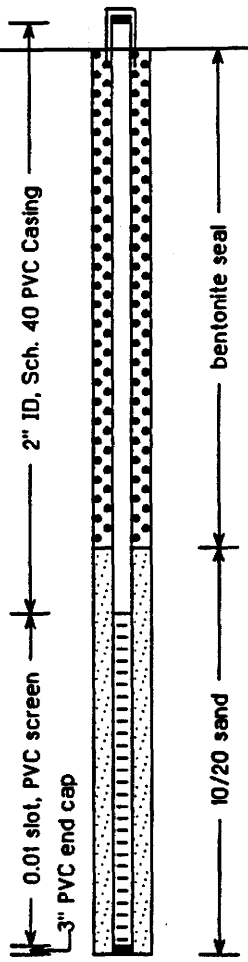
EnSafe/Allen & Hoshall

Monitoring Well 002G01UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *266.72 feet msl*
Started at *0800 on 2-13-96*	TOC Elevation: *269.30 feet msl*
Completed at *0900 on 2-13-96*	Depth to Groundwater: *11.52 feet* Measured: *4/9/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *257.78 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *27.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1					(0-27') Upper Alluvium (see descriptions below).	
								Clayey silt, moderate yellowish brown to light brown.	
5								Some organics and iron staining (5'-6').	
			2					Clayey silt, moderate yellowish brown, moist, abundant organic and iron specks from 6' to 10' becoming less frequent from 10' to 16'. speckles.	
10									
							ML		
15			3					Clayey silt, olive green with dark yellowish orange mottling.	
								Silt, light olive gray to greeenish-gray, wet at 20', some minor sand 25' to 26', sulfur-like odor.	
20									
25								Same as above, shell and small snail fragments, organic debris	239.7
								Boring terminated at 27'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent monitoring well 002G01DA.	
30									
35									
40									

WELL DIAGRAM



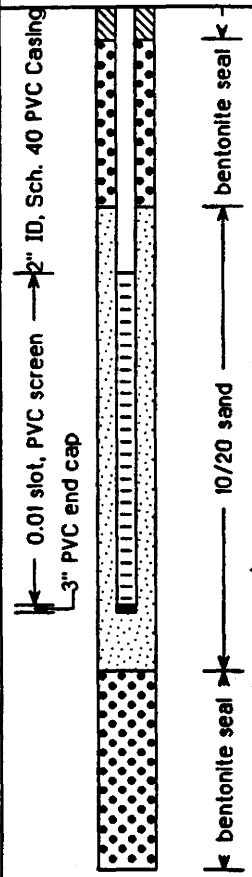
EnSafe/Allen & Hoshall

Monitoring Well 002G01DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *266.90 feet msl*
Started at *1400 on 2-12-96*	TOC Elevation: *269.55 feet msl*
Completed at *1645 on 2-12-96*	Depth to Groundwater: *6.49 feet* Measured: *4/10/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *263.06 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *66.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *48 to 58 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
45			5	30	BG		SW GW	(39-48') Sand and gravel, light yellowish-brown. Contact is approximate; location unceratin due to poor return in the core barrel.	
									218.9
50			6	120	BG		SW	Sand, light yellowish-brown, gravel from 48' to 56'.	
									210.9
55							SW GW	Sand and gravel, light yellowish brown.	
								Gravel is up to 3" diameter.	207.9
60			7	100	BG		SC	Cockfield Formation: Silty fine-grained sand, tan to light brown at contact. Changes to medium-gray, silty and clayey fine-grained sand below, micaceous, mottled with light brown silt and fine sand.	
65									200.9
								Soil boring terminated at 66'.	
70									
75									
80									

WELL DIAGRAM



EnSafe/Allen & Hoshall	Monitoring Well 002G02UA
Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.43 feet msl*
Started at *1150 on 2-12-96*	TOC Elevation: *269.57 feet msl*
Completed at *1230 on 2-12-96*	Depth to Groundwater: *10.64 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *258.93 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *27.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
							ML	(26-27') Same as above, becoming mottled with olive gray material.	240.4	10/20 sand
								Soil boring terminated at 27'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent monitoring well 002G02DA.		
30										
35										
40										
45										
50										

EnSafe/Allen & Hoshall

Monitoring Well 002G02DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.09 feet msl*
Started at *0745 on 2-7-96*	TOC Elevation: *269.56 feet msl*
Completed at *0843 on 2-7-96*	Depth to Groundwater: *9.74 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *259.82 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *41 to 51 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
				ML	(26-27') Same as above, becoming mottled with olive gray.	240.1
				ML	(27-30') Sandy silt, olive gray, moist.	237.1
30	4	100	BG	SM	(30-31') Silty sand; medium to coarse-grained, olive gray, wet, wood at 30'.	236.1
				ML	(31-32') Sandy silt; olive gray, moist.	235.1
				SM	(32-33') Silty sand; medium to coarse-grained with small diameter gravel, olive gray, wet, wood at 33'.	234.1
35				ML	(33-37.5') Silt (see descriptions below). (33-36') Clayey silt, olive gray with some snail shell fragments, moist. Some greenish-gray color material at 33.5'. (36-37.5') Same as above, becoming slightly sandy.	229.1
				SW GW	(38-53') Deeper Alluvium (see descriptions below). (38-40.5') Sand and gravel; sand is fine to coarse-grained, gravel is up to 0.5" in longest dimension, light olive gray to olive gray, with olive gray clay seams, wet. Wood at 38.5' and 40'.	226.6
40	5	100	BG	SM GW	(40.5-45') Silty sand and gravel; sand is coarse to very coarse- grained, gravel is up to 1.5" in longest dimension; mostly olive gray at 40.5' becoming moderate yellowish-brown mottled with light gray below, wet.	222.1
45				SW	Becoming lighter in color near 45'.	221.1
				SW GW	(45-46') Sand, medium to coarse-grained, dark yellowish-orange, with a few small pieces of gravel. (46-50') Gravel and sand; gravel is up to 3.5" in longest dimension; moderate yellowish-brown to dark yellowish-orange, wet.	217.1
50				SW GW		

WELL DIAGRAM

- 2" ID, Sch. 40 PVC Casing
- 0.01 slot, PVC screen
- grout
- bentonite seal
- 10/20 sand

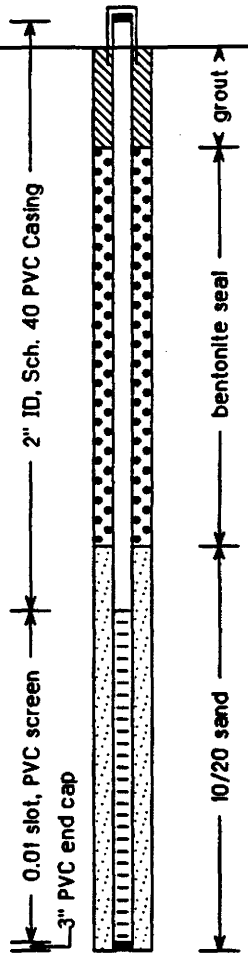
EnSafe/Allen & Hoshall

Monitoring Well 002G03UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.28 feet msl*
Started at *1400 on 2-6-96*	TOC Elevation: *269.73 feet msl*
Completed at *1500 on 2-6-96*	Depth to Groundwater: *13.09 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *256.64 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *27.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1				OL GP	(0-27') Upper Alluvium (see descriptions below).	
								(0-2') Soil, gravel and asphalt.	265.3
5							ML	(2-6') Clayey silt; olive gray to light olive gray to greenish-gray. Contains some iron-manganese nodules.	261.3
			2				ML	(6-13.5') Silt, moderate yellowish-brown and mottled with light olive gray material.	
10								(11.5-13.5') Becoming moist with iron staining and iron-manganese nodules.	253.8
			3					(13.5-27') Silt (see descriptions below).	
15								(13.5-26') Silt, olive gray to greenish-gray. Moist.	
20							ML	Iron-manganese nodules below 20', becoming more moist with scattered shell fragments.	
								Becoming slightly sandy below 22'.	
25								Wood fragment at 25.5'.	
								(26-27') Sandy and clayey silt with iron-manganese nodules.	240.3
30								Terminated soil boring at 27'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent monitoring well 002G03DA.	
35									
40									

WELL DIAGRAM



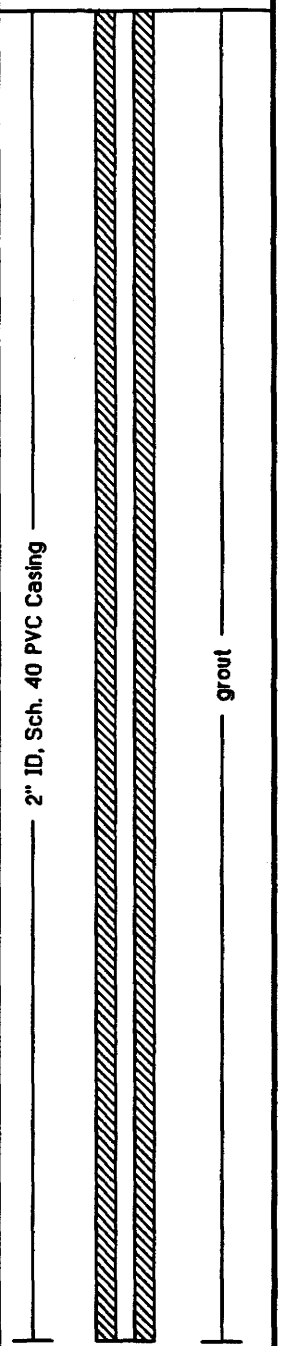
EnSafe/Allen & Hoshall

Monitoring Well 002G03DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.16 feet msl*
Started at *1015 on 2-6-96*	TOC Elevation: *269.62 feet msl*
Completed at *1150 on 2-6-96*	Depth to Groundwater: *10.91 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *258.71 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *60.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *38 to 48 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
20			3	65	BG		ML	Iron-manganese nodules below 20', becoming more moist with scattered shell fragments.	
								Becoming slightly sandy below 22'.	
25								Wood fragment at 25.5'.	
								(26-30') Sandy and clayey silt with iron-manganese nodules. Wood fragments from 28' to 29'.	
									238.2
30							SW	(29-48') Deeper Alluvium (see descriptions below).	

WELL DIAGRAM



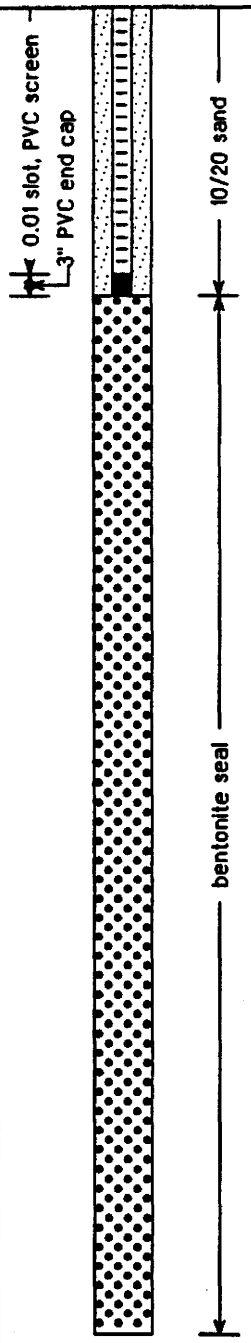
EnSafe/Allen & Hoshall

Monitoring Well 002G03DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.16 feet msl*
Started at *1015 on 2-6-96*	TOC Elevation: *269.62 feet msl*
Completed at *1150 on 2-6-96*	Depth to Groundwater: *10.91 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *258.71 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *60.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *38 to 48 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
							SW GW		221.7
							SP	(45.5-46') Sand; fine to medium-grained, light gray with some pinkish-gray.	221.2
			7	121	BG		SW GW	(46-46.5') Sand, medium to coarse-grained, and gravel; moderate yellowish-brown, wet.	220.7
							SW GW	(46.5-48') Sand, medium to very coarse-grained, and gravel; olive-gray color, wet. Bottom 3" is moderate yellowish-brown sand and gravel, with gravel piece up to 3" in longest dimension.	219.2
								(48-54') Cockfield Formation: Sand; fine-grained.	
50								(48-49.5') Light gray.	
								(49.5-50') Dusky yellow.	
							SP	(50-54') Light gray.	
								(54-60') Clay (see descriptions below).	213.2
55			8	110	BG		CL	(54-58') Silty and sandy clay; olive gray with sand seams, olive gray, dark yellowish-orange sand at top. Lignite seam near 58'.	
								(58-60') Clay; olive gray in color.	
60								Terminated soil boring at 60'.	207.2

WELL DIAGRAM



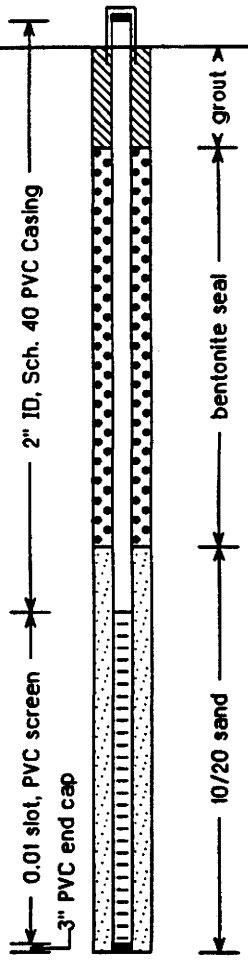
EnSafe/Allen & Hoshall

Monitoring Well 002G05UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.14 feet msl*
Started at *1315 on 2-5-96*	TOC Elevation: *269.39 feet msl*
Completed at *1400 on 2-5-96*	Depth to Groundwater: *11.45 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *257.94 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *27.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1					(0-27') Upper Alluvium (see descriptions below).	
								(0-15.5') Silt; moderate yellowish-brown mottled with some light olive gray material. Contains sattered iron-manganese nodules.	
5									
			2				ML		
10								Slightly moist near 11'.	
								Becoming mottled with some dark greenish-gray material near 14'.	
15			3						
								Increase in percentage of iron-manganese nodules near 15.5'.	251.6
								(15.5-26') Silt, dark greenish-gray, slightly moist.	
20							ML	Becoming light olive gray to greenish gray with depth.	
								Snail shell fragments near 20'.	
25									241.1
								No description available due to no sample recovery from 26' to 27'.	240.1
								Terminated soil boring at 27'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent monitoring well 002G05DA.	
30									
35									
40									

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 002G05DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.16 feet msl*
Started at *0850 on 2-5-96*	TOC Elevation: *269.33 feet msl*
Completed at *1030 on 2-5-96*	Depth to Groundwater: *12.99 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *256.34 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *55.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *40.5 to 50.5 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
								Increase in percentage of iron-manganese nodules near 15.5'.	251.7	
								(15.5-26') Silt (see descriptions below).		
								Dark greenish-gray, slightly moist.		
					BG			Becoming light olive gray to greenish-gray with depth.		
					BG					
20								Snail shell fragments near 20'.		
			3	75	BG		ML			
					BG					
25					BG					
							ML	No description available due to no sample recovery.	241.2	
				0						
								(28-34') Silt and very-fine grained sand with rare snail shell fragments, moist.	239.2	
					BG		ML SP			
30										

2" ID, Sch. 40 PVC Casing

grout

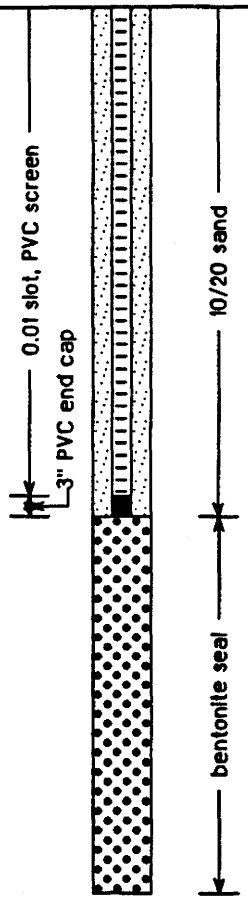
EnSafe/Allen & Hoshall

Monitoring Well 002G05DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.16 feet msl*
Started at *0850 on 2-5-96*	TOC Elevation: *269.33 feet msl*
Completed at *1030 on 2-5-96*	Depth to Groundwater: *12.99 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *256.34 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *55.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *40.5 to 50.5 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
				GW SW	(44-46') Gravel and sand; gravel is up to 3" in longest dimension and dark gray, sand is moderate yellowish-brown to dark yellowish-orange, wet.	221.2
				GW SW		220.7
			BG		(46-46.5') Gravel and sand; gravel is up to .75" in longest dimension, sand is coarse-grained and moderate yellowish-brown to dark yellowish-orange, wet.	
				GW SW	(46.5-50') Gravel and sand; gravel is up to 3" in longest dimension, sand is very coarse-grained and moderate yellowish-brown to dark yellowish-orange, wet.	
			BG			
50	6	93	BG			217.2
			BG	SC	(50-52.5') Cockfield Formation: clayey sand; fine-grained, stained moderate yellowish-brown to dark yellowish-orange with some very light gray seams of material.	
						214.7
			BG		(52.5-55') Sand, fine-grained, very light gray color mottled with some dark yellowish-orange material.	
			BG	SP		
55					Soil boring terminated at 55'.	212.2
60						

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 002G06DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.86 feet msl*
Started at *0925 on 2-2-96*	TOC Elevation: *269.69 feet msl*
Completed at *1030 on 2-2-96*	Depth to Groundwater: *16.52 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *253.17 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *55.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *44.5 to 54.5 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
				OL/GP	(0-32') Upper Alluvium (see descriptions below).	
					(0-.5') Soil, gravel, and asphalt.	
	1	75	8		(.5-15') Silt, mostly moderate yellowish-brown to light olive gray.	
5				ML	(.5-6') Silt; moderate yellowish-brown mottled with light olive gray material. Some iron staining and rare iron-manganese nodules.	
10	2	53	5		(6-14') Percentage of light olive gray-colored material decreases down to 14'.	
15					(14-15') Becoming mostly light olive gray to greenish-gray mottled with moderate yellowish-brown. Abundant iron staining and iron- manganese nodules just above 15'.	252.9
				ML	(15-19') Silt, olive gray to dark greenish-gray.	
					Wet from 16-19'.	248.9
20	3	50	5	ML	(19-25') Silt, dark greenish-gray mottled with brownish-gray material. Some snail shell fragments present.	
25					Some iron-manganese nodules at 24'. Wood at 25'.	242.9
				ML	(25-29') Silt, olive gray to greenish-gray in color.	
					Rare snail shell fragments and wet from 26-29'.	238.9
30	4	78	4	SM/ML	(29-32') Sand, very fine-grained, and silt; greenish-gray, rare snail shell fragments, wet.	
					Becoming olive gray in color near 32'.	235.9
				SW/SC	(32-54') Deeper Alluvium (see descriptions below).	
35					(32-36') Sand, fine to coarse-grained, with clay seams. Olive-gray in color with rare snail shell fragments, wet. Wood near 34'.	231.9
				SW	(36-39') Sand, fine to coarse-grained, olive gray, with scattered gravel and snail shell fragments, wet.	228.9
40				SW		

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

grout

bentonite seal

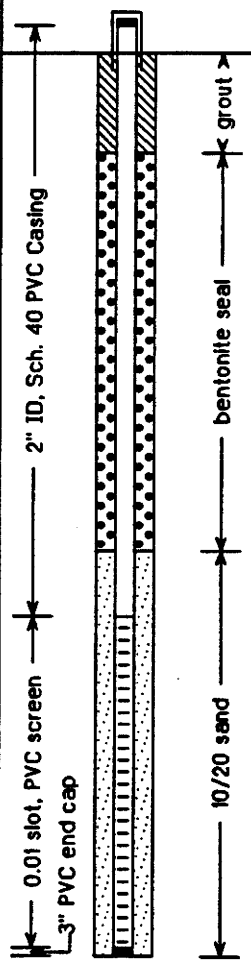
EnSafe/Allen & Hoshall

Monitoring Well 002G07UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *266.10 feet msl*
Started at *1405 on 2-1-96*	TOC Elevation: *268.21 feet msl*
Completed at *1530 on 2-1-96*	Depth to Groundwater: *15.56 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *252.65 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *27.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0	1	OL GP	(0-27') Upper Alluvium (see descriptions below). (0-4') Soil, gravel, and asphalt.	262.1
5		ML	(4-15') Silt, moderate yellowish-brown mottled with light olive gray and olive gray. (4-10') Silt, moderate yellowish-brown mottled with light olive gray, with iron-manganese nodules.	
10	2		(10-15') Clayey silt, moderate yellowish-brown mottled with olive gray, becoming moist near 15'.	
15	3		No recovery from 15' to 16'. No description available; collected a Shelby tube sample from 16' to 19'.	251.1
20		CL ML	(19-24') Clay and silt, olive gray to greenish-gray, wet.	247.1
25		SW ML ML SP	(24-27') Fluvial Deposits (see descriptions below). (24-25') Sand, fine to medium-grained, and silt, olive gray to greenish-gray, with snail shell fragments, wet.	242.1 241.1 239.1
30			(25-27') Silt and sand, very fine-grained, olive-gray to greenish- gray, with snail shell fragments, moist.	
35			Terminated soil boring at 27'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent soil boring 002S0030DA.	
40				

WELL DIAGRAM



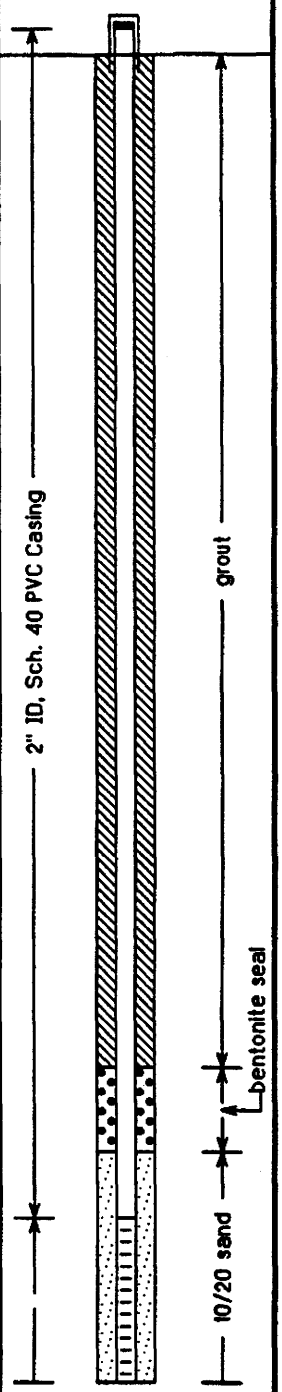
EnSafe/Allen & Hoshall

Monitoring Well 002G08DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 - Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.10 feet msl*
Started at *0930 on 1-31-96*	TOC Elevation: *269.33 feet msl*
Completed at *1425 on 1-31-96*	Depth to Groundwater: *17.54 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" core barrel inside 6" casing*	Groundwater Elevation: *251.79 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *515 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *35 to 45 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1	100	BG		OL GP	(0-22') Upper Alluvium (see descriptions below).	266.1
					BG		CL ML	(0-.5') Concrete.	
								(.5-1') Soil and gravel.	263.1
5					BG			(1-4') Silt and clay.	
					BG			(1-2') Clayey silt, light olive gray to greenish-gray and mottled with moderate yellowish-brown material.	
					BG			(2-4') Silty clay; dark greenish-gray.	
10			2	53	BG		ML	(4-18') Silt, clayey (see descriptions below).	
					BG			(4-5') Clayey silt, light olive gray mottled with moderate yellowish- brown material.	
15					BG			(5-15') Moderate yellowish-brown mottled with olive gray material. Contains iron-manganese nodules from 5' to 18'.	
					BG			Becoming moist; more clay-rich with less olive gray-colored material from 14-18'.	249.1
20			3	90	BG			(18-29') Silt and very fine-grained sand. Olive gray to greenish-gray in color. Contains snail shell fragments. Top of Deeper Alluvium deposits estimated at 22'.	
					BG		ML SP	Sand, jelly-like, lighter in color, wet at 22'.	
25					BG			Wood fragments scattered throughout from 24' to 41'.	
			4	96	BG				
					BG				238.1
30					BG		SW ML	(29-33') Silt and sand; sand is fine to coarse-grained.	
			4	96	BG			Olive gray to greenish-gray with snail shell fragments, wood scattered throughout, wet.	234.1
35					BG		SW ML	(33-39') Sand, fine to very coarse-grained, and silt, olive gray to greenish-gray, with snail shell fragments, wood scattered throughout, wet.	
					BG				
					BG				228.1
40			5	100			SW ML		

WELL DIAGRAM



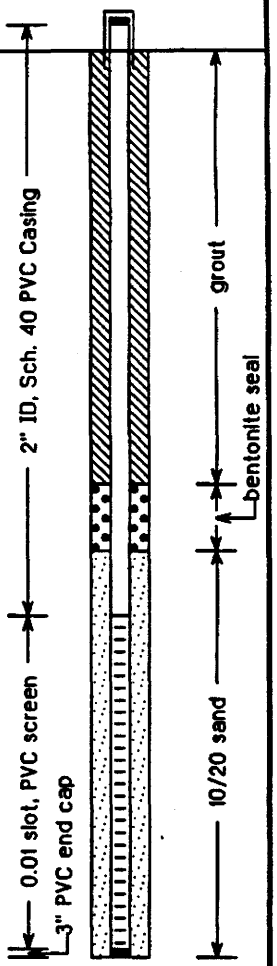
EnSafe/Allen & Hoshall

Monitoring Well 002G09UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 - Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *265.68 feet msl*
Started at *1320 on 1-30-96*	TOC Elevation: *268.09 feet msl*
Completed at *1500 on 1-30-96*	Depth to Groundwater: *16.19 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" core barrel inside 6" casing*	Groundwater Elevation: *251.90 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *27 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1				OL GW	(0-26') Upper Alluvium (see descriptions below). (0-3.5') Soil and gravel (fill).	
									262.2
5							ML	(3.5-8') Clayey silt; moderate yellowish-brown mottled with light olive gray material containing iron-manganese nodules.	
									257.7
10			2				ML	(8-19') Silt, very clayey, moderate yellowish-brown to dark yellowish- brown mottled with medium gray material. Abundant iron-manganese nodules from 9' to 11'. Moist with some iron-manganese nodules from 13' to 15'. Less iron-manganese nodules, becoming more dark yellowish-orange from 15-19'.	
15			3						
									246.7
20							ML	(19-23') Silt, clayey, olive gray to greenish-gray, becoming just olive gray from 22' to 23', containing snail shell fragments.	
									242.7
25							SM	(23-27') Silty sand; fine to medium-grained, olive gray in color, with snail shell fragments, moist to wet. Top of Deeper Alluvium deposits estimated at 26'. Wet below 25'.	
									238.7
30								Terminated soil boring at 27'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent monitoring well 002G09DA.	
35									
40									

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 002G09DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 - Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *265.51 feet msl*
Started at *0830 on 1-30-96*	TOC Elevation: *267.96 feet msl*
Completed at *0945 on 1-30-96*	Depth to Groundwater: *17.15 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" core barrel inside 6" casing*	Groundwater Elevation: *250.81 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *55.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *36 to 46 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			3	ML		234.5
	4	100	8	SM	(31-34') Silty sand, very fine-grained becoming progressively coarser near 34', olive gray to light olive gray near 34', with snail shell fragments, wet.	231.5
				SW	(34-34.5') Coarse to very coarse-grained sand with gravel. Light olive gray to greenish-gray, containing snail shell fragments, wet.	231
35			6	SW		230.5
			6	SM	(34.5-35') Sand, very fine to medium-grained, light olive gray to greenish-gray, wet.	
			7	SP GW	(35-38') Silty sand, very fine to very coarse-grained, with quartz and chert gravel up to 1" in longest dimension, olive gray, wet.	227.5
40	5	390	5		(38-43') Sand and gravel; sand is fine to very coarse-grained, gravel is up to 1"in longest dimension; moderate yellowish-brown mottled with light gray material, wet.	
			6	SP	(43-44') Coarse-grained sand, moderate yellowish-brown mottled with medium light gray material, wet.	222.5
			6	SW GW	(44-46') Sand and gravel, gravel and sand (see descriptions below).	221.5
45			5		(44-45') Sand and gravel; sand is very coarse-grained and gravel is up to 1.5" in longest dimension; moderate yellowish-brown mottled with medium light gray material, wet.	219.5
			5			
50	6	102	6	CL	(45-46') Gravel up to 1.5" in longest dimension, and sand, dark yellowish-brown to moderate yellowish-brown; becoming clayey near 46'.	
			5		(46-55') Cockfield Formation: Clay, dusky yellowish-brown to dark yellowish-brown.	
			5		With light olive gray sandy seams below 52'.	
55					With some lignite seams below 53'.	210.5
60					Terminated soil boring at 55'.	

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

0.01 slot, PVC screen

3" PVC end cap

grout

bentonite seal

10/20 sand

bentonite seal

EnSafe/Allen & Hoshall

Monitoring Well 002G10DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *270.36 feet msl*
Started at *1220 on 2-12-96*	TOC Elevation: *270.17 feet msl*
Completed at *1400 on 2-12-96*	Depth to Groundwater: *9.36 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *260.81 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *40 to 50 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0					4			(0–36') Upper Alluvium (see descriptions below).	
			1	67	4			Silt and clay (fill material) from 0' to 6', moderate brown to moderate gray in color.	
5					2				
					3			Moderate gray to light yellowish-brown, slightly moist.	264.4
					3				
10			2	35	3		ML CL		
					3			Mottling with dark yellowish-orange material with some organic material from 13' to 16'.	
15					3				
					4			Silt, moderate brown to light gray with dark orangish-yellow mottling from 16' to 25'. Organic material present. Moist.	254.4
20					3				
			3	90	3			Wet at 20'.	
					3				
25					3			Color change at 25' to light greenish-gray to olive gray. Shell fragments present. Wet.	
					2		ML	Silt with minor clay and sand. Moderate greenish-gray with common snail shells. Wet.	
			4	100	2				
30					2				
			4	100	2				
					2				
35					3				234.4
					2		SW SM	(36–50') Deeper Alluvium (see descriptions below).	
40					2				

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

grout

bentonite seal

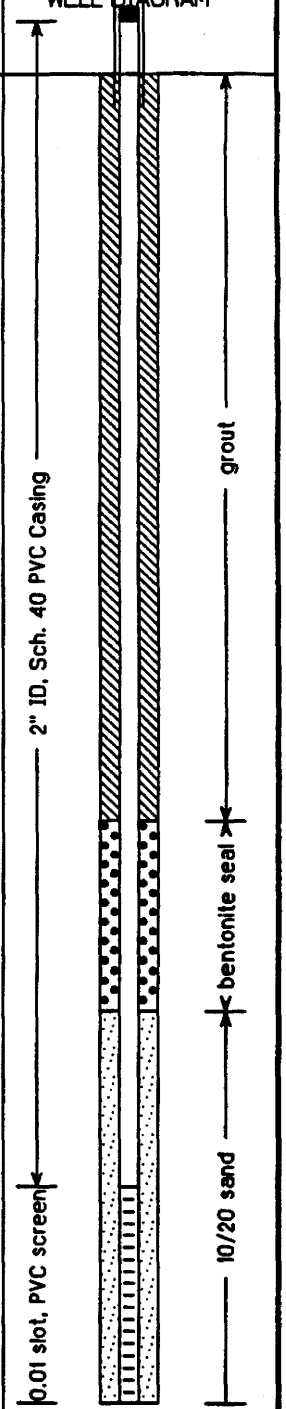
EnSafe/Allen & Hoshall

Monitoring Well 002G11UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *265.12 feet msl*
Started at *1500 on 1-17-96*	TOC Elevation: *266.91 feet msl*
Completed at *1300 on 1-18-96*	Depth to Groundwater: *3.92 feet* Measured: *4/8/96*
Drilling Method: *4 1/4" ID Hollow-Stem Auger with 5' Flights*	Groundwater Elevation: *262.99 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *26.75 feet*
Geologist: *J. Carmichael, W. Parks, D. Ladd*	Well Screen: *16.75 to 26.75 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			1					(0-27') Upper Alluvium (see descriptions below).	
								(0-1') Fill and skeet fragments.	264.1
								(1-24') Silt, clayey (see descriptions below).	
								(1-2') Clayey silt; yellowish-brown to brownish-gray in color.	
								(2-6') Silt, clayey, dark yellowish-brown with dark yellowish-orange staining. Trace of organic material.	
5								Finely laminated and contains small iron-manganese nodules from 4-6'.	
								(6-8') Silt, decreasing clay content and increasing iron-manganese nodule content. Yellowish-brown to light olive gray color, moist.	
			2					(8-18') Silt, slightly clayey, yellowish-gray to light olive gray color, moist.	
10							ML	Increase in dark yellowish-orange staining, moisture content, and iron-manganese content from 10-14'.	
								Stained dark yellowish-orange in color from 14-16'. Very moist from 14-15'.	
15			3					Less staining from 16-18'. Very moist from 16-17' (water came up the borehole when auger was advanced).	
								(18-19') Silt, slightly clayey, medium gray in color. Moist.	
20								(19-20') Silt, slightly clayey, yellowish-gray to light olive gray, moist.	

WELL DIAGRAM



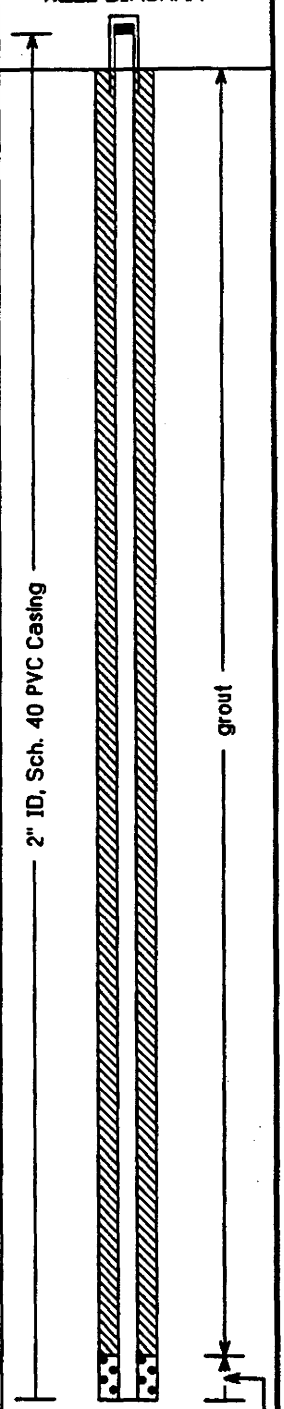
EnSafe/Allen & Hoshall

Monitoring Well 002G11DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *265.17 feet msl*
Started at *1010 on 1-16-96*	TOC Elevation: *266.77 feet msl*
Completed at *0915 on 1-17-96*	Depth to Groundwater: *4.17 feet* Measured: *4/8/96*
Drilling Method: *4 1/4" ID Hollow-Stem Auger, 5' Flights*	Groundwater Elevation: *262.60 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *46.0 feet*
Geologist: *J. Carmichael, W. Parks, D. Ladd*	Well Screen: *32.2 to 42.2 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			1	42	BG			(0-33') Upper Alluvium (see descriptions below).	264.2
								(0-1') Fill and skeet fragments.	
			2	71	BG			(1-24') Silt, clayey (see descriptions below).	
								(1-2') Clayey silt, yellowish-brown to brownish-gray in color.	
5			3	73	BG			(2-6') Silt, clayey, dark yellowish-brown with dark yellowish-orange staining. Trace of organic material.	
			4	83	BG			Finely laminated and contains small iron-manganese nodules from 4-6'.	
			5	96	BG			(6-8') Silt, decreasing clay content and increasing iron-manganese nodule content. Yellowish-brown to light olive gray, moist.	
10			6	100	BG			(8-18') Silt, slightly clayey yellowish-gray to light olive gray color, moist.	
			7	100	BG		ML	Increase in dark yellowish-orange staining, moisture content, and iron-manganese content from 10-14'.	
15			8	100	BG			Stained dark yellowish-orange in color from 14-16'. Very moist from 14-15'.	
			9	100	BG			Less staining from 16-18'. Very moist from 16' to 17' (water came up the borehole when auger was advanced).	
			10	92	BG			(18-19') Silt, slightly clayey, medium gray in color. Moist.	
20			11	83	BG			(19-20') Silt, slightly clayey, yellowish-gray to light olive gray, moist.	
			12	100	BG			(20-22') Silt, slightly clayey, medium light gray to light gray, stained moderate brown, moist.	
								(22-24') Silt, clayey, pale yellowish-brown to pale brown color, moist.	241.2
25			13	100	BG			(24-28') Silt (see descriptions below).	
							ML	(24-26') Silt; medium gray to brownish-gray with patches of dark yellowish-orange material. Moist.	
			14	100	BG				237.2
			15	100	BG		ML	(26-28') Silt; light olive gray to medium gray. Slightly moist.	
30								(28-33') Silt, sandy (see descriptions below).	

WELL DIAGRAM



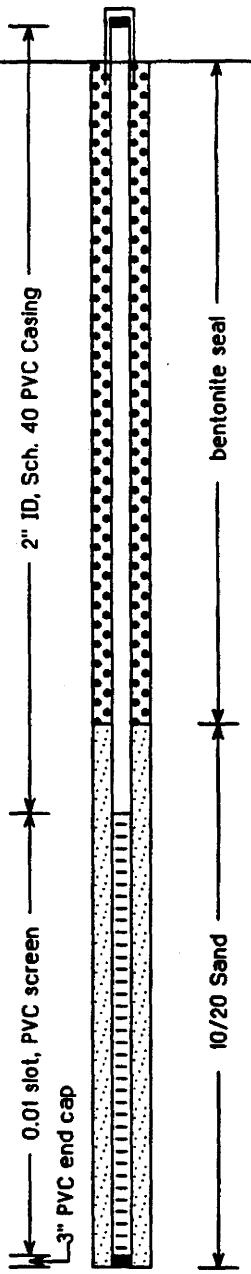
EnSafe/Allen & Hoshall

Monitoring Well 002G12UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *268.64 feet msl*
Started at *1030 on 1-23-96*	TOC Elevation: *268.63 feet msl*
Completed at *1200 on 1-29-96*	Depth to Groundwater: *12.87 feet* Measured: *4/8/96*
Drilling Method: *4 1/4" ID Hollow-Stem Auger with 5' Flights*	Groundwater Elevation: *255.76 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *28.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			1	58	4			(0-28') Upper Alluvium (see descriptions below).	
								Silt and clay; light brown to dark yellowish-brown color from 0'-2'.	
			2	75	6				
								Light brown to yellowish-brown color. Many small iron-manganese nodules. Staining with orange rust-colored material. Dry.	
5			3	50	5				
								Grayish-brown to light brown color, stained dark orange to rust- colored. Iron-manganese nodules common. Dry.	
			4	75	4				
								Slightly moist.	
			5	100	3			Fewer iron-manganese nodules, very slightly moist.	
10									
			6	92	3			Increase in percentage of iron-manganese nodules; increase in moisture content from 11.5' to 12'.	
			7	92	3			Yellowish-brown to light olive gray color. Decreased staining and percentage of iron-manganese nodules. Moist.	
							ML CL		
15			8	96	3			Medium yellowish-brown to light olive gray, moist.	
								Silt and clay, moist. Increased staining.	
			9	92	3				
								Light olive gray.	
			10	100	4			Color change to medium gray at 18.5'. Some staining with black material (iron/manganese or organics).	
20									
			11	100	4				
			12	100	3				
								Decreased moisture content.	
25			13	100	4				
								Clay and silt; greenish-gray, dry.	
			14	100	4				
								Terminated soil boring at 28'. Note: PID response likely due to moisture content of soil.	238.6
30									

WELL DIAGRAM



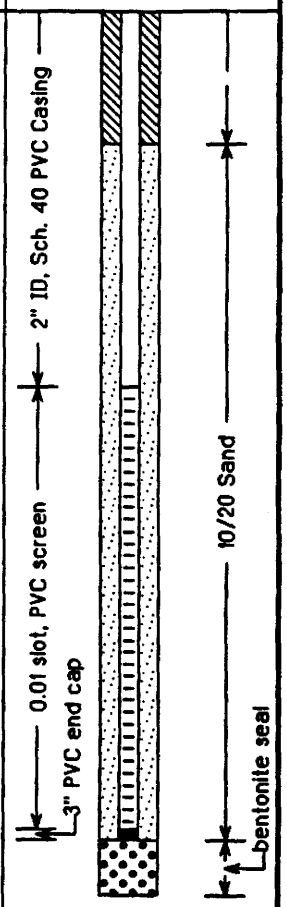
EnSafe/Allen & Hoshall

Monitoring Well 002G12DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *266.56 feet msl*
Started at *1300 on 1-29-96*	TOC Elevation: *268.63 feet msl*
Completed at *1400 on 1-30-96*	Depth to Groundwater: *6.02 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic*	Groundwater Elevation: *262.61 feet msl*
Drilling Company: *Alliance Drilling*	Total Depth: *50.0 feet*
Geologist: *J. Kingsbury, R. Thomas*	Well Screen: *38.5 to 48.5 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
	2	75	BG	ML	Contains streaks of fine to medium-grained sand approximately 1 to 2 inches thick, light olive-gray to medium gray.	
	3	83	BG			
				SC SM	Silt, sand, and clay, light olive gray.	232.6
35	4	100	BG	SW		231.6
					(35-51') Deeper Alluvium (see descriptions below).	230.6
					(35-36') Sand; fine to coarse-grained, yellowish-gray to yellowish- brown color.	
					Start five-foot split-spoon intervals.	
40	5	67	BG	SW GW	Sand and gravel; gravel up to 1" in diameter. Yellowish-gray to yellowish-brown in color.	226.6
						224.6
45	6	83	BG	SW GW	Sand and gravel, yellowish-brown to yellowish-gray.	221.6
						219.6
50	7	75	BG	SW	Sand with rare gravel, light olive gray, matrix resembles reworked Cockfield Formation from 50' to 51'. Cockfield Formation contact is at 51'.	218.6
				SC SM	Sand, fine to medium-grained, finely lignitic and micaceous, is present from 51' to 51.5'.	215.6
					Sand with silt and clay.	
55					Terminated soil boring at 51.5'. Note: Sample lithology and PID readings from 0' to 28' obtained during the advancement of 002G12UA. Lithology and PID readings from 28' to 51.5' obtained during the advancement of 002G12DA.	
60						

WELL DIAGRAM



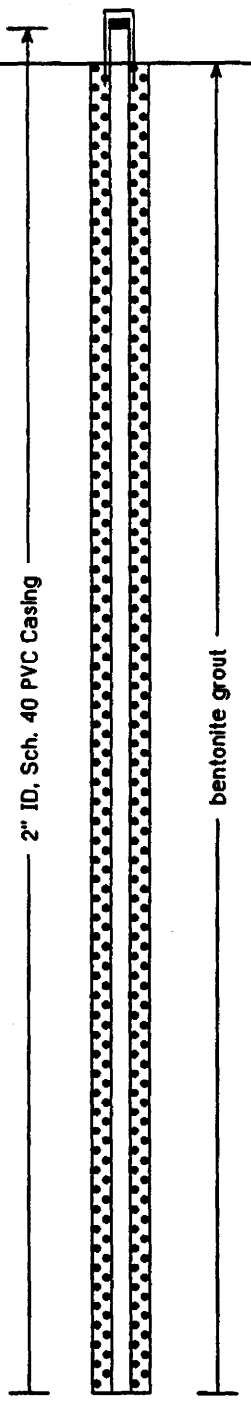
EnSafe/Allen & Hoshall

Monitoring Well 002G13MA

Project: *NAS Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.23 feet msl*
Started at *1300 on 1-21-96*	TOC Elevation: *269.20 feet msl*
Completed at *1145 on 1-22-96*	Depth to Groundwater: *5.38 feet* Measured: *4/8/96*
Drilling Method: *4 1/4" ID Hollow-Stem Auger With 5' Flights*	Groundwater Elevation: *263.82 feet msl*
Drilling Company: *Alliance Drilling*	Total Depth: *46.0 feet*
Geologist: *D. Ladd, J. Kingsbury, A. Choate*	Well Screen: *36 to 46 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1		BG		OL	(0-34') Upper Alluvium (see descriptions below).	
								Clay and silt, dark yellowish-brown, moist, with organic material and roots.	265.2
							ML CL	Silty clay/clayey silt, greenish-gray and moderate yellowish-brown, slightly moist, soft to slightly firm, with some dark iron staining.	263.2
5								Clayey silt, greenish-gray and moderate yellowish-brown, with iron/manganese inclusions and organic material, slightly moist.	
								Iron-manganese nodules increasing in percentage and size (up to .5" in diameter).	
			2		BG			Some staining with a dark yellowish-orange material.	
10								Increase in clay percentage.	
							ML	Clayey silt, light olive gray color stained light brown to dark yellowish-orange. Moisture content increases and the percentage of iron/manganese nodules decreases.	
15			3		BG			Very moist at 14' becoming less moist near 16', rare iron/manganese nodules.	
								Clayey silt, medium gray to light olive gray stained light brown to dark yellowish-orange, very moist.	
									248.2
20								Silty clay, medium light to medium gray, wet.	
								Dark greenish-gray to grayish-olive green color, wet.	
								Very moist.	
							CL		
25								Light olive gray to grayish-olive green color. Very moist and soft.	
									239.2
							ML	Clayey silt, light olive gray to grayish-olive green color, slightly moist, soft.	
30									

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 002G13DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 - Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.05 feet msl*
Started at *1110 on 1-19-96*	TOC Elevation: *269.12 feet msl*
Completed at *1130 on 1-20-96*	Depth to Groundwater: *5.36 feet* Measured: *4/8/96*
Drilling Method: *4 1/4" ID Hollow-Stem Auger, 5' Flights*	Groundwater Elevation: *263.76 feet msl*
Drilling Company: *Alliance Drilling*	Total Depth: *67.0 feet*
Geologist: *D. Ladd, J. Kingsbury, A. Choate*	Well Screen: *55 to 65 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
	1	46	BG	OL	(0-34") Upper Alluvium (see descriptions below).	
	2	83	BG	CL ML	Clay and silt, dark yellowish-brown, moist, with organic material and roots.	265
5	3	88	3		Silty clay/clayey silt, greenish-gray and moderate yellowish-brown, slightly moist, soft to slightly firm, with some dark iron staining.	263
	4	79	2.5		Clayey silt, greenish-gray and moderate yellowish-brown, with iron/ manganese inclusions and organic material, slightly moist.	
	5	100	2		Iron-manganese nodules increasing in percentage and size (up to .5" in diameter).	
10					Some staining with a dark yellowish-orange material.	
	6	108	BG	ML	Increase in clay percentage.	
	7	108	BG		Clayey silt, light olive gray color stained light brown to dark yellowish-orange. Moisture content increasing as iron/manganese nodules decrease in percentage.	
15	8	108	BG		Very moist at 14' becoming less moist near 16', rare iron/manganese nodules.	
	9	108	BG		Clayey silt, medium gray to light olive gray stained light brown to dark yellowish-orange, very moist.	
	10	100	BG			248
20					Silty clay, medium light to medium gray, wet.	
	11	92	BG		Dark greenish-gray to grayish-olive green color, wet.	
	12	100	BG	CL	Very moist.	
25	13	96	BG		Light olive gray to grayish-olive green color. Very moist and soft.	
	14	96	BG			
						239
	15	96	BG	ML	Clayey silt, light olive gray to grayish-olive green color, slightly moist, soft.	
30						

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

bentonite grout

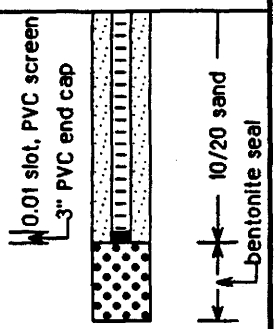
EnSafe/Allen & Hoshall

Monitoring Well 002G13DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.05 feet msl*
Started at *1110 on 1-19-96*	TOC Elevation: *269.12 feet msl*
Completed at *1130 on 1-20-96*	Depth to Groundwater: *5.36 feet* Measured: *4/8/96*
Drilling Method: *4 1/4" ID Hollow-Stem Auger, 5' Flights*	Groundwater Elevation: *263.76 feet msl*
Drilling Company: *Alliance Drilling*	Total Depth: *67.0 feet*
Geologist: *D. Ladd, J. Kingsbury, A. Choate*	Well Screen: *55 to 65 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
									206
			24	141	BG		SW GW	Sand and gravel, moderate yellowish-brown to dark yellowish-brown color.	
								Color change to dusky yellow brown. Wet.	204.8
								No sample collected from 62.5' to 65'.	
65									202.1
			25	100	BG		SW GW SP	Fine to coarse-grained sand and gravel, olive-gray to light olive gray. Fining downward and turning dark yellowish-orange to light brown in color near 65.5'.	201.1
								Cockfield Formation: Sand, fine-grained, dark yellowish-orange to light brown, wet.	200.1
70								Terminated soil boring at 67'.	
75									
80									
85									
90									

WELL DIAGRAM



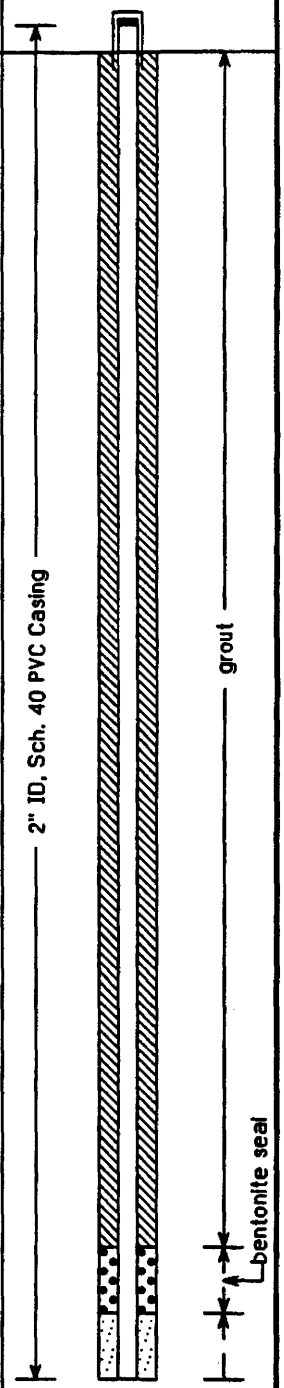
EnSafe/Allen & Hoshall

Monitoring Well 002G14DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 - Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *269.00 feet msl*
Started at *1213 on 2-14-96*	TOC Elevation: *271.00 feet msl*
Completed at *1400 on 2-14-96*	Depth to Groundwater: *6.90 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" core barrel inside 6" casing*	Groundwater Elevation: *264.10 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *76.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *40 to 50 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0								(0-32') Uper Alluvium (see descriptions below).	
			1	83	3			Clayey silt, dark yellowish-brown to brownish-gray	
5								Some organic material between 5' and 6'.	
10			2	80	BG		ML	Silt, light yellowish-brown to yellowish-gray mottled with dark orangish-yellow material. Organic material (specks) common from 10' to 16'. Very moist.	
15								Common iron staining from 16' to 20'.	
20			3	90	BG			Silt and clay, olive-gray to greenish-gray, wet.	249
25							ML CL	Slightly moist between 25' and 29'.	
30			4	90	BG			Light olive gray color; mottled with brown to reddish-brown material.	
									237
							ML SM	(32-66') Deeper Alluvium (see descriptions below). Light olive gray silt to fine sand. No mottling. Wet.	
35									233
							SM	More sand from 36' to 39'.	
40							SP		230

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 002G09DA

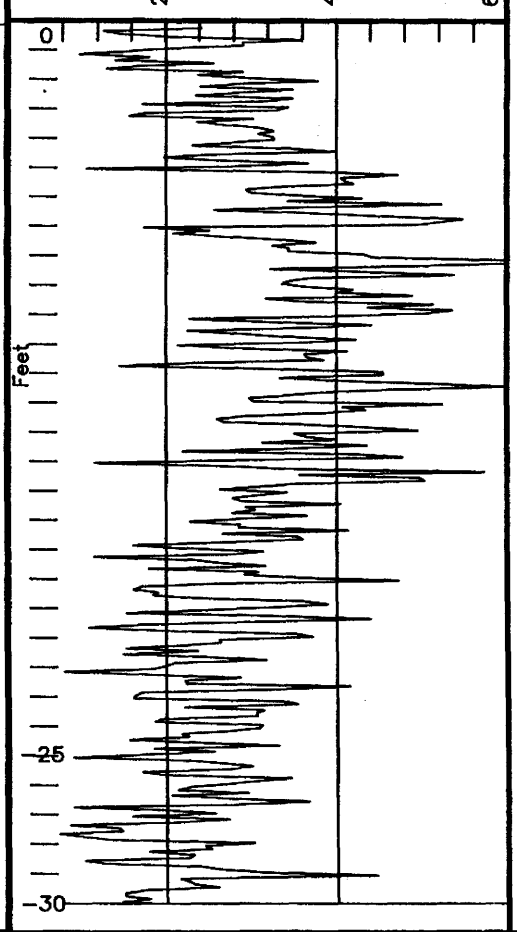
Project: NSA Memphis	Location: Millington, TN. SWMU #2–Southside Landfill
Project No.: 106–08420	Surface Elevation: 265.51 feet msl
Started at 0830 on 1–30–96	TOC Elevation: 267.96 feet msl
Completed at 0945 on 1–30–96	Depth to Groundwater: 17.15 feet Measured: 4/8/96
Drilling Method: Rotasonic–4" core barrel inside 6" casing	Groundwater Elevation: 250.81 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 55.0 feet
Geologist: D. Ladd, W. Parks	Well Screen: 36 to 46 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft–msl)
0			1	75	8 6		OL GW	(0–26') Upper Alluvium (see descriptions below). (0–3.5') Soil and gravel (fill).	
5					6 5 6		ML	(3.5–8') Clayey silt; moderate yellowish–brown mottled with light olive gray material containing iron–manganese nodules.	262
10			2	98	5 6 6		ML	(8–19') Silt, very clayey, moderate yellowish–brown to dark yellowish– brown mottled with medium gray material. Abundant iron–manganese nodules from 9' to 11'. Moist with some iron–manganese nodules from 13' to 15'.	257.5
15					4 5		ML	Less iron–manganese nodules, becoming more dark yellowish–orange from 15–19'.	
20			3	90	2 5		ML	(19–23') Silt, clayey (see descriptions below). (19–22') Silt, clayey, olive gray to greenish–gray, containing snail shell fragments. (22–23') Same as above, but olive gray in color.	246.5
25			4	100	6 6 5		SM SW	(23–27.5') Sand, fine to medium, silty, olive gray in color, with snail shell fragments, moist to wet, wet below 25'. Top of Deeper Alluvium deposits estimated at 26'. (27.5–28') Sand, fine to very coarse–grained, olive gray, with snail shell fragments, wet.	242.5 237.5
30					5		ML	(28–31') Silt; olive gray in color with snail shell fragments. Wet. Vegetation near 29'.	

WELL DIAGRAM: 2" ID, Sch. 40 PVC Casing

GAMMA RAY LOG

COUNTS PER SECOND



CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/23/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 2
SOUTHSIDE LANDFILL

DWG DATE: 12/10/96

DWG NAME: 94GL29

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

EnSafe/Allen & Hoshall

Monitoring Well 002G11DA

Project: NSA Memphis	Location: Millington,TN.SWMU#2–Southside Landfill
Project No.: 106–08420	Surface Elevation: 265.17 feet msl
Started at 1010 on 1–16–96	TOC Elevation: 266.77 feet msl
Completed at 0915 on 1–17–96	Depth to Groundwater4.17 feet Measured: 4/8/96
Drilling Method: 4 1/4" ID Hollow–Stem Auger, 5' Flights	Groundwater Elevation:262.60 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 46.0 feet
Geologist: J. Carmichael, W. Parks, D. Ladd	Well Screen: 32.2 to 42.2 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			1	42	BG			(0–33') Upper Alluvium (see descriptions below).	
								(0–1') Fill and skeet fragments.	264.2
			2	71	BG			(1–24') Silt, clayey (see descriptions below).	
5			3	73	BG			(1–2') Clayey silt, yellowish–brown to brownish–gray in color.	
			4	83	BG			(2–6') Silt, clayey, dark yellowish–brown with dark yellowish–orange staining. Trace of organic material.	
			5	96	BG			Finely laminated and contains small iron–manganese nodules from 4–6'.	
10			6	100	BG			(6–8') Silt, decreasing clay content and increasing iron–manganese nodule content. Yellowish–brown to light olive gray, moist.	
			7	100	BG		ML	(8–18') Silt, slightly clayey yellowish–gray to light olive gray color, moist.	
			8	100	BG			Increase in dark yellowish–orange staining, moisture content, and iron–manganese content from 10–14'.	
15			9	100	BG			Stained dark yellowish–orange in color from 14–16'. Very moist from 14–15'.	
			10	92	BG			Less staining from 16–18'. Very moist from 16' to 17' (water came up the borehole when auger was advanced).	
20			11	83	BG			(18–19') Silt, slightly clayey, medium gray in color. Moist.	
			12	100	BG			(19–20') Silt, slightly clayey, yellowish–gray to light olive gray, moist.	
								(20–22') Silt, slightly clayey, medium light gray to light gray, stained moderate brown, moist.	
25			13	100	BG			(22–24') Silt, clayey, pale yellowish–brown to pale brown color, moist.	241.2
							ML	(24–28') Silt (see descriptions below).	
			14	100	BG			(24–26') Silt; medium gray to brownish–gray with patches of dark yellowish–orange material. Moist.	
									237.2
			15	100	BG		ML	(26–28') Silt; light olive gray to medium gray. Slightly moist.	
30								(28–33') Silt, sandy (see descriptions below).	

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

GAMMA RAY LOG

COUNTS PER SECOND

0 20 40 60

0

Feet

-25

CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/23/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 2
SOUTHSIDE LANDFILL

DWG DATE: 12/10/96 DWG NAME: 94G0211

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

EnSafe/Allen & Hoshall

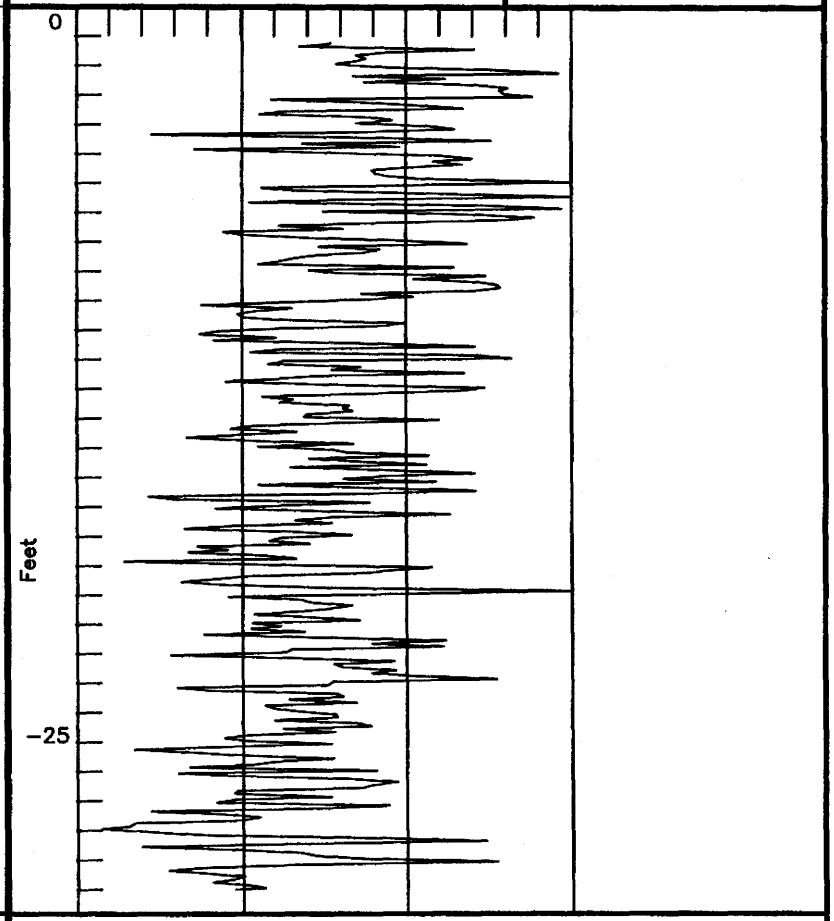
Monitoring Well 002G13DA

Project: NSA Memphis	Location: Millington,TN.SWMU#2–Southside Landfill
Project No.: 106–08420	Surface Elevation: 267.05 feet msl
Started at 1110 on 1–19–96	TOC Elevation: 269.12 feet msl
Completed at 1130 on 1–20–96	Depth to Groundwater:5.36 feet Measured: 4/8/96
Drilling Method: 4 1/4" ID Hollow–Stem Auger, 5' Flights	Groundwater Elevation:263.76 feet msl
Drilling Company: Alliance Drilling	Total Depth: 67.0 feet
Geologist: D. Ladd, J. Kingsbury, A. Choate	Well Screen: 55 to 65 feet

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft–msl)
	1	46	BG	OL	(0–34') Upper Alluvium (see descriptions below).	
	2	83	BG	CL ML	Clay and silt, dark yellowish–brown, moist, with organic material and roots.	265
5	3	88	3		Silty clay/clayey silt, greenish–gray and moderate yellowish–brown, slightly moist, soft to slightly firm, with some dark iron staining.	263
	4	79	2.5		Clayey silt, greenish–gray and moderate yellowish–brown, with iron/ manganese inclusions and organic material, slightly moist.	
	5	100	2		Iron–manganese nodules increasing in percentage and size (up to .5" in diameter).	
10	6	108	BG		Some staining with a dark yellowish–orange material.	
	7	108	BG	ML	Increase in clay percentage.	
	8	108	BG		Clayey silt, light olive gray color stained light brown to dark yellowish–orange. Moisture content increasing as iron/manganese nodules decrease in percentage.	
15	9	108	BG		Very moist at 14' becoming less moist near 16', rare iron/manganese nodules.	
	10	100	BG		Clayey silt, medium gray to light olive gray stained light brown to dark yellowish–orange, very moist.	248
20	11	92	BG		Silty clay, medium light to medium gray, wet.	
	12	100	BG		Dark greenish–gray to grayish–olive green color, wet.	
	13	96	BG	CL	Very moist.	
25	14	98	BG		Light olive gray to grayish–olive green color. Very moist and soft.	
	15	98	BG	ML	Clayey silt, light olive gray to grayish–olive green color, slightly moist, soft.	239
30						

WELL DIAGRAM: 2" ID, Sch. 40 PVC Casing

GAMMA RAY LOG
COUNTS PER SECOND



CASING TYPE: 2" PVC
TOP OF LOG = GROUND SURFACE
DATE LOGGED: 05/23/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 2
SOUTHSIDE LANDFILL

DWG DATE: 12/10/96 | DWG NAME: 94GL213

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

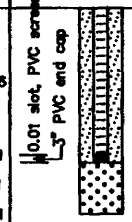
EnSafe/Allen & Hoshall

Monitoring Well 002G13DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2–Southside Landfill*
Project No.: *106–08420*	Surface Elevation: *267.05 feet msl*
Started at *1110 on 1–19–96*	TOC Elevation: *269.12 feet msl*
Completed at *1130 on 1–20–96*	Depth to Groundwater: *5.36 feet* Measured: *1/8/96*
Drilling Method: *4 1/4" ID Hollow–Stem Auger, 6" Flights*	Groundwater Elevation: *263.76 feet msl*
Drilling Company: *Alliance Drilling*	Total Depth: *67.0 feet*
Geologist: *D. Ladd, J. Kingsbury, A. Choate*	Well Screen: *55 to 65 feet*

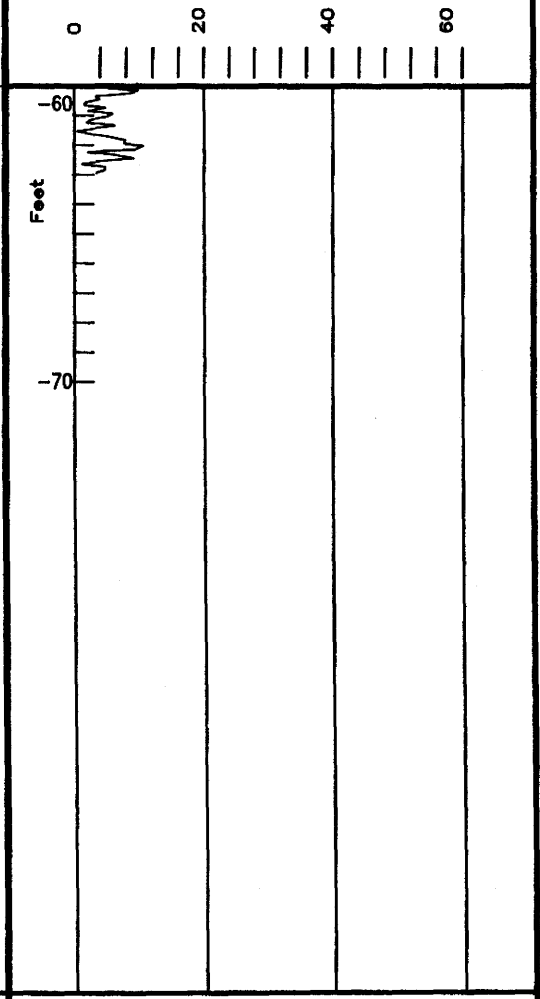
DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft–msl)
			24	141	BG		SW GW	Sand and gravel, moderate yellowish–brown to dark yellowish–brown color.	206
								Color change to dusky yellow brown. Wet.	204.6
								No sample collected from 62.5' to 65'.	
65			25	100	BG		SW GW SP	Fine to coarse–grained sand and gravel, olive–gray to light olive gray. Fining downward and turning dark yellowish–orange to light brown in color near 65.5'.	202.1 201.1 200.1
								Cockfield Formation: Sand, fine–grained, dark yellowish–orange to light brown, wet. Terminated soil boring at 67'.	
70									
75									
80									
85									
90									

WELL DIAGRAM



GAMMA RAY LOG

COUNTS PER SECOND



CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/23/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 2
SOUTHSIDE LANDFILL

DWG DATE: 10/31/96

DWG NAME: 94GL213B

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

GEOLOGICAL LOGGING SYSTEMS

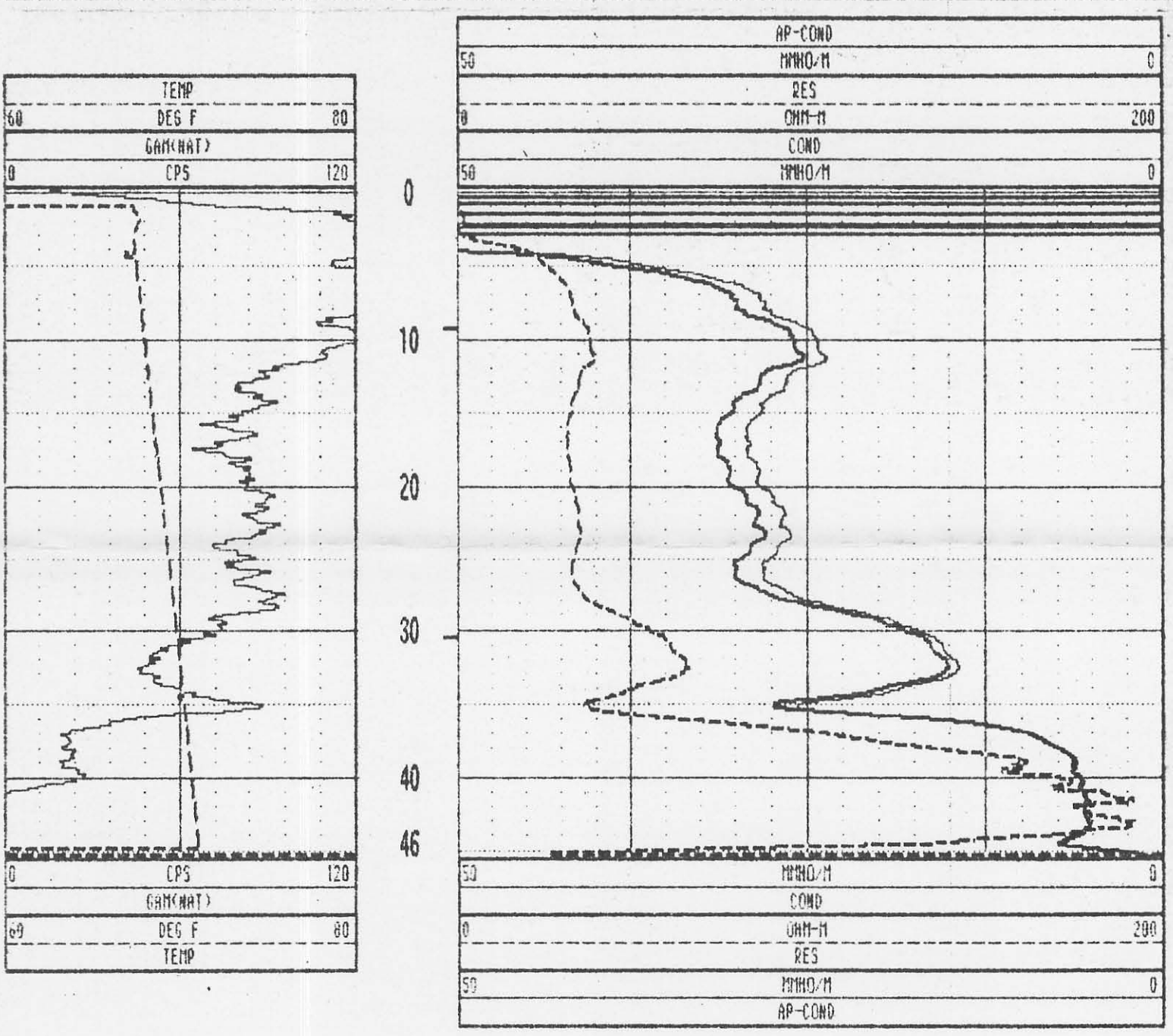
002G03DA

COMPANY	: ENSAFE,ALLEN & HOSHALL			OTHER SERVICES:	
WELL	: 002G03DA			9511	
LOCATION/FIELD	: NAS MEMPHIS			RUN ONE	
COUNTY	: SHELBY			OPEN	
STATE	: TENNESSEE				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 05/22/96	PERMANENT DATUM	: GL	ELEVATIONS	
DEPTH DRILLER	: 48	ELEV. PERM. DATUM	:	KB	:
LOG BOTTOM	: 45.50	LOG MEASURED FROM	: GL	DF	: -
LOG TOP	: -3.40	DRL MEASURED FROM	: GL	GL	: 267.2
CASING DRILLER	: 48	LOGGING UNIT	: 05		
CASING TYPE	: PVC	FIELD OFFICE	: BLUEFIELD		
CASING THICKNESS	: .25	RECORDED BY	: J T GILBERT		
BIT SIZE	: 8	BOREHOLE FLUID	: WATER	FILE	: ORIGIN
MAGNETIC DECL.	: -	RM	:	TYPE	: 9511C
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:	LOG	: 6
FLUID DENSITY	: 1.2	MATRIX DELTA T	:	PLOT	: 9510C
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:	THRESH	: 9000

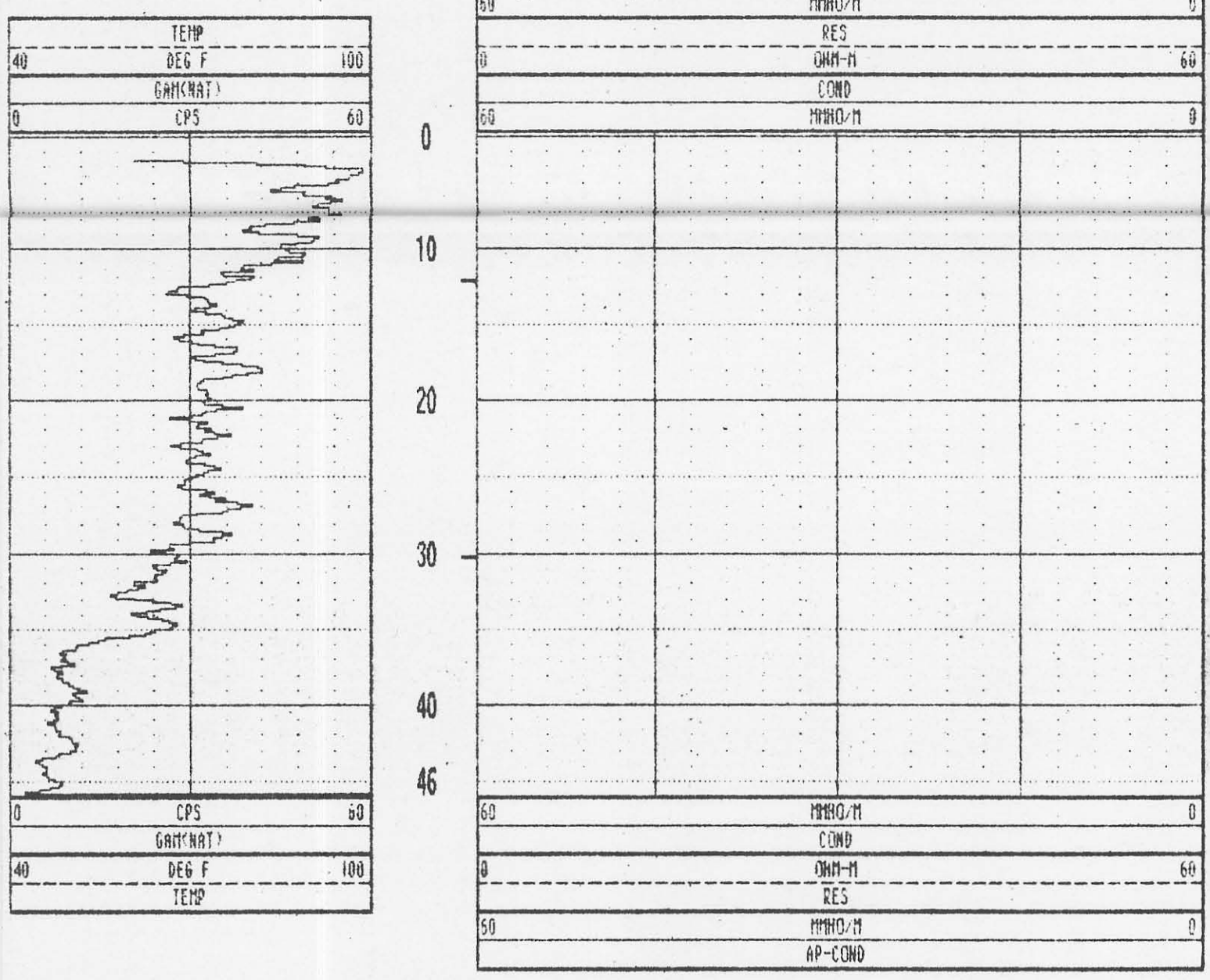
REMARKS :

ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



002G03DA 05/22/96 976



002G03DA 05/22/96 1025

GEOLOGICAL LOGGING SYSTEMS

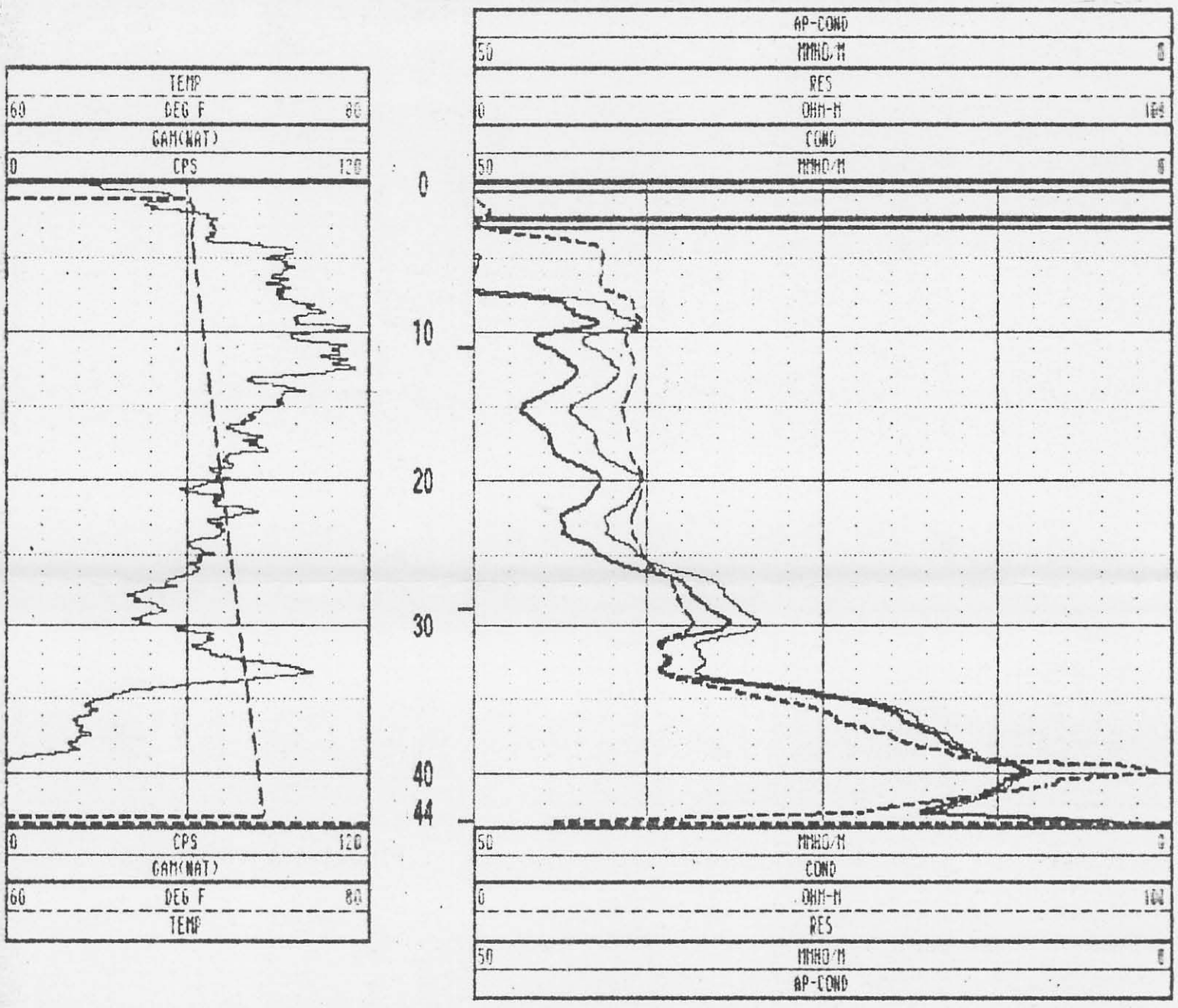
002G09DA

COMPANY	: ENSAFE,ALLEN & HOSHALL			OTHER SERVICES:	
WELL	: 002G09DA			9511	
LOCATION/FIELD	: NAS MEMPHIS			RUN ONE	
COUNTY	: SHELBY			OPEN	
STATE	: TENNESSEE				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 05/22/96	PERMANENT DATUM	: GL	ELEVATIONS	
DEPTH DRILLER	: 46	ELEV. PERM. DATUM:		KB	:
LOG BOTTOM	: 43.60	LOG MEASURED FROM:	GL	DF	: -
LOG TOP	: -3.30	DRL MEASURED FROM:	GL	GL	: 265.5
CASING DRILLER	: 46	LOGGING UNIT	: 05		
CASING TYPE	: PVC	FIELD OFFICE	: BLUEFIELD		
CASING THICKNESS	: .25	RECORDED BY	: J T GILBERT		
BIT SIZE	: 8	BOREHOLE FLUID	: WATER	FILE	: ORIGIN
MAGNETIC DECL.	: -	RM	:	TYPE	: 9511C
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:	LOG	: 4
FLUID DENSITY	: 1.2	MATRIX DELTA T	:	PLOT	: 9510C
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:	THRESH	: 9000

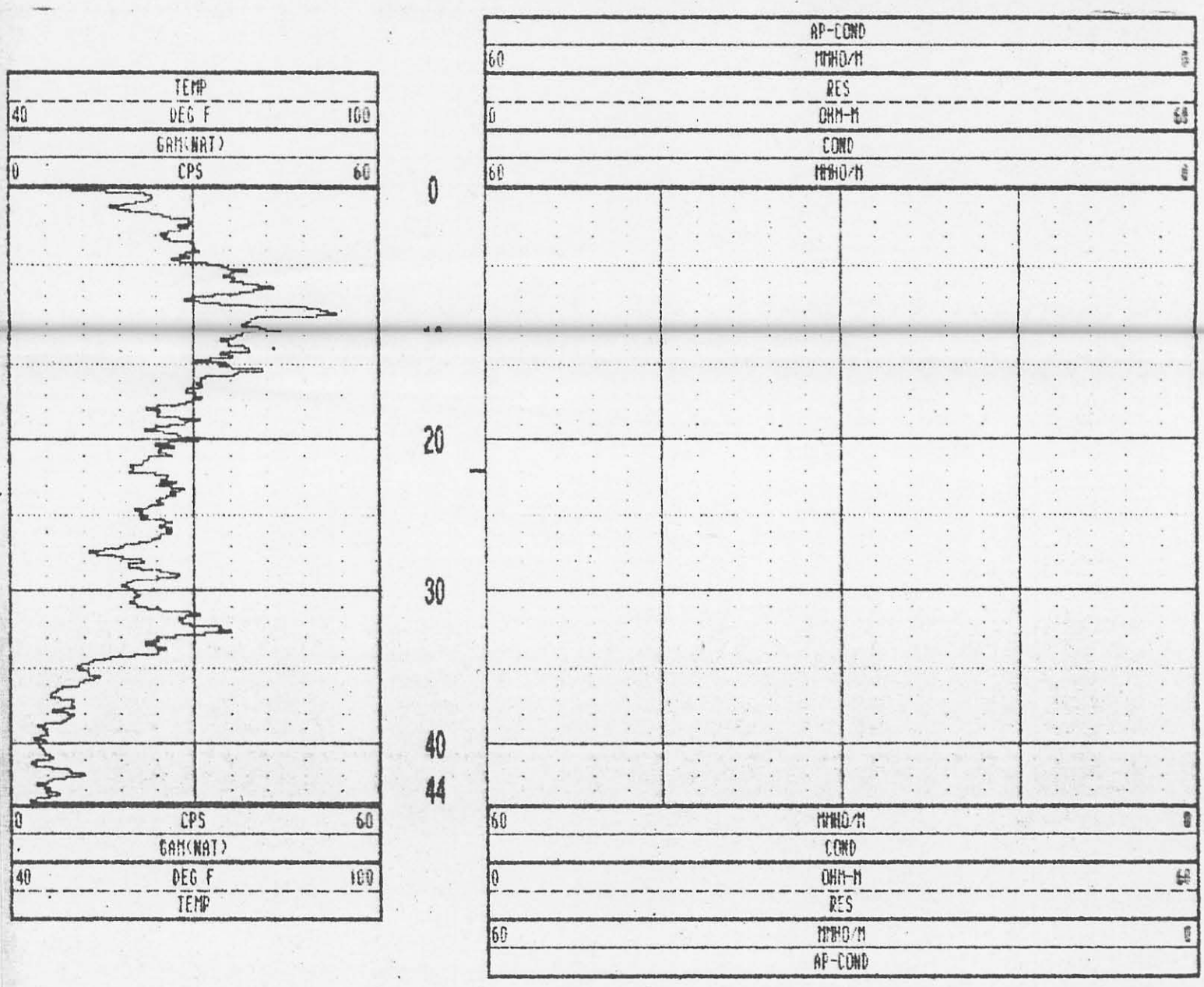
REMARKS :

ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



002G09DA 05/22/96 976



002G09DA 05/22/96 1025

GEOLOGICAL LOGGING SYSTEMS

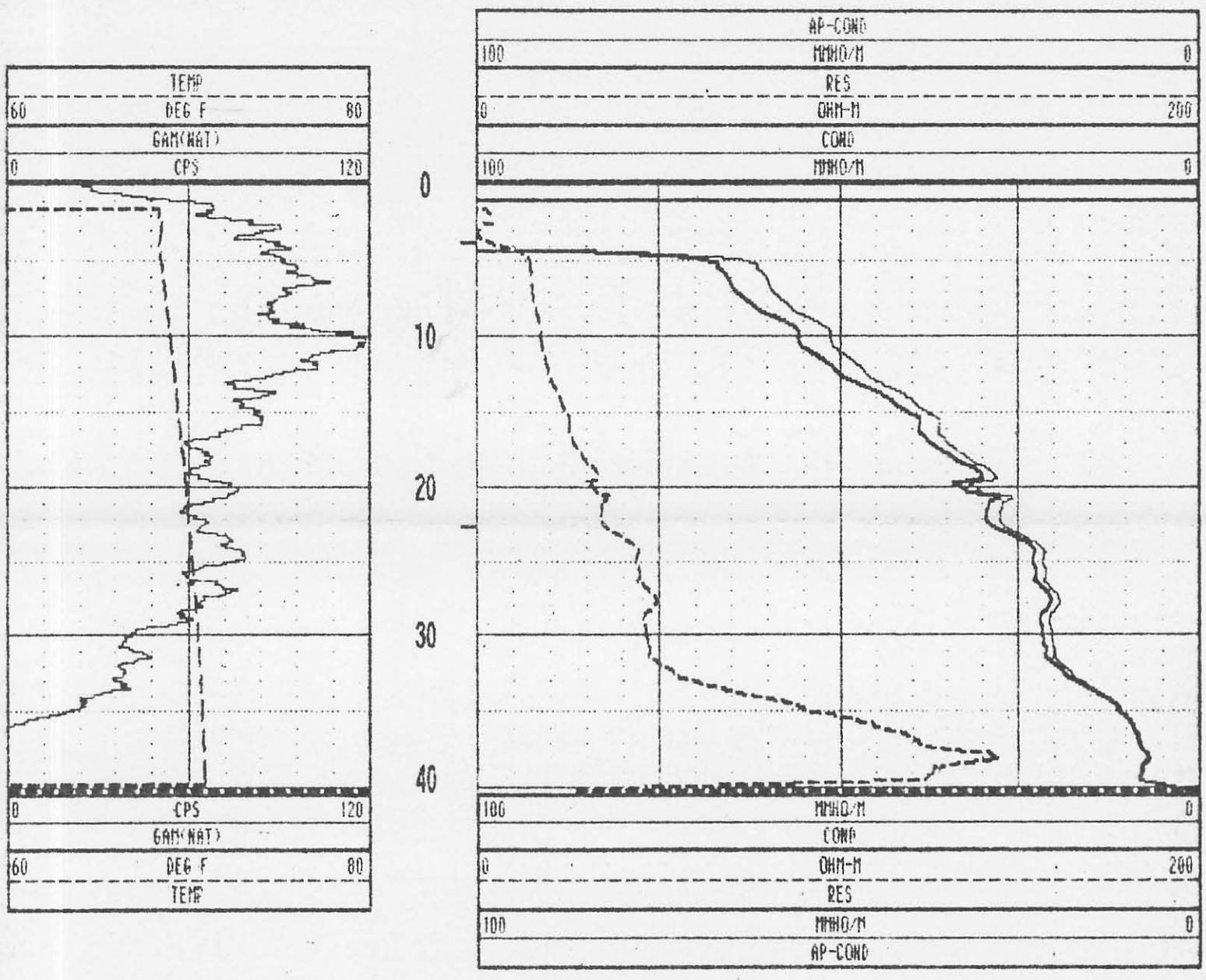
002G11DA

COMPANY	: ENSAFE,ALLEN & HOSHALL			OTHER SERVICES:	
WELL	: 002G11DA			9511	
LOCATION/FIELD	: NAS MEMPHIS			RUN ONE	
COUNTY	: SHELBY			OPEN	
STATE	: TENNESSEE				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 05/22/96	PERMANENT DATUM	: GL	ELEVATIONS	
DEPTH DRILLER	: 42.2	ELEV. PERM. DATUM	:	KB	:
LOG BOTTOM	: 40.40	LOG MEASURED FROM	: GL	DF	: -
LOG TOP	: -2.80	DRL MEASURED FROM	: GL	GL	: 265.2
CASING DRILLER	: 42	LOGGING UNIT	: 05		
CASING TYPE	: PVC	FIELD OFFICE	: BLUEFIELD		
CASING THICKNESS	: .25	RECORDED BY	: J T GILBERT		
BIT SIZE	: 8	BOREHOLE FLUID	: WATER	FILE	: ORIGIN
MAGNETIC DECL.	: -	RM	:	TYPE	: 9511C
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:	LOG	: 0
FLUID DENSITY	: 1.2	MATRIX DELTA T	:	PLOT	: 9510C
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:	THRESH	: 9000

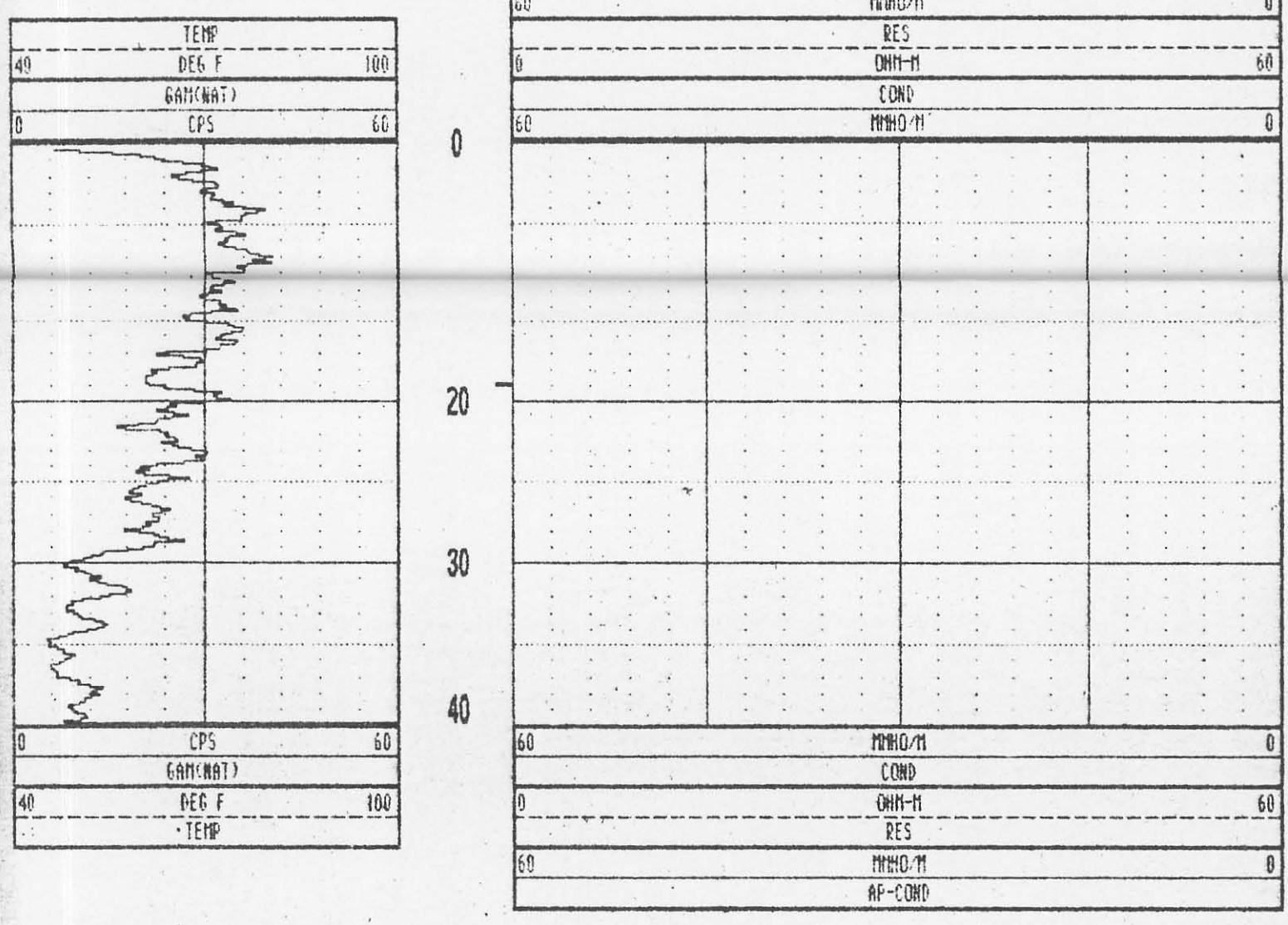
REMARKS :

ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



002G11DA 05/22/96 976



002G11DA 05/22/96 1025

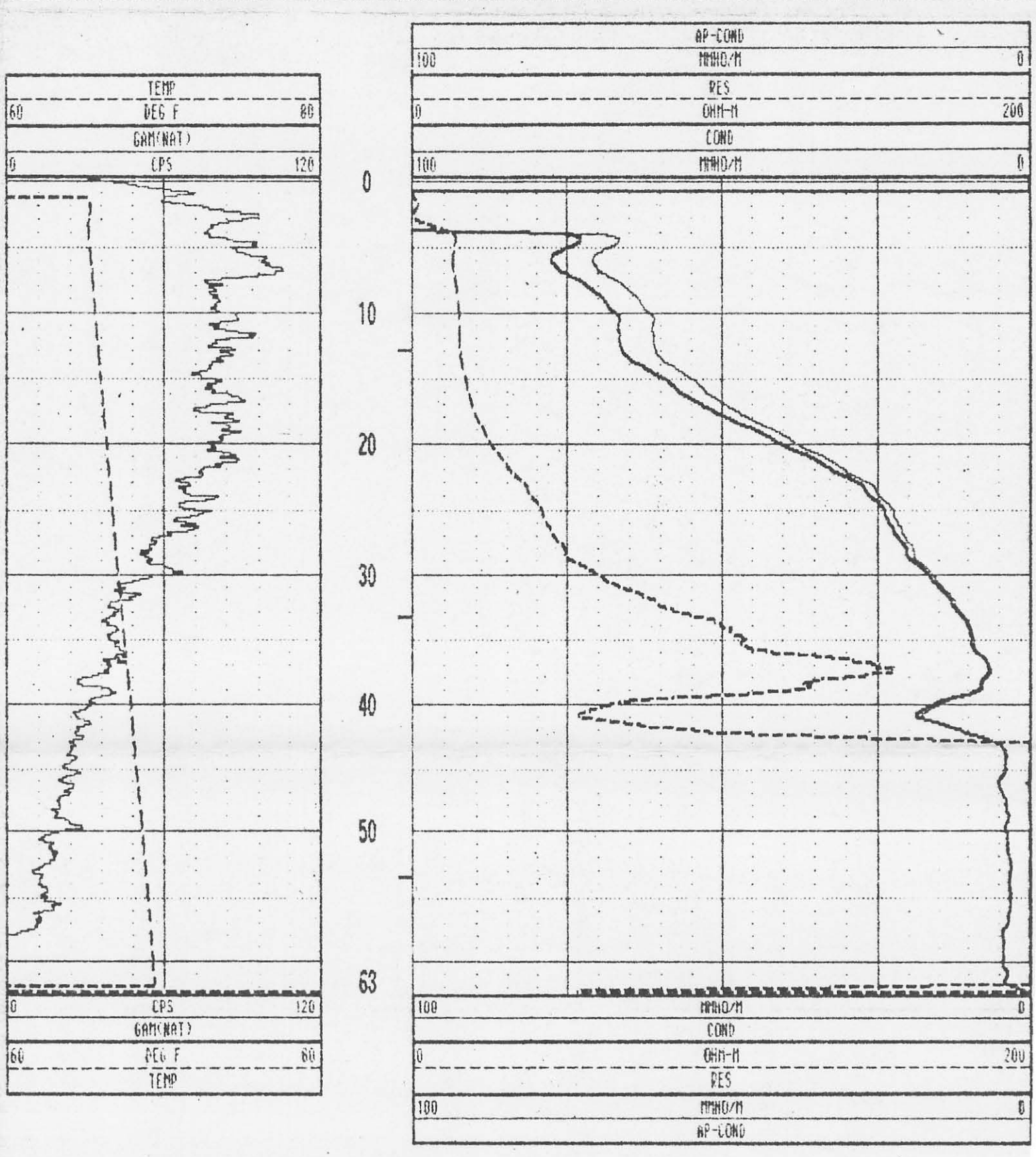
GEOLOGICAL LOGGING SYSTEMS

002G13DA

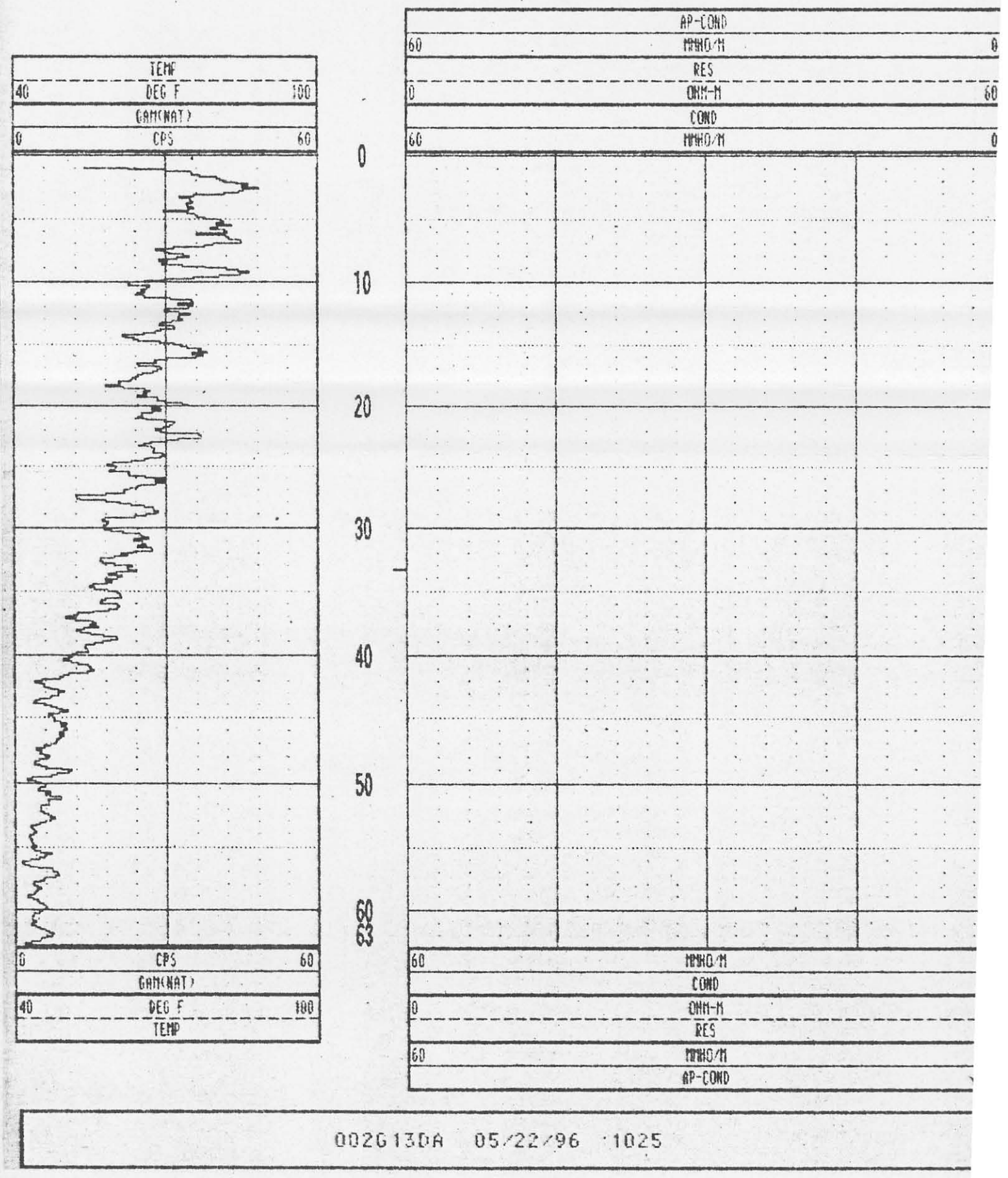
COMPANY	: ENSAFE,ALLEN & HOSHALL				
WELL	: 002G13DA				
LOCATION/FIELD	: NAS MEMPHIS				
COUNTY	: SHELBY				
STATE	: TENNESSEE				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 05/22/96	PERMANENT DATUM	: GL	ELEVATIONS	
DEPTH DRILLER	: 65	ELEV. PERM. DATUM	:	KB	:
LOG BOTTOM	: 62.60	LOG MEASURED FROM	: GL	DF	: -
LOG TOP	: -2.90	DRL MEASURED FROM	: GL	GL	: 267.0
CASING DRILLER	: 65	LOGGING UNIT	: 05		
CASING TYPE	: PVC	FIELD OFFICE	: BLUEFIELD		
CASING THICKNESS	: .25	RECORDED BY	: J T GILBERT		
BIT SIZE	: 8	BOREHOLE FLUID	: WATER	FILE	: ORIGIN
MAGNETIC DECL.	: -	RM	:	TYPE	: 9511C
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:	LOG	: 8
FLUID DENSITY	: 1.2	MATRIX DELTA T	:	PLOT	: 9510C
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:	THRESH	: 9000

OTHER SERVICES:
9511
RUN ONE
OPEN

REMARKS :
ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.
ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



002G13DA 05/22/96 976



002G13DA 05/22/96 1025

TRI STATE
TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 02/28/96 Project No.: E-3-157

Client's Project No.: 0106090000

Sample I.D.: 002S002919

Soil Description: Light Gray Clayey Silt

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	123.9	121.3
Dry Density (Lbs/ft^3)	95.7	96.0
Moisture (% Dry Wt)	29.5	26.4
Porosity (n)	.41	.40
Degree of Saturation (%)	1.0	1.0
Specific Gravity (ASTM D-854)	2.58	---

Permeability

Temperature Correction, $R_t = 1.024$

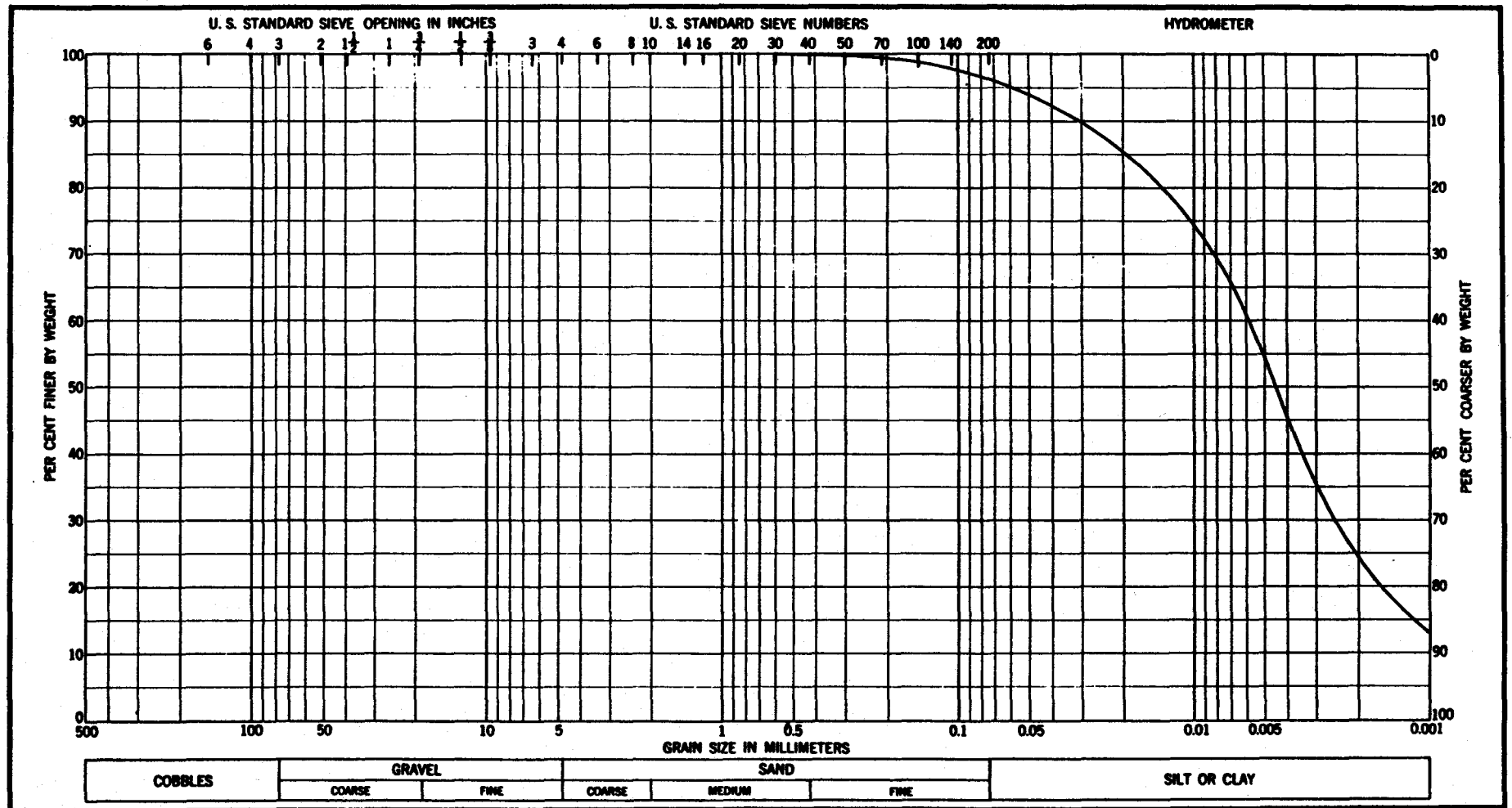
$K_1 = 6.6 \times 10^{-7}$ cm/sec
$K_2 = 6.3 \times 10^{-7}$ cm/sec
$K_3 = 6.9 \times 10^{-7}$ cm/sec
$K_4 = 6.4 \times 10^{-7}$ cm/sec

Coefficient of Permeability, $K_{20} = 6.8 \times 10^{-7}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-010 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 FAX 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
002 S0029 19			30			

GRADATION CURVES

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 02/28/96

TRI STATE
TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 02/26/96 **Project No.:** E-3-157

Client's Project No.: 0106090000

Sample I.D.: 002S003019

Soil Description: Light Gray Clayey Silt

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	119.1	119.4
Dry Density (Lbs/ft^3)	95.4	88.2
Moisture (% Dry Wt)	24.8	35.3
Porosity (n)	.42	.46
Degree of Saturation (%)	.91	1.0
Specific Gravity (ASTM D-854)	2.62	---

Permeability

Temperature Correction, $R_t = 1.009$

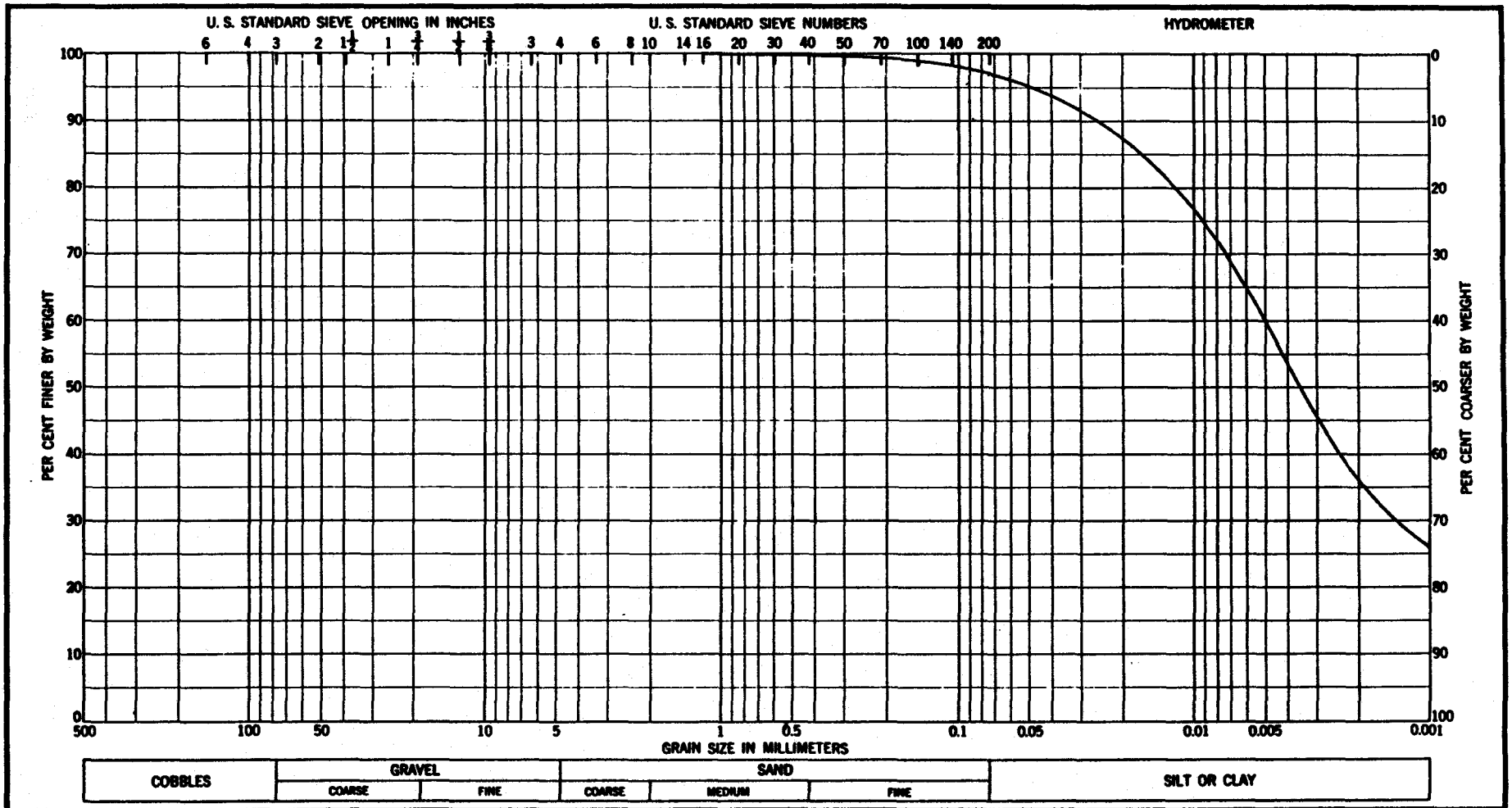
$K_1 = 3.3 \times 10^{-6}$ cm/sec
$K_2 = 1.1 \times 10^{-6}$ cm/sec
$K_3 = 2.3 \times 10^{-6}$ cm/sec
$K_4 = 2.4 \times 10^{-6}$ cm/sec

Coefficient of Permeability, $K_{20} = 2.3 \times 10^{-6}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-007 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 FAX 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
002S003019			25			

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 02/26/96

GRADATION CURVES

TRI STATE
TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 02/26/96 **Project No.:** E-3-157

Client's Project No.: 0106090000

Sample I.D.: 002S003043

Soil Description: Coarse Sand with gravel & some clay

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	123.5	126.6
Dry Density (Lbs/ft^3)	112.1	110.4
Moisture (% Dry Wt)	10.2	14.7
Porosity (n)	.33	.34
Degree of Saturation (%)	.55	.96
Specific Gravity (ASTM D-854)	2.69	---

Permeability

Temperature Correction, $R_t = 1.056$

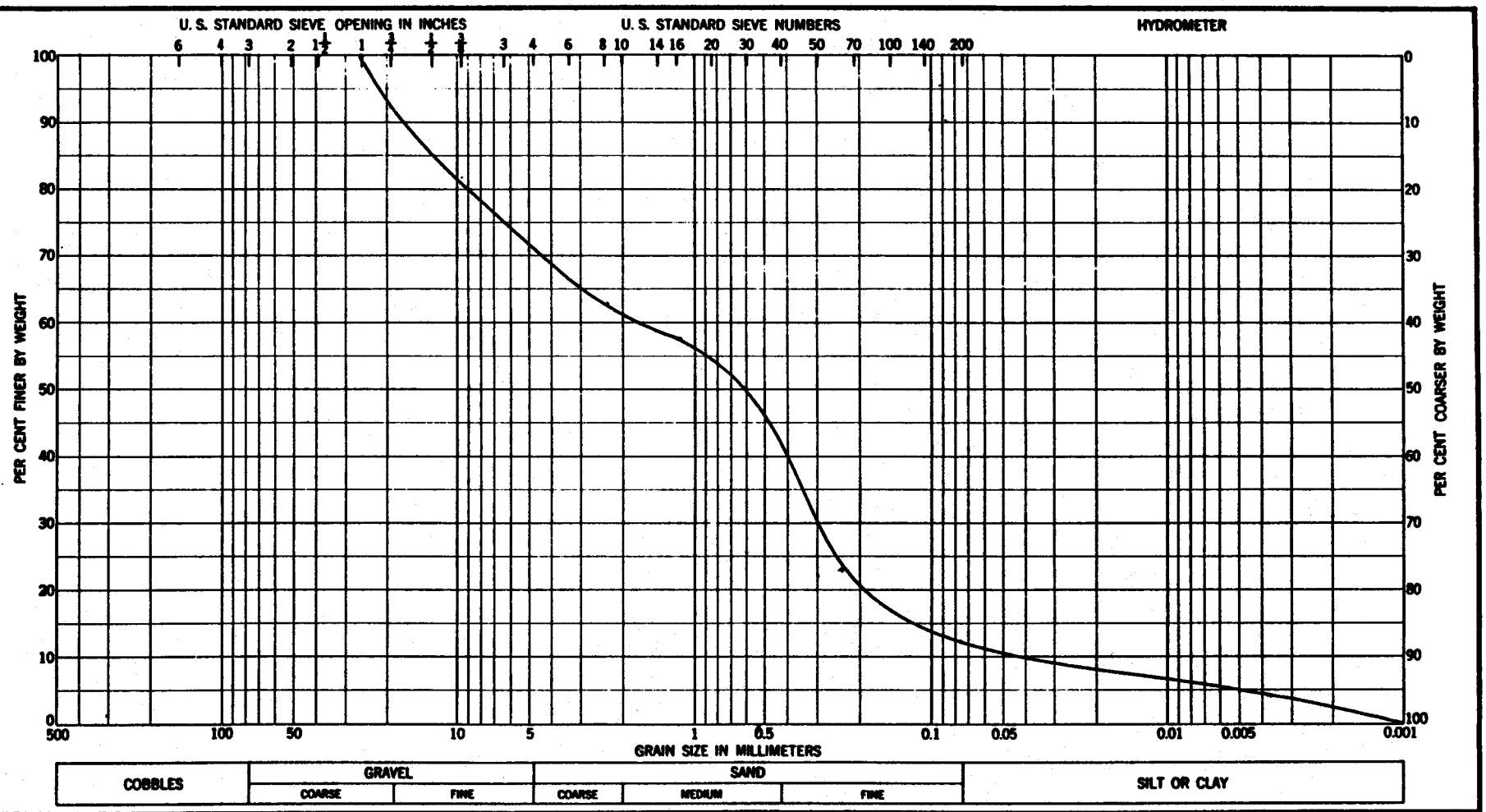
$K_1 = 1.4 \times 10^{-4}$ cm/sec
$K_2 = 3.4 \times 10^{-4}$ cm/sec
$K_3 = 4.2 \times 10^{-4}$ cm/sec
$K_4 = 3.8 \times 10^{-4}$ cm/sec

Coefficient of Permeability, $K_{20} = 3.4 \times 10^{-4}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-008 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 FAX 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
002S003048			10			

GRADATION CURVES

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 02/26/96

TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 02/27/96 **Project No.:** E-3-157

Client's Project No.: 0106090000

Sample I.D.: 002S03DA43

Soil Description: Clean Sand with some small gravel

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	127.6	130.4
Dry Density (Lbs/ft^3)	115.3	115.9
Moisture (% Dry Wt)	10.7	12.5
Porosity (n)	.29	.30
Degree of Saturation (%)	.79	1.0
Specific Gravity (ASTM D-854)	2.68	---

Permeability

Temperature Correction, $R_t = 1.031$

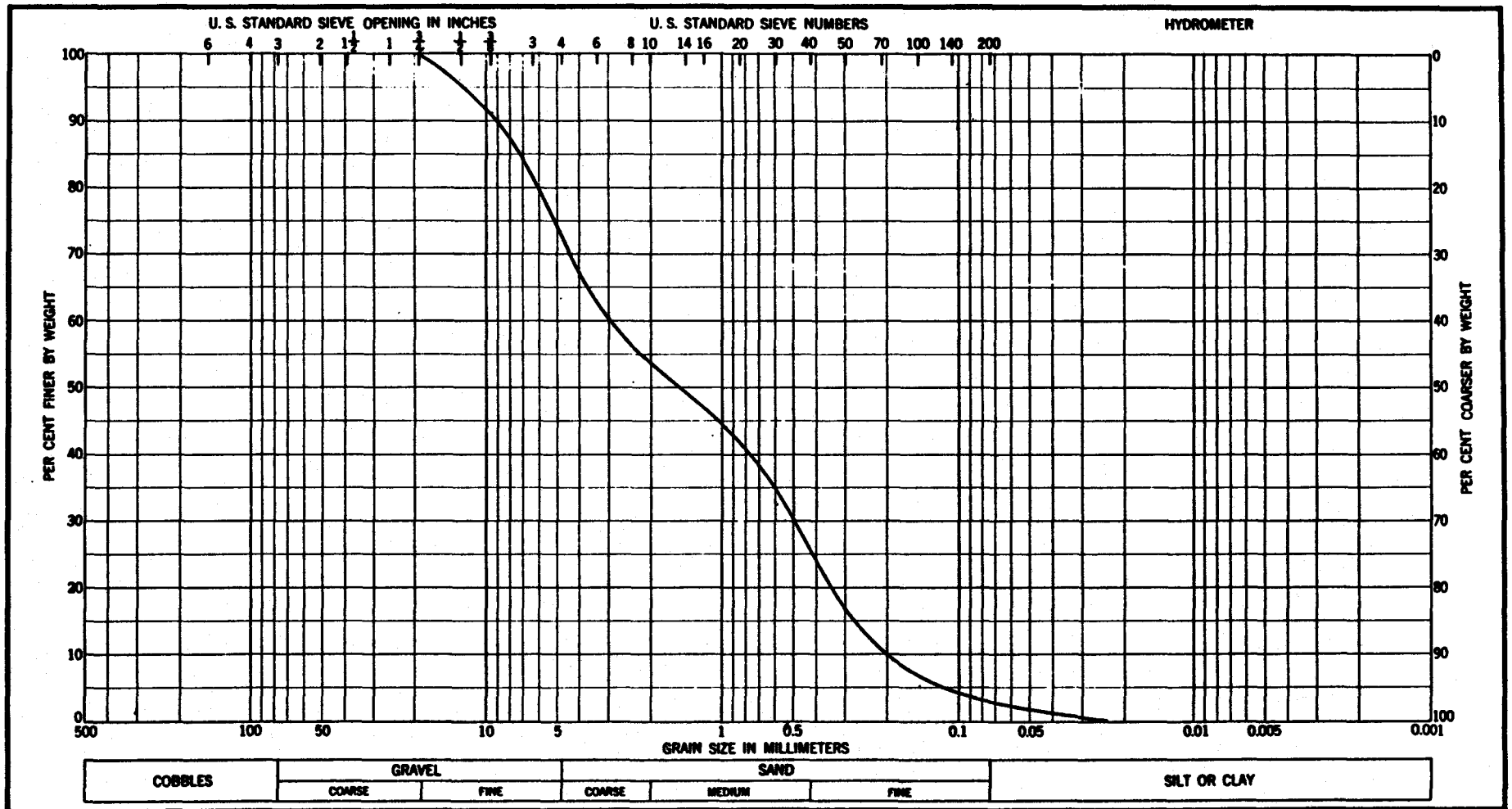
$K_1 = 8.6 \times 10^{-4}$ cm/sec
$K_2 = 8.4 \times 10^{-4}$ cm/sec
$K_3 = 8.7 \times 10^{-4}$ cm/sec
$K_4 = 8.2 \times 10^{-4}$ cm/sec

Coefficient of Permeability, $K_{20} = 8.6 \times 10^{-4}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-009 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 FAX 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
002S03DA43			11			

GRADATION CURVES

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 02/27/97

SWMU 9

SOIL BORING/MONITORING WELL LOGS
AND
GEOTECHNICAL LABORATORY RESULTS

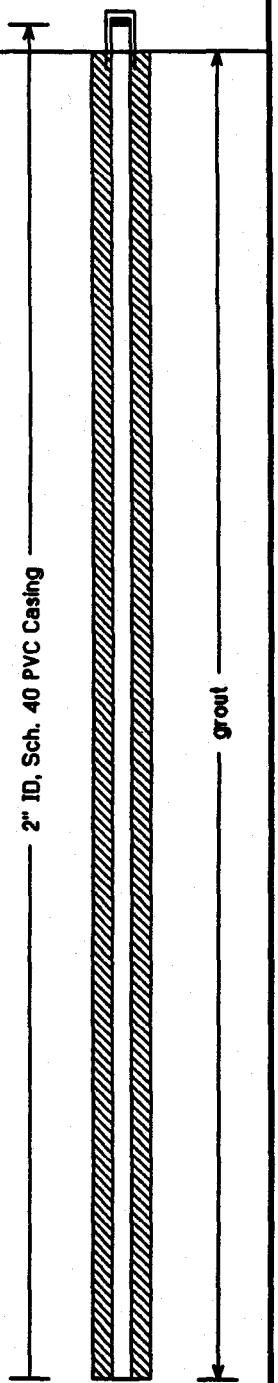
EnSafe/Allen & Hoshall

Monitoring Well 009G01DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #9 (Sewage Lagoons)*
Project No.: *0106-22111*	Surface Elevation: *269.69 feet msl*
Started at *1230 on 2-15-96*	TOC Elevation: *271.62 feet msl*
Completed at *1500 on 2-15-96*	Depth to Groundwater: *19.87 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *251.75 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *66 feet*
Geologist: *J.A. Kingsbury*	Well Screen: *46 to 56 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0					BG			(0-39') Upper Alluvium (see descriptions below).	
			1	50	BG		ML CL	(0-6') Silt and clay, brown to dark yellowish-brown in color with some organic material.	
5					BG				
					BG				263.7
					BG			(6-39') Silt (see descriptions below).	
					BG			(6-16) Medium brown in color, with some iron, organic material and dark orangish-yellow staining, moist.	
10			2	40	BG				
					BG				
15					BG				
					BG			Shelby Tube sample collected from 16-18' for geotechnical analysis. (18-24') Mottled yellowish-brown and yellowish-gray in color with dark orangish-yellow to reddish-brown iron staining.	
					BG				
20			3	70	BG				
					BG		ML		
25					BG			(24-26') Light olive gray to greenish-gray in color. Wet.	
					BG			(26-29') Greenish-gray in color.	
					BG			(29-39') Sandy silt with common snail shells. Greenish-gray to olive gray in color between 29' and 34'.	
30			4	90	BG				
					BG			Brownish-gray in color between 34' and 39'. Some snail shells present.	
35					BG				
					BG				
					BG		SP	(39-56') Deeper Alluvium (see descriptions below).	230.7
40									

WELL DIAGRAM



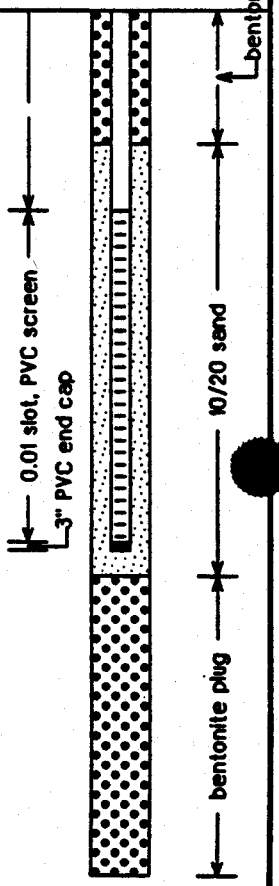
EnSafe/Allen & Hoshall

Monitoring Well 009G01DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #9 (Sewage Lagoons)*
Project No.: *0106-22111*	Surface Elevation: *269.69 feet msl*
Started at *1230 on 2-15-96*	TOC Elevation: *271.62 feet msl*
Completed at *1500 on 2-15-96*	Depth to Groundwater: *19.87 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *251.75 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *66 feet*
Geologist: *J.A. Kingsbury*	Well Screen: *46 to 56 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			5	90	BG		SP	(39-42') Coarse-grained sand, light olive gray in color.	227.7
					BG		GW	(42-42.5') Gravel lense.	227.2
							SP	(42.5-43') Coarse-grained sand.	226.7
45					BG		ML	(43-45') Silt, very light gray to moderate gray in color.	224.7
					BG		SW	(45-48') Sand with some gravel, yellowish-gray in color.	221.7
50			6	70	BG		SW GW	(48-56') Sand and gravel. Gravel is up to 3" in longest dimension. Dusky yellow to yellowish-gray in color.	
55					BG				
					BG			Cockfield Formation: Fine-grained sand, light olive gray, finely lignitic and micaceous.	213.7
60			7	90	BG		SP		
					BG				
65					BG			Terminated soil boring at 66'.	203.7
70									
75									
80									

WELL DIAGRAM



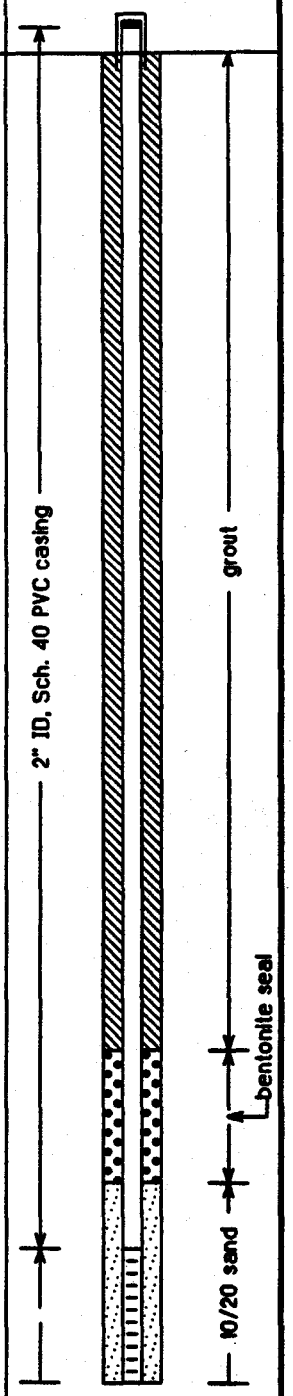
EnSafe/Allen & Hoshall

Monitoring Well 009G02DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #9 (Sewage Lagoons)*
Project No.: *0106-22111*	Surface Elevation: *268.85 feet msl*
Started at *0930 on 2-16-96*	TOC Elevation: *270.80 feet msl*
Completed at *1100 on 2-16-96*	Depth to Groundwater: *11.65 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *259.15 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56 feet*
Geologist: *J.A. Kingsbury*	Well Screen: *36 to 46 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0					BG			(0-40') Upper Alluvium (see descriptions below).	
			1	83	BG			(0-4') Fill material. Silt, moderate brown in color with some iron-staining. Wood fragments that appear to be burnt.	
5					BG			(4-40') Silt (see descriptions below).	
					BG			(4-6') Light olive gray to light brown in color. Dry.	
					BG			Clayey silt. Moderate yellowish-brown to light gray in color, mottled with some dark orangish-yellow-colored material. Moist. Organic material present from 6' to 18'.	
10			2	80	BG				
					BG				
					BG			Increased iron staining from 15' to 16'.	
15					BG				
					BG			Silt, greenish-gray to olive gray in color from 18' to 28'. Wet, with snail shells throughout.	
20			3	70	BG		ML		
					BG				
25					BG				
					BG			Color change to brownish-gray. Thin sand lenses, occasionally as thick as 6", are present from 28' to 40'.	
30			4	90	BG				
					BG				
35					BG			Shelby Tube collected from 36-38'.	
					BG				
40					BG		SP		228.9

WELL DIAGRAM



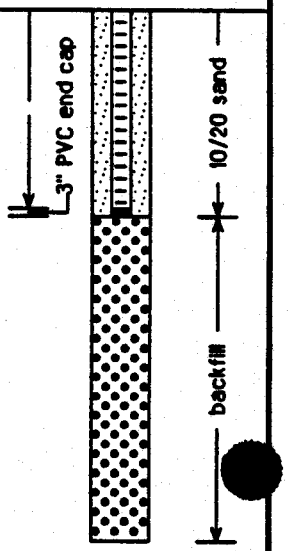
EnSafe/Allen & Hoshall

Monitoring Well 009G02DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #9 (Sewage Lagoons)*
Project No.: *0106-2211*	Surface Elevation: *268.85 feet msl*
Started at *0930 on 2-16-96*	TOC Elevation: *270.80 feet msl*
Completed at *1100 on 2-16-96*	Depth to Groundwater: *11.65 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *259.15 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56 feet*
Geologist: *J.A. Kingsbury*	Well Screen: *36 to 46 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			5	100	BG		SP	(40-46.5') Deeper Alluvium (see descriptions below). (40-46') Coarse-grained sand, yellowish-gray to dusky yellow. Some gravel (< 1" in longest dimension) is present from 45' to 46.5.	223.0
45					BG				
					BG				222.9
					BG		SM	(46-46.5') Silt and sand, olive-gray in color.	222.4
					BG		CL	Cockfield Formation: Clay, dark brown in color, hard. Fine-grained sand streaks are present from 46.5' to 56'.	
50			6	110	BG				
					BG		SC	The percentage of sand increases to greater than 50 percent from 52' to 56'.	216.9
55					BG				212.9
								Soil boring terminated at 56'.	
60									
65									
70									
75									
80									

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 009G03DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #9 (Sewage Lagoons)*
Project No.: *0106-08420*	Surface Elevation: *267.18 feet msl*
Started at *1300 on 1-31-96*	TOC Elevation: *269.05 feet msl*
Completed at *1200 on 2-1-96*	Depth to Groundwater: *15.79 feet* Measured: *4/8/96*
Drilling Method: *Hollow-Stem Auger/3" diameter split spoon*	Groundwater Elevation: *253.26 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *62 feet*
Geologist: *J.A. Kingsbury*	Well Screen: *45 to 55 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			1	75	BG		ML	(0-34') Upper Alluvium (see descriptions below). (0-2') Clayey silt. Light brown to light yellowish-brown and brownish- orange in color.	
			2	92	BG				
5			3	67	BG		ML CL	(2-4') Silt, light brown in color. Some debris with burnt wood are also present. Appears to be fill.	263.2
			4	83	BG			(4-6') Silt and clay, light gray to moderate gray color with black plant debris. Organic odor.	
			5	96	BG			From 6' to 10', silt and clay is light gray to greenish-gray in color with moderate brown specks of material. Slightly moist from 6' to 8', and moist from 8' to 10'.	
10			6	79	BG				257.2
			7	71	BG		ML	(10-14') Silt, greenish-gray to light gray/brown color. Moist.	
			8	92	BG			(14-34') Silt and clay, greenish-gray in color. Moist. Prevalent iron staining from 16' to 20'.	253.2
15			9	71	BG				
			10	100	BG			Abundant organic debris from 18' to 19'.	
20			11	71	BG			Greenish-gray to olive gray in color from 20' to 22'.	
			12	83	BG		ML CL	Light olive gray to light greenish-gray from 22' to 34'. Moist. Some organic specks of material present.	
25			13	67	BG				
			14	83	BG				
			15	100	BG				
30			16	92	BG				
			17	100	BG			With minor amount of sand near 34'.	
			18	83	BG		SW	Contact with Deeper Alluvium deposits estimated at 34'.	233.2
35									

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

bentonite grout

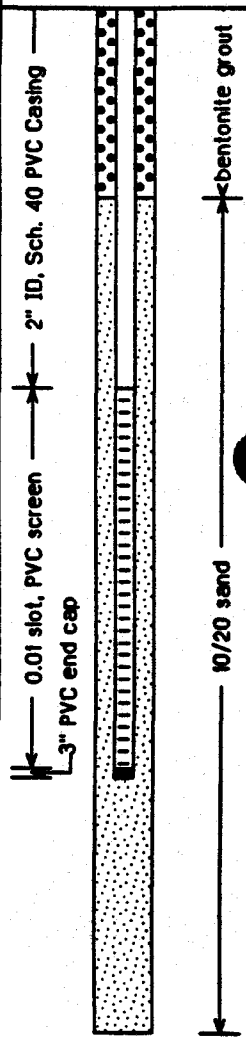
EnSafe/Allen & Hoshall

Monitoring Well 009G03DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #9 (Sewage Lagoons)*
Project No.: *0106-08420*	Surface Elevation: *267.18 feet msl*
Started at *1300 on 1-31-96*	TOC Elevation: *269.05 feet msl*
Completed at *1200 on 2-1-96*	Depth to Groundwater: *15.79 feet* Measured: *4/8/96*
Drilling Method: *Hollow-Stem Auger/3" diameter split spoon*	Groundwater Elevation: *253.26 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *62 feet*
Geologist: *J.A. Kingsbury*	Well Screen: *45 to 55 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
				SW	(34-37') Sand, fine to coarse-grained, medium olive gray in color. Some silt lenses present.	
	19	100	BG			230.2
				ML	(37-38') Silt, light olive gray.	229.2
	20	100	BG	SW	(38-39.5') Sand.	227.7
40				ML	(39.5-40') Silt.	227.2
	21	100	BG	SW	(40-42') Sand, fine to coarse-grained, light olive gray in color at 40' changing to yellowish brown/gray near 42'.	
	22	100	BG			225.2
				SW GW		224.2
	23	92	BG	SP	(42-43') Sand and gravel, light olive gray to yellowish-gray.	
45					(43-45') Coarse-grained sand, yellowish-gray.	222.2
	24	100	BG	SC GC	(45-49') Sand and gravel in a clay matrix. Yellow gravel, light gray clay.	
	25	100	BG			
					Sand and gravel with some clay, light olive gray to yellowish-gray in color.	218.2
50	26	100	BG	SW GW	(49-53') Sand and gravel. Yellowish-brown to reddish-brown.	
	27	100	BG			
						214.2
	28	0	BG		No sample recovery from 53' to 60'.	
55						
60				SP	Cockfield Formation: very fine-grained sand, light gray in color, finely lignitic.	207.2
	29	100	BG	ML		206.2
				CL	Silt and clay, light brown to light gray.	205.2
					Terminated soil boring at 62'.	
65						
70						

WELL DIAGRAM



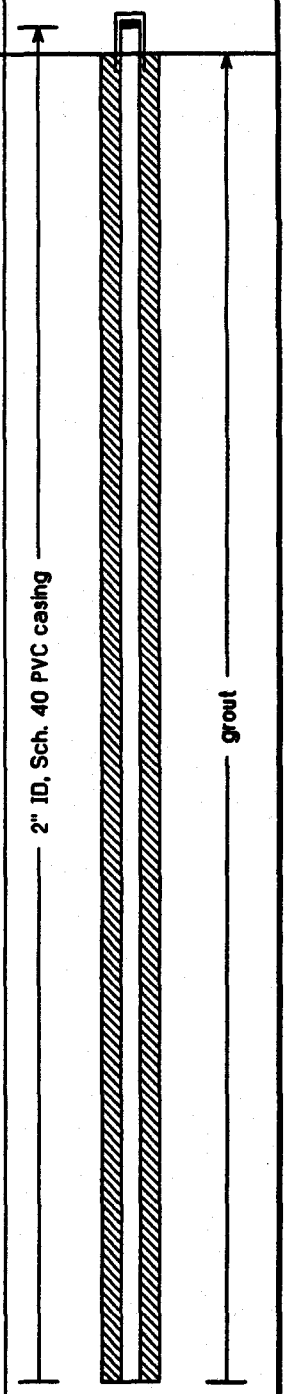
EnSafe/Allen & Hoshall

Monitoring Well 009G04DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #9 (Sewage Lagoons)*
Project No.: *0106-08420*	Surface Elevation: *268.15 feet msl*
Started at *0745 on 2-15-96*	TOC Elevation: *270.09 feet msl*
Completed at *1000 on 2-15-96*	Depth to Groundwater: *19.89 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *250.20 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *76 feet*
Geologist: *J.A. Kingsbury*	Well Screen: *62 to 72 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0					BG		ML	(0-41') Upper Alluvium (see descriptions below). (0-6') Clayey silt, brown in color. Appears to be fill material used during levee construction.	
5			1	50	BG				262.1
					BG		CL	Slightly silty clay, brownish-gray in color. Very stiff.	
10			2	85	BG			Increasing silt fraction. Mottling with olive gray-colored silt. Dark greenish-yellow staining is present with iron/organic specks.	
15					BG				252.1
					BG		ML	(16-42') Silt (see descriptions below). (16-22') Yellowish-brown to yellowish-gray in color with dark orangish-yellow staining. Moist to wet.	
20			3	100	BG			(22-26') Color change to predominantly gray. Wet.	
25					BG			(26-34') Olive gray to greenish-gray in color, with common snail shells. Wet.	
30			4	120	BG				
35					BG			Increasing clay fraction from 34' to 36'. Brownish-gray in color. (36-38') Brownish-gray in color, dry.	
40					BG			(38-42') Contains some scattered gravel and a few sand lenses. Contact with Deeper Alluvium deposits (41-72') estimated at 41'.	

WELL DIAGRAM



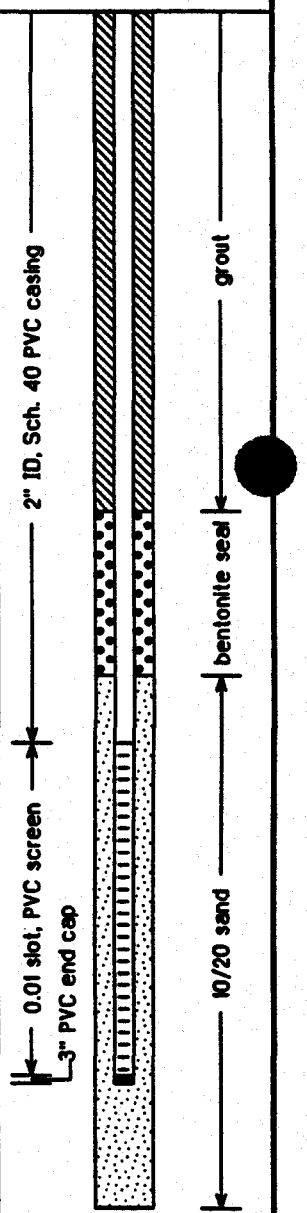
EnSafe/Allen & Hoshall

Monitoring Well 009G04DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #9 (Sewage Lagoons)*
Project No.: *0106-08420*	Surface Elevation: *268.15 feet msl*
Started at *0745 on 2-15-96*	TOC Elevation: *270.09 feet msl*
Completed at *1000 on 2-15-96*	Depth to Groundwater: *19.89 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *250.20 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *76 feet*
Geologist: *J.A. Kingsbury*	Well Screen: *62 to 72 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			5	60	BG		ML		
					BG				226.1
45					BG			(42-55') Sand and gravel; gravel is up to 2" in longest dimension. Yellowish-gray to light olive gray in color.	
					BG				
					BG			Minor clay fraction in sand and gravel from 46' to 52'. Yellowish- gray to very light gray in color.	
					BG		SW GW		
50			6	90	BG				
					BG			Sand and gravel, yellowish-gray to light yellowish-brown from 52' to 56'.	
					BG				213.1
55					BG		SM GC	Sand and gravel with intersitial silt and clay. Dark orangish-yellow to reddish-brown from 55' to 56'.	212.1
					BG			Sand and gravel with minor clay, gravel is up to 3" in longest dimension, dark yellowish-brown to reddish-brown from 56' to 72'.	
					BG				
60			7	90	BG				
					BG		SW GW		
65					BG				
					BG				
					BG				
70			8	80	BG				
					BG		SP	Cockfield Formation: Fine to medium-grained sand, very light gray to very light olive gray, micaceous and finely lignitic.	198.1
75					BG				192.1
								Soil boring terminated at 76'.	
80									

WELL DIAGRAM



EnSafe/Allen & Hoshall

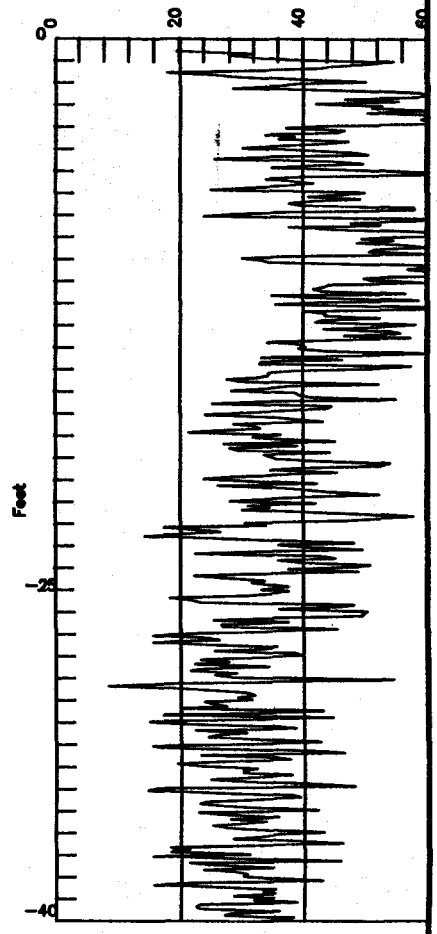
Monitoring Well 009G04DA

Project: NSA Memphis	Location: Millington, TN. SWMU #9 (Sewage Lagoons)
Project No.: 0106-08420	Surface Elevation: 268.15 feet msl
Started at 0745 on 2-15-96	TOC Elevation: 270.09 feet msl
Completed at 1000 on 2-15-96	Depth to Groundwater: 19.89 feet Measured: 4/8/96
Drilling Method: Rotasonic-4" inner core barrel/6"OD casing	Groundwater Elevation: 250.20 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 76 feet
Geologist: J.A. Kingsbury	Well Screen: 62 to 72 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
0					BG		ML	(0-41') Upper Alluvium (see descriptions below). (0-6') Clayey silt, brown in color. Appears to be fill material used during levee construction.		
5			1	50	BG				262.1	
10			2	85	BG		CL	Slightly silty clay, brownish-gray in color. Very stiff. Increasing silt fraction. Mottling with olive gray-colored silt. Dark greenish-yellow staining is present with iron/organic specks.		
15					BG				252.1	
20			3	100	BG		ML	(16-42') Silt (see descriptions below). (16-22') Yellowish-brown to yellowish-gray in color with dark orangish-yellow staining. Moist to wet. (22-26') Color change to predominantly gray. Wet.		2" ID, Sch. 40 PVC casing
25					BG			(26-34') Olive gray to greenish-gray in color, with common snail shells. Wet.		
30			4	120	BG					
35					BG			Increasing clay fraction from 34' to 36'. Brownish-gray in color. (36-38') Brownish-gray in color, dry.		
40					BG			(38-42') Contains some scattered gravel and a few sand lenses. Contact with Deeper Alluvium deposits (41-72') estimated at 41'.		

GAMMA RAY LOG

COUNTS PER SECOND



CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/22/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 9
SEWAGE LAGOONS

DWG DATE: 12/10/96

DWG NAME: 94GL904

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

EnSafe/Allen & Hoshall

Monitoring Well 009G04DA

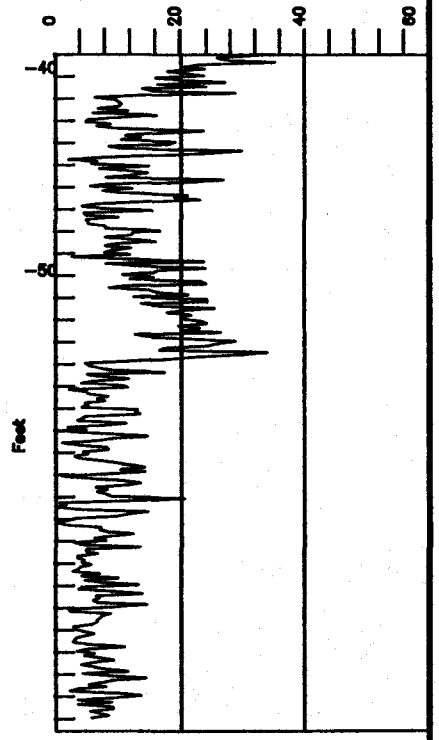
Project: NSA Memphis	Location: Millington, TN. SWMU #9 (Sewage Lagoons)
Project No.: 0106-08420	Surface Elevation: 268.15 feet msl
Started at 0745 on 2-15-96	TOC Elevation: 270.09 feet msl
Completed at 1000 on 2-15-96	Depth to Groundwater: 19.89 feet Measured: 4/8/96
Drilling Method: Rotasonic-4" inner core barrel/8" OD casing	Groundwater Elevation: 250.20 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 76 feet
Geologist: J.A. Kingsbury	Well Screen: 62 to 72 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
45			5	60	BG		ML			
					BG				226.1	
					BG			(42-55') Sand and gravel; gravel is up to 2" in longest dimension. Yellowish-gray to light olive gray in color.		
					BG			Minor clay fraction in sand and gravel from 46' to 52'. Yellowish- gray to very light gray in color.		
50					BG		SW GW			
			6	90	BG			Sand and gravel, yellowish-gray to light yellowish-brown from 52' to 56'.		
					BG					
55					BG		SM GC		213.1	
					BG			Sand and gravel with interstitial silt and clay. Dark orangish-yellow to reddish-brown from 56' to 58'.	212.1	
					BG			Sand and gravel with minor clay, gravel is up to 3" in longest dimension, dark yellowish-brown to reddish-brown from 58' to 72'.		
60			7	90	BG					
					BG					
65					BG		SW GW			
					BG					
					BG					
70			8	80	BG				196.1	
					BG		SP	Cockfield Formation: Fine to medium-grained sand, very light gray to very light olive gray, micaceous and finely lignitic.		
75					BG				192.1	
								Soil boring terminated at 76'.		
80										

WELL DIAGRAM: 0.01 slot, PVC screen; 5" PVC end cap; 2" ID, Sch. 40 PVC casing

GAMMA RAY LOG

COUNTS PER SECOND



CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/22/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 9
SEWAGE LAGOONS

DWG DATE: 12/10/96

DWG NAME: 94GL904A

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

GEOLOGICAL LOGGING SYSTEMS

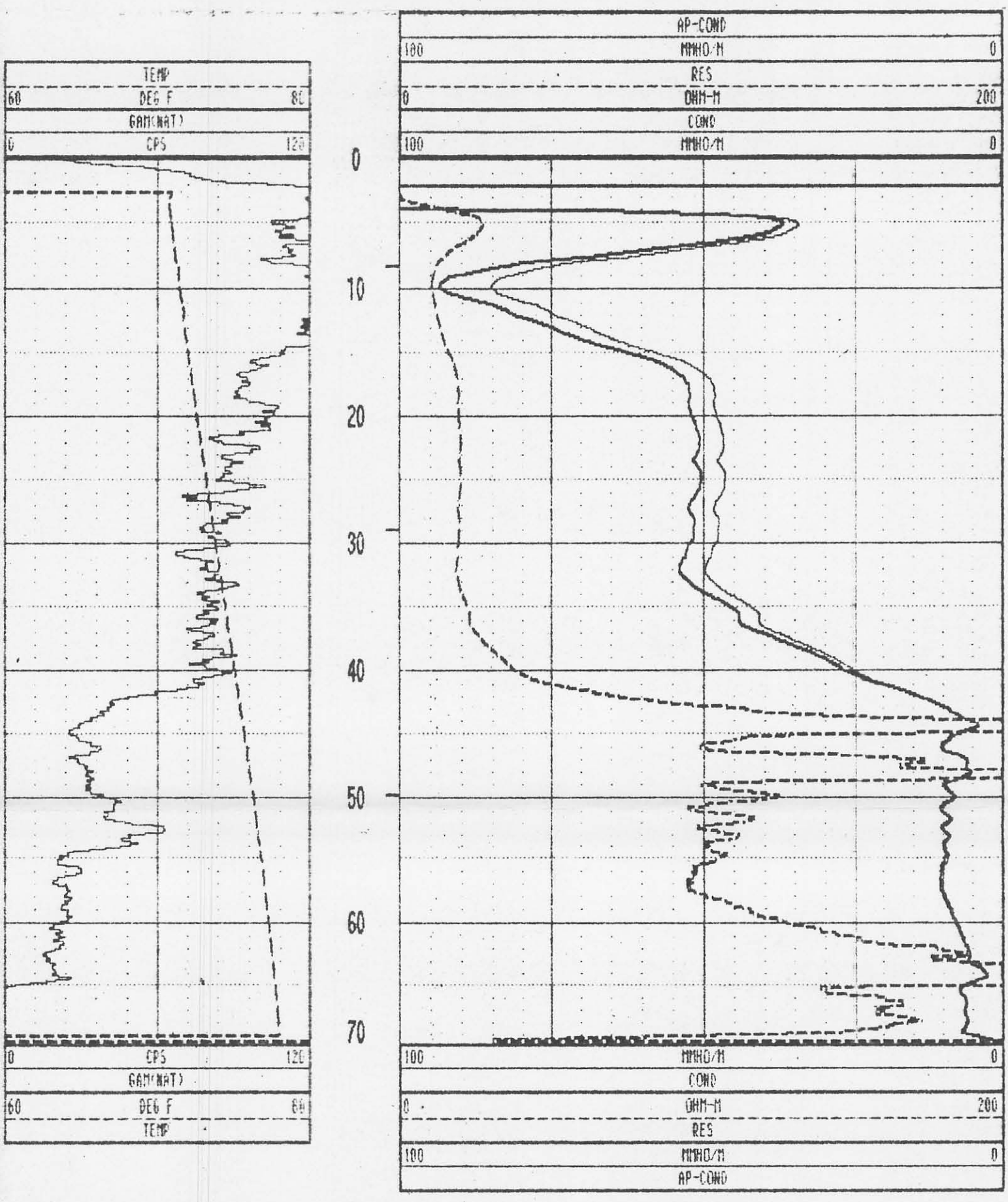
009G04DA

COMPANY	: ENSAFE,ALLEN & HOSHALL			OTHER SERVICES:	
WELL	: 009G04DA			9511	
LOCATION/FIELD	: NAS MEMPHIS			RUN ONE	
COUNTY	: SHELBY			OPEN	
STATE	: TENNESSEE				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 05/23/96	PERMANENT DATUM	: GL	ELEVATIONS	
DEPTH DRILLER	: 72	ELEV. PERM. DATUM:		KB	:
LOG BOTTOM	: 69.70	LOG MEASURED FROM:	GL	DF	: -
LOG TOP	: -1.60	DRL MEASURED FROM:	GL	GL	: 268.1
CASING DRILLER	: 72	LOGGING UNIT	: 05		
CASING TYPE	: PVC	FIELD OFFICE	: BLUEFIELD		
CASING THICKNESS	: .25	RECORDED BY	: J T GILBERT		
BIT SIZE	: 8	BOREHOLE FLUID	: WATER	FILE	: ORIGIN
MAGNETIC DECL.	: -	RM	:	TYPE	: 9511C
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:	LOG	: 0
FLUID DENSITY	: 1.2	MATRIX DELTA T	:	PLOT	: 9510C
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:	THRESH	: 9000

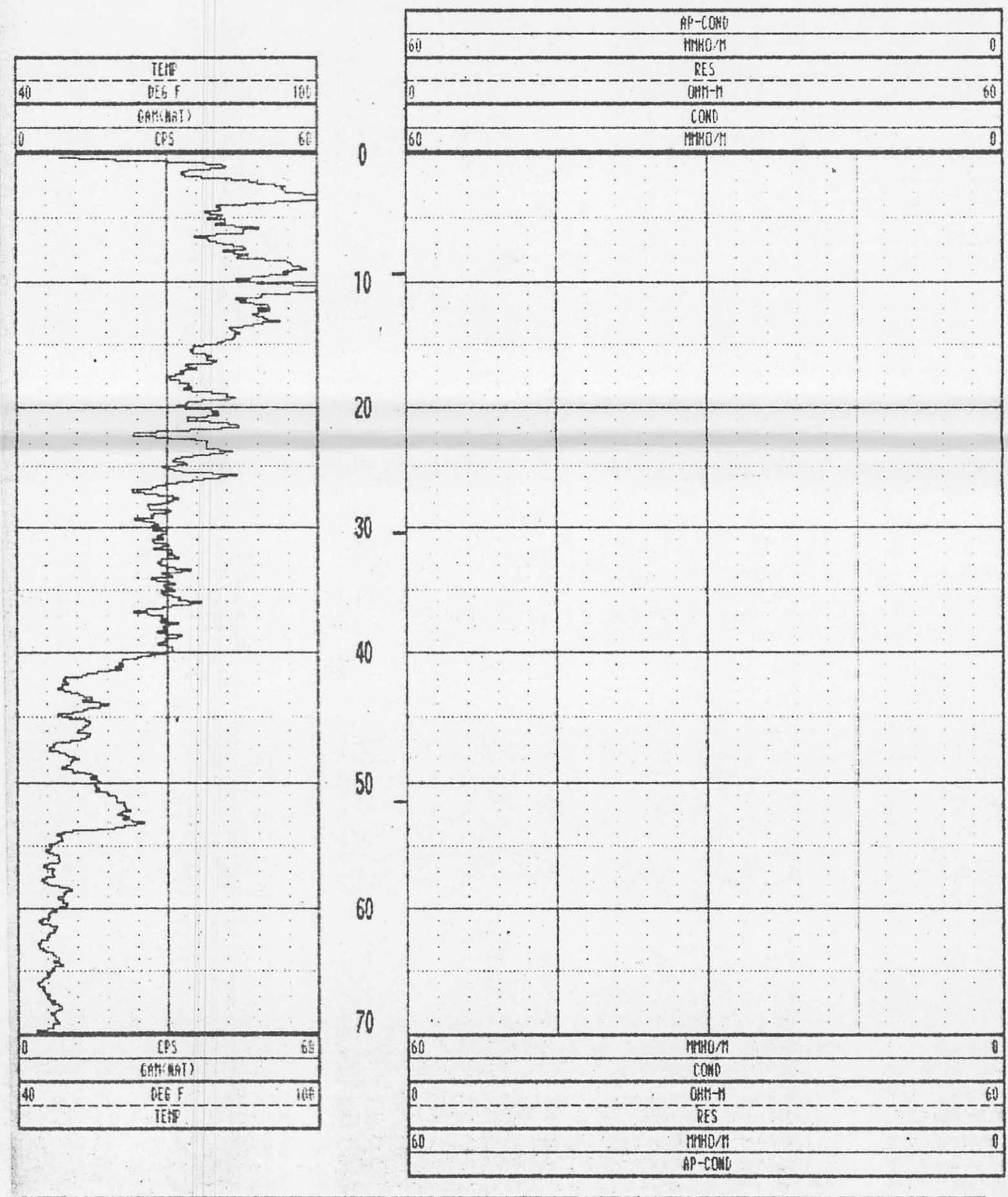
REMARKS :

ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



009G04DA 05/23/96 976



009G04DA 05/23/96 1025

TRI STATE
TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 02/29/96 Project No.: E-3-157

Client's Project No.: 0106090000

Sample I.D.: 009S01DA18

Soil Description: Tan & Light Gray Silty Clay

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	122.1	120.5
Dry Density (Lbs/ft^3)	91.3	91.0
Moisture (% Dry Wt)	33.8	32.4
Porosity (n)	.43	.44
Degree of Saturation (%)	1.0	1.0
Specific Gravity (ASTM D-854)	2.59	---

Permeability

Temperature Correction, R_t = 1.043

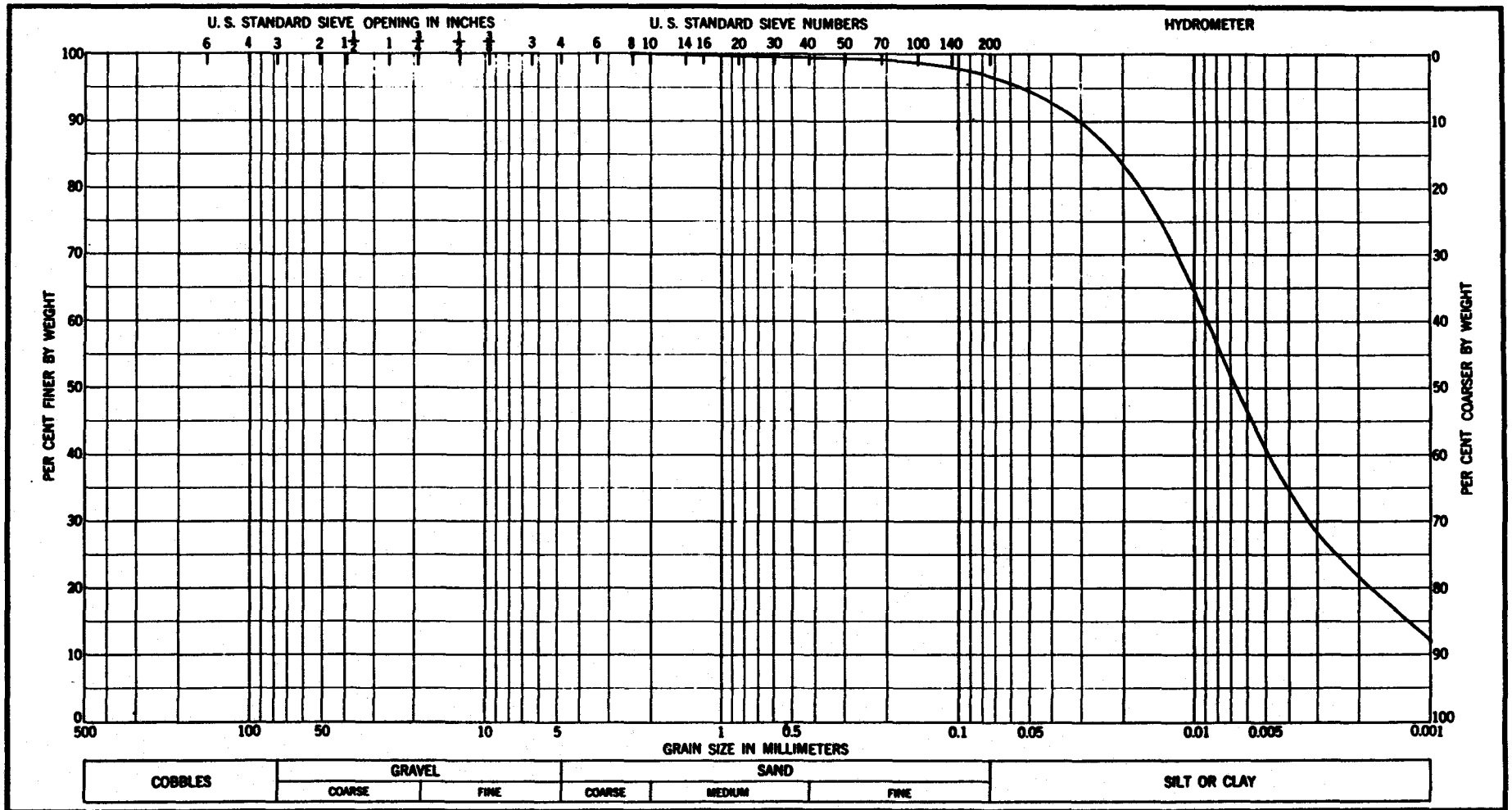
$K_1 = 9.0 \times 10^{-7}$ cm/sec
$K_2 = 8.5 \times 10^{-7}$ cm/sec
$K_3 = 9.4 \times 10^{-7}$ cm/sec
$K_4 = 9.9 \times 10^{-7}$ cm/sec

Coefficient of Permeability, $K_{20} = 9.6 \times 10^{-7}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-011 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 FAX 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
009S01D#18	16'-18'		34			

GRADATION CURVES

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 02/29/96

SWMU 14

SOIL BORING/MONITORING WELL LOGS
AND
GEOTECHNICAL LABORATORY RESULTS

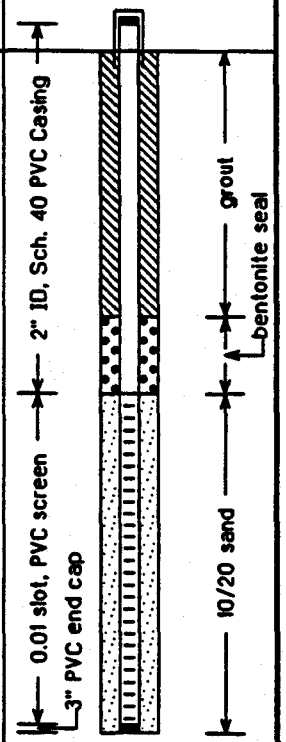
EnSafe/Allen & Hoshall

Monitoring Well 014G01LS

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *267.37 feet msl*
Started at *1030 on 1-29-96*	TOC Elevation: *269.17 feet msl*
Completed at *1245 on 1-29-96*	Depth to Groundwater: *6.79 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *262.38 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.59 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *10.34 to 20.34 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1				GP GW	(0-1') Soil and gravel.	266.4
							ML	(1-3.5') Silt and clay (see descriptions below).	
								(1-2') Clayey silt. Dark yellowish-brown to dusky yellowish-brown in in color.	263.9
5			2				CL	(2-3.5') Silty clay. Dark yellowish-brown to dusky yellowish-brown in in color.	
								(3.5-7') Clay, silty, pale yellowish-brown, mottled with light olive gray-colored material.	260.4
			3					Collected Shelby Tube from 7' to 10'. No sample for description.	257.4
10								(10-18') Clay and silt (see descriptions below).	
							CL	(10-15.5') Clay, silty, moderate yellowish-brown in color, mottled with light olive gray-colored silt. Iron-staining and iron-manganese nodules present near 15'.	
15								(15.5-16') Clayey silt, moderate yellowish-brown in color mottled with light olive gray to greenish-gray. Iron-manganese nodules and iron staining present.	251.4
							ML	(16-20.5') Clayey silt, greenish-gray mottled with moderate yellowish-brown material near 16'. Iron staining increases with depth.	246.8
20								Soil boring terminated at approximately 20.5'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent monitoring well 014G01LF.	
25									
30									
35									
40									

WELL DIAGRAM



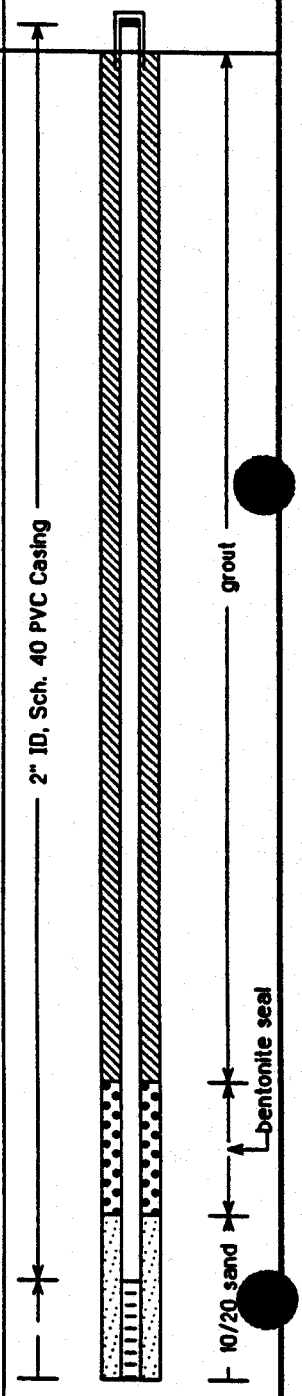
EnSafe/Allen & Hoshall

Monitoring Well 014G01LF

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *267.24 feet msl*
Started at *1320 on 1-29-96*	TOC Elevation: *269.11 feet msl*
Completed at *1530 on 1-29-96*	Depth to Groundwater: *7.46 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *261.65 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *51 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *37 to 47 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0					BG		GP GW	(0-1') Soil and gravel.	268.2
					BG		ML	(1-3.5') Silt and clay (see descriptions below).	
			1	100				(1-2') Clayey silt. Dark yellowish-brown to dusky yellowish-brown in color.	263.7
5					5		CL	(2-3.5') Silty clay. Dark yellowish-brown to dusky yellowish-brown in color.	
					4			(3.5-7') Clay, silty, pale yellowish-brown, mottled with light olive gray-colored material.	260.2
			2	83	3			No description available; collected a Shelby tube sample from 7' to 10' for geotechnical analysis.	257.2
10					BG			(10-16') Clay and silt (see descriptions below).	
			3	155	BG		CL	(10-15.5') Clay, silty, moderate yellowish-brown in color, mottled with light olive gray-colored silt. Iron-staining and iron-manganese nodules present near 15'.	
					4				
15					BG			(15.5-16') Clayey silt, moderate yellowish-brown in color mottled with light olive gray to greenish-gray. Iron-manganese nodules and iron staining present.	251.2
					BG				
					BG			(16-26) Clayey silt, greenish-gray mottled with moderate yellowish-brown material near 16'. Iron staining increases with depth.	
20			4	97	BG		ML		
					BG				
					BG				
25					BG			Iron-manganese nodules present near 26'.	
					BG			(27-32') Silt, clayey, moderate yellowish-brown in color, mottled with light olive gray to very light gray-colored material, with some hard siliceous clayey material, contains a large siliceous clay concretion at 27'.	240.2
					BG				
30			5	135	BG		ML		
					BG			(32-35') Clayey silt, moderate yellowish-brown mottled slightly with light olive gray to very light gray-colored material.	235.2
					BG		ML		
35					BG			(35-47') Fluvial Deposits (see descriptions below).	232.2
					BG		ML SC	(35-40') Silt, clay, and sand, with some scattered gravel, dusky yellow color mottled with light olive gray to very light gray material, moist.	
40			6	113	BG				227.2

WELL DIAGRAM



EnSafe/Allen & Hoshall	Monitoring Well 014G01LF
Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *267.24 feet msl*
Started at *1320 on 1-29-96*	TOC Elevation: *269.11 feet msl*
Completed at *1530 on 1-29-96*	Depth to Groundwater: *7.46 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *261.65 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *51 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *37 to 47 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
			7	93				No description available; collected a Shelby tube sample from 40' to 43' for geotechnical analysis.	227.0	
			8	125	BG		SM GW	(43-43.5') Silt, sand, and gravel (up to 1" in longest dimension), very light gray, wet.	224.2 223.7	
45					BG		SW GW	(43.5-47') Sand and gravel. Sand is fine to very coarse-grained, and gravel (up to 1.5" in longest dimension) from 44' to 45'. Moderate yellowish-brown to light gray, wet. Longest dimension of gravel increases to up to 3.5" at 47'.		0.01 slot, PVC screen; 3" PVC end cap; 10/20 sand; collapsed
					BG				220.2	
			9	142	BG		SP CL			
50					BG			(47-51') Cockfield Formation: Very fine-grained sand, silt, and clay. Dusky yellowish-brown mottled with light olive gray near 47'.	216.2	
								Soil boring terminated at 51'.		
55										
60										
65										
70										
75										
80										

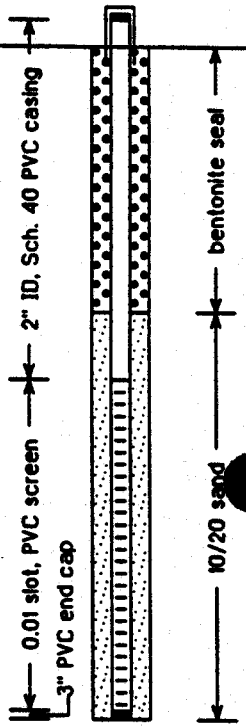
EnSafe/Allen & Hoshall

Monitoring Well 014G02LS

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.44 feet msl*
Started at *0850 on 2-14-96*	TOC Elevation: *270.12 feet msl*
Completed at *0915 on 2-14-96*	Depth to Groundwater: *7.61 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *262.51 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *A. Choate, C. Ivey*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0							ML/GC	(0-3') Gravel, silt, clay, and bricks from 0' to 3' (fill).	
									265.4
5			1	100	BG		CL	(3-6') Clay, brownish-gray in color	
									262.4
								Silt and clay, light olive gray to dark yellowish-brown in color from 6' to 9'.	
10								Silt and clay, yellowish-gray to yellowish-brown in color from 9' to 20'. Moist, with iron-staining and specks of organic material.	
							ML/CL		
15			2	120	BG				
20									248.4
								Soil boring terminated at 20'. Note: This is a replacement well. The original well was installed a few feet away on 1/23/96 but was subsequently abandoned due to faulty construction. Analytical samples indicated on this boring log were collected from the soil boring associated with the original well.	
25									
30									
35									
40									

WELL DIAGRAM



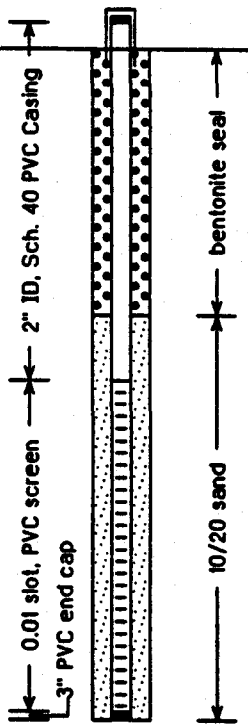
EnSafe/Allen & Hoshall

Monitoring Well 014G03LS

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.64 feet msl*
Started at *0745 on 2-14-96*	TOC Elevation: *271.09 feet msl*
Completed at *0815 on 2-14-96*	Depth to Groundwater: *8.39 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *262.70 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *J.A. Kingsbury*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			BG			
			5			
5	1	70	5	CL ML	(0-8') Clay with some silt, dark brown to brownish-gray in color.	
			6			
			6			260.6
10			6		(8-20') Silt, light yellowish-brown to yellowish-gray in color with dark orangish-yellow mottling and specks of organic material. Moist.	
			5			
15	2	90	5	ML	Small concretion present at 15'.	
			5			
			5			
20					Soil boring terminated at 20'.	248.6
25						
30						
35						
40						

WELL DIAGRAM



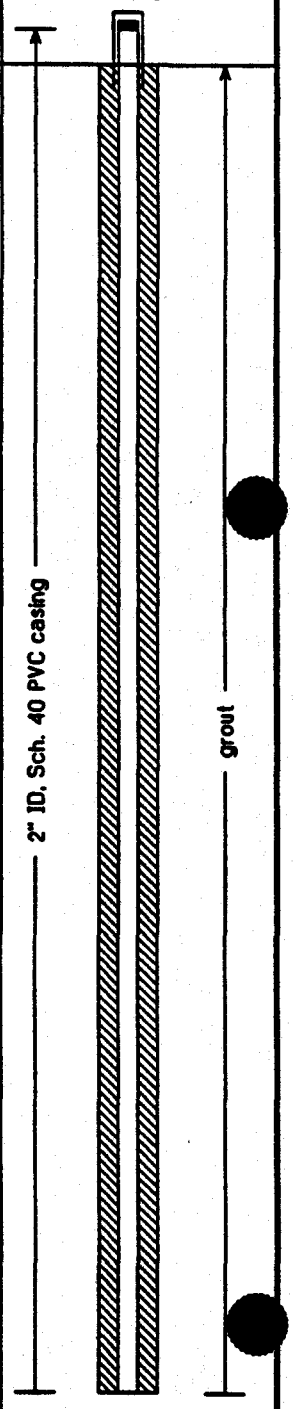
EnSafe/Allen & Hoshall

Monitoring Well 014G04LF

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.82 feet msl*
Started at *1330 on 1-23-96*	TOC Elevation: *270.88 feet msl*
Completed at *1530 on 1-23-96*	Depth to Groundwater: *8.79 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *262.09 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *55 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *39 to 49 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
	1	46	BG	GP GW	(0-2.5') Soil, gravel, brick, grass and roots (fill material).	
			BG	CL	(2.5-5') Silty clay. Dark yellowish-brown in color.	266.3
5			BG	ML	(5-20.5') Clayey silt. Moderate yellowish-brown to light olive gray in color. Mottled with light olive gray and olive gray-colored material. Iron-manganese nodules near 5'.	263.8
			BG		Moist near 7.5'.	
			BG			
10	2	107	BG		(10-12') Very moist.	
			8		Iron-manganese nodules near 11'.	
			8			
15			6			
			6			
			6			
20	3	121	6	ML	(20.5-23') Clayey silt is light olive gray in color with considerable dark yellowish-orange to moderate yellowish-brown colored iron staining. Some iron/manganese nodules are present	248.3
			6.5			245.8
			6.5	CL	(23-30') Silty clay, greenish-gray in color with some dark yellowish- orange to moderate yellowish-brown iron-staining near 23'. Iron-staining and mottled light olive brown in color near 30'.	
25			6.5			
			5		Fluvial Deposits (30-50') contact estimated at 30'.	
30				SP		238.8

WELL DIAGRAM



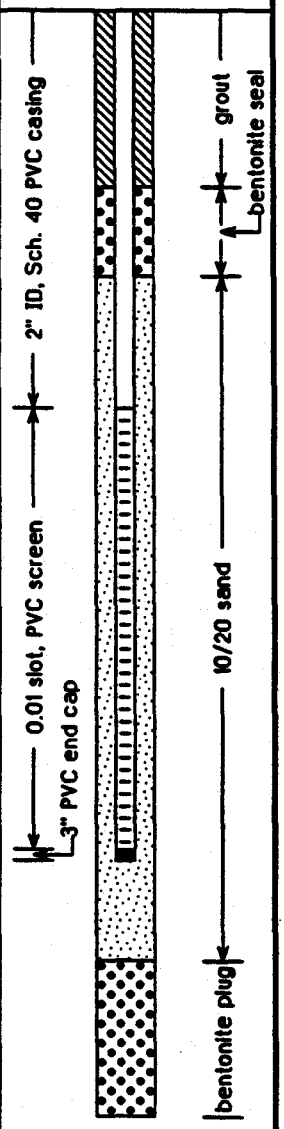
EnSafe/Allen & Hoshall

Monitoring Well 014G04LF

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.82 feet msl*
Started at *1330 on 1-23-96*	TOC Elevation: *270.88 feet msl*
Completed at *1530 on 1-23-96*	Depth to Groundwater: *8.79 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *262.09 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *55 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *39 to 49 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			4	127	5		SP	(30-32') Sand, very fine-grained, moderate yellowish-brown in color mottled light gray-colored material.	238.8
					5		SM SC	(32-35') Sand (very fine to coarse-grained), silt, and clay. Moderate yellowish-brown in color mottled with light gray material. Moist near 34'. Becomes mostly very fine-grained sand and silt near 35'.	236.8
35					5		ML CL	(35-37') Silt and clay, greenish-gray in color mottled with moderate yellowish-brown material.	233.8
					4.5		SM SC SC	(37-38') Sand, silt, and clay. Olive gray to light brownish-gray in color.	231.8
					5.5		GM	(38-39') Silty and clayey sand and gravel. Light olive gray to moderate yellowish-brown in color. Wet.	230.8
40			5	113	5		GW GC	(39-42.5') Gravel, sand, and clay. Light olive gray in color, mottled with moderate yellowish-brown and dark yellowish-orange-colored material. Very cohesive and moist.	229.8
					5		SW GW	(42.5-46.5') Sand (medium to coarse-grained) and gravel (up to 1" in longest dimension. Light gray in color mottled with moderate yellowish-brown material. Wet.	226.3
45					5				
			6	95	4				
					5		GW	(46.5-48') Sand is medium to very coarse-grained. Moderate yellowish-brown to dark yellowish-orange, wet.	220.8
50					5			(48-49.5') Gravel (up to 4" in longest dimension) with sand. Moderate yellowish-brown in color. Wet.	218.8
			7	163	4.5		SP SM	(50-55') Cockfield Formation (see description below).	
55					5			Very fine-grained silty sand, moderate yellowish-brown to dusky yellowish brown with light olive gray laminations.	213.8
60								Soil boring terminated at 55'.	

WELL DIAGRAM



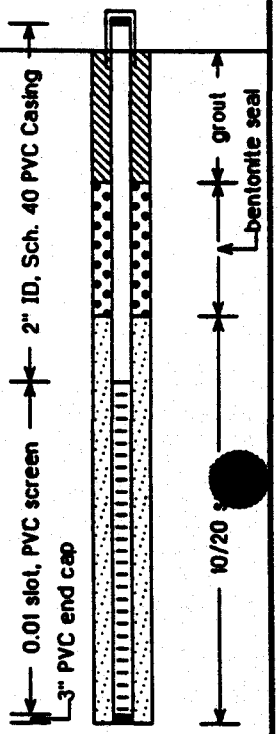
EnSafe/Allen & Hoshall

Monitoring Well 014G05LS

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.24 feet msl*
Started at *1445 on 1-21-96*	TOC Elevation: *270.12 feet msl*
Completed at *1605 on 1-21-96*	Depth to Groundwater: *9.84 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *260.28 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *A. Choate, C. Ivey*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0							OL	(0-1.5') Soil and grass.	268.7
			1	108	BG			(1.5-20') Silt and clay (see descriptions below). (1.5-6') Silt and clay, dark yellowish-brown in color, becoming dark yellowish-brown to pale yellowish-brown in color near 6'. Dry.	
5									
10			2	118	BG		ML CL	Clayey silt, dark yellowish-brown to dark yellowish-orange in color mottled with medium light gray-colored material. Slightly moist. Contains iron-manganese nodules.	
15								Wet from 15' to 16'. The percentage of iron-manganese nodules increases near 16'.	
20			3	142	BG			(16-20') Very clayey silt, light olive gray in color mottled with dark yellowish-brown to dark yellowish-orange material. The percentage of mottled material decreases with depth. Very moist. Contains iron-manganese nodules.	248.2
								Terminated soil boring at 20'.	
25									
30									
35									
40									

WELL DIAGRAM



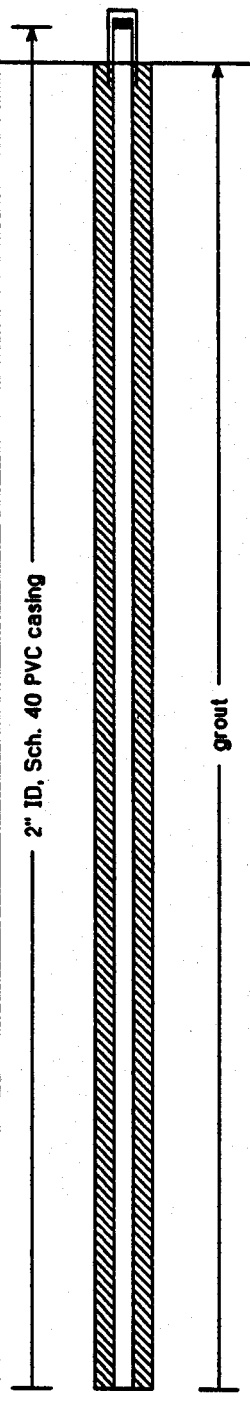
EnSafe/Allen & Hoshall

Monitoring Well 014G06LF

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.62 feet msl*
Started at *1450 on 1-20-96*	TOC Elevation: *270.57 feet msl*
Completed at *0850 on 1-21-96*	Depth to Groundwater: *10.32 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *260.25 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56 feet*
Geologist: *A. Choate, C. Ivey*	Well Screen: *39 to 49 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0					BG		OL	(0-2') Soil, roots, and brick fragments. Soil is dark yellowish-brown to moderate yellowish-brown.	268.6
			1	72	BG			(2-17') Clayey silt and silty clay (see descriptions below).	
5					BG			(2-6.5') Very clayey silt. Moderate yellowish-brown to dark yellowish- brown in color. Color becomes lighter near 6.5'.	
					BG			(6.5-17') Silty clay. Moderate yellowish-brown in color mottled with yellowish-gray-colored material. Contains iron-manganese nodules. Slightly moist, becoming more moist, oxidized, and stained dark yellowish-orange near 11'.	
10					BG		ML/CL		
			2	89	BG				
15					BG				
					BG				251.6
					BG			(17-37') Silt, clayey (see descriptions below).	
20					BG			(17-26') Clayey silt. Light olive gray to greenish-gray in color. Slightly moist. Becoming stiff near 26'.	
			3	95	BG				
					BG		ML		
25					BG				
					BG			(26-32') Clayey silt, moderate yellowish-brown in color mottled with light olive-gray material. The percentage of light olive gray material progressively decreases from 26' to 32'. Iron concretions are present near 26'. Slightly moist at 26' becoming more moist near 32'.	
30					BG				

WELL DIAGRAM



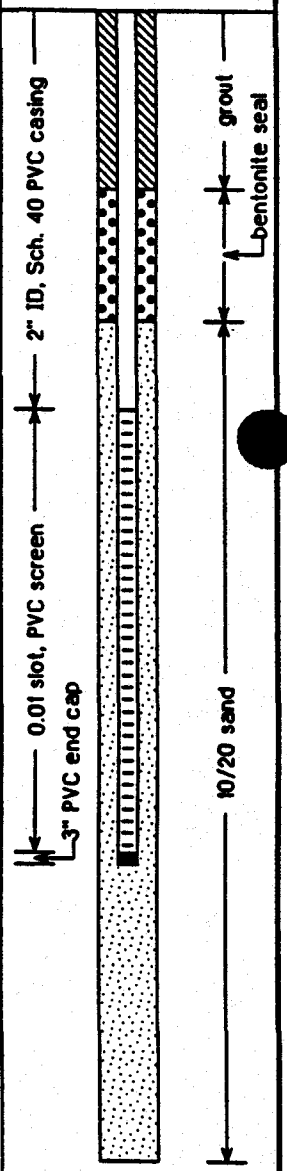
EnSafe/Allen & Hoshall

Monitoring Well 014G06LF

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.62 feet msl*
Started at *1450 on 1-20-96*	TOC Elevation: *270.57 feet msl*
Completed at *0850 on 1-21-96*	Depth to Groundwater: *10.32 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *260.25 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56 feet*
Geologist: *A. Choate, C. Ivey*	Well Screen: *39 to 49 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
35			4	113	BG		ML	(32-36') Silt, clayey, moderate yellowish-brown in color and slightly moist.	
					BG				
					BG			(36-37') Clayey silt, moderate yellowish-brown in color mottled with light olive gray material, slightly moist.	231.6
40			5	97	BG		SM GW	(37-49') Fluvial Deposits (see descriptions below). (37-49') Sand and gravel (see descriptions below).	
					BG			(37-38') Fine-grained sand and silt with gravel (up to 2" in longest dimension). Moderate yellowish-brown.	
					BG			(38-42') Sand, fine, and gravel (up to 2" in longest dimension), silty, moderate brown mottled with pale yellowish-brown material.	
45					BG			(42-45') Sand (fine to coarse-grained) and gravel (up to 2" in longest dimension). Moderate brown to dark yellowish-orange in color. Wet.	
					BG			(45-49') Sand, medium to coarse, and gravel (up to 2" in longest dimension), moderate yellowish-brown to dark yellowish-orange. Wet.	
					BG				219.6
50			6	114	BG			(49-56') Cockfield Formation (see description below).	
					BG		SM CL	Silty, very fine-grained sand with silty clay laminations. Sand is dusky yellowish brown in color; clay laminations are light gray in color.	
55					BG			Becoming waxy near 56'.	
									212.6
60								Soil boring terminated at 56'.	

WELL DIAGRAM



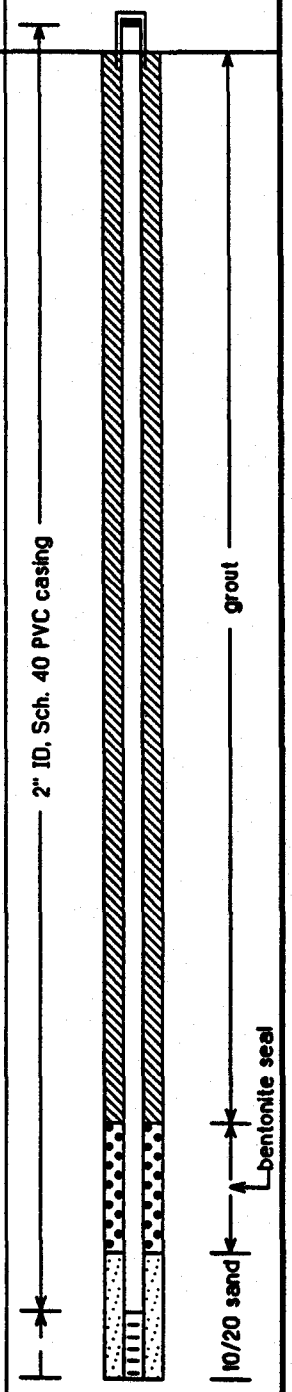
EnSafe/Allen & Hoshall

Monitoring Well 014G07LF

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.88 feet msl*
Started at *1000 on 1-22-96*	TOC Elevation: *270.63 feet msl*
Completed at *1145 on 1-22-96*	Depth to Groundwater: *9.30 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *261.33 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *50 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *38 to 48 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1	50	BG BG BG		OL	(0-5') Soil, concrete, and rubble (fill). Note: Concrete was encountered at 2' below ground surface.	
5					BG				263.9
					BG			(5-22') Clay and silt (see descriptions below).	
					BG			(5-12') Silty clay. Dark yellowish-brown in color mottled with moderate yellowish-brown to dark yellowish-orange-colored material. Mottling increases in content progressively near 12'. Hard from 4' to 7'.	
10			2		BG			Silt content increases near 11'.	
					BG		CL ML	(12-16') Silty clay, olive gray to light olive gray in color mottled with moderate yellowish-brown to dark yellowish-orange-colored material. Contains iron-manganese nodules, increasing in percentage around 16'.	
15					BG				
					BG			(16-22') Clayey silt. Moderate yellowish-brown in color mottled with light olive gray-colored material. Contains scattered iron- manganese nodules.	
20			3	139	BG			Dark yellowish-orange staining near 21'.	248.9
					BG			(22-32.5') Silt (see descriptions below). (22-25') Silt, medium dark gray to medium gray, mottled with some moderate yellowish-brown material near 22' where a few scattered iron-manganese nodules are located.	
25					BG		ML	(25-31.5') Silt, olive gray to greenish-gray in color, mottled with moderate yellowish-brown near 32.5'. Contains iron staining and iron-manganese nodules mostly near 29'.	
					BG				
30			4	118	BG			(31.5-32.5') Silt, moderate yellowish-brown mottled with light gray.	236.4
					BG		ML	(32.5-36') Clayey silt, moderate yellowish-brown in color. Mottled with light gray material near 34'.	
35					BG				232.9
					BG		SM GW	(36-48') Fluvial Deposits (see descriptions below). (36-43.5') Sand, silty, with gravel (see descriptions below).	
40					BG			(36-37.5') Silty sand (very fine-grained) with gravel. Moderate yellowish-brown in color.	

WELL DIAGRAM



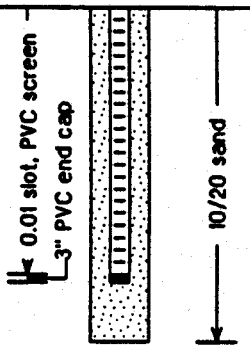
EnSafe/Allen & Hoshall

Monitoring Well 014G07LF

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.88 feet msl*
Started at *1000 on 1-22-96*	TOC Elevation: *270.63 feet msl*
Completed at *1145 on 1-22-96*	Depth to Groundwater: *9.30 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *261.33 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *50 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *38 to 48 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
45			5	107	BG		SM GW	Very silty sand (fine to coarse-grained) and gravel (up to 2" in longest dimension) subangular to rounded. Moderate yellowish-brown in color mottled with light olive gray and some dark yellowish- orange-colored material. From 37.5' to 41.5', sample is very difficult to split.	225.4
					BG				
					BG		SW GW	(43.5-48') Sand and gravel, gravel and sand (see descriptions below).	
					BG				
50			6	120	BG		SM	(43.5-46') Sand (medium to coarse-grained) and gravel (up to 2" in longest dimension). Dark yellowish-orange to moderate yellowish- brown in color. Wet.	220.9
								(46-48') Gravel and sand, dark yellowish-orange to moderate yellowish- brown. Wet.	218.9
55								(48-50') Cockfield Formation (see description below).	
								Very fine-grained silty sand. Mottled with gray to light gray-colored very fine-grained sand, which decreases with depth. Becomes clayey near 50'.	
60								Soil boring terminated at 50'.	
65									
70									
75									
80									

WELL DIAGRAM



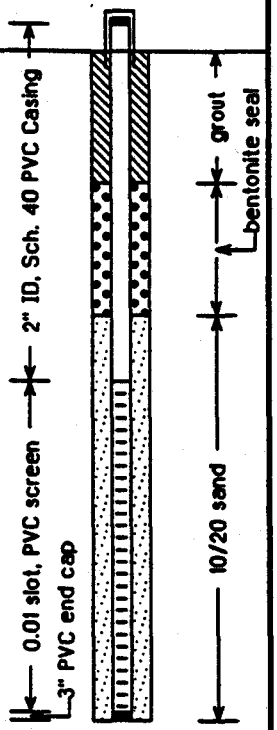
EnSafe/Allen & Hoshall

Monitoring Well 014G08LS

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.52 feet msl*
Started at *1500 on 1-22-96*	TOC Elevation: *268.14 feet msl*
Completed at *1530 on 1-22-96*	Depth to Groundwater: *6.48 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *261.66 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0					1			(0-5') Fill material: Soil, with bits of concrete and grass and roots.	
5			1	40	BG		OL		263.5
					BG			(5-17') Clay and silt (see descriptions below).	
					BG			(5-7') Silty clay. Moderate yellowish-brown to dark yellowish-orange in color and mottled with light olive gray-colored material. Slightly moist.	
10					BG				
			2	82	BG		CL ML	(7-16') Clayey silt. Moderate yellowish-brown to dark yellowish- orange in color mottled with light olive gray and some dark yellowish- orange material. Slightly moist.	
					BG				
15					BG			Moisture content increases near 16'. Sparse iron-manganese nodules are present near 16'.	252.5
			3	75	BG		ML	(16-17') Clayey silt moderate yellowish-brown to dark yellowish-orange in color and mottled with olive gray to light olive gray-colored material. Considerable iron staining. Contains iron-manganese nodules. Moist.	
20					BG				248.5
								(17-20') Silt, clayey, olive gray to light olive gray in color slightly mottled with dark yellowish-orange-colored material. Contains iron-manganese nodules, moist.	
25								Terminated soil boring at 20'.	
30									
35									
40									

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 014G04LF

Project: NSA Memphis	Location: Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)
Project No.: 0106-08420	Surface Elevation: 268.82 feet msl
Started at 1330 on 1-23-96	TOC Elevation: 270.88 feet msl
Completed at 1530 on 1-23-96	Depth to Groundwater: 8.79 feet Measured: 4/8/96
Drilling Method: Rotasonic-4" inner core barrel/6" OD casing	Groundwater Elevation: 262.09 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 55 feet
Geologist: D. Ladd, W. Parks	Well Screen: 39 to 49 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
0					BG		GL GW	(0-2.5') Soil, gravel, brick, grass and roots (fill material).		
			1	46	BG		CL	(2.5-5') Silty clay. Dark yellowish-brown in color.	266.3	
5					BG		ML	(5-20.5') Clayey silt. Moderate yellowish-brown to light olive gray in color. Mottled with light olive gray and olive gray-colored material. Iron-manganese nodules near 5'.	263.8	
					BG			Moist near 7.5'.		
					BG					
10			2	107	BG			(10-12') Very moist.		
					8			Iron-manganese nodules near 11'.		
					8					
15					6					
					6					
					6					
20			3	121	6		ML	(20.5-23') Clayey silt is light olive gray in color with considerable dark yellowish-orange to moderate yellowish-brown colored iron staining. Some iron/manganese nodules are present	248.3	
					6.5				245.8	
25					6.5		CL	(23-30') Silty clay, greenish-gray in color with some dark yellowish- orange to moderate yellowish-brown iron-staining near 23'. Iron-staining and mottled light olive brown in color near 30'.		
					6.5					
					5			Fluvial Deposits (30-50') contact estimated at 30'.		
30							SP		238.8	

WELL DIAGRAM: 2" ID, Sch. 40 PVC casing

GAMMA RAY LOG

COUNTS PER SECOND

0 20 40 60

Feet: 0, -25

CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/22/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 14
BUILDING S-140 AND
SEVENTH AVENUE DRAINAGE DITCH

DWG DATE: 12/10/96 DWG NAME: 014L144

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

EnSafe/Allen & Hoshall

Monitoring Well 014G04LF

Project: NSA Memphis	Location: Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)
Project No.: 0106-08420	Surface Elevation: 268.82 feet msl
Started at 1330 on 1-23-96	TOC Elevation: 270.88 feet msl
Completed at 1530 on 1-23-96	Depth to Groundwater 8.79 feet Measured: 1/8/96
Drilling Method: Rotasonic-4" inner core barrel/8" OD casing	Groundwater Elevation: 262.09 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 55 feet
Geologist: D. Ladd, W. Parks	Well Screen: 39 to 49 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			4	127	5		SP	(30–32') Sand, very fine–grained, moderate yellowish–brown in color mottled light gray–colored material.	238.8
					5		SM SC	(32–35') Sand (very fine to coarse–grained), silt, and clay. Moderate yellowish–brown in color mottled with light gray material. Moist near 34'. Becomes mostly very fine–grained sand and silt near 35'.	236.8
35					5		ML CL	(35–37') Silt and clay, greenish–gray in color mottled with moderate yellowish–brown material.	233.8
					4.5		SM SC	(37–38') Sand, silt, and clay. Olive gray to light brownish–gray in color.	231.8
					5.5		SC GM	(38–39') Silty and clayey sand and gravel. Light olive gray to moderate yellowish–brown in color. Wet.	230.8
40			5	113	5		GW GC	(39–42.5') Gravel, sand, and clay. Light olive gray in color, mottled with moderate yellowish–brown and dark yellowish–orange–colored material. Very cohesive and moist.	229.8
					5				226.3
45					5		SW GW	(42.5–46.5') Sand (medium to coarse–grained) and gravel (up to 1" in longest dimension. Light gray in color mottled with moderate yellowish–brown material. Wet.	
			6	95	4				
					5		GW	(46.5–48') Sand is medium to very coarse–grained. Moderate yellowish–brown to dark yellowish–orange, wet.	220.8
50					5			(48–48.5') Gravel (up to 4" in longest dimension) with sand. Moderate yellowish–brown in color. Wet.	218.8
			7	163	4.5		SC SM	(50–55') Cookfield Formation (see description below).	
55					5			Very fine–grained silty sand, moderate yellowish–brown to dusky yellowish brown with light olive gray laminations.	213.8
								Soil boring terminated at 55'.	
60									

WELL DIAGRAM

0.01 slot, PVC screen — 2" ID, Sch. 40 PVC casing

3" PVC end cap

GAMMA RAY LOG

COUNTS PER SECOND

0 20 40 60

-30 -40 -50 Feet

CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/22/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 14
BUILDING S-140 AND
SEVENTH AVENUE DRAINAGE DITCH

DWG DATE: 12/10/96

DWG NAME: 94GL144A

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

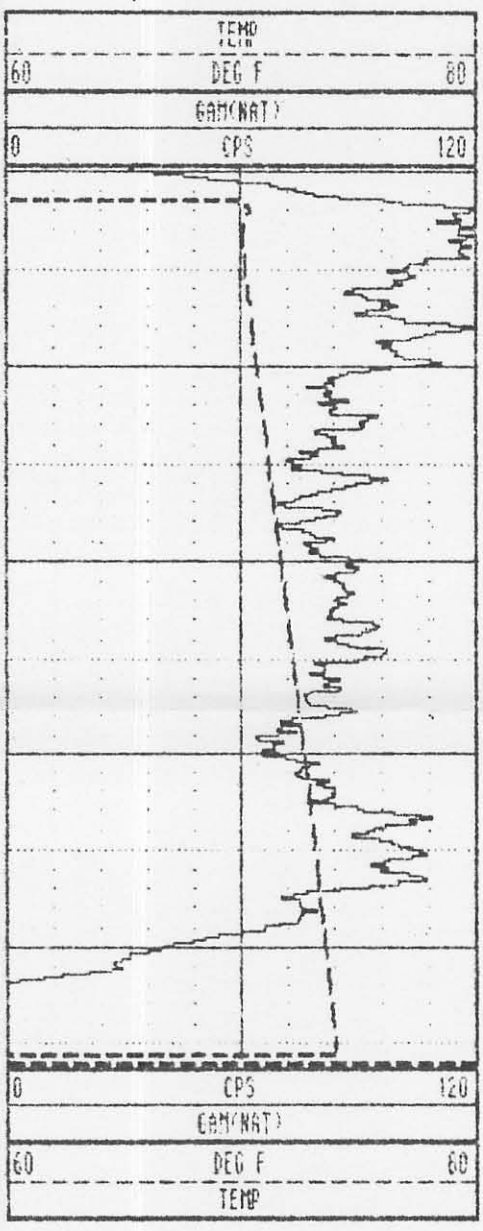
GEOLOGICAL LOGGING SYSTEMS

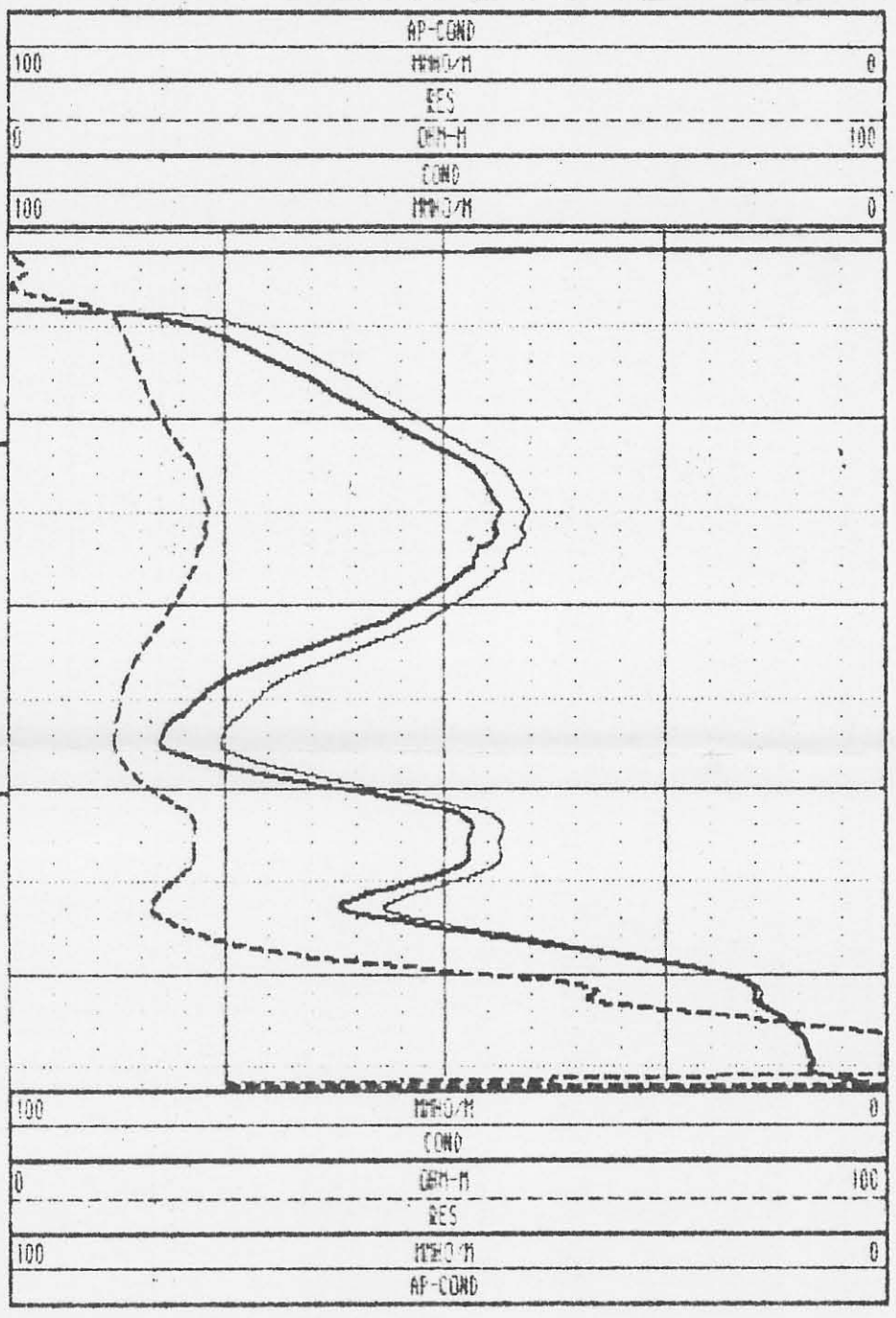
014G04LF

COMPANY	: ENSAFE,ALLEN & HOSHALL				OTHER SERVICES:		
WELL	: 014G04LF				9511		
LOCATION/FIELD	: NAS MEMPHIS				RUN ONE		
COUNTY	: SHELBY				OPEN		
STATE	: TENNESSEE						
SECTION	:	TOWNSHIP	:		RANGE	:	
DATE	: 05/22/96	PERMANENT DATUM	: GL		ELEVATIONS		
DEPTH DRILLER	: 51.5	ELEV. PERM. DATUM:			KB	:	
LOG BOTTOM	: 46.30	LOG MEASURED FROM:	GL		DF	: -	
LOG TOP	: -2.80	DRL MEASURED FROM:	GL		GL	: 268.8	
CASING DRILLER	: 51.5	LOGGING UNIT	: 05				
CASING TYPE	: PVC	FIELD OFFICE	: BLUEFIELD				
CASING THICKNESS	: .25	RECORDED BY	: J T GILBERT				
BIT SIZE	: 8	BOREHOLE FLUID	: WATER		FILE	: ORIGIN	
MAGNETIC DECL.	: -	RM	:		TYPE	: 9511C	
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:		LOG	: 4	
FLUID DENSITY	: 1.2	MATRIX DELTA T	:		PLOT	: 9510C	
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:		THRESH	: 9000	
REMARKS	:						

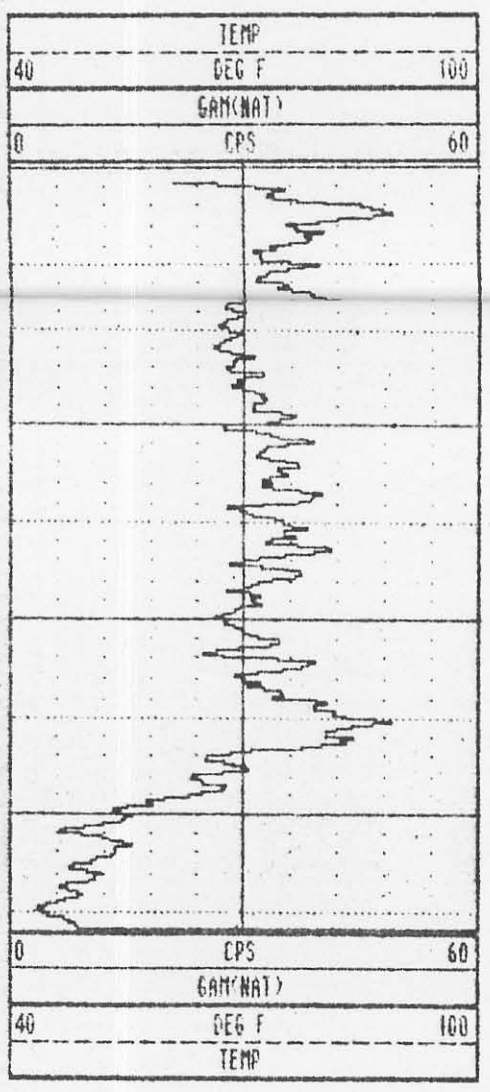
ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.

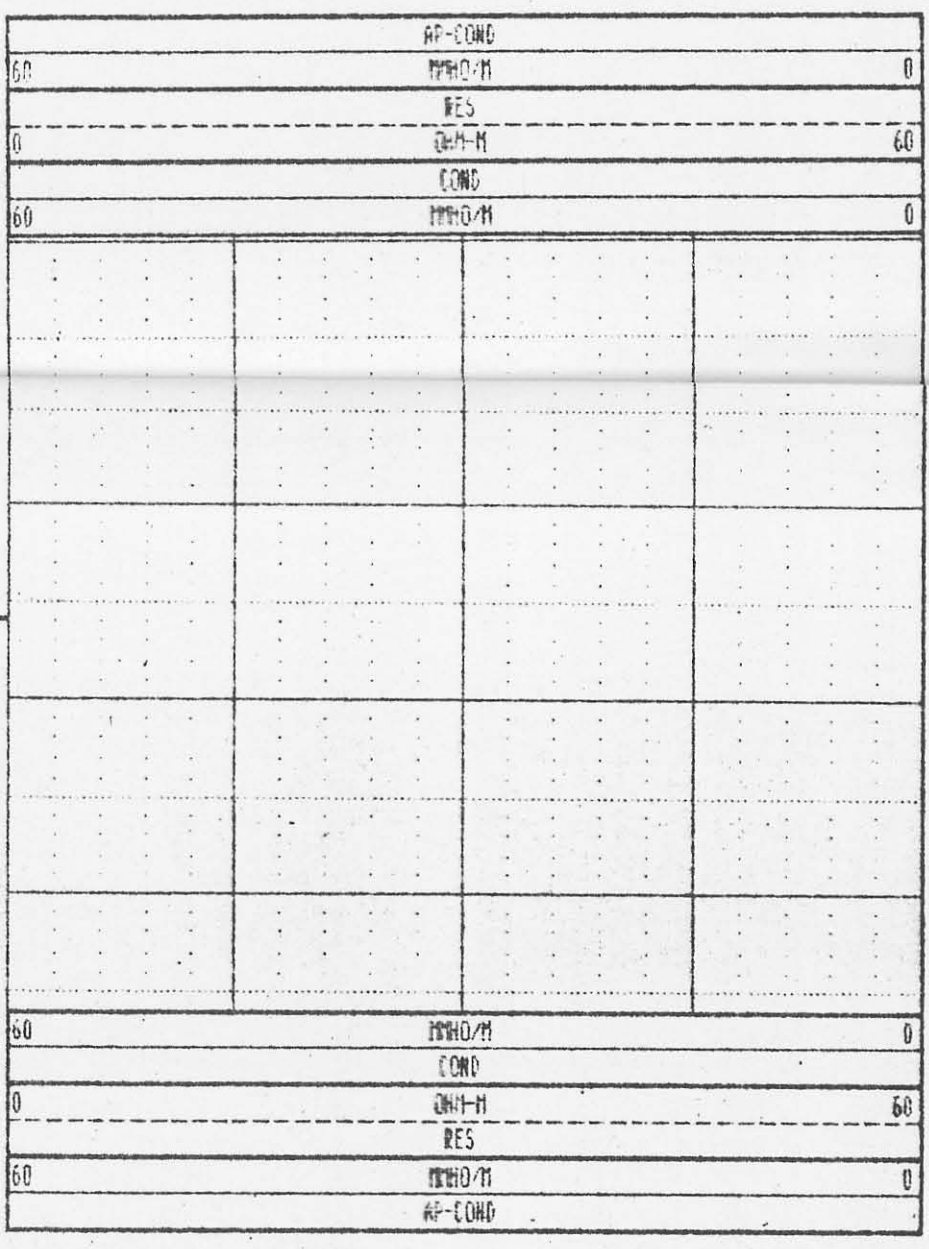
ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS





014G04LF 05/22/96 976





014G04LF 05/22/96 1025

TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 02/22/96 **Project No.:** E-3-157

Client's Project No.: 0106090000

Sample I.D.: 014S01LF10

Soil Description: Light Gray Clayey Silt

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	120.0	117.8
Dry Density (Lbs/ft^3)	90.8	92.6
Moisture (% Dry Wt)	32.1	27.2
Porosity (n)	.44	.43
Degree of Saturation (%)	1.00	.95
Specific Gravity (ASTM D-854)	2.59	---

Permeability

Temperature Correction, $R_t = 1.000$

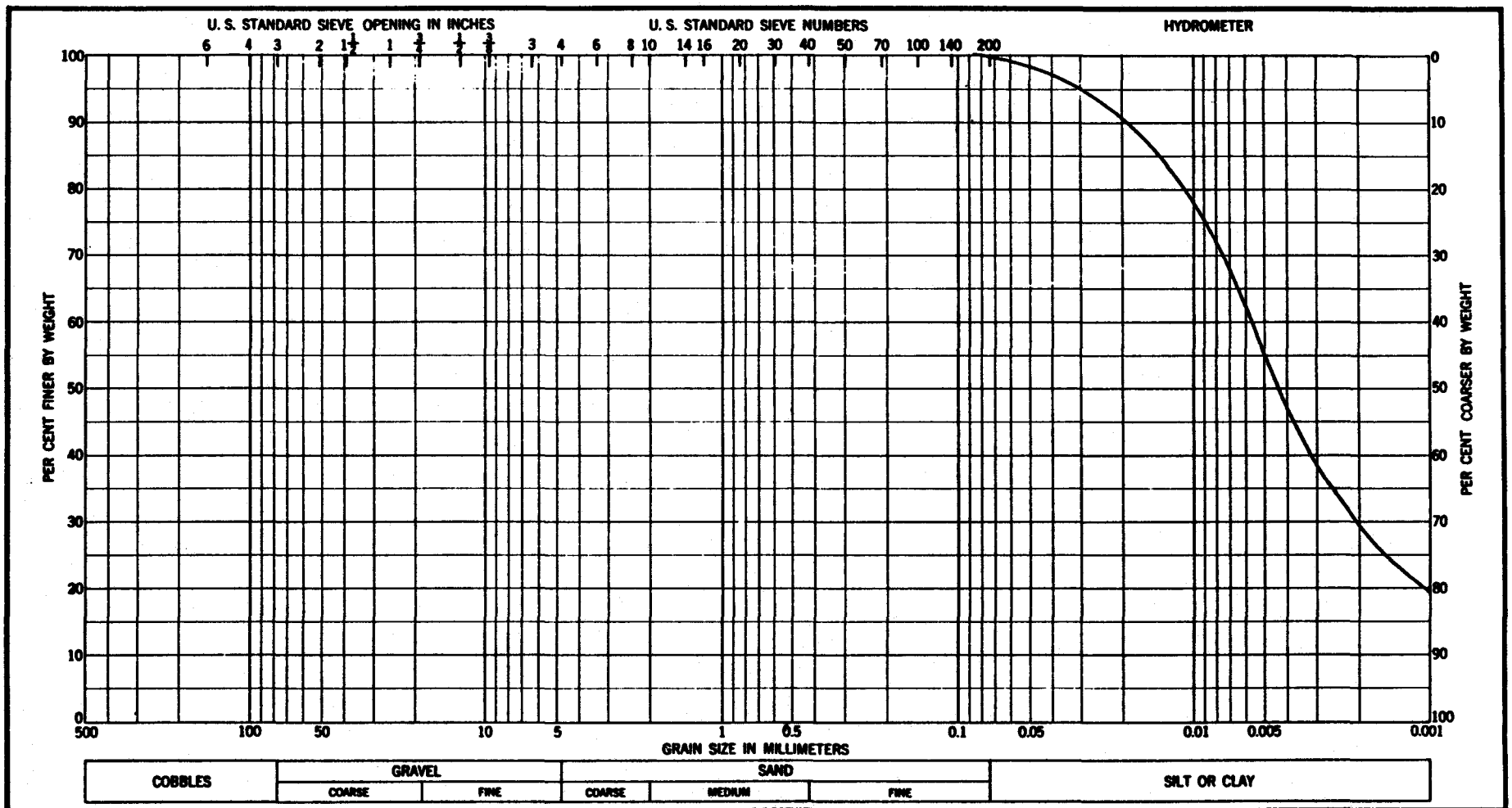
$K_1 = 4.4 \times 10^{-7}$ cm/sec
$K_2 = 3.9 \times 10^{-7}$ cm/sec
$K_3 = 4.0 \times 10^{-7}$ cm/sec
$K_4 = 4.3 \times 10^{-7}$ cm/sec

Coefficient of Permeability, $K_{20} = 4.2 \times 10^{-7}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-005 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 FAX 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
014S01LF10	7-10'		32	--	--	--

GRADATION CURVES

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 02/23/96

TRI STATE
TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 02/22/96 **Project No.:** E-3-157

Client's Project No.: 0106090000

Sample I.D.: 014S01LF43

Soil Description: Light Gray & Tan Silty Clay with Sand and small gravel

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	127.0	133.4
Dry Density (Lbs/ft^3)	105.2	113.5
Moisture (% Dry Wt)	20.7	17.5
Porosity (n)	.32	.26
Degree of Saturation (%)	1.0	1.20
Specific Gravity (ASTM D-854)	2.47	---

Permeability

Temperature Correction, $R_t = 1.010$

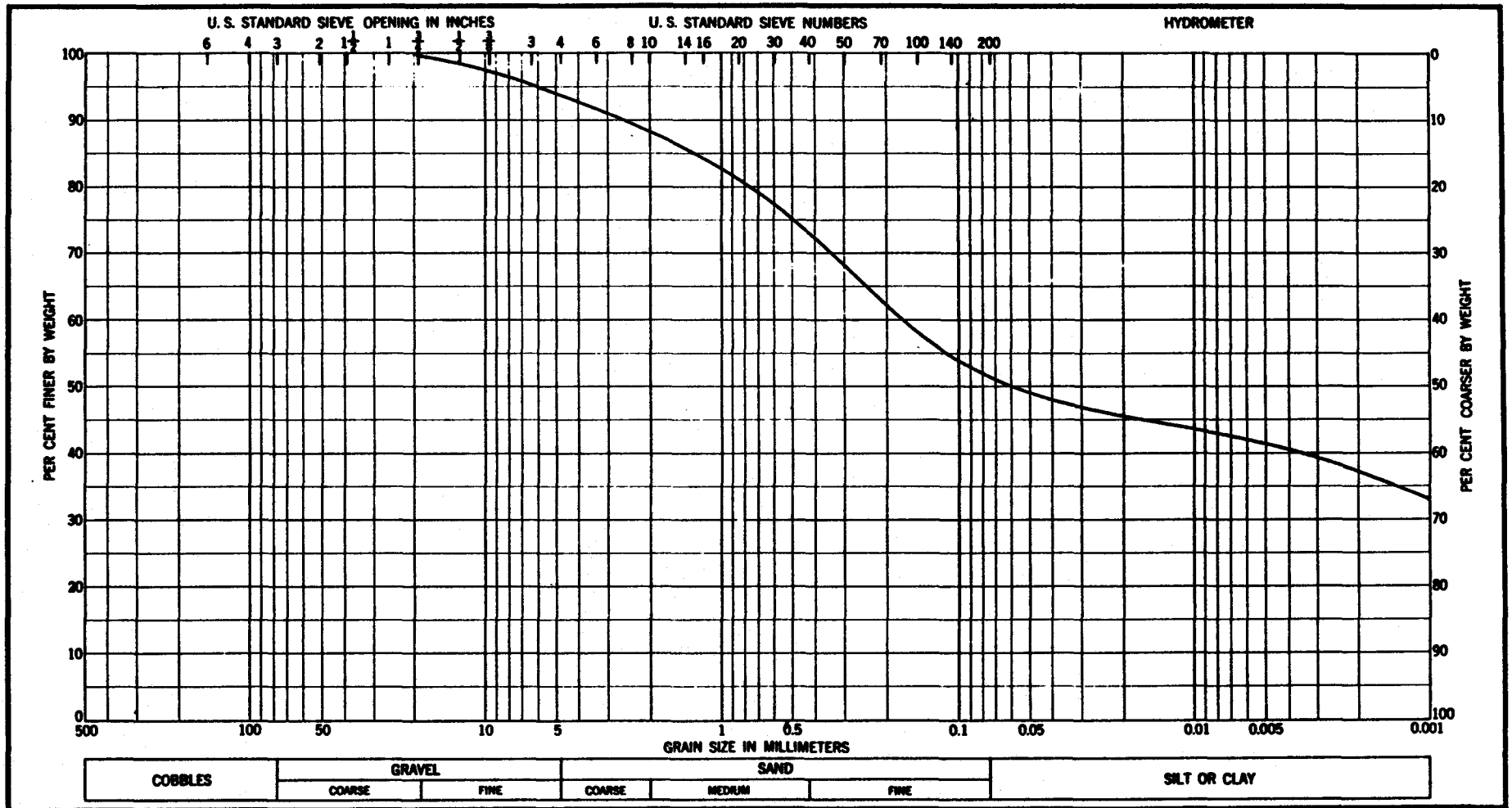
$K_1 = 3.7 \times 10^{-7}$ cm/sec
$K_2 = 4.0 \times 10^{-7}$ cm/sec
$K_3 = 4.2 \times 10^{-7}$ cm/sec
$K_4 = 4.1 \times 10^{-7}$ cm/sec

Coefficient of Permeability, $K_{20} = 4.0 \times 10^{-7}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-006 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 FAX 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
014SOILF43	40-43'		21	--	--	--

GRADATION CURVES

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 02/23/96

TRI-STATE TESTING SERVICES, INC.

SWMU 59

SOIL BORING/MONITORING WELL LOGS AND GEOTECHNICAL LABORATORY RESULTS

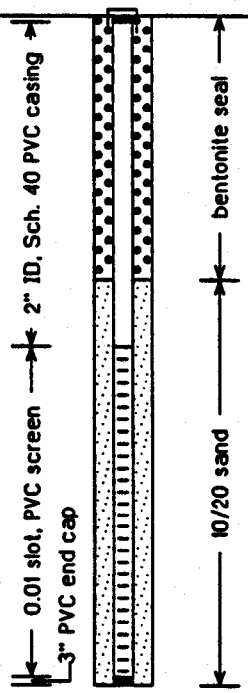
EnSafe/Allen & Hoshall

Monitoring Well 059G01LS

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #59 (Old Pesticide Shop)*
Project No.: *0106-08420*	Surface Elevation: *263.40 feet msl*
Started at *1000 on 3-4-96*	TOC Elevation: *263.24 feet msl*
Completed at *1046 on 3-4-96*	Depth to Groundwater: *7.55 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *255.69 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1	100			GW	(0-1') Asphalt and gravel fill.	262.4
			2	100			GW	(1-2') Soil and gravel fill.	261.4
			3	100			ML	(2-7') Clayey silt, olive gray in color, moist, with a trace of organic material.	
5					1.6				
			4	83	1.8		CL	(7-11') Silty clay, olive gray in color. Contains organic material. Iron-staining from 9' to 11'.	256.4
					2.4				
10					2.0				252.4
					1.6		CL	(11-20') Clay, olive gray to light olive gray in color with dark yellowish-orange iron-staining. Contains abundant iron-manganese nodules.	
15			5	120	1.6				
					1.8			Less dark yellowish-orange iron-staining from 16' to 17'.	
					2.0				
20								Terminated soil boring at 20'.	243.4
25									
30									
35									
40									

WELL DIAGRAM



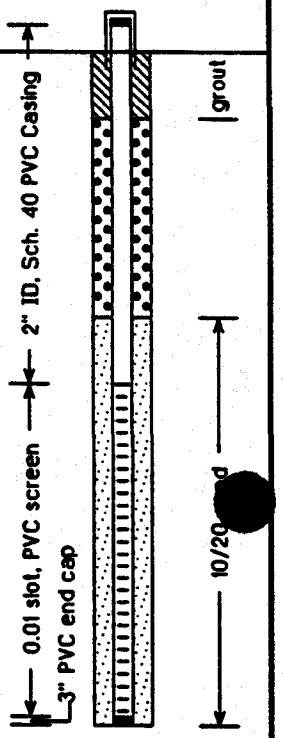
EnSafe/Allen & Hoshall

Monitoring Well 059G02LS

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #59 (Old Pesticide Shop)*
Project No.: *0106-08420*	Surface Elevation: *263.16 feet msl*
Started at *0822 on 3-2-96*	TOC Elevation: *265.18 feet msl*
Completed at *0900 on 3-2-96*	Depth to Groundwater: *10.14 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *255.04 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *D. Ladd, C. Ivey*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0							OL	(0-2') Soil, moderate yellowish-brown in color with roots.	261.2
							ML	(2-4.5') Silt, moderate yellowish-brown mottled with olive gray material, predominantly near 4.5'.	258.7
5			1	65			ML	(4.5-9') Clayey silt, olive gray in color. Contains iron-manganese nodules. Mottled with moderate yellowish-brown colored material near 9'.	
								Moist from 5' to 6'.	254.2
10								Dry and crumbly from 7' to 8'.	
								(9-18.5') Silt and silty caly (see descriptions below).	
							ML CL	(9-10') Silt. Moderate yellowish-brown in color mottled with olive gray-colored material. Very common iron-manganese nodules.	
15			2	75				(10-18') Silty clay. Olive gray in color and mottled with moderate yellowish-brown-colored material, mostly moderate yellowish-brown near 10' and again at 18'. Very common iron-manganese nodules.	244.7
20							CL	(18-18.5') Silt. Moderate yellowish-brown in color mottled with olive gray-colored material. Dry. Contains common iron-manganese nodules.	243.2
								(18.5-20') Clay, olive gray in color, moist.	
25								Terminated soil boring at 20'. Note: Due to the potential for significant contamination in this soil boring, no samples were field screened for organic vapors so that the well could be completed in minimal time.	
30									
35									
40									

WELL DIAGRAM



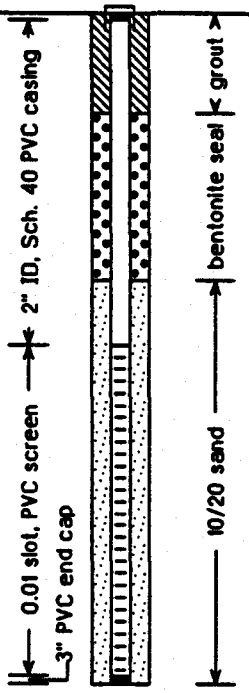
EnSafe/Allen & Hoshall

Monitoring Well 059G03LS

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #59 (Old Pesticide Shop)*
Project No.: *0106-08420*	Surface Elevation: *263.54 feet msl*
Started at *1237 on 3-4-96*	TOC Elevation: *263.35 feet msl*
Completed at *1330 on 3-4-96*	Depth to Groundwater: *9.50 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *253.85 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *10 to 10 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1				FL GW	(0-1') Asphalt, soil, and gravel fill.	262.5
5			2				ML	(1-12') Silt. Moderate yellowish-brown in color mottled with light olive gray material. Organic material and less light olive gray material from 2' to 12'. Moist from 7' to 10'. Very moist from 10' to 12'.	
10			3						251.5
15								No description available; collected a Shelby tube sample from 12' to 15'.	248.5
							ML	(15-16') Silt, moderate yellowish-brown in color mottled with light olive gray material.	247.5
20							ML	(16-20') Silt, light olive gray in color, mottled with a light moderate yellowish-brown material.	243.5
25								Terminated soil boring at 20'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log for adjacent monitoring well 059G03UF.	
30									
35									
40									

WELL DIAGRAM



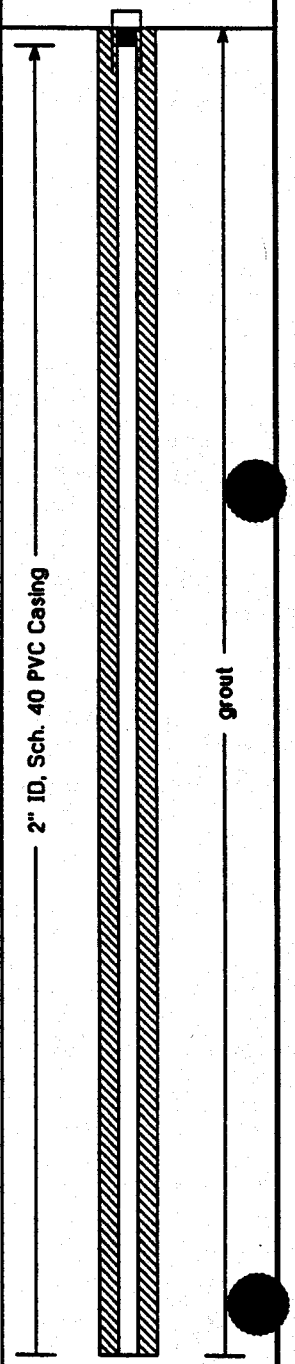
EnSafe/Allen & Hoshall

Monitoring Well 059G03UF

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #59 (Old Pesticide Shop)*
Project No.: *0106-08420*	Surface Elevation: *263.51 feet msl*
Started at *1337 on 3-4-96*	TOC Elevation: *263.32 feet msl*
Completed at *1457 on 3-4-96*	Depth to Groundwater: *14.63 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - "4 inner core barrel/6" OD casing*	Groundwater Elevation: *248.69 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *44 to 54 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			1	100			OL GW	(0-1') Asphalt, soil, and gravel fill.	
					.8				262.5
			2	100				(1-12') Silt, moderate yellowish-brown in color mottled with light olive gray-colored material. Contains organic and less light olive gray material from 2' to 12'.	
					1.0				
5					1.0				
			3	95	2.2		ML	Moist from 7' to 10'.	
					1.0				
10								Very moist from 10' to 12'.	
					1.2				
								No description available; collected Shelby tube sample from 12' to 15'.	251.5
			4	83					
15					.6		ML		248.5

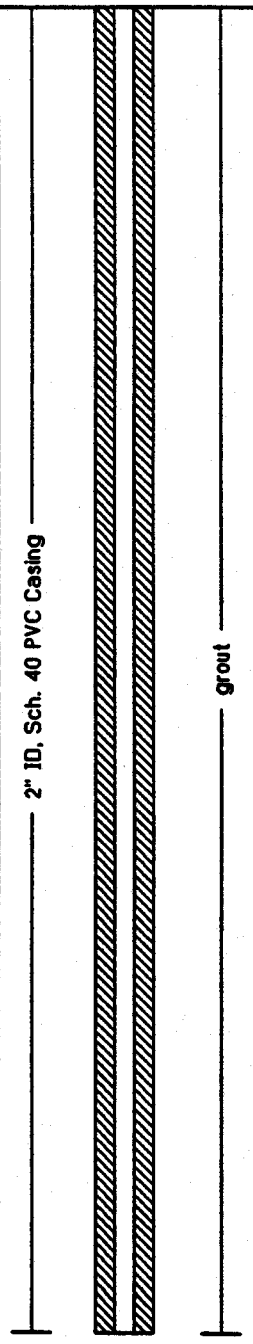
WELL DIAGRAM



EnSafe/Allen & Hoshall	Monitoring Well 059G03UF
Project: *NSA Memphis*	Location: *Millington, TN. SWMU #59 (Old Pesticide Shop)*
Project No.: *0106-08420*	Surface Elevation: *263.51 feet msl*
Started at *1337 on 3-4-96*	TOC Elevation: *263.32 feet msl*
Completed at *1457 on 3-4-96*	Depth to Groundwater: *14.63 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - "4 inner core barrel/6" OD casing*	Groundwater Elevation: *248.69 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *44 to 54 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
							ML	(15-16') Silt, moderate yellowish-brown in color mottled with light olive gray-colored material.	248.5
					1.4			(16-22') Silt, light olive gray in color, mottled with a light moderate yellowish-brown-colored material from 16' to around 20'.	247.5
					1.6		ML		
20			5	82	2.0				
					1.4			(22-26') Silt, moderate yellowish-brown to dusky yellow in color. Contains iron-staining and iron-manganese nodules.	241.5
							ML		
25					0.8				
								(26-31') Silt, moderate yellowish-brown to dark yellowish-orange in color mottled with dark yellowish-brown-colored material.	237.5
					1.2				
							ML		
					1.4				
30									

WELL DIAGRAM



EnSafe/Allen & Hoshall	Monitoring Well 059G03UF
Project: *NSA Memphis*	Location: *Millington, TN. SWMU #59 (Old Pesticide Shop)*
Project No.: *0106-08420*	Surface Elevation: *263.51 feet msl*
Started at *1337 on 3-4-96*	TOC Elevation: *263.32 feet msl*
Completed at *1457 on 3-4-96*	Depth to Groundwater: *14.63 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - "4 inner core barrel/6" OD casing*	Groundwater Elevation: *248.69 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *44 to 54 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
	6	100	1.4	ML		232.5
					(31-35') Silt, moderate yellowish-brown in color mottled with very fine, very light gray colored sand. Dark yellowish-orange staining and iron-manganese nodules are present near 35'.	
			1.4	ML		
35			1.4	SW	(35-36.5') Sand, very fine-grained, very light gray in color mottled with dark yellowish-orange material. Wet.	228.5
					Contains some coarse dark yellowish-orange sand from 36' to 36.5'.	227
			2.4	SW GW		226.5
	7	100		CL	(36.5-37') Sand (medium to very coarse-grained) and gravel. Moderate yellowish-brown to dark yellowish-orange in color.	
			2.6	SM	(37-39') Sandy clay, moderate yellowish-brown to dark yellowish- orange in color mottled with very light gray-colored material. Becomes mostly pale yellowish-brown in color near 39'.	224.5
40					Top of Fluvial Deposits estimated at 39'.	223.5
					(39-40') Silty sand, medium to coarse-grained, with scattered gravel. Moderate yellowish-brown to dark yellowish-orange. Wet.	
	8	100			No description available; collected a Shelby tube sample from 40' to 43'.	
			1.4	SW GW	(43-44.5') Sand, fine to very coarse-grained, moderate yellowish-brown to dark yellowish-orange, and gravel, up to .75" in longest dimension, angular to rounded, composed of quartz and chert, wet.	220.5
	9	125				219
45			1.2	SW GW		

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

grout

bentonite seal

10/20 sand

EnSafe/Allen & Hoshall	Monitoring Well 059G03UF
Project: *NSA Memphis*	Location: *Millington, TN. SWMU #59 (Old Pesticide Shop)*
Project No.: *0106-08420*	Surface Elevation: *263.51 feet msl*
Started at *1337 on 3-4-96*	TOC Elevation: *263.32 feet msl*
Completed at *1457 on 3-4-96*	Depth to Groundwater: *14.63 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - "4 inner core barrel/6" OD casing*	Groundwater Elevation: *248.69 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *44 to 54 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
50			10	130	1.2		SW GW	(44.5-47.5') Sand, coarse to very coarse-grained, moderate yellowish- brown to dark yellowish-orange, and gravel, up to 2.5" in longest dimension, composed mostly of angular chert, wet.	218	0.01 slot, PVC screen
							SW GW	(47.5-48') Sand, fine to coarse-grained, very light gray and mottled with dark yellowish-orange, and gravel, up to 1.5" in longest dimension, composed mostly of angular to rounded quartz and chert, wet.	215.5	
					1.0		SW		214.5	
					1.6		SW GW	(48-49') Sand, fine to medium-grained, with rare quartz gravel. Yellowish-gray in color mottled with dark yellowish-orange material, slightly micaceous, wet.		
							SW GW	(49-51.5') Sand (fine to coarse-grained) and gravel (mostly quartz and chert); dark yellowish-orange in color mottled with yellowish-gray material; micaceous; wet.	212	
					1.6		SW GW	(51.5-53.5') Sand, fine to very coarse-grained, and gravel (quartz and chert) is up to .75" in longest dimension; yellowish-gray and wet.		
55									210	3" PVC end cap
					0.8		SW	(53.5-56') Sand, fine to medium-grained, with rare gravel. Yellowish- gray color, micacous, wet.		10/20 sand
60								Terminated soil boring at 56'.	207.5	

EnSafe/Allen & Hoshall

Monitoring Well 059G03UF

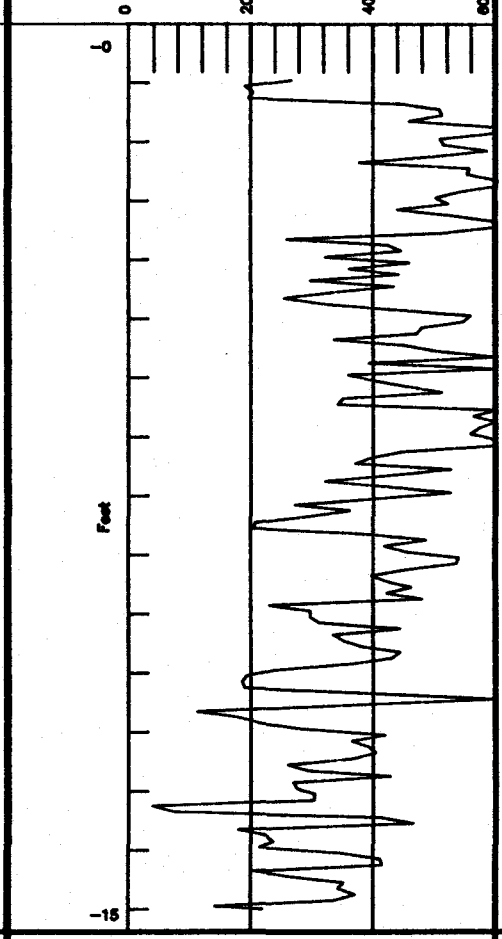
Project: NSA Memphis	Location: Millington,TN.SWMU #59 (Old Pesticide Shop)
Project No.: 0106-08420	Surface Elevation: 263.51 feet msl
Started at 1337 on 3-4-96	TOC Elevation: 263.32 feet msl
Completed at 1457 on 3-4-96	Depth to Groundwater:14.63 feet Measured: 4/8/96
Drilling Method: Rotasonic-4" inner core barrel/8" OD casing	Groundwater Elevation:248.69 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 56 feet
Geologist: D. Ladd, W. Parks	Well Screen: 44 to 54 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
			1	100	.8		GP GW	(0-1') Asphalt, soil, and gravel fill.	262.5	
			2	100				(1-12') Silt, moderate yellowish-brown in color mottled with light olive gray-colored material. Contains organic and less light olive gray material from 2' to 12'.		
5					1.0					
					1.0					
			3	95	2.2		ML	Moist from 7' to 10'.		
					1.0					
10								Very moist from 10' to 12'.		
					1.2					
								No description available; collected Shelby tube sample from 12' to 15'.	251.5	
			4	83						
15					.6		ML		248.5	

2" ID, Sch. 40 PVC Casing

GAMMA RAY LOG

COUNTS PER SECOND



CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/22/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 59
OLD PESTICIDE SHOP

DWG DATE: 12/10/96

DWG NAME: 94GL593

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

EnSafe/Allen & Hoshall

Monitoring Well 059G03UF

Project: NSA Memphis	Location: Millington, TN. SWMU #59 (Old Pesticide Shop)
Project No.: 0106-08420	Surface Elevation: 263.51 feet msl
Started at 1337 on 3-4-96	TOC Elevation: 263.32 feet msl
Completed at 1457 on 3-4-96	Depth to Groundwater: 14.63 feet Measured: 4/8/96
Drilling Method: Rotasonic-4" inner core barrel/6" OD casing	Groundwater Elevation: 248.69 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 56 feet
Geologist: D. Ladd, W. Parks	Well Screen: 44 to 54 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
							ML	(15–16') Silt, moderate yellowish–brown in color mottled with light olive gray–colored material.	248.5	
					1.4			(16–22') Silt, light olive gray in color, mottled with a light moderate yellowish–brown–colored material from 16' to around 20'.	247.5	
20			5	82	1.6		ML			
					2.0					
					1.4			(22–26') Silt, moderate yellowish–brown to dusky yellow in color. Contains iron–staining and iron–manganese nodules.	241.5	
25					0.8		ML			
					1.2			(26–31') Silt, moderate yellowish–brown to dark yellowish–orange in color mottled with dark yellowish–brown–colored material.	237.5	
30					1.4		ML			

2" ID, Sch. 40 PVC Casing

GAMMA RAY LOG

COUNTS PER SECOND

0 20 40 60

Feet: -15 to -30

CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/22/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 59
OLD PESTICIDE SHOP

DWG DATE: 12/10/96

DWG NAME: 94GL593A

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

EnSafe/Allen & Hoshall

Monitoring Well 059G03UF

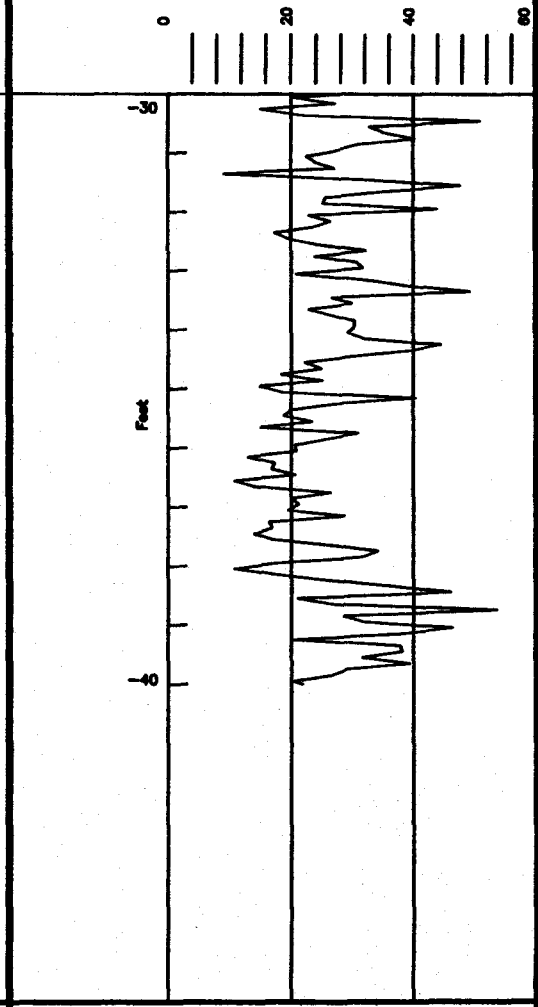
Project: NSA Memphis	Location: Millington,TN.SWMU #59(Old Pesticide Shop)
Project No.: 0106-08420	Surface Elevation: 263.51 feet msl
Started at 1337 on 3-4-96	TOC Elevation: 263.32 feet msl
Completed at 1457 on 3-4-96	Depth to Groundwater:14.63 feet Measured: 4/8/96
Drilling Method: Rotasonic-4" inner core barrel/6" OD casing	Groundwater Elevation:248.69 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 56 feet
Geologist: D. Ladd, W. Parks	Well Screen: 44 to 54 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			6	100	1.4		ML	(31-35') Silt, moderate yellowish-brown in color mottled with very fine, very light gray colored sand. Dark yellowish-orange staining and iron-manganese nodules are present near 35'.	232.5
					1.4		ML		
35					1.4		SW	(35-36.5') Sand, very fine-grained, very light gray in color mottled with dark yellowish-orange material. Wet.	228.5
							SW GW	Contains some coarse dark yellowish-orange sand from 36' to 36.5'.	227
					2.4		SW GW	(36.5-37') Sand (medium to very coarse-grained) and gravel. Moderate yellowish-brown to dark yellowish-orange in color.	226.5
			7	100			CL	(37-39') Sandy clay, moderate yellowish-brown to dark yellowish- orange in color mottled with very light gray-colored material. Becomes mostly pale yellowish-brown in color near 39'.	224.5
					2.6		SM	Top of Fluvial Deposits estimated at 39'.	223.5
40								(39-40') Silty sand, medium to coarse-grained, with scattered gravel. Moderate yellowish-brown to dark yellowish-orange. Wet.	
			8	100				No description available; collected a Shelby tube sample from 40' to 43'.	
					1.4		SW GW	(43-44.5') Sand, fine to very coarse-grained, moderate yellowish-brown to dark yellowish-orange, and gravel, up to .75" in longest dimension, angular to rounded, composed of quartz and chert, wet.	220.5
			9	125			SW GW		219
45					1.2				

WELL DIAGRAM: 2" ID, Sch. 40 PVC Casing

GAMMA RAY LOG

COUNTS PER SECOND



CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/23/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 59
OLD PESTICIDE SHOP

DWG DATE: 12/10/96 | DWG NAME: 94GL593B

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

EnSafe/Allen & Hoshall

Monitoring Well 059G03UF

Project: NSA Memphis	Location: Millington,TN.SWMU #59(Old Pesticide Shop)
Project No.: 0106-08420	Surface Elevation: 263.51 feet msl
Started at 1337 on 3-4-96	TOC Elevation: 263.32 feet msl
Completed at 1457 on 3-4-96	Depth to Groundwater:14.63 feet Measured: 4/8/96
Drilling Method: Rotasonic-4" inner core barrel/6" OD casing	Groundwater Elevation:248.69 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 56 feet
Geologist: D. Ladd, W. Parks	Well Screen: 44 to 54 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
					1.2		SW GW	(44.5–47.5') Sand, coarse to very coarse-grained, moderate yellowish- brown to dark yellowish-orange, and gravel, up to 2.5" in longest dimension, composed mostly of angular chert, wet.	216
							SW GW	(47.5–48') Sand, fine to coarse-grained, very light gray and mottled with dark yellowish-orange, and gravel, up to 1.5" in longest dimension, composed mostly of angular to rounded quartz and chert, wet.	215.5
					1.0		SW		214.5
50							SW GW	(48–49') Sand, fine to medium-grained, with rare quartz gravel. Yellowish-gray in color mottled with dark yellowish-orange material, slightly micaceous, wet.	
			10	130	1.6			(49–51.5') Sand (fine to coarse-grained) and gravel (mostly quartz and chert); dark yellowish-orange in color mottled with yellowish-gray material; micaceous; wet.	212
					1.6		SW GW	(51.5–53.5') Sand, fine to very coarse-grained, and gravel (quartz and chert) is up to .75" in longest dimension; yellowish-gray and wet.	210
55					0.8		SW	(53.5–56') Sand, fine to medium-grained, with rare gravel. Yellowish- gray color, micaceous, wet.	
								Terminated soil boring at 56'.	207.5
60									

WELL DIAGRAM: 0.01 slot, PVC screen; 3" PVC end cap

GAMMA RAY LOG
COUNTS PER SECOND

CASING TYPE: 2" PVC
TOP OF LOG = GROUND SURFACE
DATE LOGGED: 05/23/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 59
OLD PESTICIDE SHOP

DWG DATE: 12/10/96 | DWG NAME: 94GL593C

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

TRI STATE
TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 03/22/96 **Project No.: E-3-157**

Client's Project No.: 0106090000

Sample I.D.: 0059S03UF15

Soil Description: Brown & Gray Clayey Silt

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	139.4	139.9
Dry Density (Lbs/ft^3)	107.6	107.7
Moisture (% Dry Wt)	29.5	29.9
Porosity (n)	.36	.34
Degree of Saturation (%)	.99	1.0
Specific Gravity (ASTM D-854)	2.66	---

Permeability

Temperature Correction, $R_t = 1.008$

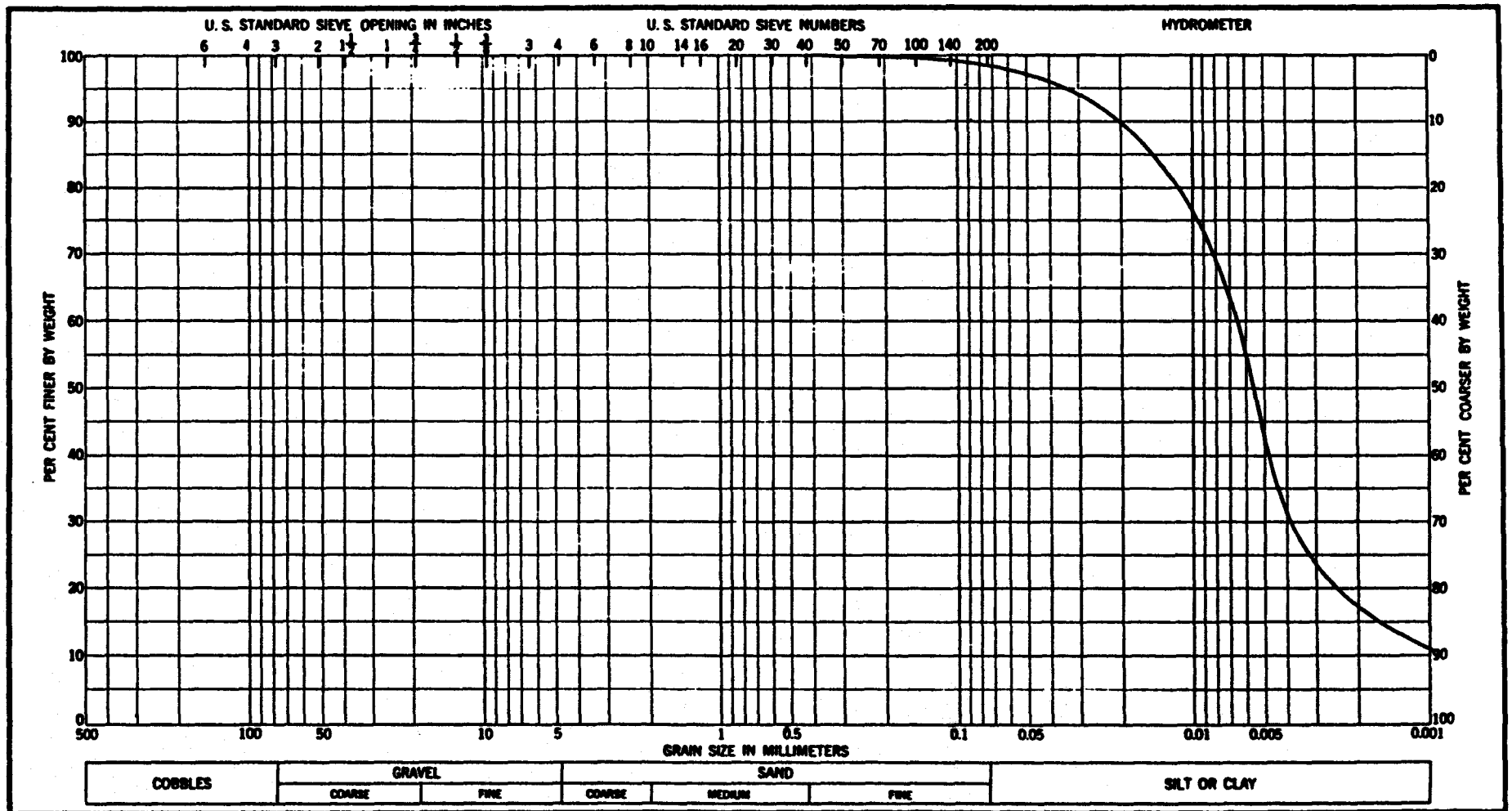
$K_1 = 6.0 \times 10^{-7}$ cm/sec
$K_2 = 4.1 \times 10^{-7}$ cm/sec
$K_3 = 7.2 \times 10^{-7}$ cm/sec
$K_4 = 5.5 \times 10^{-7}$ cm/sec

Coefficient of Permeability, $K_{20} = 5.7 \times 10^{-7}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-017 **Reviewed By:** David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 Fax 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
059S03UF15			30	--	--	--

GRADATION CURVES

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 03/22/96

GEOLOGICAL LOGGING SYSTEMS

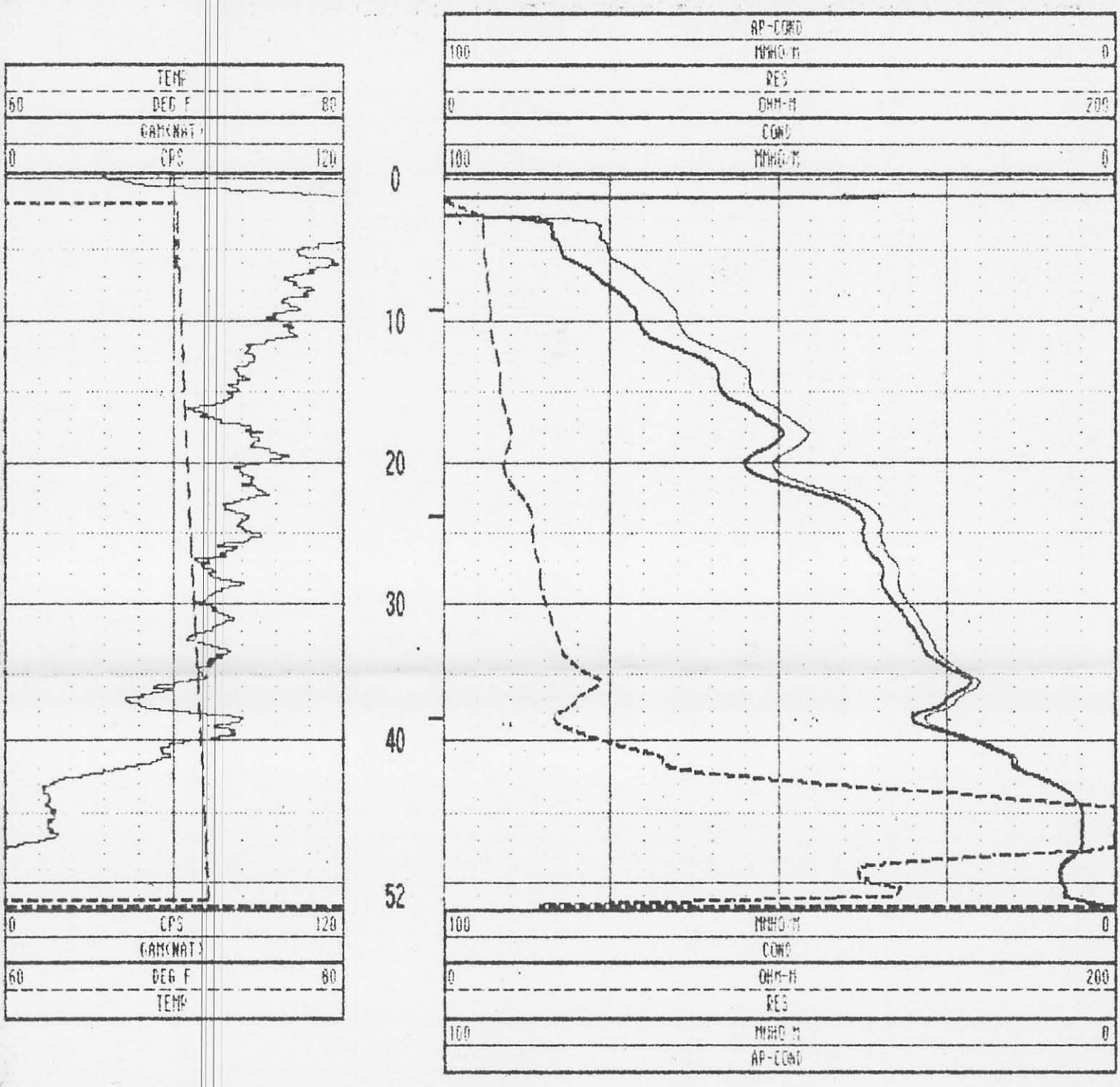
059G03UF

COMPANY	: ENSAFE,ALLEN & HOSHALL			OTHER SERVICES:	
WELL	: 059G03UF			9511	
LOCATION/FIELD	: NAS MEMPHIS			RUN ONE	
COUNTY	: SHELBY			OPEN	
STATE	: TENNESSEE				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 05/22/96	PERMANENT DATUM	: GL	ELEVATIONS	
DEPTH DRILLER	: 50	ELEV. PERM. DATUM:		KB	:
LOG BOTTOM	: 52.00	LOG MEASURED FROM:	GL	DF	: -
LOG TOP	: -2.50	DRL MEASURED FROM:	GL	GL	: 263.5
CASING DRILLER	: 50	LOGGING UNIT	: 05		
CASING TYPE	: PVC	FIELD OFFICE	: BLUEFIELD		
CASING THICKNESS:	.25	RECORDED BY	: J T GILBERT		
BIT SIZE	: 8	BOREHOLE FLUID	: WATER	FILE	: ORIGIN
MAGNETIC DECL.	: -	RM	:	TYPE	: 9511C
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:	LOG	: 8
FLUID DENSITY	: 1.2	MATRIX DELTA T	:	PLOT	: 9510C
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:	THRESH	: 9000

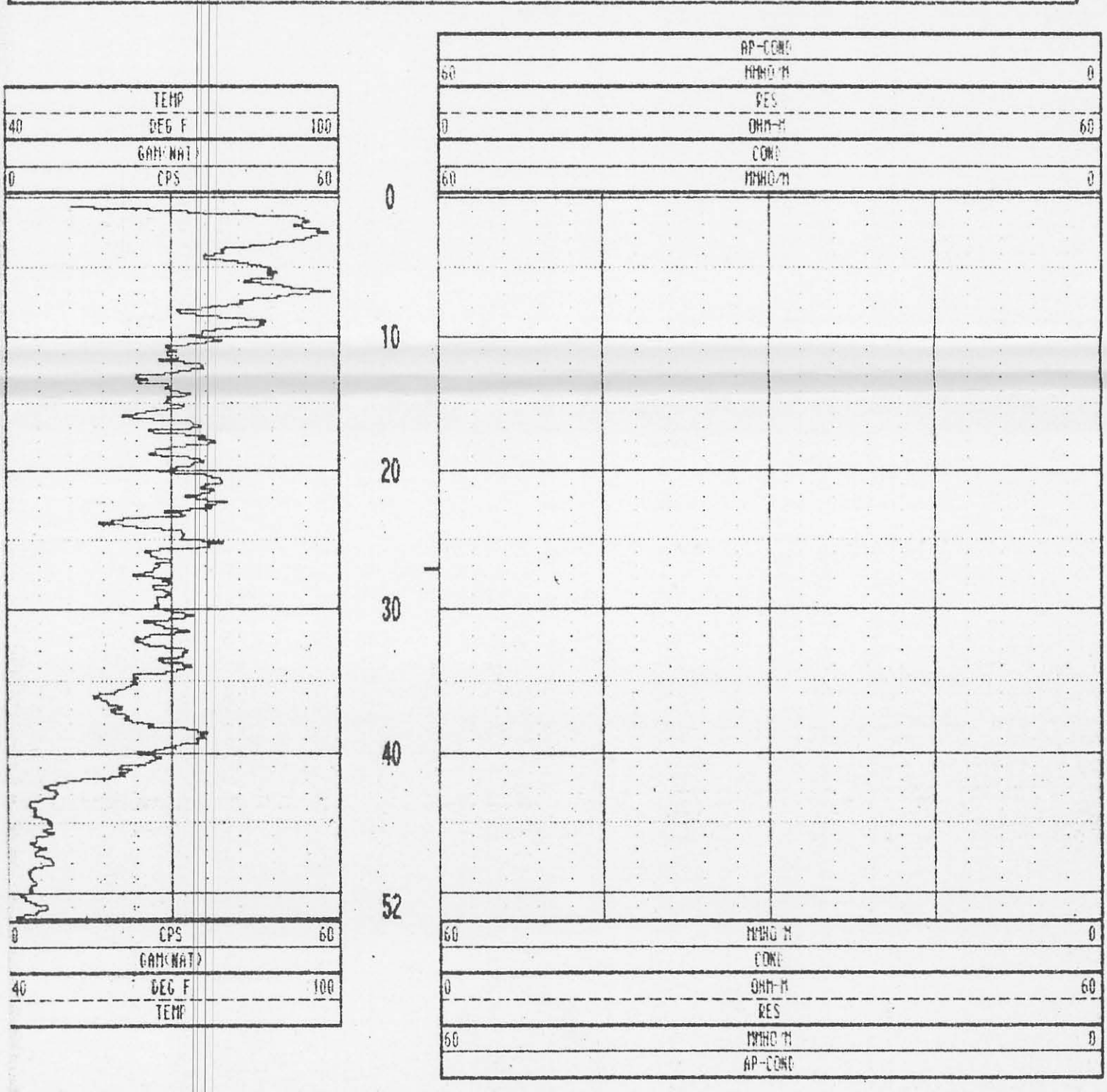
REMARKS :

ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



059G03UF 05/22/96 976



059G03UF 05/22/96 1025

TRI STATE
TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 03/22/96 **Project No.:** E-3-157

Client's Project No.: 0106090000

Sample I.D.: 059S03UF43

Soil Description: Brown Sandy Gravel

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	136.7	148.7
Dry Density (Lbs/ft^3)	115.7	130.0
Moisture (% Dry Wt)	18.2	14.4
Porosity (n)	.30	.22
Degree of Saturation (%)	.97	1.0
Specific Gravity (ASTM D-854)	2.65	---

Permeability

Temperature Correction, $R_t = 1.043$

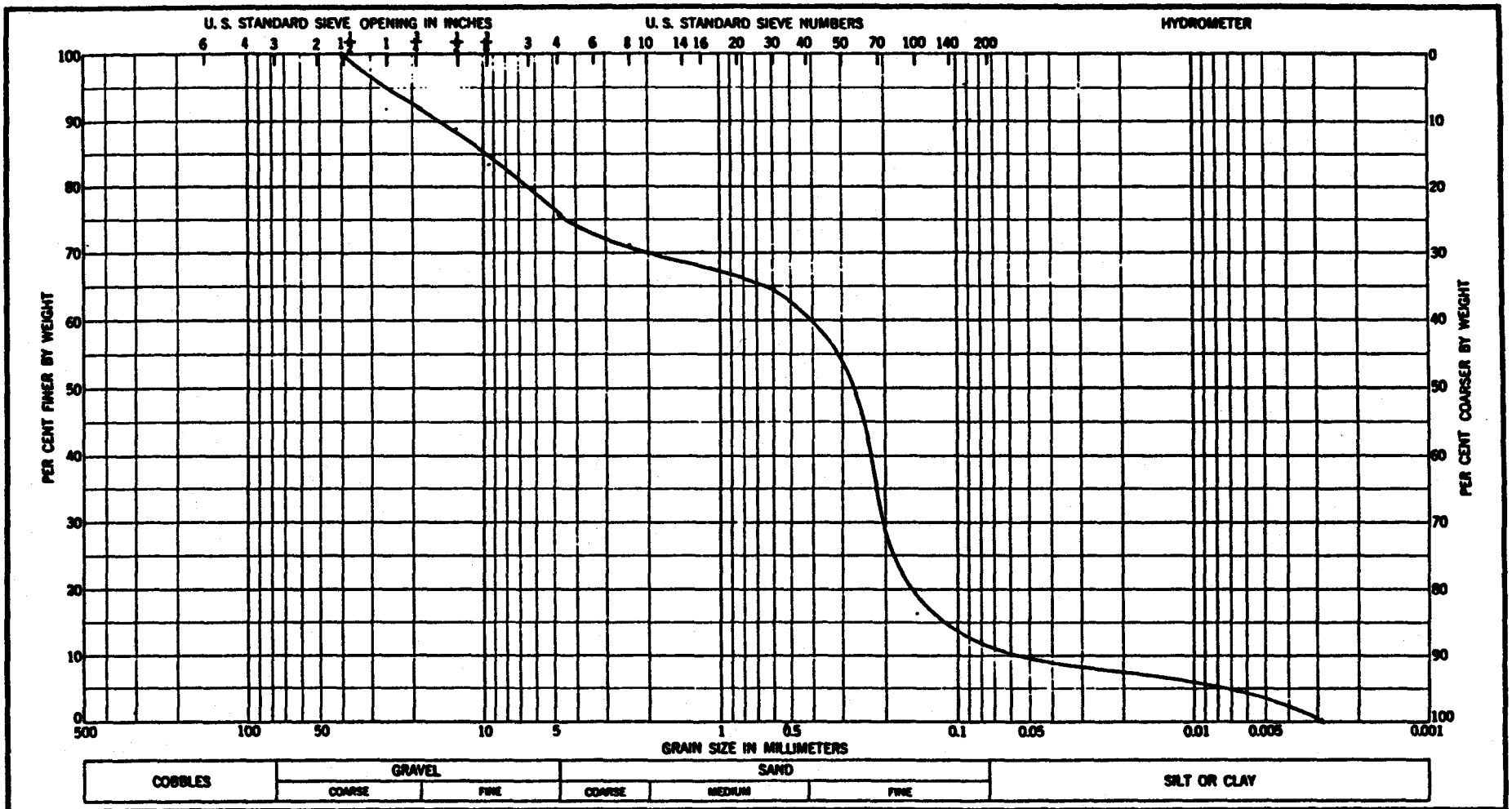
$K_1 = 1.4 \times 10^{-4}$ cm/sec
$K_2 = 2.7 \times 10^{-4}$ cm/sec
$K_3 = 4.3 \times 10^{-4}$ cm/sec
$K_4 = 1.5 \times 10^{-4}$ cm/sec

Coefficient of Permeability, $K_{20} = 2.6 \times 10^{-4}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-018 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 FAX 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
059S03UF43	40-43'		18	--	--	--

GRADATION CURVES

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 03/22/96

NAVY CLEAN
ENSAFE/ALLEN & HOSHALL
(901) 383-9115

CHAIN OF CUSTODY RECORD

PAGE 1 OF 1

CLIENT EnSafe
ADDRESS 5724 Summer Trees Dr.
PROJECT NAME/NUMBER 0106.09000
MEDIA STATUS: (A, B, OR C) _____

PROJECT MANAGER A. Choate
TELEPHONE NO. 9013727962
FAX. NO. 3722454
SAMPLERS: (SIGNATURE) Alison Choate

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION TEMP.	PRESERVATION CHEMICAL	NO. OF CONTAINERS	ANALYSIS REQUIRED: Hydraulic Conductivity	Porosity	Bulk Density	Particle Size	Percent Moisture	Specific Gravity	REMARKS
0595MW0315	3/4/96	1400	soil	3" dia. Shelby Tube	-	-	1	X	X	X	X	X	X	X	
0595MW0343	3/4/96	1422	soil	3" dia. Shelby Tube	-	-	1	X	X	X	X	X	X	X	

RELINQUISHED BY:	DATE	RELINQUISHED BY:	DATE	RELINQUISHED BY:	DATE	RELINQUISHED BY:	DATE
SIGNATURE Alison Choate	3/4/96	SIGNATURE		SIGNATURE		SIGNATURE	
PRINTED Alison Choate	TIME	PRINTED	TIME	PRINTED	TIME	PRINTED	TIME
COMPANY EnSafe	1700	COMPANY		COMPANY		COMPANY	
REASON Analysis		REASON		REASON		REASON	

METHOD OF SHIPMENT: direct
SHIPMENT NO. transport.
SPECIAL INSTRUCTION: _____

COMMENTS: _____

AFTER ANALYSIS, SAMPLES ARE TO BE:
- ☐ DISPOSED OF (ADDITIONAL FEE)
- ☐ STORED (90 DAYS MAX)
- ☐ STORED OVER 90 DAYS (ADDITIONAL FEE)
- ☐ RETURNED TO CUSTOMER

SWMU 65

SOIL BORING/MONITORING WELL LOGS
AND
GEOTECHNICAL LABORATORY RESULTS

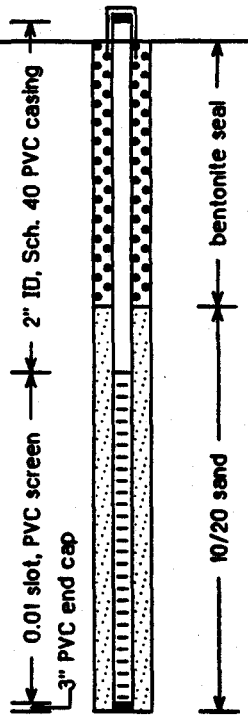
EnSafe/Allen & Hoshall

Monitoring Well 065G05UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #65 (Training Mock-Up Site)*
Project No.: *0106-08420*	Surface Elevation: *264.10 feet msl*
Started at *1230 on 2-17-96*	TOC Elevation: *266.04 feet msl*
Completed at *1320 on 2-17-96*	Depth to Groundwater: *3.99 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *262.05 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *J. Kingsbury*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0					BG		CL	(0-20') Upper Alluvium (see descriptions below). Clay, brownish-gray in color, hard and dry.	
5			1	100	BG				259.1
					BG		ML	Silt. From 5' to 8', is very light brown in color and moist. From 8' to 18', silt is yellowish-brown to yellowish-gray in color, with specks of organic material and some orangish-colored staining.	
10					BG				
					BG				
					BG				
15			2	70	BG				
					BG				
20					BG			At 18', color changes to greenish-gray/olive gray. Very moist to wet with some snail shells present.	244.1
								Terminated soil boring at 20'.	
25									
30									
35									
40									

WELL DIAGRAM



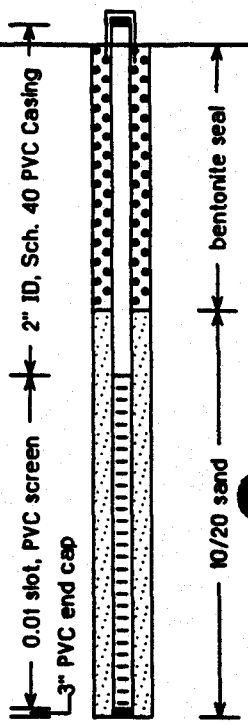
EnSafe/Allen & Hoshall

Monitoring Well 065G06UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #65 (Training Mock-Up Site)*
Project No.: *0106-08420*	Surface Elevation: *264.25 feet msl*
Started at *0930 on 2-17-96*	TOC Elevation: *266.28 feet msl*
Completed at *1045 on 2-17-96*	Depth to Groundwater: *4.90 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *261.38 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *J. Kingsbury*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1				ML	(0-20') Upper Alluvium (see descriptions below).	
								Silt. Light brown to yellowish-brown in color.	262.2
							CL	Clay. Brownish-gray to light brown in color. Hard.	
5									258.2
			2					Silt. Yellowish-gray to yellowish-brown in color. Rare organics with iron-stained haloes around them from 6' to 12'.	
10							ML		
			3					From 12' to 14', increase in orange-colored iron staining and mottling. Silt is yellowish-brown to with some gray, and moist.	250.2
15								No description available; collected Shelby tube sample from 14' to 16' in 65MW06DA.	248.2
							ML	Silt, yellowish-brown with some gray, with orange-colored iron staining and mottling, moist to wet.	
20									244.2
								Terminated soil boring at 20'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent monitoring well 65MW06DA.	
25									
30									
35									
40									

WELL DIAGRAM



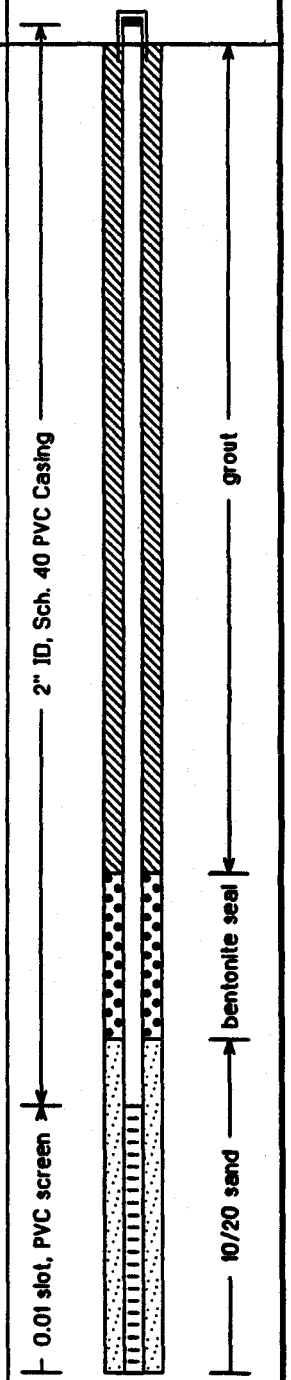
EnSafe/Allen & Hoshall

Monitoring Well 065G06DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #65 (Training Mock-Up Site)*
Project No.: *0106-08420*	Surface Elevation: *264.18 feet msl*
Started at *0815 on 2-17-96*	TOC Elevation: *266.12 feet msl*
Completed at *0930 on 2-17-96*	Depth to Groundwater: *9.62 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *256.50 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *46 feet*
Geologist: *J. Kingsbury*	Well Screen: *32 to 42 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			BG	ML	(0-29') Upper Alluvium (see descriptions below).	
	1	25	BG		Silt. Light brown to yellowish-brown in color.	262.2
5			BG	CL	Clay. Brownish-gray to light brown in color. Hard.	
			BG			258.2
			BG		Silt. Yellowish-gray to yellowish-brown in color. Rare organics with iron-stained haloes around them from 6' to 12'.	
10	2	120	BG	ML		
			BG		From 12' to 14', increase in orange-colored iron staining and mottling. Silt is yellowish-brown to with some gray, and moist.	250.2
15	3	100			No description available; collected Shelby tube sample from 14' to 16'.	248.2
			BG		Silt, yellowish-brown with some gray, with orange-colored iron staining and mottling, moist to wet.	
			BG			
20	4	90	BG		From 20' to 34', clayey silt, olive gray to brownish-gray, with some snail shells, moist.	
			BG			
			BG	ML		
25			BG			
			BG		With lenses of sand from 28' to 34'.	
			BG			
30			BG		Top of Deeper Alluvium deposits estimated at 29'.	
	5	83	BG			
			BG			230.2
35			BG	SW	Sand, dusky yellow to olive gray, with gravel up to 1" in longest dimension. Percentage of gravel increases with depth to 38'.	
			BG			228.2
	6	100			No description available; collected Shelby tube sample from 38' to 40'.	
40				SW GW		224.2

WELL DIAGRAM



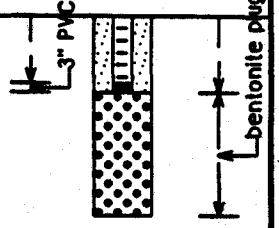
EnSafe/Allen & Hoshall

Monitoring Well 065G06DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #65 (Training Mock-Up Site)*
Project No.: *0106-08420*	Surface Elevation: *264.18 feet msl*
Started at *0815 on 2-17-96*	TOC Elevation: *266.12 feet msl*
Completed at *0930 on 2-17-96*	Depth to Groundwater: *9.62 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *256.50 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *46 feet*
Geologist: *J. Kingsbury*	Well Screen: *32 to 42 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
					BG		SW GW	Sand and gravel.	224.2
			7	125	BG		CL	Cockfield Formation: Brown stiff clay with fine-grained sand interbeds.	222.2
45					BG				
								Terminated soil boring at 46'.	218.2
50									
55									
60									
65									
70									
75									
80									

WELL DIAGRAM



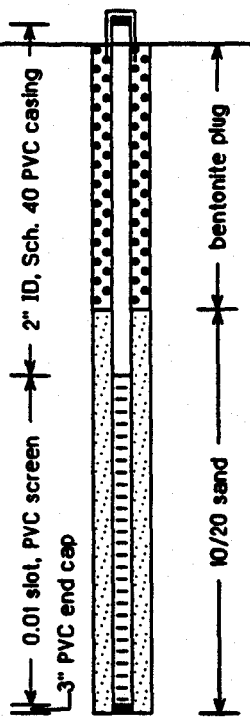
EnSafe/Allen & Hoshall

Monitoring Well 065G07UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #65 (Training Mock-Up Site)*
Project No.: *0106-08420*	Surface Elevation: *262.85 feet msl*
Started at *1100 on 2-17-96*	TOC Elevation: *264.86 feet msl*
Completed at *on 2-17-96*	Depth to Groundwater: *4.13 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *260.73 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *J. Kingsbury*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0					BG		ML	(0-20') Upper Alluvium (see descriptions below).	
					BG			Fill material is present from 0' to 2'. Silt with some gravel, brown in color.	260.9
5			1	100	BG		CL	Clay, brown in color, hard and dry.	
					BG				
					BG				253.9
10					BG			Silt, yellowish-gray to yellowish-brown in color, moist.	
					BG			Some mottling with dark yellowish-orange stained material from 10' to 20'.	
15			2	70	BG		ML		
					BG				
					BG			Silt exhibits a color change near 20' to olive gray/greenish-gray.	
20									242.9
								Terminated soil boring at 20'.	
25									
30									
35									
40									

WELL DIAGRAM



GEOLOGICAL LOGGING SYSTEMS

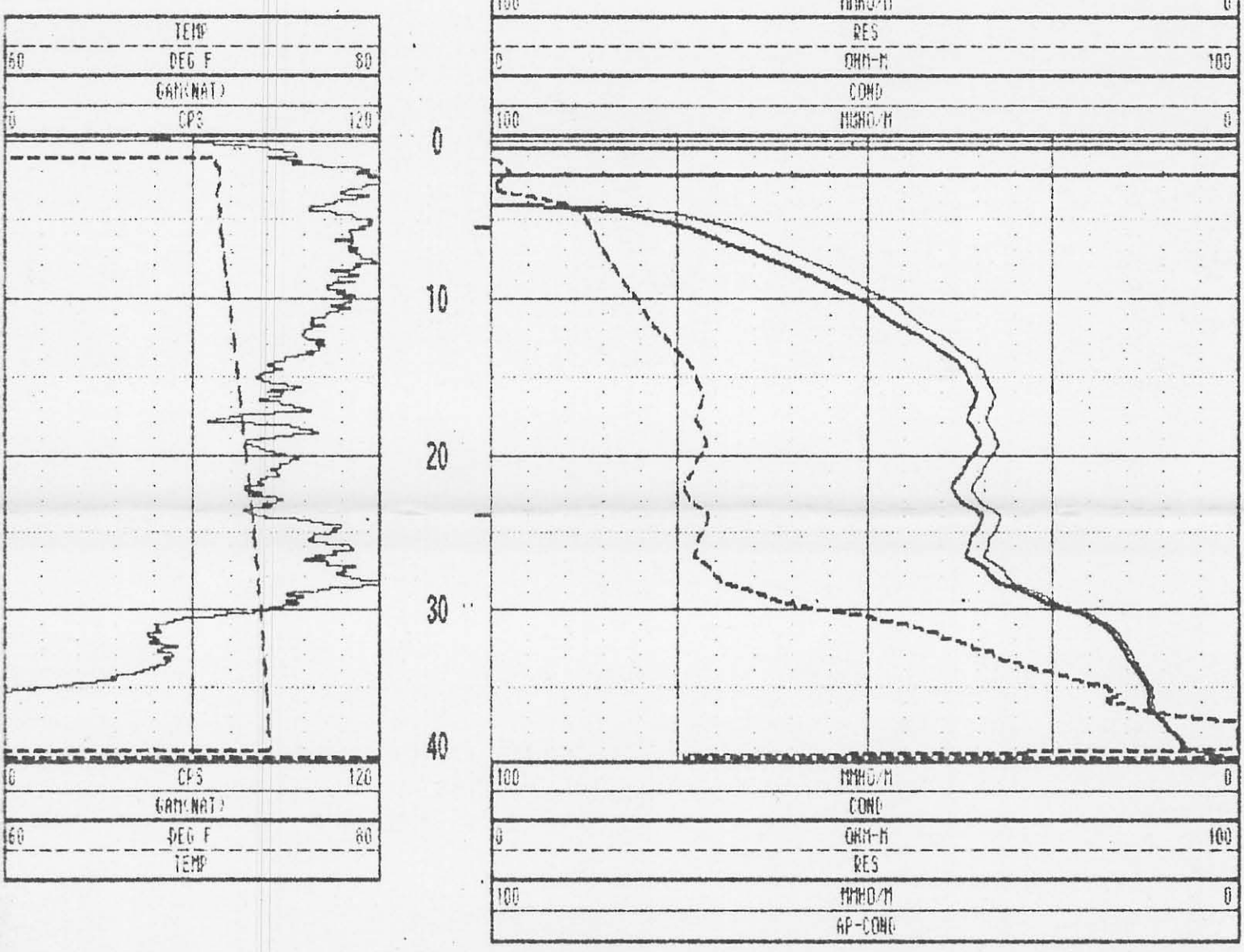
065G06DA

COMPANY	: ENSAFE,ALLEN & HOSHALL				OTHER SERVICES:	
WELL	: 065G06DA				9511	
LOCATION/FIELD	: NAS MEMPHIS				RUN TWO	
COUNTY	: SHELBY				OPEN	
STATE	: TENNESSEE					
SECTION	:	TOWNSHIP	:		RANGE :	
DATE	: 05/23/96	PERMANENT DATUM	:	GL	ELEVATIONS	
DEPTH DRILLER	: 42	ELEV. PERM. DATUM:			KB	:
LOG BOTTOM	: 39.80	LOG MEASURED FROM:		GL	DF	: -
LOG TOP	: -3.20	DRL MEASURED FROM:		GL	GL	: 264.2
CASING DRILLER	: 42	LOGGING UNIT	:	05		
CASING TYPE	: PVC	FIELD OFFICE	:	BLUEFIELD		
CASING THICKNESS	: .25	RECORDED BY	:	J T GILBERT		
BIT SIZE	: 8	BOREHOLE FLUID	:	WATER	FILE	: ORIGIN
MAGNETIC DECL.	: -	RM	:		TYPE	: 9511C
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:		LOG	: 2
FLUID DENSITY	: 1.2	MATRIX DELTA T	:		PLOT	: 9510C
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:		THRESH	: 9000

REMARKS :

ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



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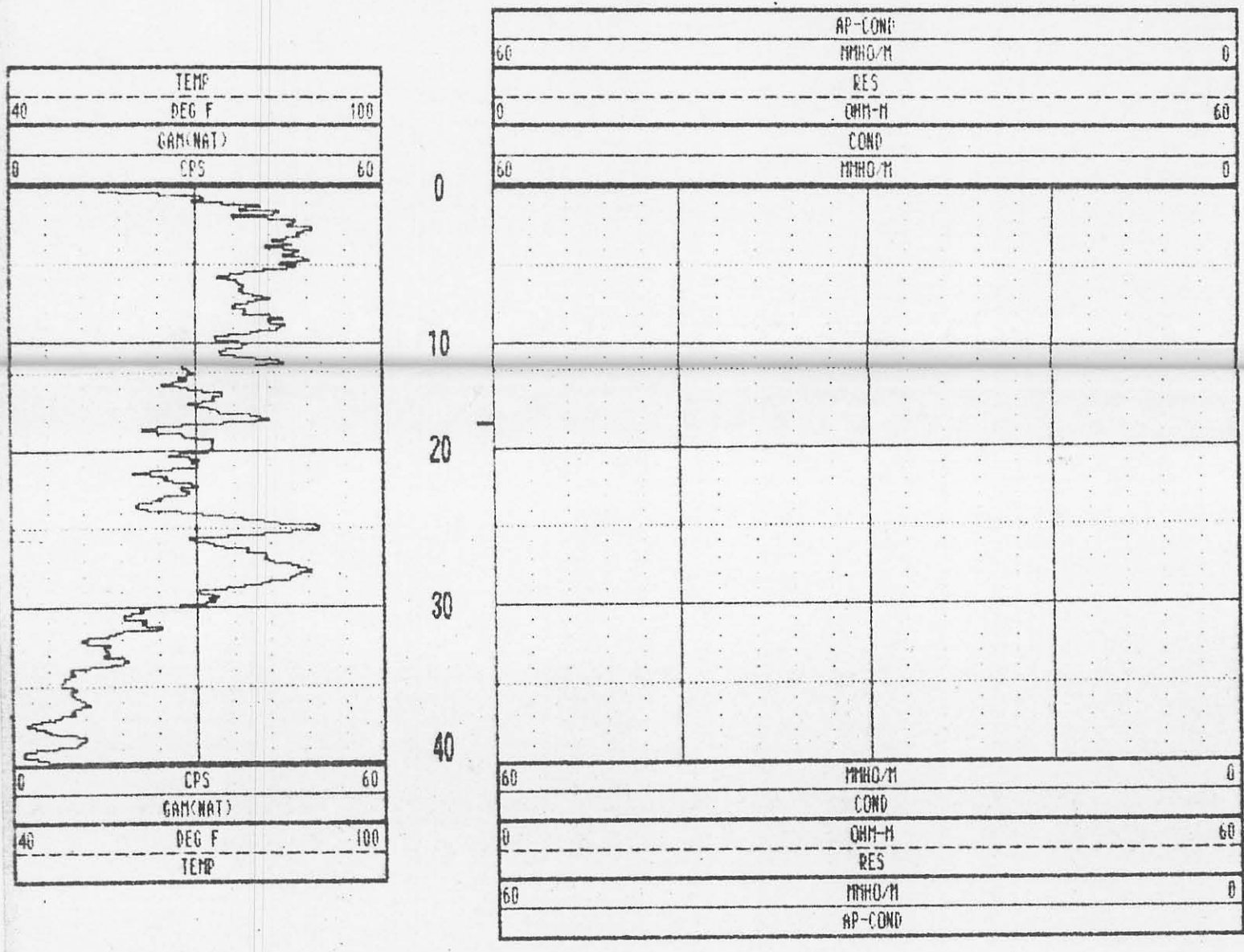

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Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-02-UF~~ OBG02UF

Project: *NAS Memphis*	Location: *Millington, TN. Background Site #2*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *0745 on 1-17-95*	TOC Elevation: *feet msl*
Completed at *0845 on 1-17-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *46.0 feet*
Geologist: *Jack Carmichael and William Parks*	Well Screen: *36 to 46 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
45			7	90	BG		GP	Same as above but dark yellowish orange.		10/20 sand
								Log information taken form the boring for the lower fluvial well BG-2.		
50										
55										
60										
65										
70										
75										
80										

ENSAFE

Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-04-S~~ OBGG04LS

Project: *NAS Memphis*	Location: *Memphis, TN*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *1000 on 1-11-95*	TOC Elevation: *feet msl*
Completed at *1115 on 1-11-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *20.0 feet*
Geologist: *Jack Carmichael*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
0								Fill and debris.		
5			1	100	BG			Silty clay, pale olive with reddish brown mottling, stiff.		
10							ML	Clayey silt, yellow gray to yellow brown, mottled with reddish brown.		
			2	100	BG			Clayey silt, yellow gray to yellow brown mottled yellowish orange, laminated, low plasticity.		
15										
20			3	100	BG			Log information taken from the boring for the lower fluvial well bg-4.		
25										
30										
35										
40										

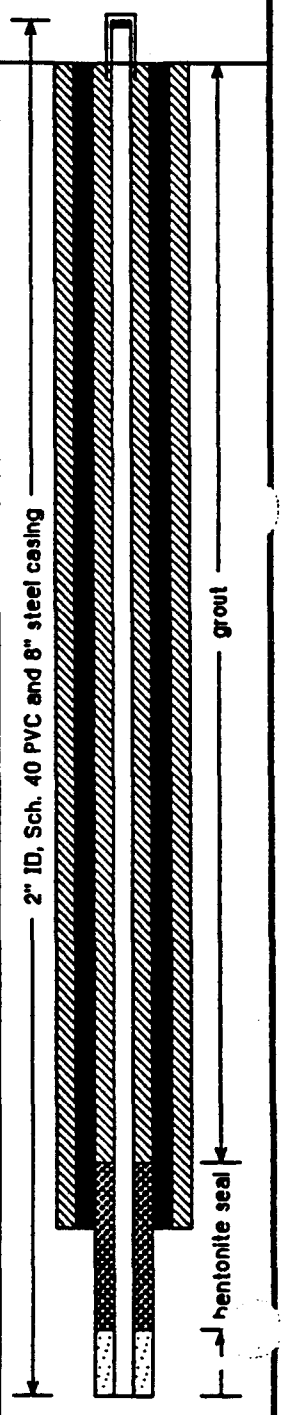
WELL DIAGRAM: 0.01 slot, PVC screen; 10/20 sand; grout; bentonite seal

Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-04-UF~~ OBGG04UF

Project: *NAS Memphis*	Location: *Millington, TN. Background Site #4*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *1000 on 1-16-95*	TOC Elevation: *feet msl*
Completed at *1115 on 1-16-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *50.0 feet*
Geologist: *Jack Carmichael*	Well Screen: *40 to 50 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
								Fill and debris.	
5			1	100	BG			Silty clay, pale olive with reddish brown mottling, stiff.	
10								Clayey silt, yellow gray to yellow brown, mottled with reddish brown.	
			2	100	BG			Clayey silt, yellow gray to yellow brown mottled yellowish orange, laminated, low plasticity.	
15									
20			3	100	BG		ML	Silt, medium gray, massive, low plasticity, traces of iron inclusions.	
25								Silt, clayey, medium gray stained yellowish orange, plastic.	
			4	100	BG				
30								Silt, clayey, yellow gray to olive gray.	
35			5	100	BG				
40							GP	Sand, silty, with gravel, yellowish gray to yellowish brown, mottled yellow orange, moist to wet	



Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-04-UF~~ OBGG04UF

Project: *NAS Memphis*	Location: *Millington, TN. Background Site #4*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *1000 on 1-16-95*	TOC Elevation: *feet msl*
Completed at *1115 on 1-16-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *50.0 feet*
Geologist: *Jack Carmichael*	Well Screen: *40 to 50 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
45			6	108	BG		GP	Gravel, sandy, fine to very coarse sand, traces of silt, wet, yellow gray.		0.01 slot, PVC screen; 10/20 sand
			7	100	BG					
50								Log information taken from the boring for the lower fluvial well bg-4.		
55			8	90	BG					
60										
65										
70										
75										
80										

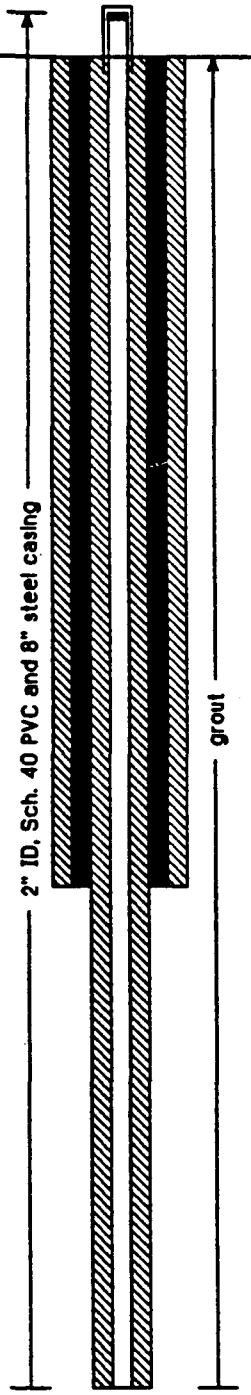
Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-02-LF~~ OBG-G02LF

Project: *NAS Memphis*	Location: *Millington, TN. Background Site #2*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *0745 on 1-17-95*	TOC Elevation: *feet msl*
Completed at *0845 on 1-17-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *87.0 feet*
Geologist: *Jack Carmichael and William Parks*	Well Screen: *67 to 77 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0								Fill and roots.	
5			1	75	BG			Silt, clayey, yellow brown to gray brown, moist, soft.	
10			2	50	BG			Silt, clayey, yellow gray to olive gray, stained yellow orange, laminated with orange to brown thin striations.	
15			3	87.5	BG		ML		
20			4	75	BG				
25			5	100	BG			Silt, clayey, light olive gray to yellow gray with iron staining, trace gravel. Silt, clayey, light olive gray, less iron staining.	
30								Sand, silty, trace clay, some gravel, yellow brown to gray brown. Sand, medium to coarse with gravel, orange brown to yellow.	
35			6	108	BG		GP	Sand, fine, with trace gravel, grayish pink to grayish orange, some yellow orange mottling.	
40									

WELL DIAGRAM



Environmental & Safety Designs, Inc.

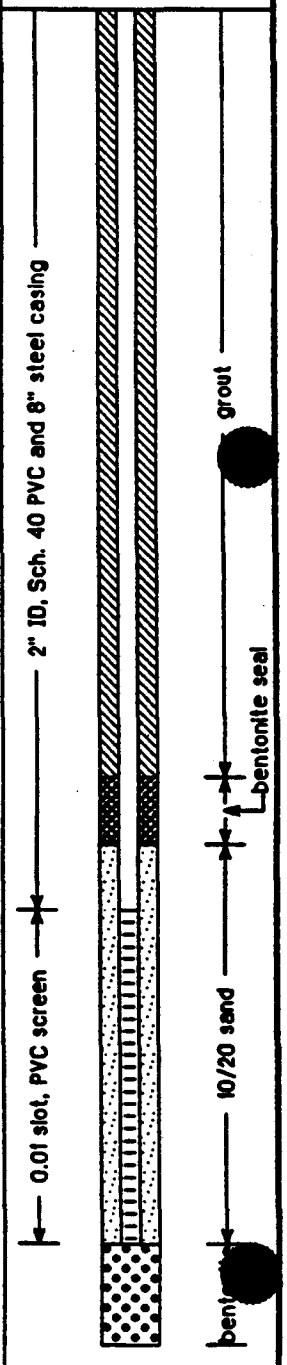
Monitoring Well BG-02-LF

OBGG02LF

Project: *NAS Memphis*	Location: *Millington, TN. Background Site #2*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *0745 on 1-17-95*	TOC Elevation: *feet msl*
Completed at *0845 on 1-17-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *87.0 feet*
Geologist: *Jack Carmichael and William Parks*	Well Screen: *67 to 77 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
45			7	90	BG			Same as above but dark yellowish orange. Sand, gravelly, silty, dark yellowish orange, wet.	
50									
55			8	100	BG		GP	Sand, very fine to fine, silty, traces of clay, yellowish gray to grayish orange.	
60									
65			9	105	BG				
70									
75			10	120	BG		SC	Sand, fine, clayey and silty, moderate gray to brownish gray, laminated, soft to stiff.	
80									

WELL DIAGRAM



Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-02-LF~~ OBGG02LF

Project: *NAS Memphis*	Location: *Millington, TN. Background Site #2*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *0745 on 1-17-95*	TOC Elevation: *feet msl*
Completed at *0845 on 1-17-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *87.0 feet*
Geologist: *Jack Carmichael and William Parks*	Well Screen: *67 to 77 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
85			11	100	BG		SC	End of boring at 87'.		bentonite
90										
95										
100										
105										
110										
115										
120										

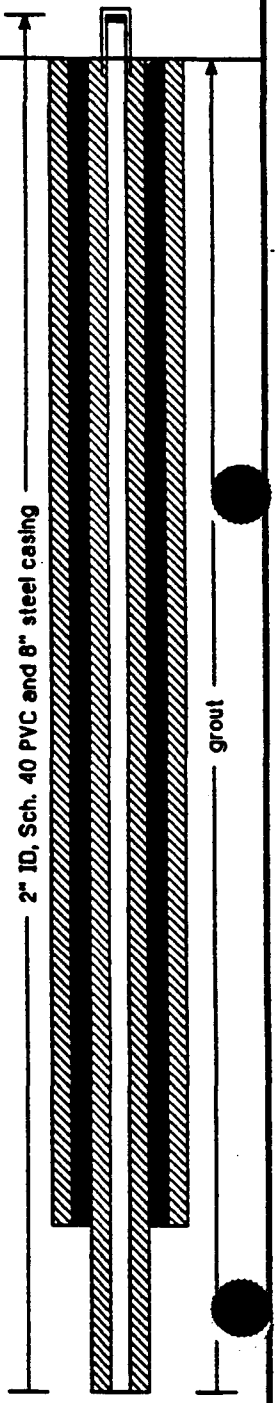
Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-04-LF~~ OBGG04LF

Project: *NAS Memphis*	Location: *Millington, TN: Background Site #4*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *1000 on 1-11-95*	TOC Elevation: *feet msl*
Completed at *1115 on 1-11-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *76.0 feet*
Geologist: *Jack Carmichael*	Well Screen: *60 to 70 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0								Fill and debris.	
5			1	100	BG			Silty clay, pale olive with reddish brown mottling, stiff.	
10								Clayey silt, yellow gray to yellow brown, mottled with reddish brown.	
			2	100	BG			Clayey silt, yellow gray to yellow brown mottled yellowish orange, laminated, low plasticity.	
15									
20			3	100	BG		ML	Silt, medium gray, massive, low plasticity, traces of iron inclusions.	
25								Silt, clayey, medium gray stained yellowish orange, plastic.	
			4	100	BG				
30								Silt, clayey, yellow gray to olive gray.	
35			5	100	BG				
40							GP	Sand, silty, with gravel, yellowish gray to yellowish brown, mottled yellow orange, moist to wet.	

WELL DIAGRAM



Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-04-LE~~ OBGG04LF

Project: *NAS Memphis*	Location: *Millington, TN. Background Site #4*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *1000 on 1-11-95*	TOC Elevation: *feet msl*
Completed at *1115 on 1-11-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *76.0 feet*
Geologist: *Jack Carmichael*	Well Screen: *60 to 70 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			6	108	BG			Gravel, sandy, fine to very coarse sand, traces of silt, wet, yellow gray.	
45			7	100	BG				
50									
55			8	90	BG		GP	Same as above with color changing to dark yellowish orange to moderate yellowish brown.	
60									
65			9	85	BG				
70								Sand with clay, sand is yellow gray stained yellowish orange, clay light brownish gray, moist to wet.	
							SC	Sand, very fine, clay, medium dark gray, olive black laminations.	
75			10	100	BG			End of boring at 76'	
80									

WELL DIAGRAM

- 2" ID, Sch. 40 PVC and 8" steel casing
- 0.01 slot, PVC screen
- grout
- bentonite seal
- 10/20 sand
- bentonite

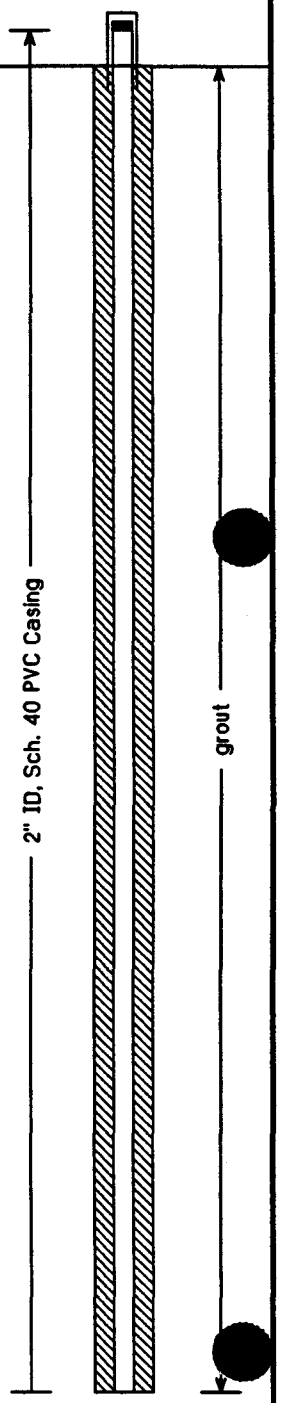
EnSafe/Allen & Hoshall

Monitoring Well OBGG11UA

Project: *NSA Memphis*	Location: *Millington, TN. Background Location #11*
Project No.: *0106-08420*	Surface Elevation: *261.81 feet msl*
Started at *0800 on 3-18-96*	TOC Elevation: *263.84 feet msl*
Completed at *1300 on 3-18-96*	Depth to Groundwater: *16.42 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic*	Groundwater Elevation: *247.42 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *76.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *38 to 48 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
				GP GM	Gravel and silt (fill)	
						259.8
	1	100	BG		Brown silt with some dark yellowish-orange staining and organic flecks	
5					Silt, yellowish brown mottled with yellowish gray, moist	
10	2	90	BG		Silt, olive gray to greenish-gray, wet	
15				ML	Silt, brownish-gray to greenish-gray, wet	
					Large wood fragment	
20					With sand streaks between 22' and 26', wet	
25	3	105	BG			
30						

WELL DIAGRAM



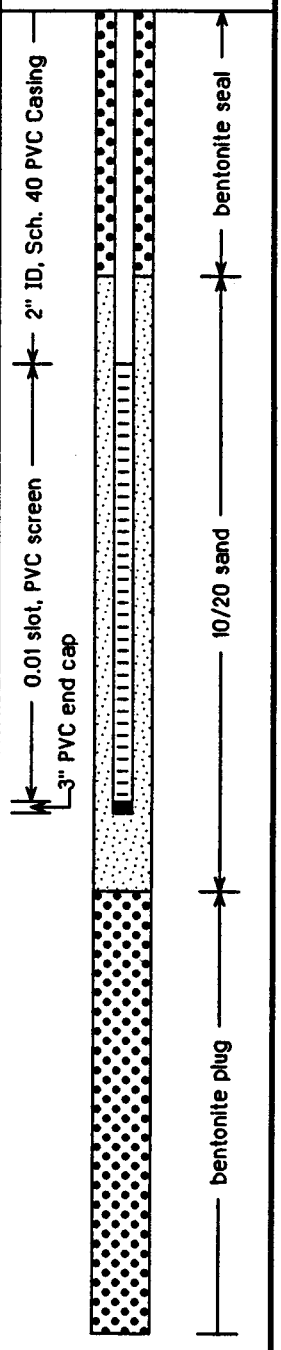
EnSafe/Allen & Hoshall

Monitoring Well OBGG11UA

Project: *NSA Memphis*	Location: *Millington, TN. Background Location #11*
Project No.: *0106-08420*	Surface Elevation: *261.81 feet msl*
Started at *0800 on 3-18-96*	TOC Elevation: *263.84 feet msl*
Completed at *1300 on 3-18-96*	Depth to Groundwater: *16.42 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic*	Groundwater Elevation: *247.42 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *76.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *38 to 48 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
35							ML	With sand streaks between 30' and 36', wet Silt and sand, olive-gray	224.8
40							SW GW	Sand and gravel, reddish-brown to orangish-yellow	217.8
45			4	100	BG		SW	Sand, coarse-grained, with some gravel, grayish-yellow to dusky yellow	209.8
50							GW GC	Gravel with some sand and clay in the matrix, grayish-yellow to 54' turning to reddish-brown at 56'.	205.8
55							SW GW	Sand and gravel, reddish-brown to yellowish-orange	202.8
60							GW	Gravel lense between 59' and 61'	

WELL DIAGRAM



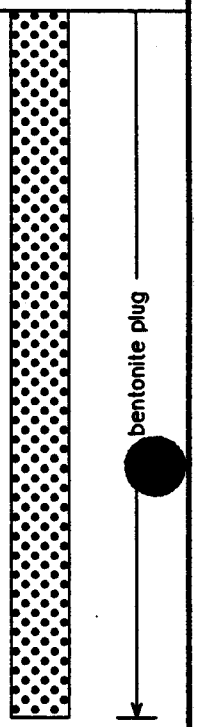
EnSafe/Allen & Hoshall

Monitoring Well OBGG11UA

Project: *NSA Memphis*	Location: *Millington, TN. Background Location #11*
Project No.: *0106-08420*	Surface Elevation: *261.81 feet msl*
Started at *0800 on 3-18-96*	TOC Elevation: *263.84 feet msl*
Completed at *1300 on 3-18-96*	Depth to Groundwater: *16.42 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic*	Groundwater Elevation: *247.42 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *76.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *38 to 48 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			5	100	BG		GW		200.8
65							SW GW	Predominantly sand with several layers of iron-cemented gravel 1" to 2" thick, maximum diameter of gravel is 2"	
									192.8
70			6	120	BG		SP CL	Cockfield Formation: sand, fine-grained and olive-gray, with some seams of brown clay and organic material	
75									185.8
								Soil boring terminated at 76'.	
80									
85									
90									

WELL DIAGRAM



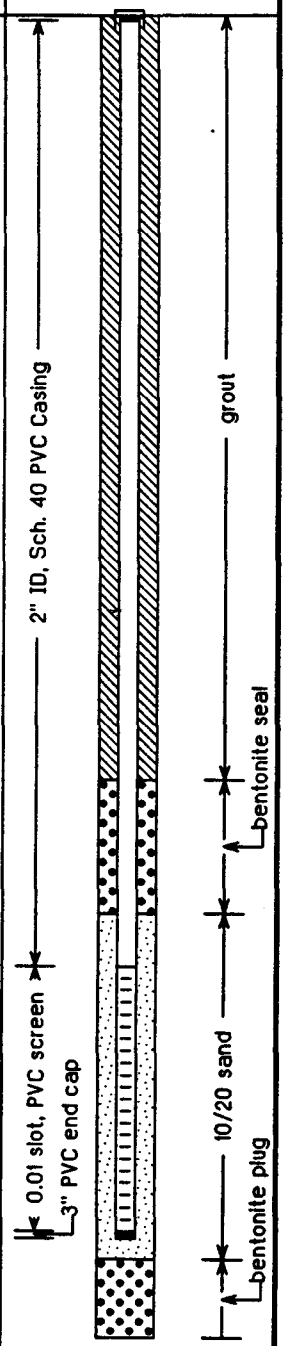
EnSafe/Allen & Hoshall

Monitoring Well OBGG12UF

Project: *NSA Memphis*	Location: *Millington, TN. Background Location #12*
Project No.: *0106-08420*	Surface Elevation: *268.90 feet msl*
Started at *1415 on 2-18-96*	TOC Elevation: *268.71 feet msl*
Completed at *1530 on 2-18-96*	Depth to Groundwater: *9.09 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic*	Groundwater Elevation: *259.62 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *66.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *36 to 46 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0				SP/SC	Asphalt, sand, and clay (fill)	
	1	100	BG			265.9
5				CL/ML	Clay and silt, gray	
						262.9
					Silt, yellowish-brown to yellowish-gray with organic specks and iron staining, moist	
10	2	90	BG	ML		
15						252.9
				CL	Clay with some silt, brownish-gray, stiff	
20						248.9
					Silt, light olive gray with some reddish-brown staining and mottling	
25	3	75	BG	ML		
30						238.9
				SP	Fine sand, tan to yellowish-brown	
						234.9
35				SW	Sand, medium to coarse-grained, reddish-brown to light brown	232.9
					Sand and gravel, reddish-brown, majority of gravel from 40' to 47', with gravel up to 2" diameter	
40				SW/GW		
45	4	100	BG			221.9
				SC/SM	Cockfield Formation: sand, silt, and clay, light olive gray to light yellowish-brown, micaceous, finely lignitic, with streaks of clay throughout	
50						

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well OBGG12UF

Project: *NSA Memphis*	Location: *Millington, TN. Background Location #12*
Project No.: *0106-08420*	Surface Elevation: *268.90 feet msl*
Started at *1415 on 2-18-96*	TOC Elevation: *268.71 feet msl*
Completed at *1530 on 2-18-96*	Depth to Groundwater: *9.09 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic*	Groundwater Elevation: *259.62 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *66.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *36 to 46 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
55										bentonite plug
60			5	80	BG		SC SM			
65									202.9	
								Soil boring terminated at 66.0'.		
70										
75										
80										
85										
90										
95										
100										

TRI STATE
TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 03/01/96 **Project No.:** E-3-157

Client's Project No.: 010609000

Sample I.D.: 065S06DA16

Soil Description: Gray & Brown Clayey Silt

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	124.8	125.6
Dry Density (Lbs/ft^3)	96.5	97.6
Moisture (% Dry Wt)	29.3	28.7
Porosity (n)	.43	.42
Degree of Saturation (%)	1.0	1.0
Specific Gravity (ASTM D-854)	2.70	---

Permeability

Temperature Correction, $R_t = 1.041$

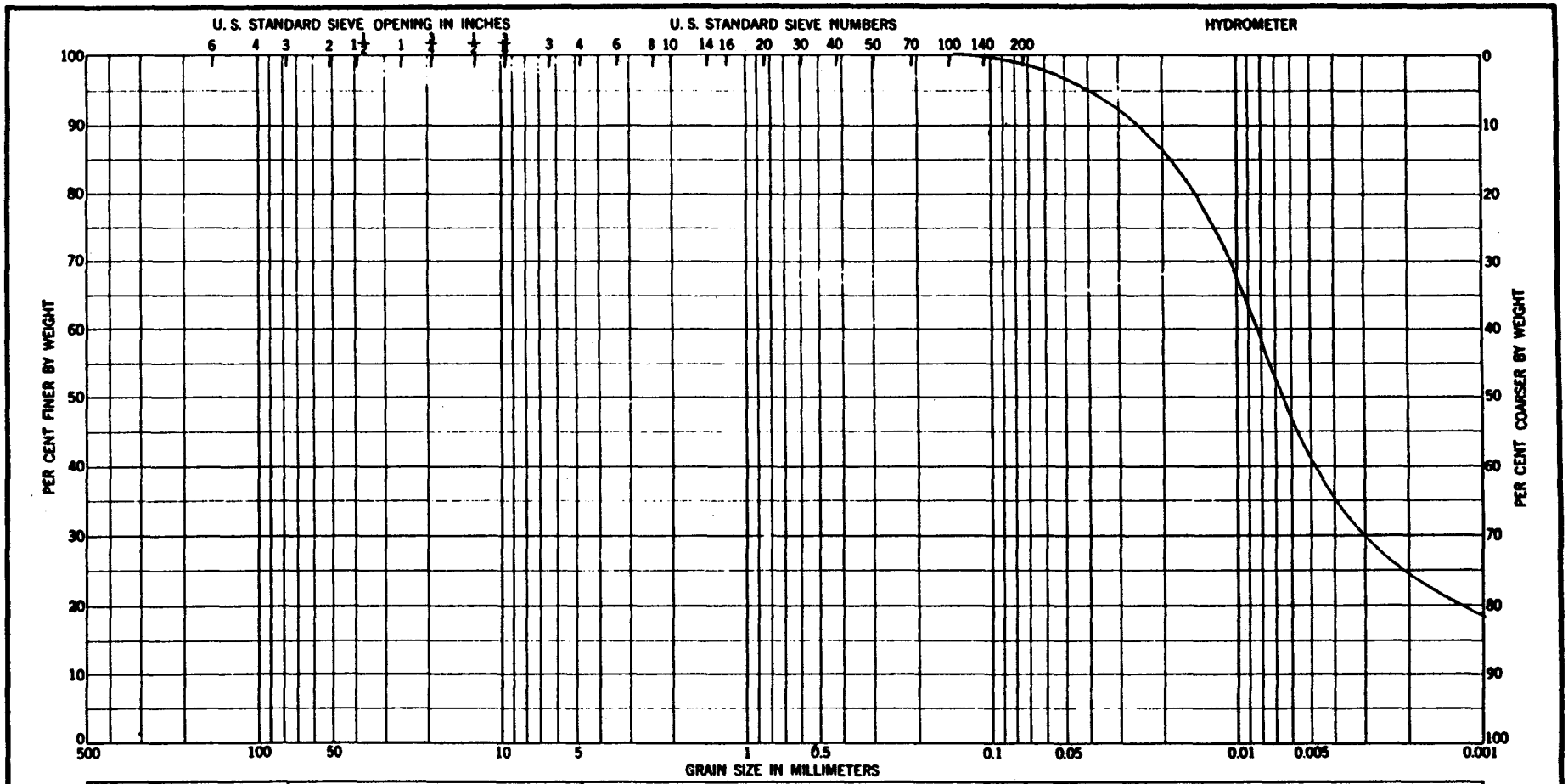
$K_1 = 4.6 \times 10^{-6}$ cm/sec
$K_2 = 4.0 \times 10^{-6}$ cm/sec
$K_3 = 5.1 \times 10^{-6}$ cm/sec
$K_4 = 4.7 \times 10^{-6}$ cm/sec

Coefficient of Permeability, $K_{20} = 4.8 \times 10^{-6}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-012 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 FAX 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
065S06DA16			29			

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 03/01/96

GRADATION CURVES

TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 03/01/96 **Project No.:** E-3-157

Client's Project No.: 0106090000

Sample I.D.: 065S06DA40

Soil Description: Gray gravelly Sand with trace of silt

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	136.9	137.4
Dry Density (Lbs/ft^3)	127.8	120.6
Moisture (% Dry Wt)	7.1	13.9
Porosity (n)	.20	.24
Degree of Saturation (%)	.71	1.0
Specific Gravity (ASTM D-854)	2.57	---

Permeability

Temperature Correction, $R_t = 1.000$

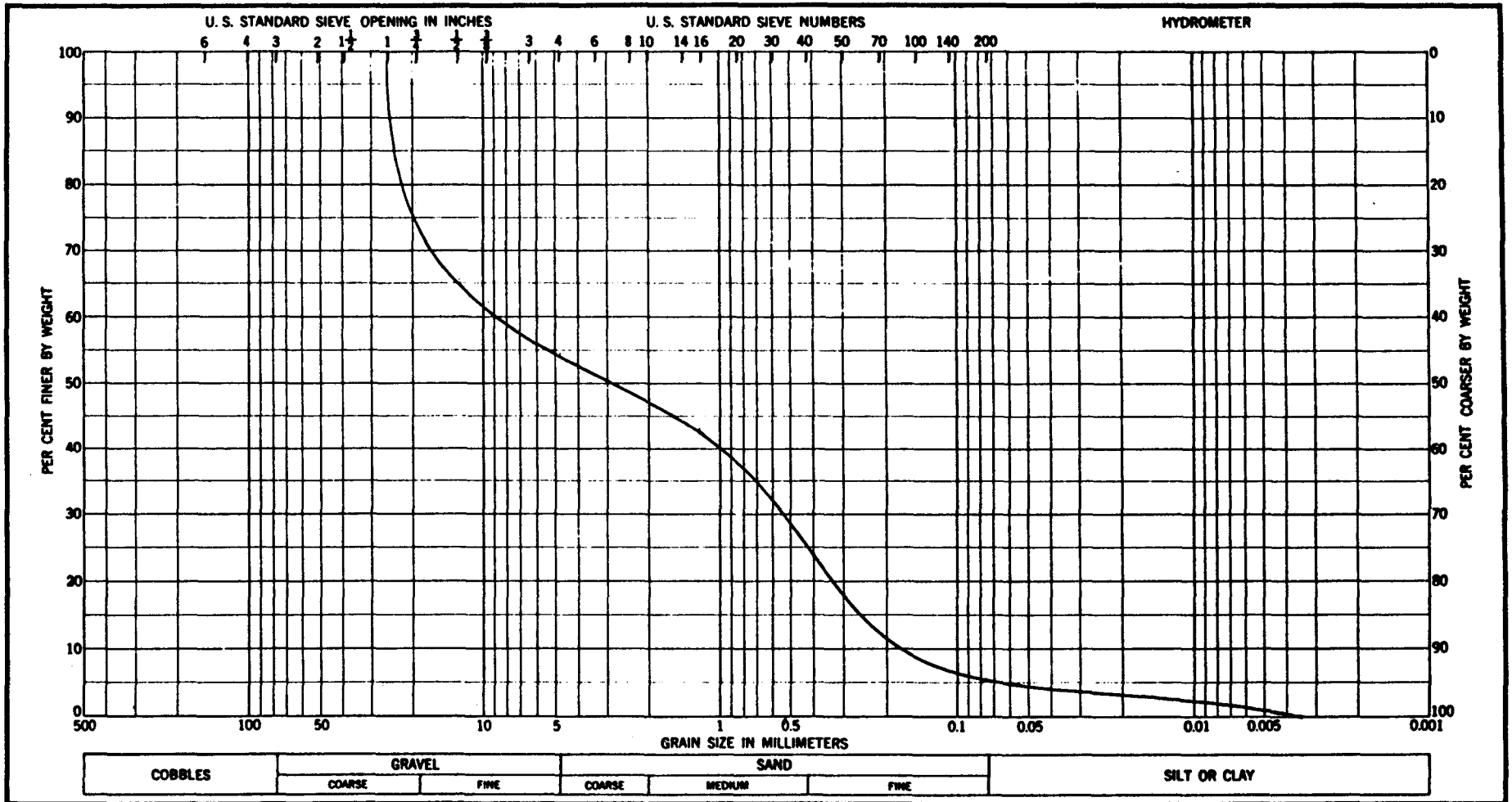
$K_1 = 1.9 \times 10^{-4}$ cm/sec
$K_2 = 2.0 \times 10^{-4}$ cm/sec
$K_3 = 1.1 \times 10^{-4}$ cm/sec
$K_4 = 1.8 \times 10^{-4}$ cm/sec

Coefficient of Permeability, $K_{20} = 1.8 \times 10^{-4}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-013 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 FAX 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
065S06DA40			7			

GRADATION CURVES

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 03/01/96

TRI-STATE TESTING SERVICE, INC.

BACKGROUND WELLS

SOIL BORING/MONITORING WELL LOGS

ENSAFE

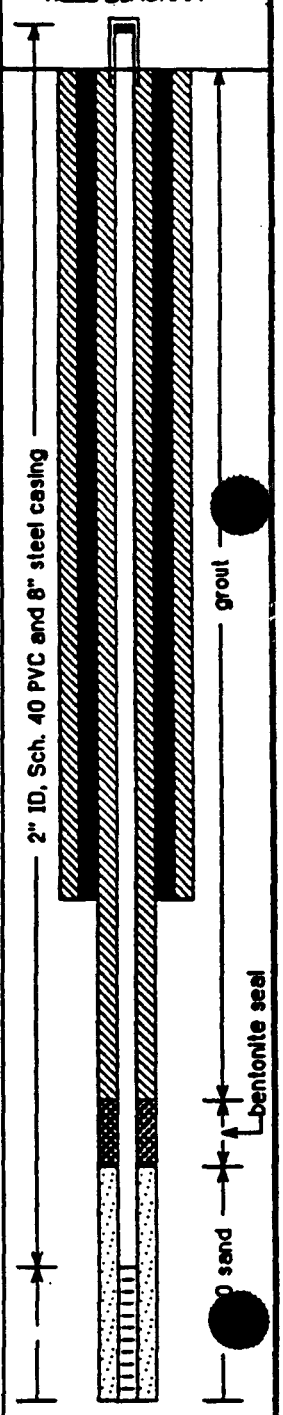
Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-02-UF~~ OBG02UF

Project: *NAS Memphis*	Location: *Millington, TN. Background Site #2*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *0745 on 1-17-95*	TOC Elevation: *feet msl*
Completed at *0845 on 1-17-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *46.0 feet*
Geologist: *Jack Carmichael and William Parks*	Well Screen: *36 to 46 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0								Fill and roots.	
5			1	75	BG			Silt, clayey, yellow brown to gray brown, moist, soft.	
10			2	50	BG			Silt, clayey, yellow gray to olive gray, stained yellow orange, laminated with orange to brown thin striations.	
15			3	87.5	BG		ML		
20			4	75	BG				
25			5	100	BG			Silt, clayey, light olive gray to yellow gray with iron staining, trace gravel. Silt, clayey, light olive gray, less iron staining.	
30								Sand, silty, trace clay, some gravel, yellow brown to gray brown. Sand, medium to coarse with gravel, orange brown to yellow.	
35			6	108	BG		GP	Sand, fine, with trace gravel, grayish pink to grayish orange, some yellow orange mottling.	
40									

WELL DIAGRAM



★ Change BG log IDs

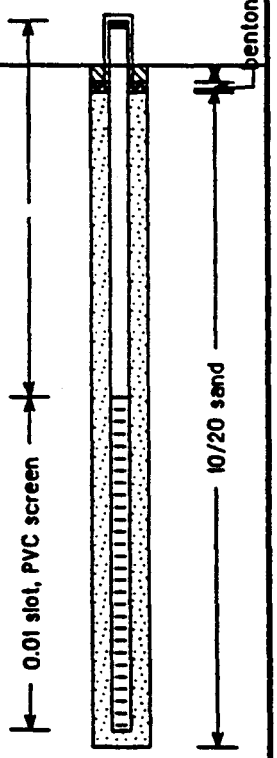
Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-02-S~~ OBGG-02LS

Project: *NAS Memphis*	Location: *Millington, TN. Background Site #2*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *0745 on 1-12-95*	TOC Elevation: *feet msl*
Completed at *0845 on 1-12-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *20.0 feet*
Geologist: *Jack Carmichael and William Parks*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0								Fill and roots.	
5			1	75	BG			Silt, clayey, yellow brown to gray brown, moist, soft.	
10			2	50	BG		ML	Silt, clayey, yellow gray to olive gray, stained yellow orange, laminated with orange to brown thin striations.	
15			3	87.5	BG				
20			4	75	BG			Log information taken form the boring for the lower fluvial well BG-2.	
25									
30									
35									
40									

WELL DIAGRAM



GEOLOGICAL LOGGING SYSTEMS

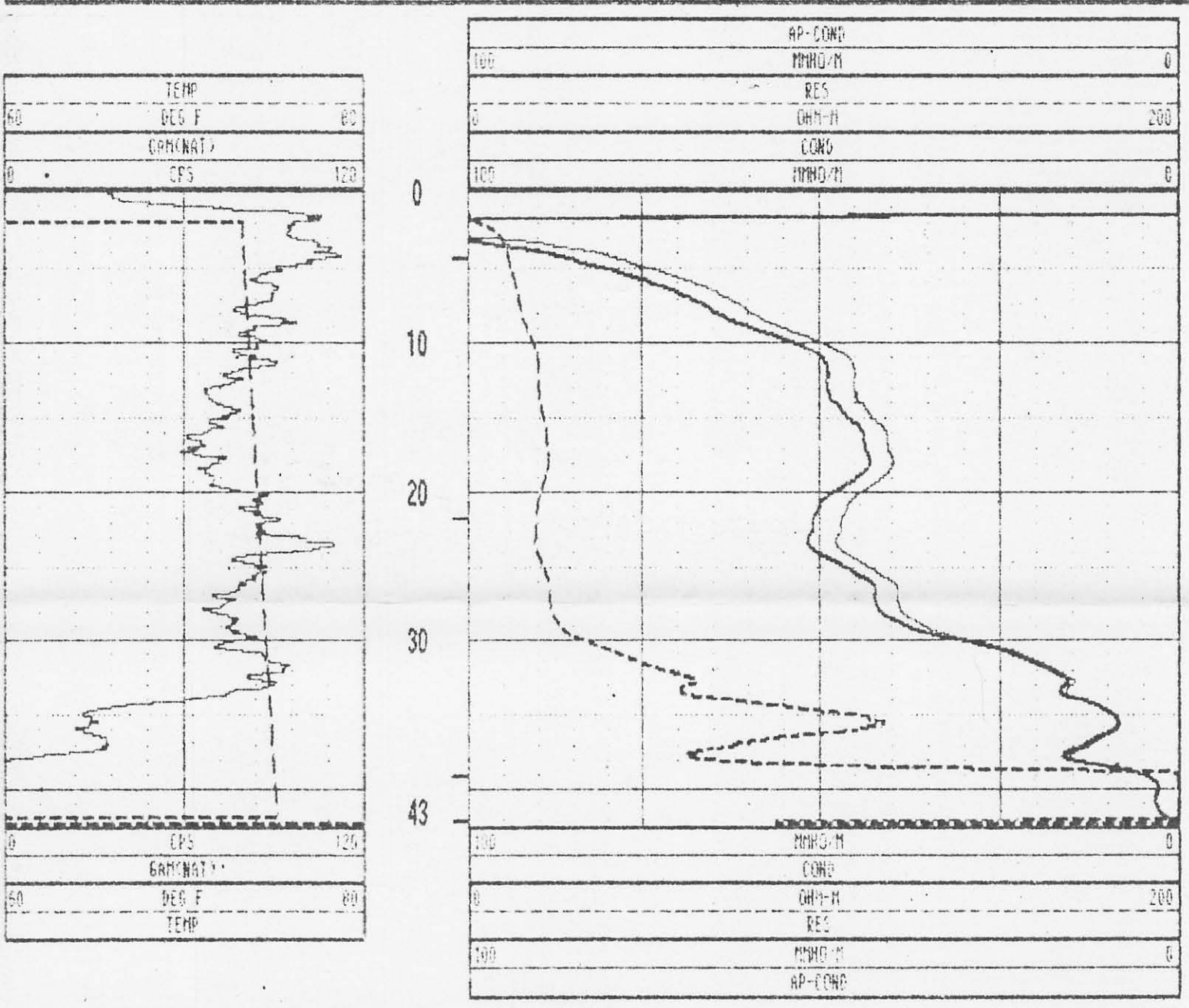
OBGG12UF

COMPANY	: ENSAFE,ALLEN & HOSHALL			OTHER SERVICES:	
WELL	: OBGG12UF			9511	
LOCATION/FIELD	: NAS MEMPHIS			RUN ONE	
COUNTY	: SHELBY			OPEN	
STATE	: TENNESSEE				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 05/21/96	PERMANENT DATUM	: GL	ELEVATIONS	
DEPTH DRILLER	: 46	ELEV. PERM. DATUM:		KB	:
LOG BOTTOM	: 42.50	LOG MEASURED FROM:	GL	DF	: -
LOG TOP	: -2.30	DRL MEASURED FROM:	GL	GL	: 268.9
CASING DRILLER	: 46	LOGGING UNIT	: 05		
CASING TYPE	: PVC	FIELD OFFICE	: BLUEFIELD		
CASING THICKNESS:	.25	RECORDED BY	: J T GILBERT		
BIT SIZE	: 8	BOREHOLE FLUID	: WATER	FILE	: ORIGIN
MAGNETIC DECL.	: -	RM	:	TYPE	: 9511C
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:	LOG	: 2
FLUID DENSITY	: 1.2	MATRIX DELTA T	:	PLOT	: 9510C
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:	THRESH:	9000

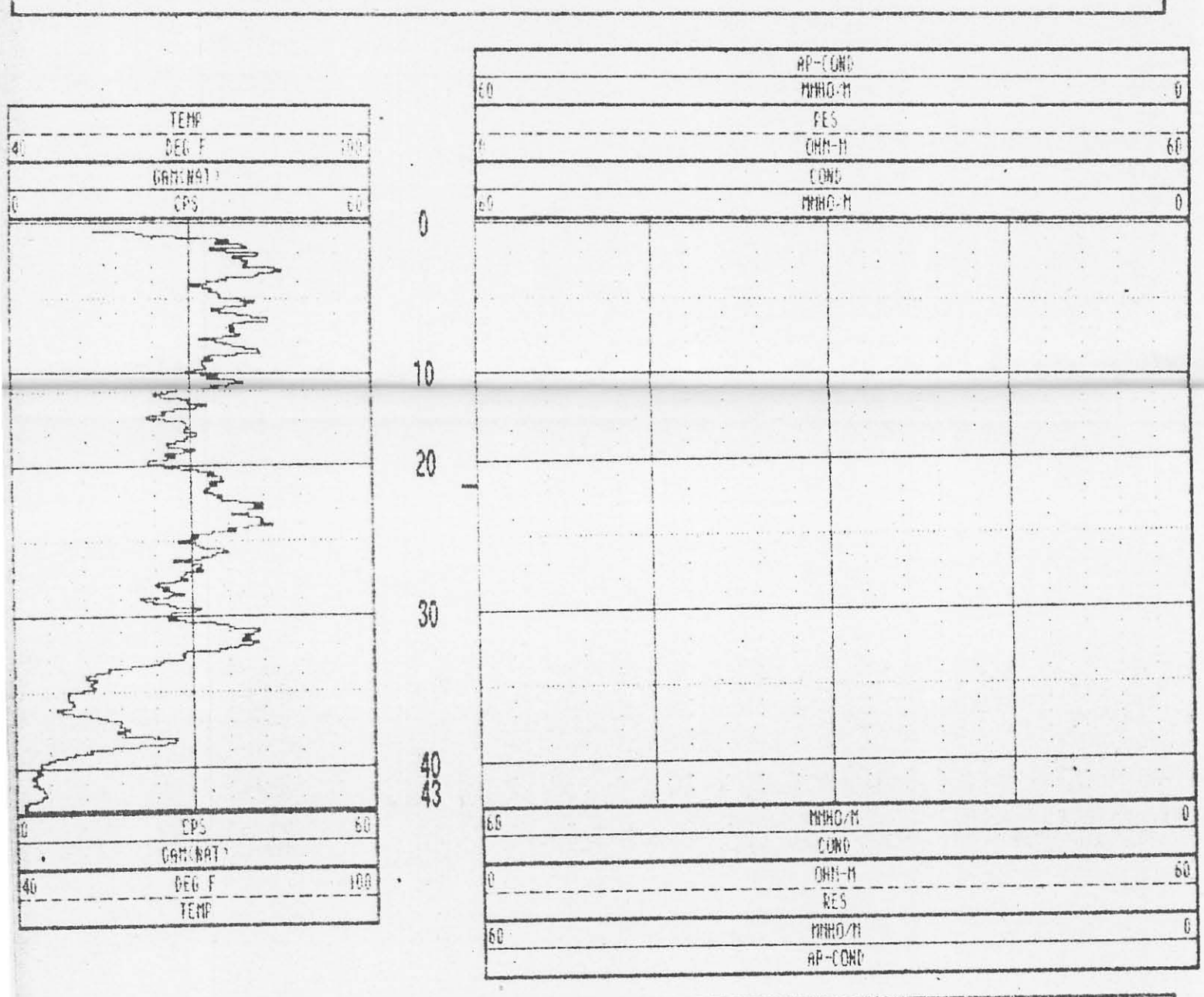
REMARKS :

ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



OBGG12UF 05/21/96 936



OBGG12UF 05/21/96 1025

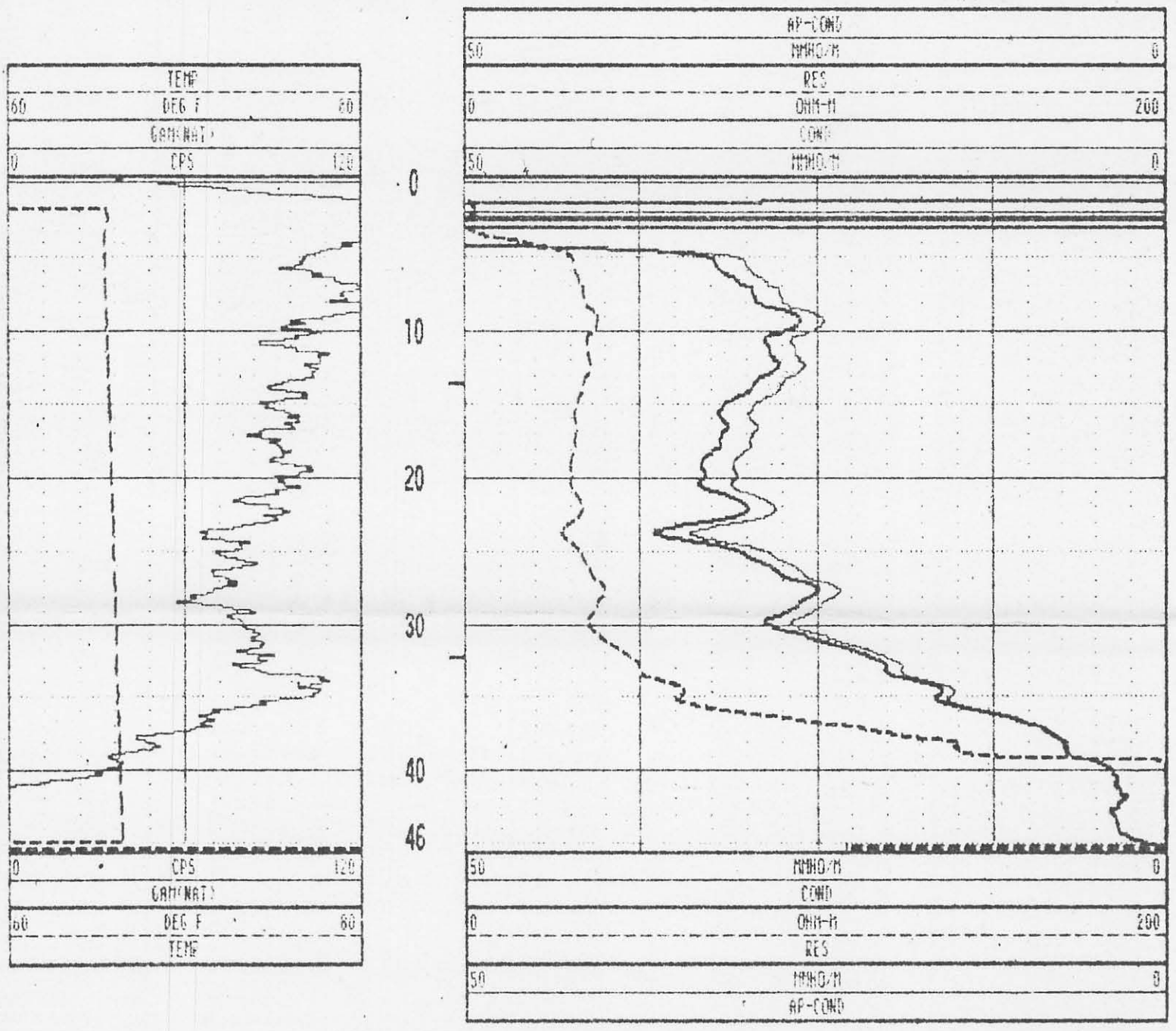
GEOLOGICAL LOGGING SYSTEMS

OBGG11UA

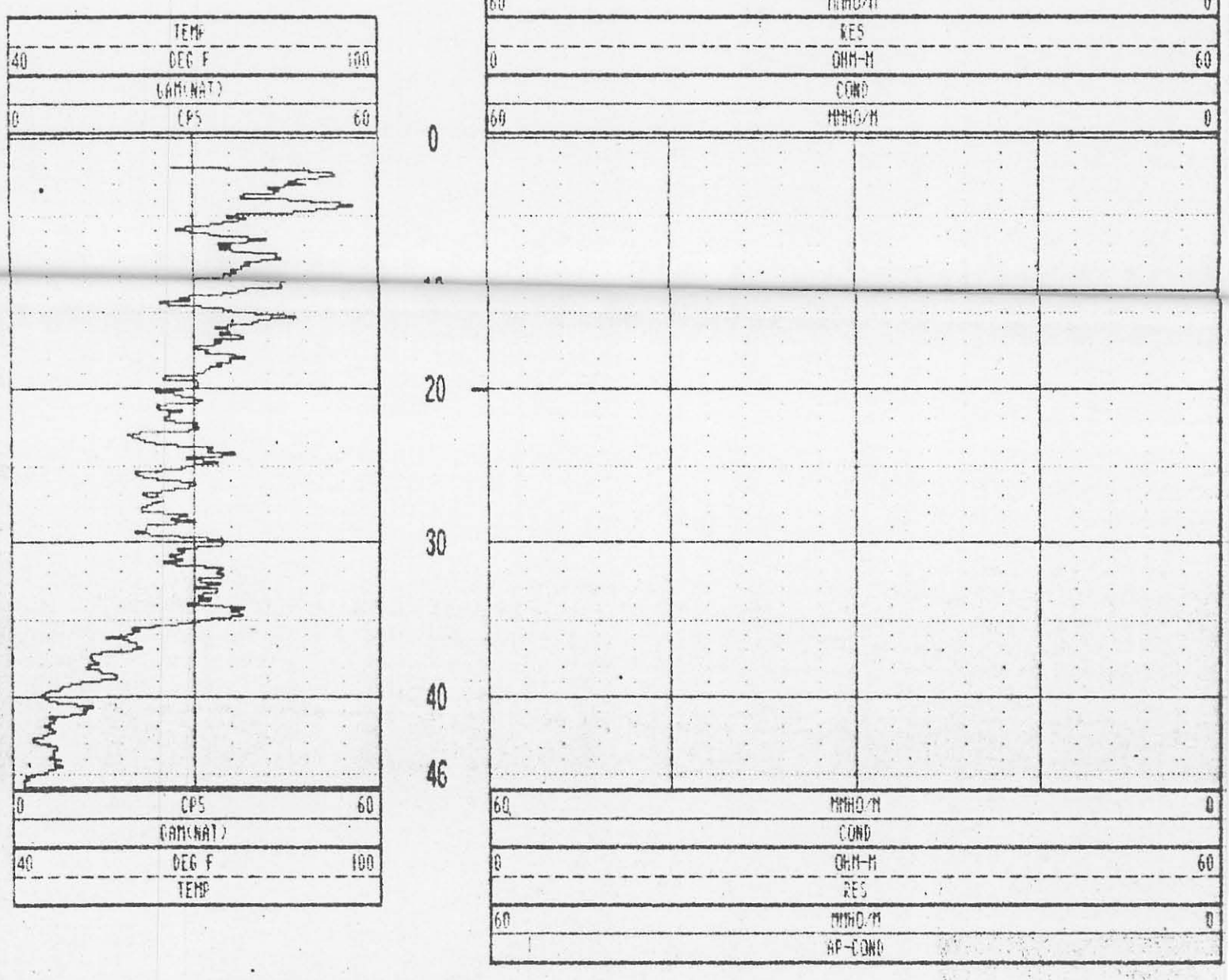
COMPANY	: ENSAFE,ALLEN & HOSHALL			OTHER SERVICES:	
WELL	: OBGG11UA			9511	
LOCATION/FIELD	: NAS MEMPHIS			RUN ONE	
COUNTY	: SHELBY			OPEN	
STATE	: TENNESSEE				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 05/21/96	PERMANENT DATUM	: GL	ELEVATIONS	
DEPTH DRILLER	: 48	ELEV. PERM. DATUM:		KB	:
LOG BOTTOM	: 45.60	LOG MEASURED FROM:	GL	DF	: -
LOG TOP	: -2.60	DRL MEASURED FROM:	GL	GL	: 261.8
CASING DRILLER	: 40	LOGGING UNIT	: 05		
CASING TYPE	: PVC	FIELD OFFICE	: BLUEFIELD		
CASING THICKNESS	: .25	RECORDED BY	: J T GILBERT		
BIT SIZE	: 8	BOREHOLE FLUID	: WATER	FILE	: ORIGIN
MAGNETIC DECL.	: -	RM	:	TYPE	: 9511C
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:	LOG	: 2
FLUID DENSITY	: 1.2	MATRIX DELTA T	:	PLOT	: 9510C
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:	THRESH	: 9000
REMARKS	:				

ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



OBGG11UA 05/21/96 976



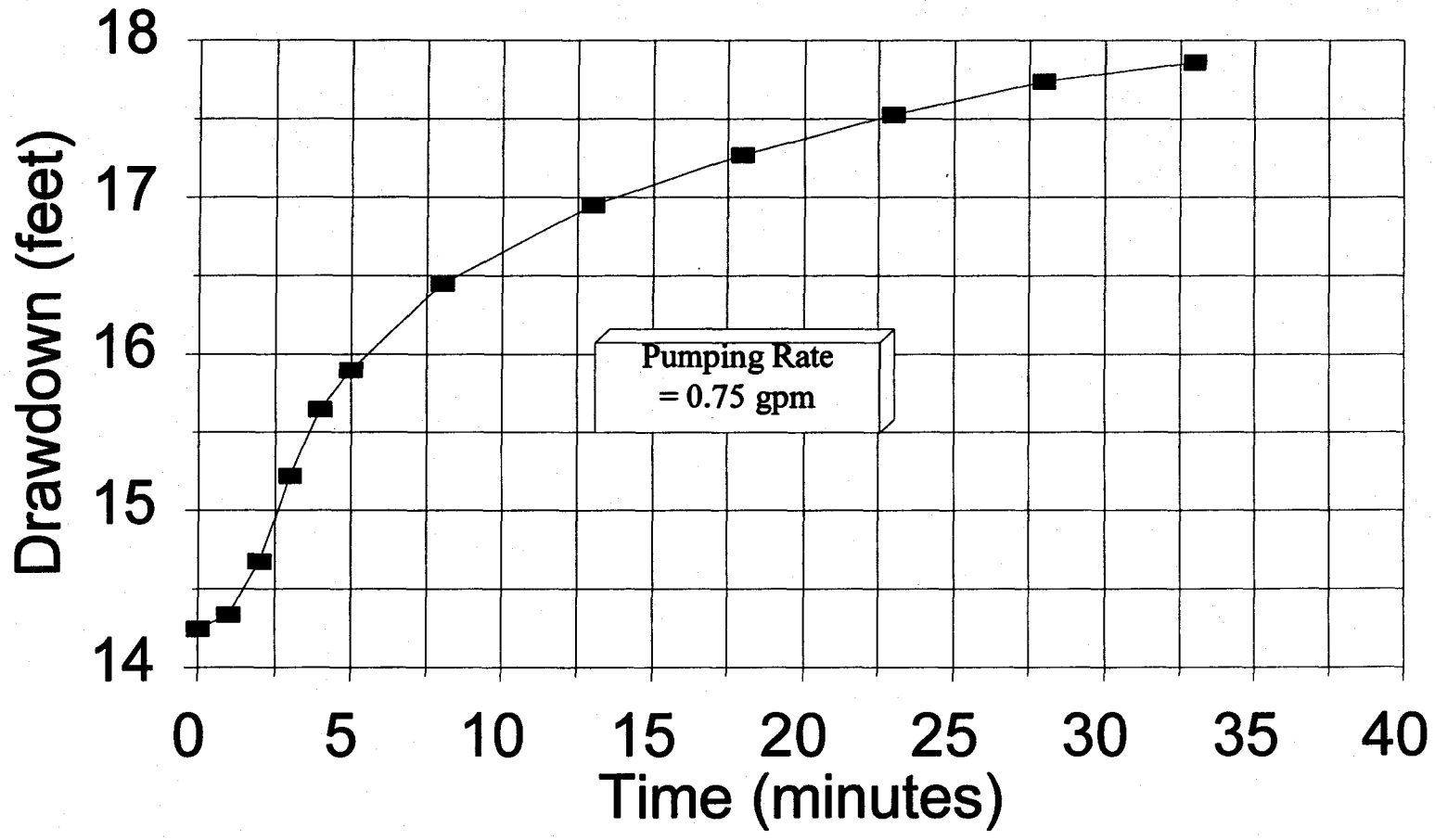
OBGG11UA 05/21/96 1025

Appendix D

Assembly E Specific Capacity Test Results and Data Input Files

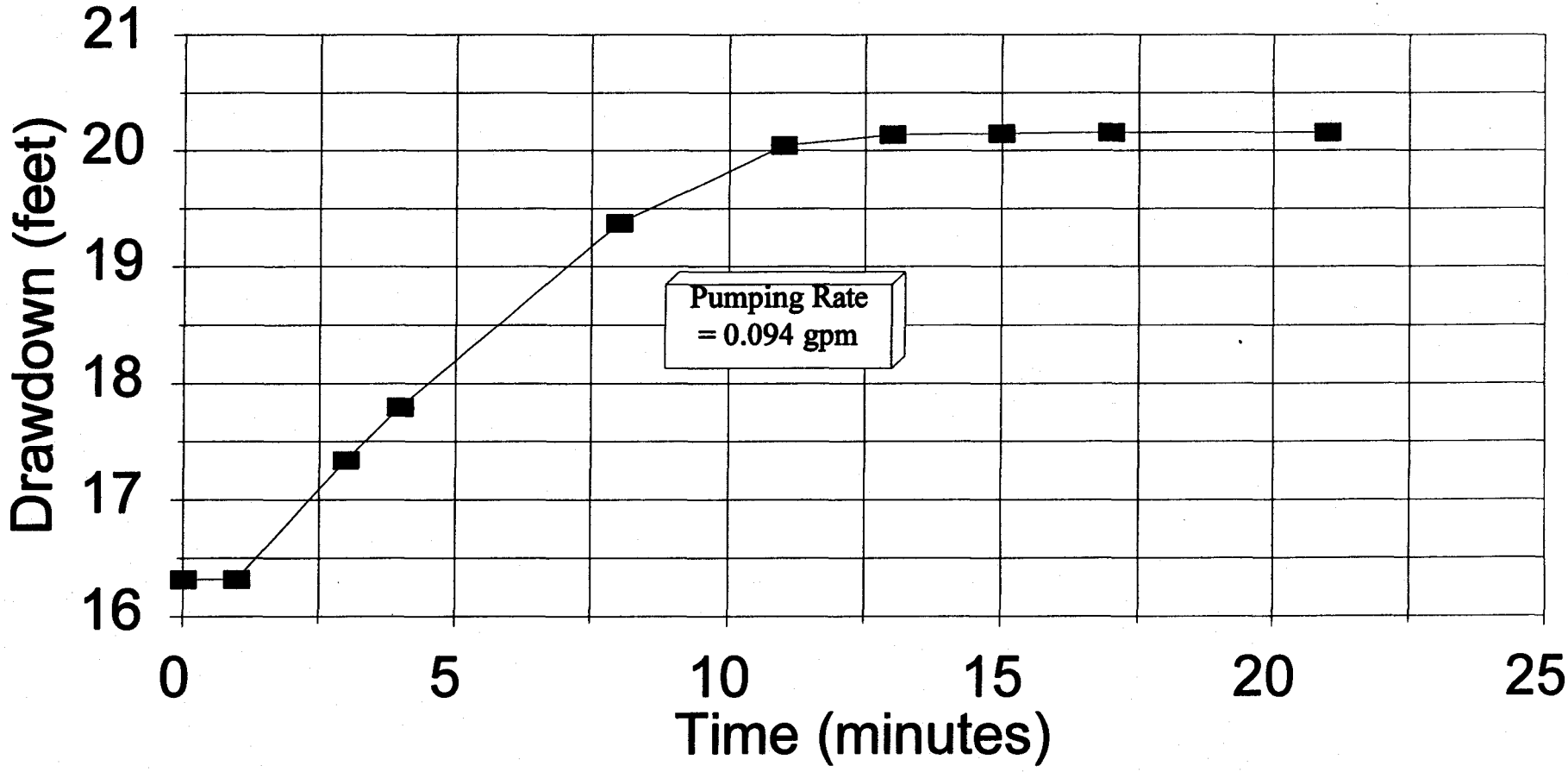
Specific Capacity Test

002G03DA



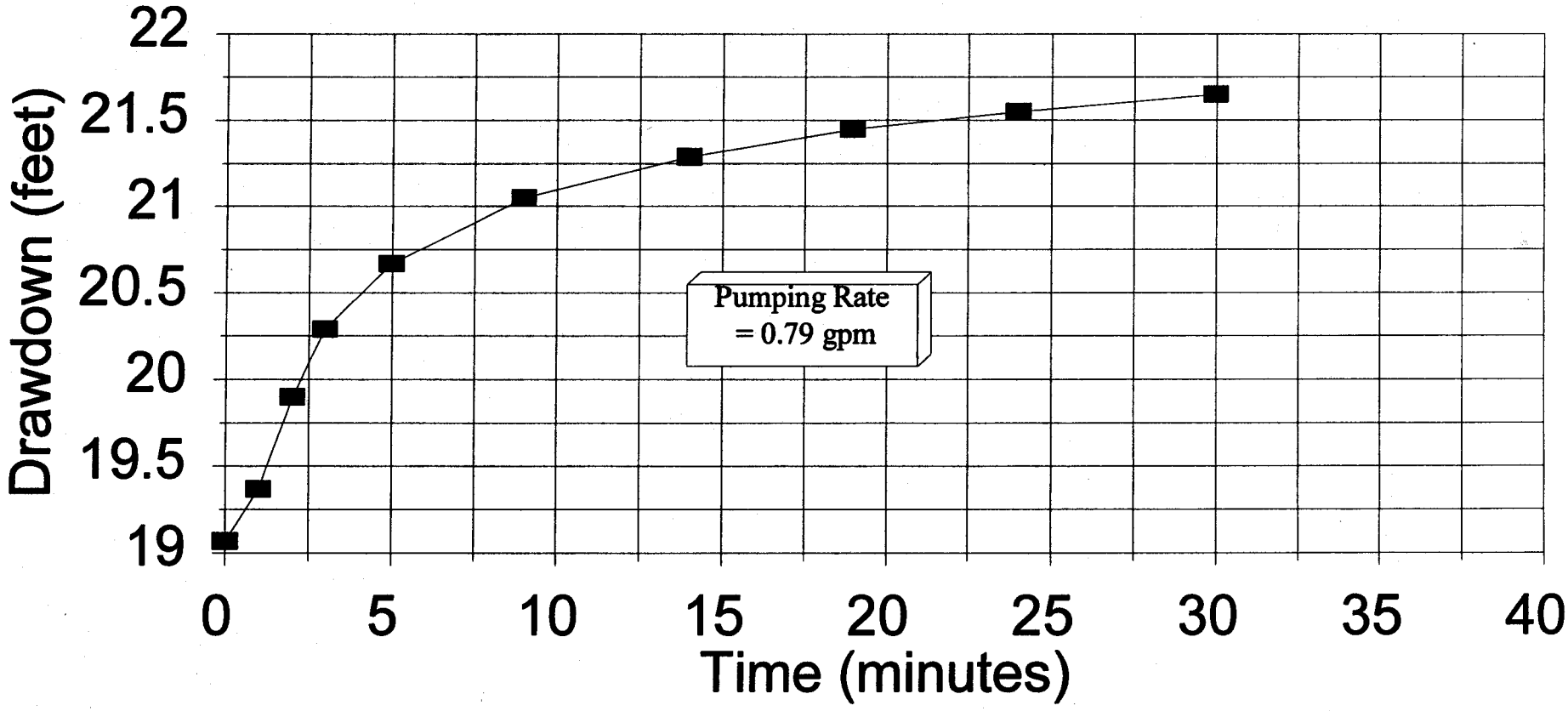
Specific Capacity Test

002G03UA



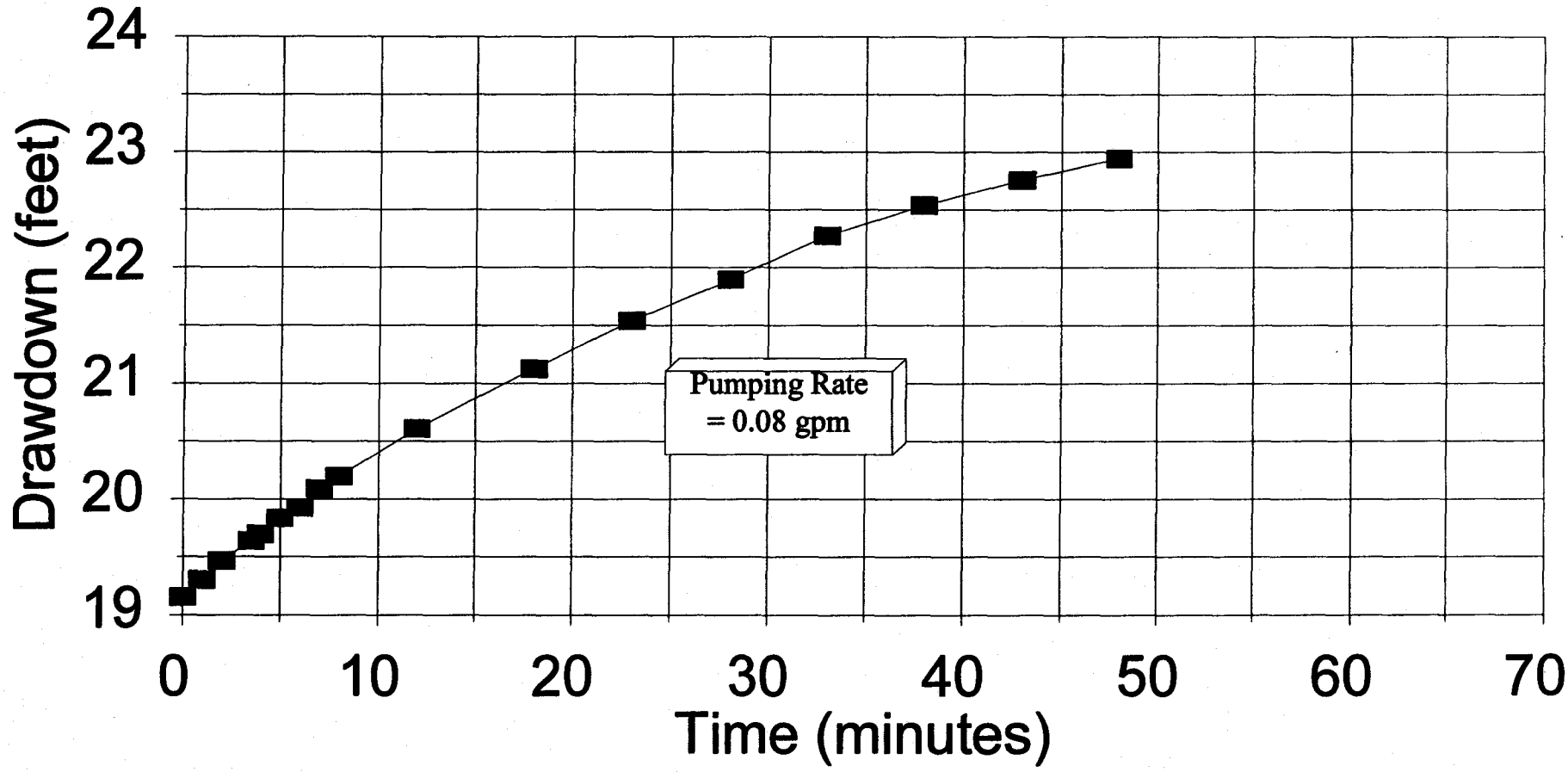
Specific Capacity Test

002G09DA



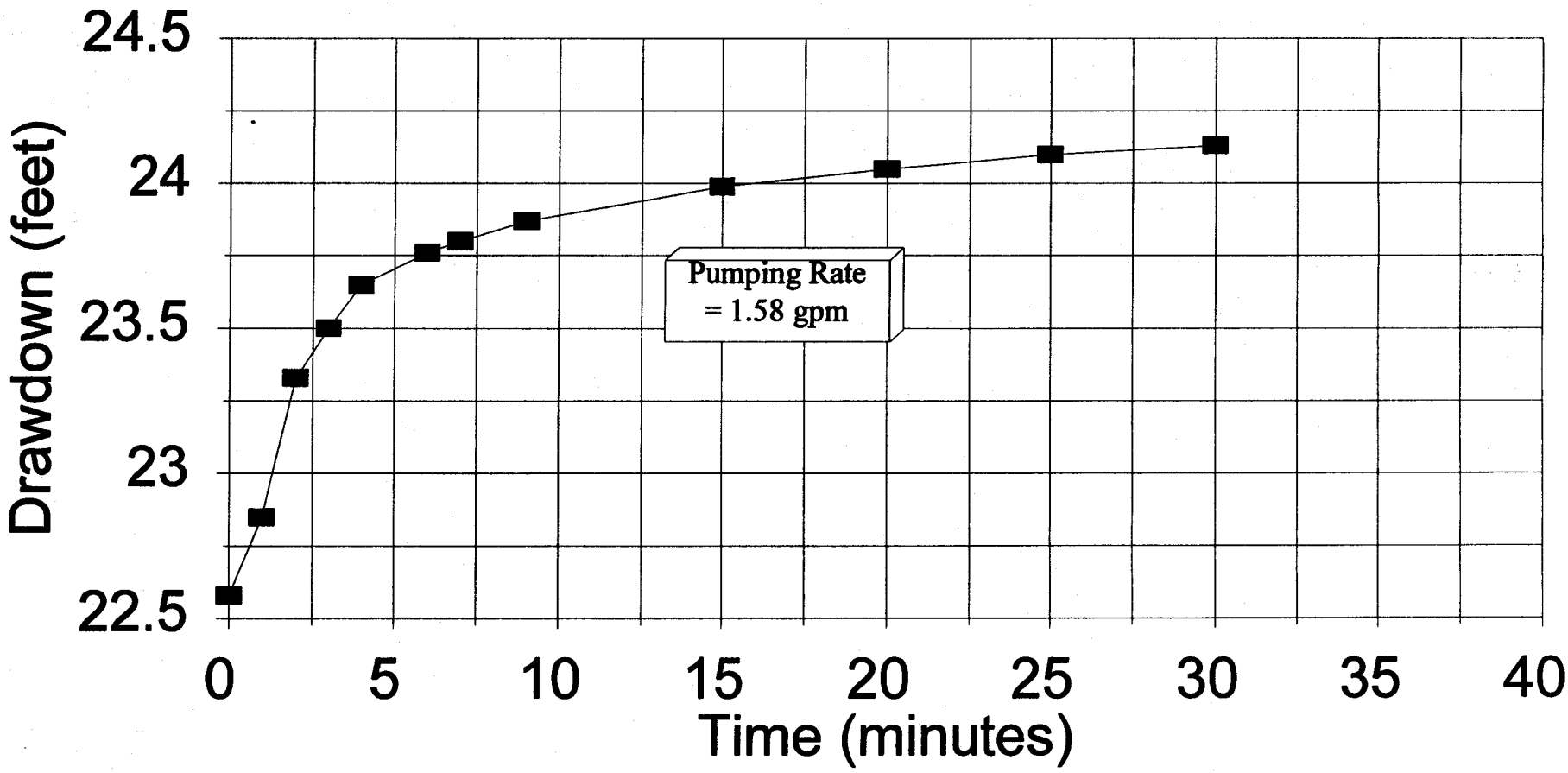
Specific Capacity Test

002G09UA



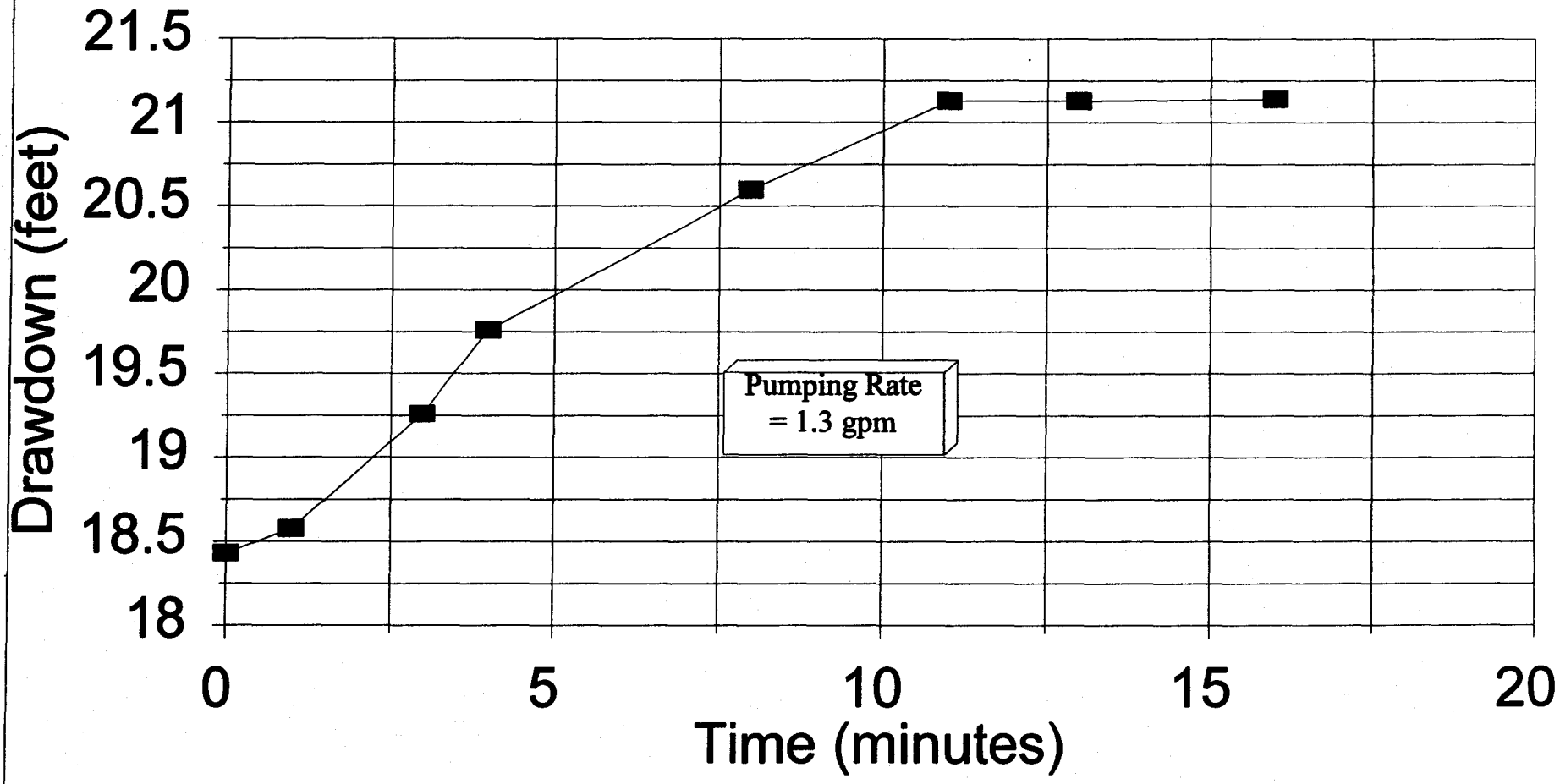
Specific Capacity Test

009G01DA



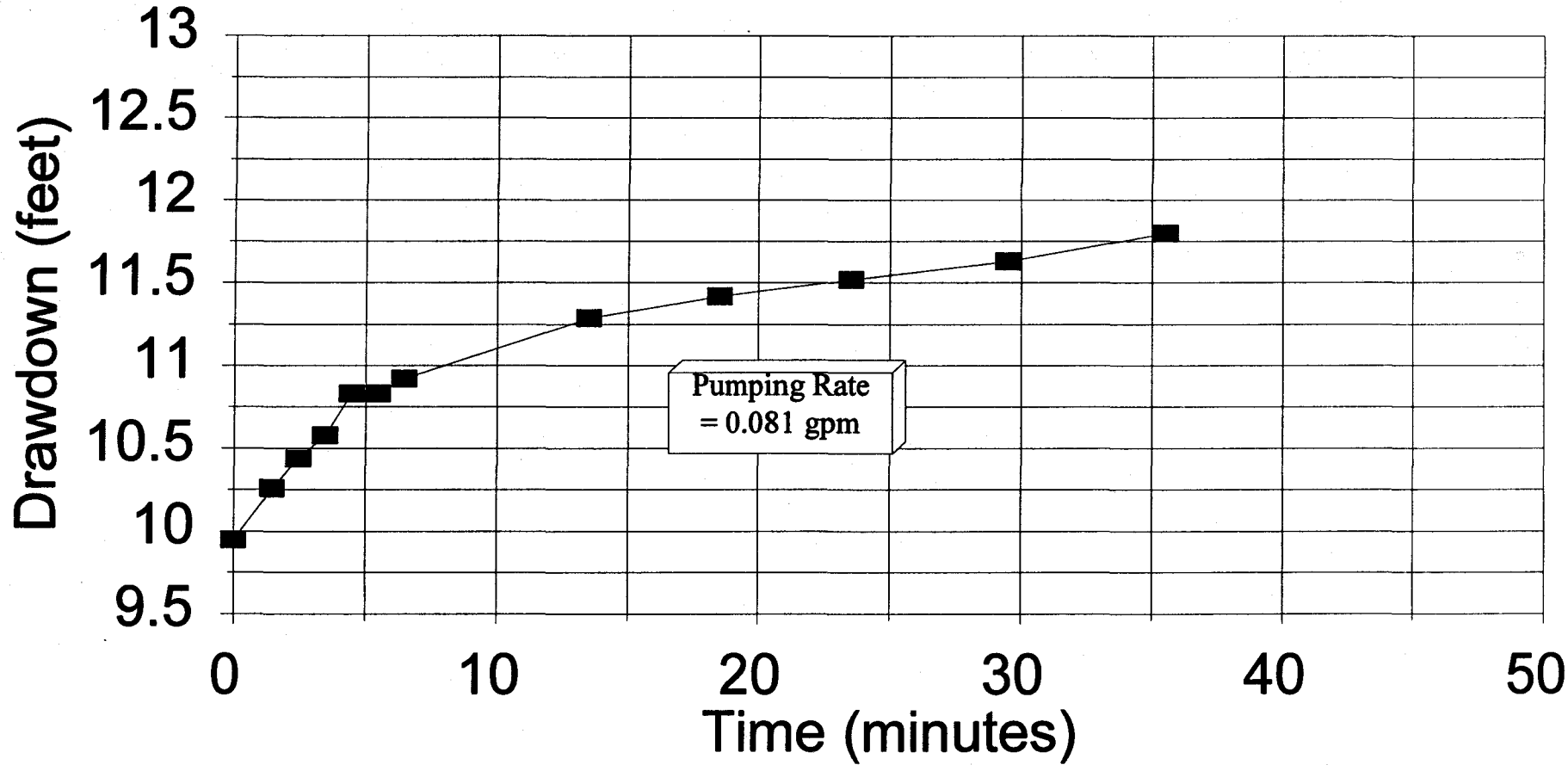
Specific Capacity Test

009G03DA



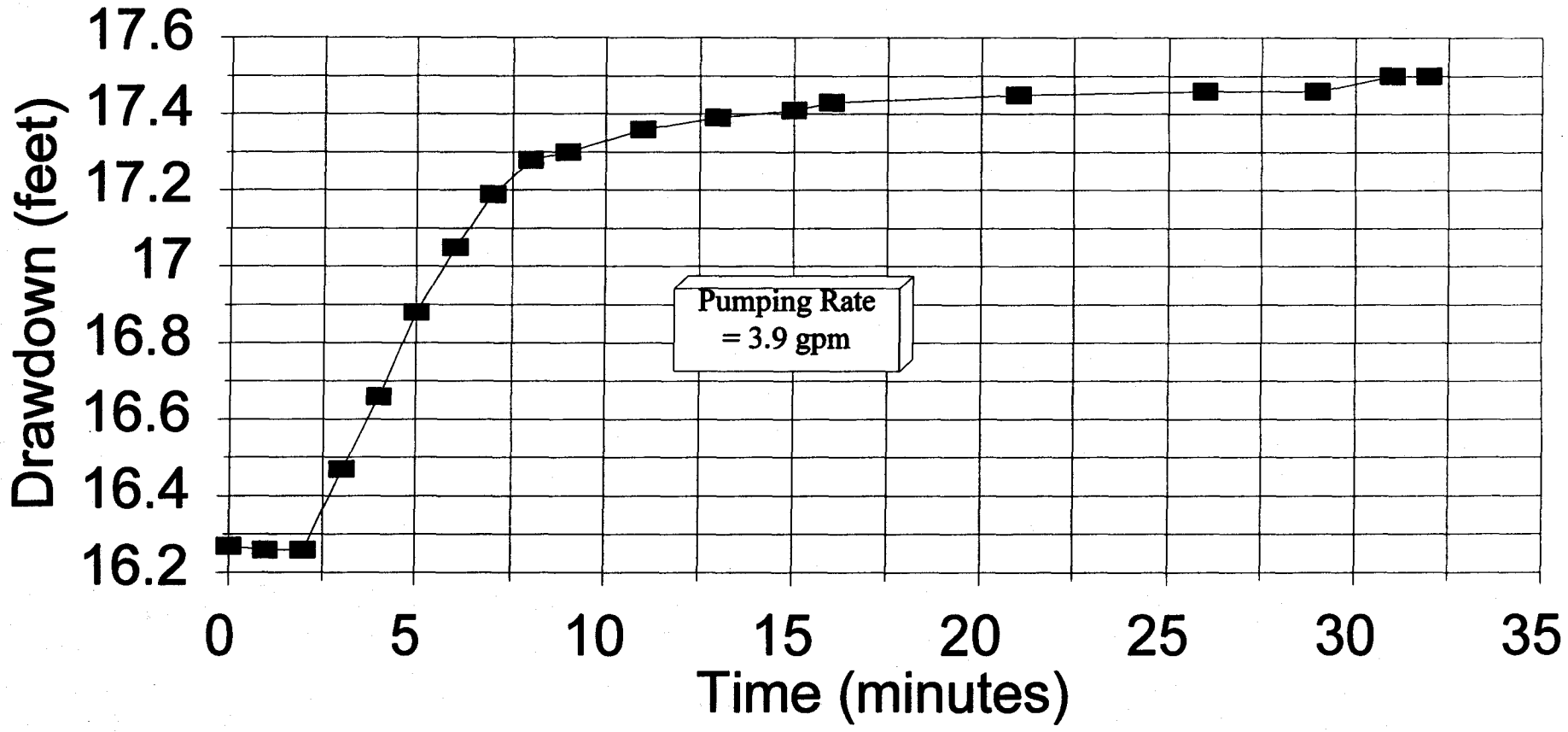
Specific Capacity Test

014G07LF



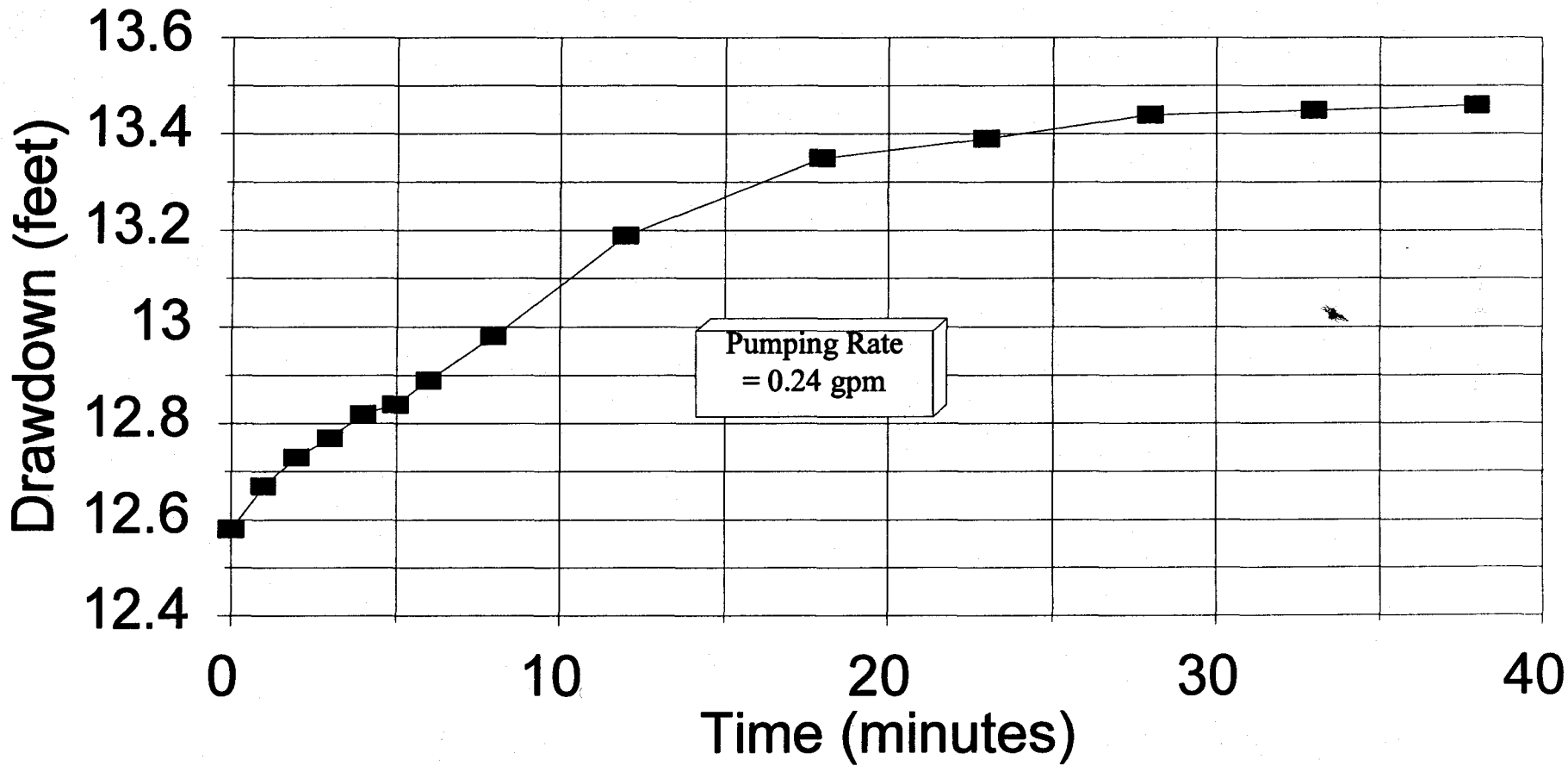
Specific Capacity Test

059G03UF



Specific Capacity Test

065G06DA



TGUESS -- Version 1.2

****

AQUIFER PROPERTIES AS DETERMINED BY ANALYSIS OF SPECIFIC CAPACITIES

****

WELL NUMBER.....= 2G03UA

INPUT DATA (English units):

WELL DIAMETER (IN OR M)	2
STATIC WATER LEVEL (FT OR M)	16.32
DEPTH TO WATER DURING TEST (FT OR M)	20.14
DURATION OF THE TEST (HRS)	.22
PUMPING RATE (GPM OR CUB.M/S)	.094
THICKNESS OF AQUIFER (FT OR M)	12
OPEN INTERVAL (SCREEN LENGTH; FT OR M)	10
STORAGE COEFFICIENT	.000696
WELL LOSS COEFFICIENT	1

RESULTS:

SPECIFIC CAPACITY (GPM/FT OR SQ.M/S)	2.460733E-02
TRANSMISSIVITY (SQ FT/SEC OR SQ.M/S)	4.77337E-05
HYDRAULIC CONDUCTIVITY (FT/SEC OR M/S)	3.977808E-06
NUMBER OF ITERATIONS	3

WELL NUMBER.....= 2G03DA

INPUT DATA (English units):

WELL DIAMETER (IN OR M)	2
STATIC WATER LEVEL (FT OR M)	14.25
DEPTH TO WATER DURING TEST (FT OR M)	17.86
DURATION OF THE TEST (HRS)	.55
PUMPING RATE (GPM OR CUB.M/S)	.75
THICKNESS OF AQUIFER (FT OR M)	19
OPEN INTERVAL (SCREEN LENGTH; FT OR M)	10
STORAGE COEFFICIENT	.0000228
WELL LOSS COEFFICIENT	1

RESULTS:

SPECIFIC CAPACITY (GPM/FT OR SQ.M/S)	.2077564
TRANSMISSIVITY (SQ FT/SEC OR SQ.M/S)	8.833193E-04
HYDRAULIC CONDUCTIVITY (FT/SEC OR M/S)	4.649049E-05
NUMBER OF ITERATIONS	3

WELL NUMBER.....= 2 609UA

INPUT DATA (English units):

WELL DIAMETER (IN OR M)	2
STATIC WATER LEVEL (FT OR M)	19.16
DEPTH TO WATER DURING TEST (FT OR M)	23.5
DURATION OF THE TEST (HRS)	1.166
PUMPING RATE (GPM OR CUB.M/S)	.08
THICKNESS OF AQUIFER (FT OR M)	5
OPEN INTERVAL (SCREEN LENGTH; FT OR M)	5
STORAGE COEFFICIENT	.000006
WELL LOSS COEFFICIENT	1

RESULTS:

SPECIFIC CAPACITY (GPM/FT OR SQ.M/S)	1.843318E-02
TRANSMISSIVITY (SQ FT/SEC OR SQ.M/S)	5.3305E-05
HYDRAULIC CONDUCTIVITY (FT/SEC OR M/S)	1.0661E-05
NUMBER OF ITERATIONS	2

WELL NUMBER.....= 2 609DA

INPUT DATA (English units):

WELL DIAMETER (IN OR M)	2
STATIC WATER LEVEL (FT OR M)	19.07
DEPTH TO WATER DURING TEST (FT OR M)	21.65
DURATION OF THE TEST (HRS)	.5
PUMPING RATE (GPM OR CUB.M/S)	.79
THICKNESS OF AQUIFER (FT OR M)	15
OPEN INTERVAL (SCREEN LENGTH; FT OR M)	10
STORAGE COEFFICIENT	.000018
WELL LOSS COEFFICIENT	1

RESULTS:

SPECIFIC CAPACITY (GPM/FT OR SQ.M/S)	.3062019
TRANSMISSIVITY (SQ FT/SEC OR SQ.M/S)	1.132542E-03
HYDRAULIC CONDUCTIVITY (FT/SEC OR M/S)	7.550278E-05
NUMBER OF ITERATIONS	3

WELL NUMBER.....= 9601DA

INPUT DATA (English units):

WELL DIAMETER (IN OR M)	2
STATIC WATER LEVEL (FT OR M)	22.58
DEPTH TO WATER DURING TEST (FT OR M)	24.13
DURATION OF THE TEST (HRS)	.5
PUMPING RATE (GPM OR CUB.M/S)	1.58
THICKNESS OF AQUIFER (FT OR M)	17
OPEN INTERVAL (SCREEN LENGTH; FT OR M)	10
STORAGE COEFFICIENT	.00002
WELL LOSS COEFFICIENT	1

RESULTS:

SPECIFIC CAPACITY (GPM/FT OR SQ.M/S)	1.019364
TRANSMISSIVITY (SQ FT/SEC OR SQ.M/S)	4.302742E-03
HYDRAULIC CONDUCTIVITY (FT/SEC OR M/S)	2.531025E-04
NUMBER OF ITERATIONS	3

WELL NUMBER.....= 9603DA

INPUT DATA (English units):

WELL DIAMETER (IN OR M)	2
STATIC WATER LEVEL (FT OR M)	18.43
DEPTH TO WATER DURING TEST (FT OR M)	21.13
DURATION OF THE TEST (HRS)	.18
PUMPING RATE (GPM OR CUB.M/S)	1.3
THICKNESS OF AQUIFER (FT OR M)	21
OPEN INTERVAL (SCREEN LENGTH; FT OR M)	10
STORAGE COEFFICIENT	.0000252
WELL LOSS COEFFICIENT	1

RESULTS:

SPECIFIC CAPACITY (GPM/FT OR SQ.M/S)	.4814832
TRANSMISSIVITY (SQ FT/SEC OR SQ.M/S)	2.176555E-03
HYDRAULIC CONDUCTIVITY (FT/SEC OR M/S)	1.036455E-04
NUMBER OF ITERATIONS	3

WELL NUMBER.....= 14 G07LF

INPUT DATA (English units):

WELL DIAMETER (IN OR M).....=	2
STATIC WATER LEVEL (FT OR M).....=	9.95
DEPTH TO WATER DURING TEST (FT OR M).....=	11.63
DURATION OF THE TEST (HRS).....=	.49
PUMPING RATE (GPM OR CUB.M/S).....=	.081
THICKNESS OF AQUIFER (FT OR M).....=	12
OPEN INTERVAL (SCREEN LENGTH; FT OR M)....=	10
STORAGE COEFFICIENT.....=	.0000144
WELL LOSS COEFFICIENT.....=	1

RESULTS:

SPECIFIC CAPACITY (GPM/FT OR SQ.M/S).....=	4.821428E-02
TRANSMISSIVITY (SQ FT/SEC OR SQ.M/S).....=	1.428461E-04
HYDRAULIC CONDUCTIVITY (FT/SEC OR M/S)....=	1.190384E-05
NUMBER OF ITERATIONS.....=	3

WELL NUMBER.....= 59 G03UF

INPUT DATA (English units):

WELL DIAMETER (IN OR M).....=	2
STATIC WATER LEVEL (FT OR M).....=	16.27
DEPTH TO WATER DURING TEST (FT OR M).....=	17.45
DURATION OF THE TEST (HRS).....=	.35
PUMPING RATE (GPM OR CUB.M/S).....=	3.9
THICKNESS OF AQUIFER (FT OR M).....=	33
OPEN INTERVAL (SCREEN LENGTH; FT OR M)....=	10
STORAGE COEFFICIENT.....=	.00004
WELL LOSS COEFFICIENT.....=	1

RESULTS:

SPECIFIC CAPACITY (GPM/FT OR SQ.M/S).....=	3.305295
TRANSMISSIVITY (SQ FT/SEC OR SQ.M/S).....=	2.299535E-02
HYDRAULIC CONDUCTIVITY (FT/SEC OR M/S)....=	6.968288E-04
NUMBER OF ITERATIONS.....=	4

WELL NUMBER.....= 65 606 DA

INPUT DATA (English units):

WELL DIAMETER (IN OR M).....=	2
STATIC WATER LEVEL (FT OR M).....=	12.58
DEPTH TO WATER DURING TEST (FT OR M).....=	13.44
DURATION OF THE TEST (HRS).....=	.47
PUMPING RATE (GPM OR CUB.M/S).....=	.24
THICKNESS OF AQUIFER (FT OR M).....=	13
OPEN INTERVAL (SCREEN LENGTH; FT OR M)....=	10
STORAGE COEFFICIENT.....=	.0000156
WELL LOSS COEFFICIENT.....=	1

RESULTS:

SPECIFIC CAPACITY (GPM/FT OR SQ.M/S).....=	.27907
TRANSMISSIVITY (SQ FT/SEC OR SQ.M/S).....=	9.494165E-04
HYDRAULIC CONDUCTIVITY (FT/SEC OR M/S)....=	7.303204E-05
NUMBER OF ITERATIONS.....=	3

Appendix E

Assembly E Investigative-Derived Waste Technical Memorandums

EnSafe / Allen & Hoshall

a joint venture for professional services

Program Management Office
Shelby Oaks Plaza
5909 Shelby Oaks Dr.
Suite 201
Memphis, TN 38134
Phone (901) 383-9115
Fax (901) 383-1743

EnSafe/Allen & Hoshall Branch Offices:

Charleston
935 Houston Northcutt Blvd.
Suite 113
Mt. Pleasant, SC 29464
Phone (803) 884-0029
Fax (803) 856-0107

Cincinnati
400 TechneCenter Dr.
Suite 301
[illegible]rd, OH 45150
[illegible] (513) 248-8449
[illegible]513) 248-8447

Pensacola
2114 Airport Blvd.
Suite 1150
Pensacola, FL 32504
Phone (904) 479-4595
Fax (904) 479-9120

Norfolk
303 Butler Farm Road
Suite 113
Hampton, VA 23666
Phone (804) 766-9556
Fax (804) 766-9558

Raleigh
5540 Centerview Drive
Suite 205
Raleigh, NC 27606
Phone (919) 851-1886
Fax (919) 851-4043

Nashville
311 Plus Park Blvd.
Suite 130
Nashville, TN 37217
Phone (615) 399-8800
Fax (615) 399-7467

[illegible]s
[illegible]uller Drive
[illegible]526
Irving, TX 75038
Phone (214) 791-3222
Fax (214) 791-0405

MEMORANDUM

TO: Rob Williamson
NSA Memphis Public Works Environmental Division

Mark Taylor
SOUTHNAVFACENGCOM

FROM: Robert Smith
EnSafe/Allen & Hoshall

SUBJECT: Characterization of Investigation-Derived Waste from Assembly E SWMUs: NSA Memphis RFI, Millington, Tennessee; CT0-106

DATE: October 14, 1996

Beginning in November 1995, EnSafe/Allen & Hoshall conducted a RCRA Facility Investigation at Naval Support Activity (NSA) Memphis. Investigation derived waste (IDW) was generated during the investigation.

The IDW consisted of two types of media: soil/formation material, and water. The water was generated from activities such as decontamination of soil and groundwater sampling equipment, development of groundwater monitoring wells, and purging of the monitoring wells prior to sampling. The water was contained in a 2,000 gallon polyethylene tank at Facility S-775. Each time the tank reached its capacity, a sample was collected by E/A&H for analysis by an offsite laboratory for waste characterization parameters. The analytical results from the IDW characterization were then submitted to the City of Millington's contracted engineer, Mr. James Cox of Fisher & Arnold Engineering for discharge approval. Upon receiving discharge approval from Mr. Cox, the contents of the tank were discharged to the sanitary sewer system via an onsite oil/water separator. The 2,000 gallon tank has been cycled a total of 13 times since the beginning of the Assembly E investigation.

The second media type, soil/formation material, was generated during drilling activities, which included drilling spoils and soil/mud generated during the decontamination of the drilling and sampling equipment. Formation material consisted of all subsurface material (sand, gravel, clay) brought to the surface during the drilling/sampling activities. All material generated was containerized in 168 DOT-approved, lined, 55-gallon drums, and were properly labeled and staged in the NSA Memphis IDW storage area (Facility N-1665), where they presently remain. During a recent inspection of the IDW containers, E/A&H found that all labels

placed on the drums have become illegible preventing the correlation of individual drums with specific boring locations. This IDW characterization has been conducted as a basis for disposal and is based the on the concentrations of compounds detected in the Assembly E soil borings.

CHARACTERIZATION

A total of 101 compounds were detected during the Assembly E RFI Investigation. Each compound has been characterized based on the U.S. Environmental Protection Agency (USEPA) Hazardous Waste Rules as outlined in Title 40 of the Code of Federal Regulations, Part 261 (40 CFR 261), and the guidelines set forth by Tennessee Department of Environment and Conservation (TDEC), Division of Solid Waste Management (DSWM).

Of the 101 compounds detected, the following six compounds were defined in 40 CFR 261.30 as being "F-listed" hazardous wastes. F-listed wastes, by definition, are compounds from specific sources, which have been listed due to their Hazard Code (i.e., Toxicity, Ignitability, Corrosivity). The criteria for the selection of these compounds, as well as the USEPA Region III Risk-Based Concentration (RBC) and pertinent ignitability data, is presented in Table 1:

Table 1

NSA Memphis RFI; Assembly E IDW Characterization

F-Listed Wastes

Compound	Hazardous Waste Code as defined in 40 CFR 261	Maximum Detected Concentration (µg/kg)	Residential RBC (µg/kg)	Flashpoint (ignitability) (°C/°F))	Selection Criteria as defined in 40 CFR 261
Trichloroethylene	F001	19.0	58,000	N/A	Toxicity
Methylene Chloride	F002	5.0	85,000	N/A	Toxicity
Tetrachloroethene	F002	23.0	12,000	N/A	Toxicity
4-methyl-2-pentanone (MIBK)	F003	170	N/A	17.8°C/64°F	Ignitability
Acetone	F003	48000	7,800,000	0°C/0°F	Ignitability
2-butanone (MEK)	F005	3600	47,000,000	-8.75°C/16°F	Ignitability, Toxicity

Notes:

N/A = Data not available

According to 40 CFR 261.3(a)(2)(iii), "A solid waste, as defined in § 261.2, is a hazardous waste if....it is a mixture of a solid waste and a hazardous waste that is listed in Subpart D of this part solely because it exhibits one or more of the characteristics of hazardous waste identified in subpart C of this part, ***unless the resultant mixture no longer exhibits any characteristics of hazardous waste identified in subpart C of this part.....***"

According to 40 CFR 261.30, the F001 and F002 wastes (trichloroethylene, methylene chloride, and tetrachloroethene) were listed due to their toxicity, and the F005 waste (MEK) was listed due to its toxicity and ignitability. Also, according to 40 CFR 261.30, the F003 (MIBK and Acetone)

wastes were listed due to their ignitability. Because of the low contaminant concentrations detected and the medium (i.e., soil) in which they are contained, soil found at the Assembly E SWMUs does not exhibit the ignitable characteristic. However, because toxicity cannot be physically defined as ignitability can, it would be difficult to prove that the soil/F001, soil/F002, and soil/F005 mixtures are not toxic.

The Land Disposal Restriction (LDR) Guide #5 provides the following discussion of the Contained-In Interpretation (USEPA Office of Solid Waste Management dated November 13, 1986). "The contained-in policy states that any mixture of a non-solid waste and a RCRA listed hazardous waste must be managed as a hazardous waste as long as the material contains (i.e., is above health based levels) the listed hazardous waste." The contained in policy was developed to address contaminated environmental media (i.e., soil, groundwater, surface water), as opposed to the mixture rule which governs mixtures of hazardous and solid wastes. E/A&H has previously confirmed that TDEC's DSWM concurs with and applies the USEPA contained-in policy using RBCs as health-based levels.

Characterization of the soil/formation material generated during the RFI will be based on the contained in policy. Past disposal of soil at NSA Memphis has also applied the contained-in policy in this situation (Memorandum, *Characterization of Investigation Derived Waste from Assembly A SWMUs;* CTO-094; June 6, 1995). A comparison of the soil boring data to the residential RBCs for soil (Table 1) shows that the maximum concentrations of the potentially listed hazardous wastes contained in the IDW do not exceed the health-based risk levels.

Petroleum Constituents

As part of the full scan analytical parameter list associated with the investigation, each sample collected was submitted for total petroleum hydrocarbon (TPH) analysis using the Tennessee-

modified USEPA methods 8015 for gasoline range organics (GRO) and diesel range organics (DRO). The maximum detected concentrations of TPH-GRO and TPH-DRO were 260 mg/kg and 650 mg/kg, respectively; however, the average detected concentrations of TPH-GRO and TPH-DRO were 7.5 mg/kg and 49.8 mg/kg, respectively; with 4% of the samples analyzed exceeding 100 mg/kg TPH. Because labels on the drums containing the IDW are illegible, individual sample results cannot be correlated to the representative IDW on a drum by drum basis. Therefore, all IDW must be characterized together as one unit; for this reason, the average of all detected results was used in the characterization process. Based on the low average concentration of petroleum constituents detected, and the infrequency of detections exceeding 100 mg/kg of TPH, the material would not meet the TDEC DSWM criteria for a petroleum contaminated soil of 100 mg/kg TPH.

NON-HAZARDOUS IDW DISPOSAL

Options for the disposal of the non-hazardous IDW include:

1. All soil and formation material can be spread or buried at an existing SWMU (e.g., Salvage Yard #2, SWMU 41) on property being retained by the Navy, preferably in a single, predetermined area to facilitate future locating and sampling of the material, if necessary. The spreading of this material at an existing SWMU would eliminate the potential for creating a future SWMU and material handling activities should blend the IDW, creating a more homogeneous mixture, which would be more representative of the average concentrations discussed previously.

2. All soil can be sent to a TDEC-approved, non-hazardous landfill.

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Memorandum

Date: January 24, 1997

To: NSA Memphis, BRAC Cleanup Team

From: Robert Smith, E/A&H

Re: Assembly E IDW Drum Screening Results

E/A&H has recently completed the drum screening activities associated with the NSA Memphis Assembly E investigation derived waste (IDW). The drum screening, conducted at the request of the BCT, was in response to the *Characterization of Investigation-Derived Waste from Assembly E SWMUs* memorandum (E/A&H, October 14, 1996) which stated that 4% of the samples collected during the Assembly E RFI contained petroleum hydrocarbon concentrations exceeding 100 mg/kg.

The screening activities were conducted following the procedures outlined in the *Drum Screening Procedures, Assembly E IDW* memorandum (E/A&H, December 9, 1996) presented to the BCT, with one procedural change made at the request of Mr. Jim Morrison (Tennessee Department of Environment and Conservation [TDEC]). In addition to collecting headspace data from each drum, a sample was also collected from each drum and placed in an air tight bag (i.e., zip-lock), and the contents of the bag were subsequently screened using a flame ionization detector (FID).

At the request of TDEC, their office was notified prior to beginning any screening activities; however, due to technical difficulties associated with the instruments (i.e, PID, FID), no work was performed while TDEC was on site.

The data, presented in the attached table and associated graph, indicate that 6 out of the 160 (3.75%) drums screened exhibited elevated organic vapor concentrations in relation to the rest of the drums. Due to varying factors associated with organic vapor readings and containerized soil (i.e., painted surfaces on the interior of the drum, moisture, etc.), the organic vapor levels detected may or may not be indicative of the petroleum concentration of the drum contents.

The available disposal options for the Assembly E IDW include onsite disposal (identical to the Assembly A IDW), however, the petroleum levels in the soil may need to be confirmed by collecting samples of the material contained in the 6 drums exhibiting elevated headspace readings. If the BCT decides the data is needed, composite samples will be collected from each drum using a stainless steel hand auger to allow the samplers to obtain material from 3 points within the material contained in each drum. These composite samples, a total of 6, would be submitted for total petroleum hydrocarbon analysis by EPA Method 418.1.

Should the analytical data indicate that the petroleum levels of any of the drums exceed the current TDEC definition of a petroleum contaminated soil (presently 100 ppm TPH), that drum will be segregated for disposal under the TDEC Special Waste Policy. The remaining soil may be spread onsite, at a location agreed upon by the NSA Memphis Public Works Office and the BCT.

Naval Support Activity Memphis RCRA Facility Investigation
Assembly E Investigation Derived Waste Drum Organic Vapor Screening Log (ppm)

Drum	Headspace	Baggie
1	73	2
2	600	1600
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	27	0
9	0	0
10	10	0
11	4	3100
12	0	0
13	0	0
14	0	< 1
15	0	0
16	7700	0
17	0	0
18	0	0
19	0	0
20	0	0
21	0	0
22	0	0
23	0	0
24	0	0
25	0	0
26	0	0
27	0	0
28	0	0
29	0	0
30	0	0
31	0	0
32	13	7
33	20	45
34	0	0
35	0	0
36	< 1	< 1

Naval Support Activity Memphis RCRA Facility Investigation
Assembly E Investigation Derived Waste Drum Organic Vapor Screening Log (ppm)

Drum	Headspace	Baggie
37	0	< 1
38	0	3
39	5	< 1
40	< 1	0
41	< 1	0
42	< 1	0
43	< 1	0
44	< 1	0
45	0	0
46	0	0
47	0	< 1
48	0	0
49	0	0
50	0	0
51	0	0
52	0	0
53	0	0
54	0	0
55	0	0
56	0	0
57	0	0
58	0	0
59	0	0
60	0	0
61	0	0
62	0	0
63	0	4257
64	0	0
65	0	0
66	0	0
67	0	0
68	0	0
69	4651	217
70	2	0
71	0	0
72	0	0
73	0	0

Naval Support Activity Memphis RCRA Facility Investigation
Assembly E Investigation Derived Waste Drum Organic Vapor Screening Log (ppm)

Drum	Headspace	Baggie
74	165	83
75	0	730
76	0	0
77	0	0
78	0	0
79	0	0
80	0	0
81	0	0
82	0	0
83	0	0
84	110	105
85	0	0
86	0	0
87	0	0
88	0	0
89	0	0
90	0	0
91	0	0
92	0	0
93	0	0
94	0	0
95	0	0
96	0	0
97	222	0
98	8	0
99	0	0
100	0	0
101	0	0
102	0	238
103	0	0
104	-	-
105	-	-
106	0	0
107	0	0
108	0	0
109	0	0
110	-	-

Naval Support Activity Memphis RCRA Facility Investigation
Assembly E Investigation Derived Waste Drum Organic Vapor Screening Log (ppm)

Drum	Headspace	Baggie
111	–	–
112	0	0
113	–	–
114	5	0
115	0	0
116	–	–
117	0	0
118	0	0
119	–	–
120	0	0
121	0	0
122	20	0
123	–	–
124	0	0
125	0	0
126	0	0
127	0	0
128	0	0
129	57	14
130	29	0
131	0	0
132	0	0
133	0	0
134	0	0
135	0	0
136	121	0
137	0	0
138	0	0
139	0	0
140	0	0
141	0	0
142	–	–
143	0	0
144	0	0
145	0	0
146	224	0
147	0	0

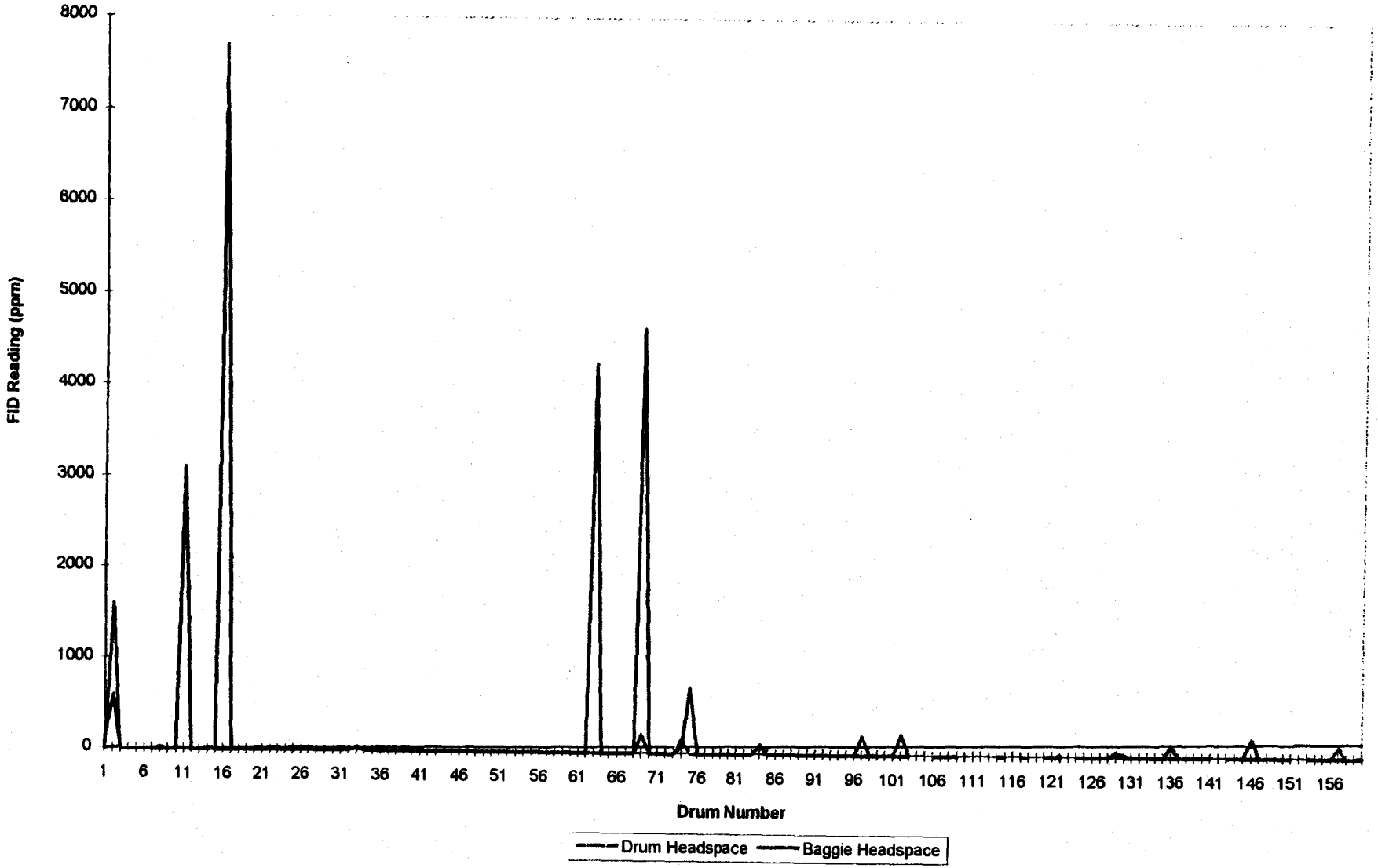
Naval Support Activity Memphis RCRA Facility Investigation
Assembly E Investigation Derived Waste Drum Organic Vapor Screening Log (ppm)

Drum	Headspace	Baggie
148	0	0
149	0	0
150	0	0
151	0	0
152	-	-
153	0	0
154	0	0
155	0	0
156	0	0
157	123	0
158	0	0
159	0	0
160	13	0

Notes:
- = Data not available due to inaccessibility to drum, or drum contained waste plastic sheeting.
Bolded items indicate elevated organic vapor readings, relative to all drums screened.

NSA Memphis Assembly E IDW Screening Results

Assembly E IDW Drum Screening Results



Appendix F

Technical Memorandum — General Human Health Risk Assessment

TECHNICAL MEMORANDUM

TO: Mark Taylor/David Porter, SOUTHDIV
Tonya Barker/Rob Williamson, NSA Memphis
Brian Donaldson, USEPA
Jim Morrison, TDEC
Jack Carmichael, USGS
Brenda Duggar, MSCHD
E/A&H Project Team

FROM: Brian Mulhearn, E/A&H

DATE: February 4, 1997

RE: Revision 1 General Human Health Risk Assessment (HHRA) Approach for NSA Memphis

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This memorandum discusses the general HHRA approach for NSA Memphis and incorporates USEPA's suggestions received during the January 28, 1997 Base Realignment and Closure (BRAC) Cleanup Team meeting. This text will not be reproduced in subsequent HHRAs with the exception of the final report, where the text will be included as an appendix. Initially, HHRAs will include only site-specific information and will reference this memorandum, reducing the bulk necessary to present site-specific risk information to risk managers. Deviations from these general methods will be justified and discussed in site-specific HHRAs.

1 BASELINE RISK ASSESSMENT

1.1 Introduction

A baseline risk assessment (BRA) establishes a baseline of risk to facilitate risk management decisions. Risk is the estimated potential for toxic effects on actual or hypothetical human or ecological receptors, while baseline risk refers to risk arising from exposures to chemicals assuming site conditions remain unchanged. BRAs are used by risk managers to decide if remedial actions are necessary and to determine the extent of remediation necessary to reduce the risk to acceptable levels. Generally, a BRA is divided into two sections, one assessing human health risk, and a second addressing ecological risk. This section addresses generally applied HHRA methods, while ecological risk assessment methods will be addressed in the site-specific assessments. Data management and analysis methods which will be used to reach the conclusions of site-specific HHRAs are discussed below. The following sections describe the methods, procedures, considerations, toxicological information, and related uncertainties possibly affecting HHRAs at NSA Memphis.

1.2 Background

The site background will be summarized in this section of the site-specific HHRAs.

2 General Guidance

HHRAs will generally be prepared in accordance with the guidelines set forth in the following documents, although some may not apply to every site:

- *Provisional Guidance for Quantitative Risk Assessment of PAHs*, U.S. Environmental Protection Agency, ECAO-CIN-842, EPA/600/BP92/001C, July 1993.

- *Risk Assessment Guidance for Superfund (RAGS), Volume I – Human Health Evaluation Manual, Part A*, U.S. Environmental Protection Agency/Office of Emergency and Remedial Response (OERR), EPA/540/1-89/002, December 1989 (Interim).

- *RAGS, Volume I — Human Health Evaluation Manual, (Part B, Development of Risk-Based Preliminary Remediation Goals)*, USEPA/OERR, EPA/540/R92/003, December 1991 (Interim).

- *RAGS, Volume I — Human Health Evaluation Manual, Supplemental Guidance — Standard Default Exposure Factors — Interim Final,* EPA/OERR, Office of Solid Waste and Emergency Response (OSWER) Directive: 9285.6-03, March 25, 1991. (RAGS Supplement).

- *RAGS, Volume I — Human Health Evaluation Manual, Supplemental Guidance-Dermal Risk Assessment — Interim Guidance,* EPA/OERR, August 18, 1992. (Supplemental Dermal Guidance).

- Supplemental Guidance to RAGS: Region IV Bulletin, *Development of Health-Based Preliminary Remediation Goals, Remedial Goal Options (RGO) and Remediation Levels* (Supplemental RGO Guidance).

- Supplemental Guidance to RAGS: Region IV Bulletin, *Provisional Guidance of Quantitative Risk Assessment of PAHs* (EPA Document EPA/600/R-93-089 July 1993).

- *Supplemental Guidance to RAGS: Calculating the Concentration Term*, May 1992.

- USEPA Region III *Selecting Exposure Routes and Contaminants of Concern by Risk-Based Table*, March 18, 1994, (RBC Screening Tables).

- USEPA Region III *Risk-Based Concentration Table*, January 1995, and subsequent versions (USEPA 1995).

2.1 Objectives

The objectives of the BRA will be to:

- Characterize the source media and determine the chemicals of potential concern (COPCs) for affected environmental media.

- Identify potential receptors and quantify their potential exposures under current and future conditions for all affected environmental media.

- Qualitatively and quantitatively evaluate the adverse effects associated with the site-specific COPCs in each medium.

- Characterize the baseline carcinogenic and noncarcinogenic risks associated with exposure to environmental media at the site(s) under current and future land use conditions.

- Evaluate the uncertainties related to exposure predictions, toxicological data, and resulting carcinogenic risk and noncarcinogenic hazard estimations.

- Establish Remedial Goal Options (RGOs) for chemicals of concern (COC) in each environmental medium based on risk/hazard to facilitate risk management decision-making.

The value of the risk assessment as a basis for making remedial decisions and determining whether detected site concentrations have the potential for toxic effects or increased cancer incidences depends upon adequately characterizing chemical contamination. Variables considered in characterizing the study area and its associated risk will include the amount, type, and location of sources; the pathways of exposure (media type and migration routes); and the type, sensitivities, exposure duration, and dynamics of the exposed populations (receptors). Sampling activities

typically consist of collecting surface (0 to 1-foot interval) and subsurface soil samples, and groundwater samples from monitoring wells installed in various water-bearing zones.

2.2 Organization

A human health risk assessment, as defined by RAGS Part A, includes the following steps:

- *Site characterization*: evaluation of data regarding site geography, geology, hydrogeology, climate, and demographics.

- *Data collection*: analysis of environmental media samples, including background/reference samples.

- *Data evaluation*: statistical analysis of analytical data to identify the nature and extent of contamination and to establish a preliminary list of COPCs based on risk-based and background screening. This list will subsequently be refined to identify COCs.

- *Exposure assessment*: identification of potential receptors under current and predicted conditions and potential exposure pathways, and calculation/quantitation of exposure point concentrations and chemical intakes.

- *Toxicity assessment*: qualitative evaluation of the adverse effects of the COPCs, and quantitative estimate of the relationship between exposure and severity or probability of effect.

- *Risk characterization*: combination of the output of the exposure and the toxicity assessments to quantify the total noncancer and cancer risk to the hypothetical receptors.

- *Uncertainty*: discussion and evaluation of the areas of recognized uncertainty in human health risk assessments in addition to medium - and exposure pathway-specific influences.

- *Risk/hazard summary*: presentation and discussion of the results of the quantification of exposure (risk and hazard) for the potential receptors and their exposure pathways identified under the current and future conditions.

- *RGOs*: computation of exposure concentrations corresponding to risk projections within the USEPA target risk range of 1E-6 to 1E-4 for carcinogenic COCs and hazard quotient goals of 0.1, 1, and 3 for noncarcinogenic COCs.

3 Site Characterization

When performing a HHRA, environmental media data are compiled to determine potential site-related chemicals and exposures as outlined in RAGS Part A. The steps identifying COPCs are discussed below.

3.1 Data Sources

The number of samples collected from each medium will be detailed in this section of the site-specific HHRAs, and tables will show which sample designations will be included and how data are grouped (when applicable). In addition, the analytical methods, the name of the analyzing laboratory, and data quality objectives will be referenced at this point in the HHRA.

3.2 Data Validation

Data validation is an after-the-fact, independent, systematic process of evaluating data and comparing them to established criteria to confirm they are of the technical quality necessary to support the decisions made in the RFI process. Parameters specific to the data are reviewed to determine whether they meet the stipulated DQOs. The quality objectives address five principal

parameters: precision, accuracy, completeness, comparability, and representativeness. To verify that these objectives are met, field measurements, sampling and handling procedures, laboratory analysis and reporting, and nonconformances and discrepancies in the data are examined to determine compliance with appropriate and applicable procedures.

Data for NSA Memphis will be validated in accordance with the methods outlined in the *Comprehensive RFI Work Plan* (E/A&H, 1994b). The data validation report will be referenced in this section of the HHRA.

3.3 Management of Site-Related Data

All environmental sampling data will be evaluated for suitability for use in the quantitative BRA. Data obtained via the following methods will be considered inappropriate:

- Analytical methods that are not specific for a particular chemical, such as total organic carbon, total organic halogen, or TPH (design parameter samples).

- Field screening instruments including total organic vapor monitoring units and organic vapor analyzers.

Additional data excluded will be detailed in the site-specific HHRAs.

Limitations of analytical results will be addressed in HHRAs by including estimated concentration values for reported nondetects. A nondetect indicates that the analyte was not detected above the practical quantitation limit of the sample ("U" qualified results), which is determined by the analytical method, the instrument used, and possible matrix interferences. However, a nondetected analyte could exist at a concentration between zero and the quantitation limit. For this reason, one-half the "U" value could serve as an unbiased estimate of the nondetect. Because the

estimated values of "J" qualified hits are frequently much lower than the sample quantitation limits of "U" qualified nondetects for organic compounds, one-half of each "U" value will be compared to one-half of the lowest hit (normally "J" qualified) at the same site. The lesser of these two values will be used as the best estimate of the concentration potentially present below the sample quantitation limit, and will be inserted into the adjusted dataset. For inorganic chemicals, the rule is simpler: One-half of each "U" value will be used to represent the concentration of the corresponding sample when compiling the adjusted dataset. If two nondetects are reported for any one location (a result of QA/QC samples), one-half the lesser of the "U" values will be compared to the lowest hit at the site (for organics, as above) or applied directly (for inorganics) to estimate a concentration value to be used in the NSA Memphis risk calculations. If a parameter is not detected at a site, neither data management method will be applied, and the parameter will not be considered in screening or formal assessment.

Once the dataset is complete, statistical methods will be used to evaluate the analytical results to (1) identify COPCs and (2) establish exposure point concentrations (EPCs) at potential receptor locations. The statistical methods used in data evaluation are discussed below. The rationale used to develop this methodology and the statistical techniques is based on the following sources:

- RAGS Part A
- *Supplemental Guidance to RAGS: Calculating the Concentration Term*, May 1992
- *Statistical Methods for Environmental Pollution Monitoring* (Gilbert, 1987)

Microsoft Fox Pro and Borland[1] Quattro Pro will typically be used for data management and statistical calculations. For each set of data used to describe the concentration of chemicals in a contaminated area, the following information will be tabulated in accordance with RAGS:

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1 References to specific software products are not to be construed as an endorsement by the U.S. Navy or E/A&H.

frequency of detection, range of quantitation limits, range of detected values, and average of detected concentrations. For datasets of 10 or more, the upper confidence limit (UCL) on the mean of log-transformed values of the concentration will be presented. In accordance with RAGS, the lesser of either the maximum concentration detected or the UCL will be used to quantify potential exposure, as detailed in Section 4, Exposure Assessment.

3.4 Selection of COPCs

The substances detected (chemicals present in site samples, or CPSSs) will be screened to develop a list or group of COPCs. COPCs are, therefore, chemicals selected by comparison to screening concentrations, intrinsic toxicological properties, persistence, fate and transport characteristics, and cross-media transport potential. The nature and general extent of CPSSs will be referenced in this section of the site-specific HHRAs. To reduce the list of CPSSs and focus the risk assessment on COPCs, the following two comparisons will be performed.

3.4.1 Comparison of Site-Related Data to Risk-Based Screening Concentrations

The maximum concentrations of CPSSs detected during sampling will be compared to risk-based screening values. These values will be obtained from *Risk Based Screening Concentrations*, USEPA Region III, January through June, 1996 (and subsequent versions). As stated in the EPA Region III document, a risk goal of 1E-6 will be used to calculate screening concentrations for carcinogens. RBCs will be adjusted to reflect a target HQ of 0.1 for noncarcinogens, in accordance with USEPA Region IV *Supplemental Guidance to RAGS Bulletin 1* (USEPA, November 1995). Groundwater results will be compared to tap water screening values, and reported soil concentrations will be compared to residential soil screening values. CPSSs with maximum detected concentrations exceeding their corresponding concentrations, goals, levels, and/or standards will be evaluated further and compared to reference background concentrations. In addition, surrogate screening values based on toxicological similarities will be used if no screening value are available in USEPA's table, and surrogate screening values will be noted where applied.

The maximum concentration reported for each carcinogenic polycyclic aromatic hydrocarbon (PAH) will be compared to its corresponding screening value. In addition, all carcinogenic PAH concentrations reported at that location will be converted to the benzo(a)pyrene equivalent concentration (BEQ), which will be compared to the screening value for benzo(a)pyrene. PAH conversions will be performed using current Toxic Equivalency Factors (TEFs) for PAHs in accordance with USEPA Region IV *Supplemental Guidance to RAGS Bulletin 2* (USEPA, November 1995).

3.4.2 Comparison of Site-Related Data to Background Concentrations

Background data for NSA Memphis will be referenced in this section, or background reference concentrations from E/A&H's August 27, 1996 *Reference Concentrations* technical memorandum will be used. Following comparison to risk- and hazard-based screening values, CPSSs whose maximum detected concentrations exceeded corresponding background reference concentrations will be formally assessed in the HHRA, unless otherwise noted.

The maximum reported concentration of a CPSS will be compared to its reference background concentration (when applicable). This comparison helps account for naturally occurring elements, such as beryllium, manganese, and arsenic. Thus, risk and/or hazard associated with naturally occurring elements are not addressed where their concentrations are similar to corresponding background.

In the HHRA, if the maximum concentration of a CPSS is determined to be less than either two-times mean background or the risk-based screening values, then the CPSS will not be considered further unless deemed appropriate based on chemical-specific characteristics (e.g., degradation product with greater toxicity).

3.4.3 Elimination of Essential Elements: Calcium, Iron, Magnesium, Potassium, and Sodium

In accordance with RAGS Part A, essential elements that are potentially toxic only at extremely high concentrations may be eliminated as COPCs in a risk assessment. Specifically, an essential nutrient may be screened out if it is present at concentrations that are not associated with adverse health effects. Based on RAGS, the lack of risk-related data, and USEPA Region IV's recommendations, the following essential nutrients will not be included in HHRAs: calcium, iron, magnesium, potassium, and sodium.

Risk information usually obtained from the Integrated Risk Information System (IRIS) or Health Effects Assessment Summary Tables (HEAST) is necessary to calculate risk and hazard estimates (and risk-based screening values). This information is based on toxicological and epidemiological data which are critiqued and approved by the scientific and regulatory community (i.e., listed in IRIS and/or HEAST). Risk information (or surrogate risk information) is not always available for all CPSSs, so their risk and/or hazard will not be calculated. The results of the screening process will be tabulated in the HHRA. No risk-based screening values are available for TPH and chemical-specific analyses were performed on site samples, so exposure will not be quantified for this group of compounds. The most toxic TPH constituents would generally be included in the chemical-specific analyses.

3.4.4 Summary of COPCs

The results of the screening evaluations will be tabulated on a medium-specific basis in the site-specific HHRAs.

3.5 Estimation of Risk and Hazard

COPCs will be identified, and exposure will be estimated for these compounds. Risk/hazard will be subsequently calculated based on exposure estimates, then exposure scenarios (e.g., soil

exposure during commercial land use) exceeding USEPA acceptable limits will be identified. An exposure scenario of concern will be identified as a scenario with incremental excess lifetime cancer risk (ILCR) estimated greater than 1E-4 or a hazard index (HI) estimated greater than 1. In the next step, COPCs exceeding 1E-6 ILCR or a HQ greater than 0.1 in a scenario of concern are retained as COCs. Section 5, Toxicity Assessment, discusses cancer risk thresholds and noncancer toxicity in detail.

4 Exposure Assessment

This section of the HHRAs will determine the magnitude of contact that a potential receptor may have with site-related COPCs. Exposure assessment involves four stages:

- Characterizing the physical setting and land use of the site.
- Identifying COPC release and migration pathway(s).
- Identifying the potential receptors, under various land use or site condition scenarios, and the pathways through which they might be exposed.
- Quantifying the intake rates, or contact rates, of COPCs.

4.1 Exposure Setting and Land Use

The site setting and land use will be detailed or referenced in this section of the site-specific HHRAs. This information is used to develop appropriate exposure estimates for different land use assumptions. If the future use of the area in question is known, this information will be used to define exposure assumptions used when calculating risk (e.g., sites known to be commercially zoned will not be assessed for residential land use). Future land use will be specified with as much accuracy as possible in site-specific HHRAs, particularly for property being transferred from the Navy to the City of Millington.

4.2 Potentially Exposed Populations

This section will describe who may be exposed to contaminants in environmental media. The populations typically addressed will be one or a combination of the following: current site workers, hypothetical current site trespassers, as well as hypothetical future site residents. Because current site workers at most sites within NSA Memphis would be expected to have limited contact with contaminated media at most sites, worker-related exposure may be addressed exclusively for maximally exposed site workers, assuming the future worker scenario would be protective of both current and future site workers. Specifics will be discussed in this section of the site-specific HHRAs.

4.3 Exposure Pathways

This section will summarize how potential human receptors may be exposed to site media. In general, soil matrix-related pathways will include incidental ingestion and dermal contact. Ingestion and inhalation of volatilized contaminants will be typical groundwater exposure pathways. The hypothetical future scenarios will assume continuous, uniform exposure to current surface soil conditions and the use of site groundwater as a potable water source, unless otherwise noted in the site-specific HHRA. A table in the site-specific HHRA will justify and summarize exposure pathways and potential human receptors.

4.4 Exposure Point Concentrations

The EPC is the estimated concentration of a contaminant in an exposure medium that will be contacted by a real or hypothetical receptor. Determining the exposure point concentration depends on factors such as:

- Availability of data
- Amount of data available to perform statistical analysis
- Reference concentrations not attributed to site impacts
- Location of the potential receptor

USEPA Region IV guidance calls for assuming lognormal distributions for environmental data and the calculation of 95% UCL on the mean for use in exposure quantification. Applying the UCL is generally inappropriate with less than 10 samples. Therefore, the maximum concentrations detected will be used for all datasets with less than 10 samples. In general, outliers have been included when calculating the UCL because high values seldom appear as outliers for a lognormal distribution. Including outliers increases the overall uncertainty of the calculated risks and conservatively biases exposure estimates.

For sample sets of 10 and greater, the UCL will be calculated for a lognormal distribution as follows:

$$UCL = e^{\left(\bar{a}+0.5s_a^2 + \frac{H_{0.95} \times s_a}{\sqrt{n-1}}\right)}$$

where:

$\bar{a}$	=	$\Sigma a/n$ = sample arithmetic mean of the log-transformed data, $a = \ln(x)$
s_a	=	sample standard deviation of the log-transformed data
n	=	number of samples in the data set
$H_{0.95}$	=	value for computing the one-sided upper 95% confidence limit on the lognormal mean from standard statistical tables (Gilbert, 1987)

EPCs and UCLs will be summarized and tabulated when applicable in the site-specific HHRA.

4.5 Quantification of Exposure

This section describes the models, equations, and intake model variables used to quantify doses or intakes of the COPCs for the surface soil and groundwater exposure pathways. The models are

designed to estimate route- and medium-specific factors, which are multiplied by the EPC to estimate chronic daily doses. The intake model variables generally reflect 50th or 95th percentile values which, when applied to the EPC, ensure that the estimated intakes represent the reasonable maximum exposure (RME, which is considered 95th percentile). Formulae are derived from RAGS, Part A unless otherwise indicated. Table 1 lists intake model variables used to compute chronic daily intake (CDI) for potential receptors exposed to surface soil and/or groundwater contaminants.

Because NSA Memphis is part of BRAC, future site use cannot be determined with any certainty. Therefore, the conservative assumptions will be used to account for any reasonable future use. Current reuse plans will be referenced and discussed in the site-specific HHRAs. NSA Memphis media analytical results and exposure methods have been formatted to allow exposure estimates to be fine-tuned based on actual conditions as base reuse plans materialize, and this information will be used on a site-specific basis, if known.

In accordance with USEPA's recommendations, the adult and child intake variables will be combined to estimate exposure to carcinogens. This factor is referred to as the lifetime weighted average, or LWA. The LWA considers the difference in daily ingestion rates for soil and drinking water, body weights, and exposure durations for children (ages 1 to 6) and adults (ages 7 to 31). The exposure frequency is assumed to be identical for the adult and child exposure groups, and an example is shown after the equations are presented below.

Before quantifying soil exposure, it will first be necessary to derive the appropriate fraction ingested (or contacted) (FI/FC) from contaminated area factors for each applicable COPC. These factors will be derived by evaluating the spatial distribution of COPCs. The FI/FC will be computed by estimating the maximum area affected and dividing it by the total exposure unit area. These computations will be performed conservatively to account for uncertainty associated with contaminant distributions.

Table 1
Parameters Used to Estimate CDI

Pathway Parameters	Resident Adult	Resident Child	Adult Worker	Trespassing Child (age 7-16)	Units
Surface Soil Ingestion and Dermal Contact					
Ingestion Rate (soil)	100[a]	200[a]	50[a]	100[a]	mg/day
Ingestion Rate (water)	2	1	1	NA	L/day
Exposure Frequency	350[b]	350[b]	250[b]	52[f]	days/year
Exposure Duration	24[c]	6[c]	25[c]	10[g]	years
Dermal Contact Area	4,100[a]	2,900[a]	4,100[a]	4,100[a]	cm^2
Skin Adherence Factor	1	1	1	1	mg/cm^2
Absorption Factor	0.01 (organics) 0.001 (inorganics)	0.01 (organics) 0.001 (inorganics)	0.01 (organics) 0.001 (inorganics)	0.01 (organics) 0.001 (inorganics)	unitless
Oral Absorption Efficiency	0.8 (VOCs) 0.5 (other organic compounds) 0.2 (inorganics)	0.8 (VOCs) 0.5 (other organic compounds) 0.2 (inorganics)	0.8 (VOCs) 0.5 (other organic compounds) 0.2 (inorganics)	0.8 (VOCs) 0.5 (other organic compounds) 0.2 (inorganics)	unitless
Conversion Factor	1E-6	1E-6	1E-6	1E-6	kg/mg
Body Weight	70[a]	15[a]	70[a]	45[a]	kg
Averaging Time, Noncancer	8,760[d]	2,190[d]	9,125[d]	3,650[d]	days
Averaging Time, Cancer	25,550[e]	25,550[e]	25,550[e]	25,550[e]	days

Notes:
a — USEPA (1989a) *Risk Assessment Guidance for Superfund Vol. I, Human Health Evaluation Manual (Part A).*
b — USEPA (1991b) *Risk Assessment Guidance for Superfund Vol. I: Human Health Evaluation Manual Supplemental Guidance, Standard Default Exposure Factors, Interim Final,* OSWER Directive: 9285.6-03.EPA/600/8-89/043.
c — USEPA (1991a), *Risk Assessment Guidance for Superfund: Vol. I – Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals),* OSWER Directive 9285.7-01B.
d — Calculated as the product of ED (years) x 365 days/year.
e — Calculated as the product of 70 years (assumed lifetime) x 365 days per year.
f — Assuming one day per week exposure.
g — Assuming trespassing occurs during the 10-year adolescent/teenage period.
NA — Not applicable.

The FI/FC factors modify the concentrations to more closely approximate site-wide exposure conditions for a given exposure unit area. When the UCL is used as EPC, no FI/FC adjustments will be made. In addition, CPSSs not eliminated from the HHRAs based on the screening comparisons described in Section 3.4 may be eliminated as a COPC because the UCL concentration does not exceed the corresponding background concentration or RBC. This will be discussed on a site-specific basis.

4.5.1 Surface Soil Pathway Exposure

Ingestion of COPCs in Surface Soil

Except CDI for a site resident's exposure to carcinogens, the following equation is used to estimate the ingestion of COPCs in soil:

$$CDI_s = (EPC_s)(IR)(EF)(ED)(F)(FI)/(BW)(AT)$$

where:

CDI_s = ingested dose (mg/kg-day)

EPC_s = exposure point concentration of contaminant in soil (mg/kg)

IR = ingestion rate (milligrams per day [mg/day])

EF = exposure frequency (days/year)

ED = exposure duration (years)

F = conversion factor (1E-6 kg/mg)

FI = fraction ingested from contaminated source (unitless)

BW = body weight (kg)

AT = averaging time (days)

The LWA is used to calculate carcinogenic CDI for site residents. An example of the LWA calculation is shown below for the soil ingestion pathway, and LWAs are similarly calculated for subsequent equations.

$$LWA = [(IR_a \times ED_a)/BW_a] + [(IR_c \times ED_c)/BW_c]$$

where:

LWA = lifetime weighted average

IR = ingestion rate (milligrams per day [mg/day])

ED = exposure duration (years)

BW = body weight (kg)

$_a$ = adult

$_c$ = child

Consequently, CDI for carcinogens would be calculated as follows for site residents:

$$CDI_s = (EPC_s)(EF)(LWA)(F)(FI)/(AT)$$

where:

CDI_s = ingested dose (mg/kg-day)

EPC_s = exposure point concentration of contaminant in soil (mg/kg)

EF = exposure frequency (days/year)

F = conversion factor (1E-6 kg/mg)

FI = fraction ingested from contaminated source (unitless)

AT = averaging time (days)

LWA = lifetime weighted average

Dermal Contact with COPCs in Surface Soil

The following equation is used to estimate intake due to dermal contact with COPCs in soil:

$$CDI_{sd} = (EPC_s)(CF)(EF)(ED)(F)(FC)(ABS)(AF)/(BW)(AT)$$

where:

CDI_{sd} = dermal dose (mg/kg-day)

EPC_s = exposure point concentration of contaminant in soil (mg/kg)

CF = contact factor (cm^2)

EF = exposure frequency (days/year)

ED = exposure duration (years)

F = conversion factor (1E-6 kg/mg)

FC = fraction contacted from contaminated source (unitless)

ABS = absorption factor (unitless value, specific to organic versus inorganic compounds)

AF = adherence factor (milligrams per square centimeter [mg/cm^2])

BW = body weight (kg)

AT = averaging time (days)

4.5.2 Groundwater Pathway Exposure

Ingestion and Inhalation of COPCs in Groundwater

The following equation is used to estimate the ingestion and/or inhalation of COPCs in groundwater:

$$CDI_w = (EPC_w)(IR)(EF)(ED)(FI)/(BW)(AT)$$

where:

CDI_w = ingested/inhaled dose (mg/kg-day)

EPC_w = exposure point concentration of contaminant in water (milligrams per liter [mg/L])

IR = ingestion rate (L/day)

EF = exposure frequency (days/year)

ED = exposure duration (years)

FI = fraction ingested from contaminated source (unitless)

BW = body weight (kg)

AT = averaging time (days)

HHRAs are comprised of many tables, and intake tables serve only as an intermediate check when reviewing the document. The CDI equations above can be solved assuming a concentration of 1, and the result can be used as a universal multiplier. Multipliers were developed for each typical land use scenario and are shown in Table 2. Consequently, a significant number of the tables in HHRAs can be eliminated. An example of the abbreviated CDI method is shown below:

$$CDI = (EPC)(M)$$

where:

CDI = chronic daily intake (mg/kg-day)

EPC = exposure point concentration (mg/kg or mg/L)

M = multiplier specific to the exposure scenario, land use, and potential receptor selected

Table 2
Multipliers[a] Used to Estimate Chronic Daily Intake

		Soil		Groundwater
		Ingestion	*Dermal Contact*	*Ingestion*
Exposure Scenario	**Exposure Type**	**All Chemicals**	**Organics[b]**	**All Chemicals[c]**
Resident	Noncarcinogens (adult)	1.37E-6	5.62E-7	2.74E-2
	Noncarcinogens (child)	1.28E-5	1.85E-6	6.39E-2
	Carcinogens (LWA)	1.57E-6	3.51E-7	1.49E-2
Trespasser	Noncarcinogens	3.17E-7	1.30E-7	NA
(age 7-16)	Carcinogens	4.52E-8	1.85E-8	NA
Site Worker	Noncarcinogens	4.89E-7	4.01E-7	9.78E-3
	Carcinogens	1.75E-7	1.43E-7	3.49E-3

Notes:
NA — Not applicable
LWA — Lifetime weighted average
[a] — The product of the multiplier and the exposure point concentration equals the chronic daily intake for a given chemical assuming a reasonable maximal exposure scenario.
[b] — The multiplier for inorganics is multiplied by a factor of 0.1 to account for the dermal absorption factor of 0.001 for inorganics; the multiplier for organic compounds includes the 0.01 factor.
[c] — The ingestion intake is also used to address inhalation risk in accordance with USEPA's Supplemental Guidance To RAGS Bulletin 3; ingestion risk is approximately equal to risk posed by dermal and inhalation exposure while showering, and this is applied to volatile organic compounds only.

Because multipliers can be reviewed separately, CDI will be incorporated into the risk and hazard equations and *will not be presented* in separate tables.

5 Toxicity Assessment

5.1 Carcinogenicity and Noncancer Effects

USEPA has established a classification system for rating the potential carcinogenicity of environmental contaminants based on the weight of scientific evidence. The cancer classes are described below. Cancer weight-of-evidence class "A" (human carcinogens) means that human toxicological data have shown a proven correlation between exposure and the onset of cancer (in varying forms). The "B1" classification indicates some human exposure studies have implicated the compound as a probable carcinogen. Weight-of-evidence class "B2" indicates a possible human carcinogen based on confirmatory carcinogenic laboratory animal data. Weight-of-evidence class "C" identifies possible human carcinogens, and class "D" indicates a compound not classifiable with respect to its carcinogenic potential. A class "A" compound posing risk higher than USEPA's acceptable risk range has more weight than would a class "C" compound. There is more uncertainty in the lower classifications, so the weight-of-evidence should be used by risk managers when making risk management decisions based on cancer risk.

USEPA has established slope factors (SF) for carcinogenic compounds. The SF is defined as a "plausible upper-bound estimate of the probability of a response (cancer) per unit intake of a chemical over a lifetime" (RAGS, Part A). Upper-bound estimates are more likely to overestimate cancer potential.

In addition to potential carcinogenic effects, most substances also can produce other toxic responses at doses greater than experimentally derived threshold concentrations. USEPA has derived reference dose (RfD) values for these substances. A chronic RfD is defined as, "an estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a daily exposure

concentration for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime." These toxicological values are used in risk formulae to assess the upper-bound level of cancer risk and noncancer hazard associated with exposure to a given chemical concentration.

For carcinogens, the potential risk posed by a chemical is computed by multiplying the CDI (as mg/kg-day) by the SF (in reciprocal mg/kg-day). The HQ (for noncarcinogens) is computed by dividing the CDI by the RfD. USEPA has set standard limits (or points of departure) for carcinogens and noncarcinogens to evaluate whether significant risk is posed by a chemical (or combination of chemicals). For carcinogens, the point-of-departure range is 1E-6, with a generally accepted range of 1E-6 to 1E-4. These risk values correlate with one in 10,000 (1E-4) and one in 1 million (1E-6) excess cancer incidence resulting from exposure to toxic compounds from outside the body.

For noncarcinogens, other toxic effects are generally considered possible if the HQ (or sum of HQs for a pathway-hazard index) exceeds the threshold value of 1. Although both cancer risk and noncancer hazard are generally additive only if the target organ is common to multiple chemicals, a most conservative estimate of each may be obtained by summing the individual risks or hazards, regardless of target organ. Site-specific HHRAs for NSA Memphis will take the universal summation approach for each class of toxicant. Details regarding the risk formulae applied to site data are provided in Section 6, Risk Characterization.

Critical studies used in establishing toxicity classifications by USEPA are shown in the IRIS database, which is the primary source for information necessary to estimate risk. HEAST, Fiscal Year 1995 is the secondary source for this information. In addition, USEPA's National Center for Environmental Assessment (NCEA) will be used as a source when necessary. In accordance with RAGS, a table will summarize toxicological data in the site-specific HHRAs in the form of RfDs and SFs obtained for COPCs identified in site media, as well uncertainty/modifying factors, target organs, and cancer classes (where available).

5.2 Evaluating Dermal Exposure and the Resulting Toxicity

In accordance with USEPA Region IV's *Supplemental Guidance to RAGS Bulletin 2*, dermal RfD values and SFs are derived from the corresponding oral values. As described in the supplemental guidance, the oral RfD is multiplied by an oral absorption efficiency factor (OAF), expressed as a decimal. The resulting dermal RfD is based on the absorbed dose. The RfD based on absorbed dose is the appropriate value with which to compare a dermal dose, because dermal doses are expressed as absorbed rather than administered (intake) doses. For the same reasons, a dermal SF is derived by dividing the oral SF by the OAF. The oral SF is divided rather than multiplied because SFs are expressed as reciprocal doses.

Appendix A of RAGS, Part A states that in the absence of specific data, an assumption of 5% oral absorption would be relatively conservative. *Supplemental Guidance to RAGS: Region IV Bulletin 2* indicates that in the absence of specific data, USEPA Region IV suggests an oral absorption factor of 80% for volatile organics, 50% for semivolatile organics, and 20% for inorganic chemicals. These percentages (or associated fractions) will be used in the site-specific HHRAs

5.3 Toxicity Profiles for COPCs

In accordance with RAGS, toxicological summary paragraphs will be included in the body of the HHRA text for all COPCs. Most information for the profiles will be gleaned from IRIS and HEAST. Another source of information will be NCEA. Any additional references will be noted specifically in the text. The profiles will summarize adverse effects of COPCs and the amount associated with such effects.

6 Risk Characterization

Risk characterization combines the exposure assessment and toxicity assessment results to yield qualitative and quantitative expressions of risk and/or hazard for the exposed receptors. The quantitative component expresses the probability of developing cancer, or a threshold comparison

of the estimated dose with a reference dose for noncancer effects. These quantitative estimates are developed for individual chemicals, exposure pathways, transfer media, and source media, and for each receptor for all media to which one may be exposed. The qualitative component usually involves comparing COC concentrations in media with established criteria or standards for chemicals for which there are no corresponding toxicity values. The risk characterization helps guide risk-management decisions.

Generally, the risk characterization will follow the methodology prescribed by RAGS Part A, as modified by more recent information and supplemental guidance cited in the earlier sections of this memorandum. *The USEPA methods are designed to be health-protective and tend to overestimate risk rather than underestimate it. The risk results, therefore, are generally overly conservative, because risk characterization involves summing the overestimated risk estimates.*

6.1 Risk Characterization Methodology

Potential excess risks to humans following exposure to COPCs will be estimated using methods established by USEPA, when available. As discussed above, these methods are health-protective and are likely to overestimate risk. Risks from hazardous chemicals are calculated for either carcinogenic or noncarcinogenic effects. Some carcinogenic chemicals may also pose a noncarcinogenic hazard. The potential human health effects associated with chemicals that produce carcinogenic and other toxic effects will be characterized separately, as discussed below.

6.1.1 Carcinogenic Effects of Chemicals

The risk attributed to exposure to carcinogens is estimated as the probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. In the low-dose range, which would be expected for most environmental exposures, cancer risk is estimated from the following linear equation (EPA, 1989a):

$$ILCR = (CDI)(SF)$$

where:

ILCR	=	incremental lifetime excess cancer risk, a unitless expression of the probability of developing cancer, adjusted for reference incidence
CDI	=	chronic daily intake, averaged over 70 years (mg/kg-day)
SF	=	cancer slope factor $(mg/kg\text{-}day)^{-1}$

For a given pathway with simultaneous exposure of a receptor to several carcinogens, the following equation is used to sum cancer risks:

$$Risk_p = ILCR(chem_1) + ILCR(chem_2) + \ldots ILCR(chem_i)$$

where:

$Risk_p$	=	total pathway risk of cancer incidence
$ILCR(chem_i)$	=	incremental lifetime excess cancer risk for a specific chemical

Cancer risk for a given receptor across pathways and across media is summed in the same manner.

6.1.2 Noncarcinogenic Effects of Chemicals

The risks associated with the noncarcinogenic effects of chemicals are evaluated by comparing an exposure level or intake with a reference dose. The HQ, defined as the ratio of intake to RfD, is defined as (RAGS, Part A):

$$HQ = CDI/RfD$$

where:

HQ	=	hazard quotient (unitless)
CDI	=	intake of chemical (mg/kg-day)

RfD = reference dose (mg/kg-day)

Chemical noncarcinogenic effects are evaluated on a chronic basis, using chronic RFD values. An HQ of 1 indicates that the estimated intake equals the RfD. If the HQ is greater than unity, there may be a concern for potential adverse health effects.

In the case of simultaneous exposure of a receptor to several chemicals, an HI will be calculated as the sum of the HQs by:

$$HI = HQ_1 + HQ_2 + \ldots HQ_i$$

where:

HI = Hazard Index (unitless)

HQ = Hazard Quotient (unitless)

Risk and hazard projections will be summarized in tabular format on a medium- and exposure pathway-specific basis in the HHRAs.

6.2 Surface Soil Pathways

Generally, the incidental ingestion and dermal contact pathways will be characterized for surface soil. Surface soil onsite will be evaluated under scenarios and exposure pathways outlined in the site-specific HHRAs.

6.3 Groundwater Pathways

Groundwater pathways will typically consist of ingestion and inhalation of volatilized chemicals in groundwater. The site-specific HHRAs will detail the pathways which will be addressed. Most groundwater pathways are not complete because municipal water supplies are used, and this will be discussed in the HHRAs.

6.4 COCs Identified

COCs will be identified based on cumulative (all pathway) risk and hazard projected for the sites. USEPA has established a generally acceptable risk range of 1E-4 to 1E-6, and an HI threshold of 1.0. Any COPC that is carried through the risk assessment process and found to contribute to a scenario with an ILCR in excess of 1E-4 or HI greater than 1 for any of the exposure scenarios evaluated in this risk assessment, and has an individual exposure pathway risk greater than 1E-6 or exposure pathway HQ greater than 0.1, will be referred to as a COC. A table will present the COCs identified in site-specific HHRAs.

7 Risk Uncertainty

This section will discuss the uncertainty and variability inherent in the risk assessment process in addition to site-, medium-, and exposure pathway-specific influences. Overall, uncertainties associated with the initial stages of the risk assessment process become magnified when they are combined with other uncertainties. It is not possible to eliminate all uncertainties; however, recognizing the uncertainties is fundamental to understanding and subsequently using risk assessment results.

Where chronic RME estimates of risk/hazard indicated a significant threat (e.g., ILCR greater than 1E-4) would be posed to human health, central tendency (CT) analysis may be performed. RME estimates are based on the upper bound (90th or 95th percentile) exposure assumptions, while CT estimates are based on the 50th percentile (mean or median) values. CT exposure scenarios are constructed consistent with standard CT exposure assumptions provided in *Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure-Draft* (USEPA, November 1993). CT exposure assumptions will be presented in the site-specific HHRAs, when applicable.

8 Risk Summary

Risk estimates will be presented and summarized in table form in the site-specific HHRAs.

9 Remedial Goal Options

RGOs are chemical concentrations computed to equate with specific risk and/or hazard goals that may be established for a particular site. As previously discussed, COCs are identified as any COPC that significantly contributes to a scenario of concern. RGOs will be calculated for each land use scenario with cumulative risk estimates greater than 1E-4 or cumulative hazard indices greater than 1.0. Based on this method, COCs may be identified, requiring RGO calculation. Inclusion in the RGO table does not necessarily indicate that remedial action will be required to address a specific chemical. Instead, RGOs are provided to facilitate risk-management decisions.

In accordance with USEPA Supplemental RGO Guidance, RGOs will be calculated at 1E-4, 1E-5, and 1E-6 risk levels for carcinogenic COCs and HI goals of 3, 1, and 0.1 for noncarcinogenic COCs. RGOs will be based on specific scenarios which will be identified in the site-specific HHRAs.

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Appendix G

Wildlife Toxicity Data — Baseline Risk Assessment Table

Appendix G
Wildlife Toxicity Data
Baseline Risk Assessment
Assembly E
NSA Memphis – Millington, Tennessee

Chemical	Test Species	Test Type	Duration	Effect	Oral LD_{50} (mg/kg/BW)	LOAEL (mg/kgBW/day)	Reference
SVOCs							
Anthracene	Mouse	Oral	NR	Mortality	17,000		RTECS, 1993
Benzo(a)pyrene	Rat	Oral (chronic)	Pregnancy	Sterility in offspring		40	USEPA, 1984
	Rat	Oral (chronic)	3.5 months	Reproductive		50	USEPA, 1984
	Rodents	Single oral dose	NR	Mortality	50		Eisler, 1987
Bis(2-ethylhexyl)phthalate	Rat	Oral	NR	Mortality	30,600		RTECS, 1993
	Rat	Oral	NR	Reproductive effects		7,140	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		35	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		6,000	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		17,200	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		10,000	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		9,766	RTECS, 1993
	Mouse	Oral	NR	Mortality	30,000		RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		78,880	RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		4,200	RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		50	RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		1,000	RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		2,040	RTECS, 1993
	Rabbit	Oral	NR	Mortality	34,000		RTECS, 1993
	Guinea pig	Oral	NR	Mortality	26,000		RTECS, 1993
	Guinea pig	Oral	NR	Reproductive effects		20,000	RTECS, 1993
	Mammal	Oral	NR	Reproductive effects		20,000	RTECS, 1993
	Mammal	Oral	NR	Reproductive effects		509,000	RTECS, 1993

Appendix G
Wildlife Toxicity Data
Baseline Risk Assessment
Assembly E
NSA Memphis – Millington, Tennessee

Chemical	Test Species	Test Type	Duration	Effect	Oral LD_{50} (mg/kg/BW)	LOAEL (mg/kgBW/day)	Reference
SVOCs							
Bis(2-ethylhexyl)phthalate) (Continued)	Mouse	Single oral dose		Mortality	800		RTECS, 1993 and NIOSH, 1985
	Mouse	Oral (subchronic)	13 weeks	Renal effects		125	RTECS, 1993
Butylbenzylphthalate	Rat	Oral	NR	Mortality	2,330		RTECS, 1994
	Rat	Oral	NR	Reproductive effects		21,000	RTECS, 1994
	Rat	Oral	NR	Reproductive effects		16,400	RTECS, 1994
	Rat	Oral	NR	Reproductive effects		16,400	RTECS, 1994
	Rat	Oral	NR	Reproductive effects		4,900	RTECS, 1994
	Mouse	Oral	NR	Mortality	4,170		RTECS, 1994
	Guinea Pig	Oral	NR	Mortality	13,750		RTECS, 1994
1,4-Dichlorobenzene	Rat	Oral	NR	Mortality	500		RTECS, 1994
	Rat	Oral	NR	Reproductive effects		7,500	RTECS, 1994
	Rat	Oral	NR	Reproductive effects		10,000	RTECS, 1994
	Mouse	Oral	NR	Mortality	2,950		RTECS, 1994
	Rabbit	Oral	NR	Mortality	2,830		RTECS, 1994
Di-n-butylphthalate	Rat	Oral (subchronic)	48 days	Reproductive		125	ATSDR, 1989
	Rat	Oral	1 year	Mortality		600	IRIS, 1991
Fluoranthene	Rat	Oral	NR	Mortality	2,000		RTECS, 1994
Phenanthrene	Mouse	Oral	NR	Mortality	700		RTECS, 1994
Pyrene	Rat	Single oral dose	NR	Mortality	2,700		RTECS, 1993 and NIOSH, 1985
	Mouse	Single oral dose	NR	Mortality	800		RTECS, 1993 and NIOSH, 1985

Appendix G
Wildlife Toxicity Data
Baseline Risk Assessment
Assembly E
NSA Memphis – Millington, Tennessee

Chemical	Test Species	Test Type	Duration	Effect	Oral LD_{50} (mg/kg/BW)	LOAEL (mg/kgBW/day)	Reference
Pesticides/PCBs							
Aroclor 1248	Rat	Oral	NR	Mortality	11,000		RTECS, 1993
	Rabbit	Oral	NR	Reproductive effects		165	RTECS, 1993
	Monkey	Oral	NR	Reproductive effects		32	RTECS, 1993
	Monkey	Oral	NR	Reproductive effects		55	RTECS, 1993
	Monkey	Oral	NR	Reproductive effects		17	RTECS, 1993
	Monkey	Oral	NR	Reproductive effects		35	RTECS, 1993
	Monkey	Oral	NR	Reproductive effects		24	RTECS, 1993
	Monkey	Oral	NR	Reproductive effects		83	RTECS, 1993
	Chicken	Oral	8-9 weeks	Egg hatchability		4.88	USEPA, 1993
	Chicken	Oral	NR	Egg production and hatchability		9.8	USEPA, 1993
	Chicken	Maternal diet	NR	Chick growth		0.98	USEPA, 1993
	Chicken	Oral	8 weeks	Egg production and hatchability		4.9	USEPA, 1993
Aroclor 1254	Mouse	Oral	NR	Reproductive		1.53	USEPA, 1993
	Chicken	Oral (chronic)	NR	Embryonic mortality		0.9[a]	USEPA, 1993
	Rock dove	Oral (chronic)	NR	Parental incubation behavior		0.9[a]	Peakall and Peakall, 1973
	American kestrel	Oral (chronic)	69 days	Reduced sperm concentration		9	Eisler, 1986
	Mink	Oral dose of contaminated meat	160 days	Reproductive		0.096	USEPA, 1993

Appendix G
Wildlife Toxicity Data
Baseline Risk Assessment
Assembly E
NSA Memphis – Millington, Tennessee

Chemical	Test Species	Test Type	Duration	Effect	Oral LD_{50} (mg/kg/BW)	LOAEL (mg/kgBW/day)	Reference
Pesticides/PCBs							
Aroclor 1260	Rat	Oral	NR	Mortality	13,15		RTECS, 1993
	Rat	Single oral dose	NR	Mortality	500		Eisler, 1986
	Rat	Single oral dose	NR	Mortality	1,300		Eisler, 1986
	Rat	Oral	NR	Reproductive effects		1,674	RTECS, 1993
	Rat	Oral (chronic)	2 generations	Reduced littler size		7.6	USEPA, 1985
	Rat	Oral (subchronic)	9 weeks	Fetal mortality; maternal toxicity		6.4	ATSDR, 1987
	Mouse	Oral	NR	Reproductive effects		74	RTECS, 1993
	Mink	Single oral dose		Mortality	4,000		Eisler, 1986
	Mink	Single oral dose		Mortality	3,000		Eisler, 1986
	Mink	Single oral dose		Mortality	750		Eisler, 1986
	Mink	Oral (subchronic)	4 months	Impaired reproduction		0.0075[b]	Newell et al., 1987
	Chicken	Oral (chronic)	NR	Embryonic mortality		0.9[a]	USEPA, 1976
Chlordane	Rat	Oral	NR	Mortality	283		RTECS, 1993
	Rat	Single oral dose		Mortality	430		Allen et al., 1979
	Rat	Single oral dose		Mortality	335		Allen et al., 1979
	Rabbit	Single oral dose		Mortality	300		Allen et al., 1979
	Rabbit	Single oral dose		Mortality	100		Allen et al., 1979
	Dog	Single oral dose		Mortality	200		Allen et al., 1979
	Goat	Single oral dose		Mortality	180		Allen et al., 1979
	Japanese quail	Oral (acute)	5 days	Mortality	35*		Hill et al., 1975
	Bobwhite	Oral (acute)	5 days	Mortality	29*		Hill et al., 1975
	Mallard	Oral (acute)	5 days	Mortality	62*		Hill et al., 1975
	Pheasant	Single oral dose		Mortality	24		USFWS, 1984

Appendix G
Wildlife Toxicity Data
Baseline Risk Assessment
Assembly E
NSA Memphis – Millington, Tennessee

Chemical	Test Species	Test Type	Duration	Effect	Oral LD_{50} (mg/kg/BW)	LOAEL (mg/kgBW/day)	Reference
Pesticides/PCBs							
4,4'-DDE	Rat	Oral	NR	Mortality	800		RTECS, 1993
	Mouse	Oral	NR	Mortality	700		RTECS, 1993
	Hamster	Oral	NR	Mortality	>5,000		RTECS, 1993
	Mallard	Oral	NR	Eggshell thinning		2.91	USEPA, 1993
	Mallard	Oral	2 years	Reproductive: embryo mortality, cracked eggs		0.58	USEPA, 1993
	Kestrel	Oral	NR	Eggshell thinning		0.39	USEPA, 1993
4,4'-DDT	Rat	Oral	NR	Mortality	87		RTECS, 1993
	Rat	Single oral dose		Mortality	100		USEPA, 1985
	Rat	Oral	NR	Reproductive		112	RTECS, 1993
	Rat	Oral	NR	Reproductive		100	RTECS, 1993
	Rat	Oral	NR	Reproductive		430	RTECS, 1993
	Rat	Oral	NR	Reproductive		1,890	RTECS, 1993
	Rat	Oral	NR	Reproductive		250	RTECS, 1993
	Rat	Oral	NR	Reproductive		50	RTECS, 1993
	Rat	Oral (chronic)	3 generations	Reproductive		0.2	IRIS, 1991
	Rat	Oral	2 years	Reproductive		2.5	USEPA, 1993
	Mouse	Oral	NR	Mortality	135		RTECS, 1993
	Mouse	Single oral dose		Mortality	200		USEPA, 1985
	Mouse	Oral	NR	Reproductive		504	RTECS, 1993
	Mouse	Oral	NR	Reproductive		81	RTECS, 1993
	Mouse	Oral	NR	Reproductive		124	RTECS, 1993
	Mouse	Oral	NR	Reproductive		148	RTECS, 1993

Appendix G
Wildlife Toxicity Data
Baseline Risk Assessment
Assembly E
NSA Memphis – Millington, Tennessee

Chemical	Test Species	Test Type	Duration	Effect	Oral LD_{50} (mg/kg/BW)	LOAEL (mg/kgBW/day)	Reference
Pesticides/PCBs							
4,4'-DDT (continued)	Rabbit	Oral	NR	Mortality	250		RTECS, 1993
	Rabbit	Oral	NR	Reproductive		150	RTECS, 1993
	Guinea pig	Oral	NR	Mortality	150		RTECS, 1993
	Hamster	Oral	NR	Mortality	> 5,000		RTECS, 1993
	Dog	Oral	NR	Mortality	150		RTECS, 1993
	Dog	Single oral dose		Mortality	60		USEPA, 1985
	Dog	Oral	NR	Reproductive		3,540	RTECS, 1993
	Monkey	Oral	NR	Mortality	200		RTECS, 1993
	Chicken	Oral (subchronic)	10 weeks	Decreased reproductive success; toxic symptoms		91.4[a]	USEPA, 1985
	Rock dove	Single oral dose		Mortality	4,000		USFWS, 1984
	Black duck	Oral (chronic)	2 years	Reduced eggshell thickness		0.14[a]	Longcore and Stendell, 1977
	Mallard	Single oral dose		Mortality	2,240		USFWS, 1984
	Mallard	Oral (subchronic)	96 days	Reduced eggshell thickness		2.8	Longcore and Stendell, 1977
	Mallard	Oral	NR	Eggshell thinning		1.16	USEPA, 1993
	Mallard	Oral	NR	Eggshell thinning		2.91	USEPA, 1993
	Mallard	Oral	2 years	Reproductive		1.45	USEPA, 1993
	California quail	Single oral dose		Mortality	595		USFWS, 1984
	Japanese quail	Single oral dose		Mortality	841		USFWS, 1984
	Pheasant	Single oral dose		Mortality	1,334		USFWS, 1984
	Sandhill crane	Single oral dose		Mortality	1,200		USFWS, 1984

Appendix G
Wildlife Toxicity Data
Baseline Risk Assessment
Assembly E
NSA Memphis – Millington, Tennessee

Chemical	Test Species	Test Type	Duration	Effect	Oral LD_{50} (mg/kg/BW)	LOAEL (mg/kgBW/day)	Reference
Pesticides/PCBs							
4,4'-DDT (continued)	Kestrel	Oral (chronic)	7 wk - 1 yr	Reduced eggshell thickness		0.56[a]	USEPA, 1985
	Kestrel	Oral (chronic)	1 year	Reduced eggshell thickness		0.16[a]	Wiemeyer, et al., 1986
	Barn owl	Oral (chronic)	2 years	Reduced eggshell thickness		0.14[a]	Longcore and Stendell, 1977
Dieldrin	Mouse	Single oral dose	NR	Mortality	38		Allen et al., 1979
	Mouse	Oral (chronic)	80 weeks	Body tremors		0.33	ATSDR, 1992
	Rat	Single oral dose	NR	Mortality	46		Allen et al., 1979
	Guinea pig	Single oral dose	NR	Mortality	25		Allen et al., 1979
	Rabbit	Single oral dose	NR	Mortality	45		Allen et al., 1979
	House sparrow	Single oral dose	NR	Mortality	48		USFWS, 1984
	Chicken	Single oral dose	NR	Mortality	20		Allen et al., 1979
	Rock dove	Single oral dose	NR	Mortality	27		USFWS, 1984
	Gray partridge	Single oral dose	NR	Mortality	9		USFWS, 1984

Appendix G
Wildlife Toxicity Data
Baseline Risk Assessment
Assembly E
NSA Memphis – Millington, Tennessee

Chemical	Test Species	Test Type	Duration	Effect	Oral LD_{50} (mg/kg/BW)	LOAEL (mg/kgBW/day)	Reference
Dieldrin (continued)	Chukar	Single oral dose	NR	Mortality	25		USFWS, 1984
	Japanese quail	Oral (acute)	5 days	Mortality	6[a]		Hill et al., 1975
	Japanese quail	Single oral dose	NR	Mortality	70		USFWS, 1984
	California quail	Single oral dose	NR	Mortality	9		USFWS, 1984
	Bobwhite	Oral (acute)	5 days	Mortality	3[a]		Hill et al., 1975
	Pheasant	Single oral dose	NR	Mortality	79		USFWS, 1984
	Mallard	Oral (acute	5 days	Mortality	12[a]		Hill et al., 1975
	Mallard	Oral (acute)	5 days	Mortality	11[a]		Hill et al., 1975
	Mallard	Single oral dose	NR	Mortality	381		USFWS, 1984
	Whistling duck	Single oral dose	NR	Mortality	100		USFWS, 1984
	Canada goose	Single oral dose	NR	Mortality	141		USFWS, 1984
	Goat	Single oral dose	NR	Mortality	100		Allen et al., 1979
	Sheep	Single oral dose	NR	Mortality	50		Allen et al., 1979
	Cattle	Single oral dose	NR	Mortality	60		Allen et al., 1979
	Mule deer	Single oral dose	NR	Mortality	75		Allen et al., 1979
	Cat	Single oral dose	NR	Mortality	300		Allen et al., 1979
	Dog	Single oral dose	NR	Mortality	65		Allen et al., 1979
Endosulfan	Mouse	Oral (chronic)	78 weeks	Mortality		0.9	ATSDR, 1991
	Mouse	Oral (chronic)	78 weeks	Ovarian cyst development		0.26	ATSDR, 1991
	Rat	Single oral dose	NR	Mortality	24		ATSDR, 1991
	Rat	Oral (chronic)	2 years	Reduced testes weight		10	USEPA, 1980
	Mallard	Single oral dose	NR	Mortality	33		USFWS, 1984
	Mallard	Single oral dose	NR	Mortality	31.2		USFWS, 1984

Appendix G
Wildlife Toxicity Data
Baseline Risk Assessment
Assembly E
NSA Memphis – Millington, Tennessee

Chemical	Test Species	Test Type	Duration	Effect	Oral LD_{50} (mg/kg/BW)	LOAEL (mg/kgBW/day)	Reference
Endrin	Pheasant	Single oral dose	NR	Mortality	80		USFWS, 1984
	Mouse	Oral (chronic)	80 weeks	Mortality		0.53	ATSDR, 1990
	Dog	Oral (chronic)	19 months	Decreased weight gain		0.1	USEPA, 1985
2,3,7,8-TCDD	Northern Bobwhite	Single oral dose	NR	Mortality	0.015		Hudson et al., 1984
	Ringed Turtle Dove	Single oral dose	NR	Mortality	0.810		Hudson et al., 1984
	Mallards	Single oral dose	NR	Mortality	0.108		Hudson et al., 1984
	Chicken	Single oral dose	NR	Mortality	0.037		Kociba & Schwetz, 1982
	Guinea pig	Oral	NR	Mortality	0.002		Kociba & Schwetz, 1982
	Mouse	Oral	NR	Mortality	0.284		Kociba & Schwetz, 1982
	Guinea Pig	Single oral dose	NR	Mortality	0.0006		Harless et al., 1982
	Rat	Single oral dose	NR	Mortality	0.022		Kociba & Schwetz, 1982
	Monkey	Single oral dose	NR	Mortality	0.070		Olson et al., 1980
	Dog	Single oral dose	NR	Mortality	0.1		Kociba & Schwetz, 1982
	Mouse	Single oral dose	NR	Mortality	0.114		Kociba & Schwetz, 1982
	Rabbit	Single oral dose	NR	Mortality	0.115		Olson et al., 1980
	Hamster	Single oral dose	NR	Mortality	1.157		Kociba & Schwetz, 1982
	Rat	Oral (chronic)	NR	Reproductive effects		1.0E-05	McNulty, 1977
	Monkey	Oral (chronic)	NR	Reproductive effects		1.7E-06	Ramel, 1978
	Chicken	Oral (chronic)	21 days	Chick liver disease		0.001	NRCC 1981
Inorganics							
Aluminum	Mouse	Oral	2-3 genrtns	Reduced bodyweight gain of newborns		425	NIOSH, 1985
	Rat	Oral	15 days	Reduced growth		100	Bernuzzi, et al., 1989

Appendix G
Wildlife Toxicity Data
Baseline Risk Assessment
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NSA Memphis – Millington, Tennessee

Chemical	Test Species	Test Type	Duration	Effect	Oral LD_{50} (mg/kg/BW)	LOAEL (mg/kgBW/day)	Reference
Arsenic	Rat	Oral	NR	Reproductive effects		0.61	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		0.58	RTECS, 1993
	Rat	Oral	NR	Mortality	763		RTECS, 1993
	Mouse	Oral	NR	Mortality	145		RTECS, 1993
Beryllium	Rat	Single oral dose	NR	Mortality	10		USEPA, 1985
Inorganics							
Cadmium	Rat	Oral	NR	Reproductive effects		155	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		220	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		21.5	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		23	RTECS, 1993
	Rat	Single oral dose		Mortality	250		Eisler, 1985
	Rat	Oral	NR	Mortality	225		RTECS, 1993
	Mouse	Oral	NR	Mortality	890		RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		448	RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		1,700	RTECS, 1993
	Guinea pig	Single oral dose		Mortality	150		Eisler, 1985
	Mallard	Oral (subchronic)	90 days	Egg production suppressed		10	Eisler, 1985
Chromium (Potassium dichromate)	Japanese quaii	Oral (acute)	5 days	Mortality	126		Hill and Camardese, 1986
Copper	Rat	Single oral dose		Reproductive effects		152	NIOSH, 1985 and RTECS, 1993
	Mallard	Oral (subchronic)	29 days	NOAEL for survivorship		10.5[b]	Demayo et al., 1982

Appendix G
Wildlife Toxicity Data
Baseline Risk Assessment
Assembly E
NSA Memphis – Millington, Tennessee

Chemical	Test Species	Test Type	Duration	Effect	Oral LD_{50} (mg/kg/BW)	LOAEL (mg/kgBW/day)	Reference
Inorganics							
Iron	Rat	Single oral dose	NR	Mortality	319		Sax, 1984
	Mouse	Single oral dose	NR	Mortality	979		Sax, 1984
	Guinea pig	Single oral dose	NR	Mortality	1,200		Sax, 1984
Lead	Rat	Oral	NR	Reproductive effects		790	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		1,140	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		520	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		1,100	RTECS, 1993
	Calf	Single oral dose	NR	Mortality	220		Eisler, 1988
	Mouse	Oral	NR	Reproductive effects		1,120	RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		6,300	RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		300	RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		4,800	RTECS, 1993
	Domestic animal	Oral	NR	Reproductive effects		662	RTECS, 1993
	Mammal	Oral	NR	Reproductive effects		2,118	RTECS, 1993
	Kestrel	Diet	NR	Decreased egg laying fertility; decreased egg shell thickness		250[b]	Eisler, 1988
	Nestlings	Oral	NR	Reduced growth and brain weight; abnormal development		125	Eisler, 1988
	Japanese quail	Diet	5 days	Mortality	24,752		Hill and Camardese, 1986

Appendix G
Wildlife Toxicity Data
Baseline Risk Assessment
Assembly E
NSA Memphis – Millington, Tennessee

Chemical	Test Species	Test Type	Duration	Effect	Oral LD_{50} (mg/kg/BW)	LOAEL (mg/kgBW/day)	Reference
Inorganics							
Manganese	Mouse	Oral (subchronic)	90 days	Delayed growth of testes		140	ATSDR, 1990
	Mouse	Oral (chronic)	103 weeks	Mortality		4,050	ATSDR, 1990
	Rat	Single oral dose	NR	Mortality	410		ATSDR, 1990
	Rat	Oral (acute)	20 days	Mortality	225		ATSDR, 1990
	Rat	Oral (subchronic)	20 days	Decreased littler weight during gestation		3,100[b]	ATSDR, 1990
	Rat	Oral (chronic)	103 weeks	Mortality		930	ATSDR, 1990
	Guinea pig	Single oral dose	NR	Mortality	400		USEPA, 1984
Mercury	Monkey	Oral (chronic)	18 months	Weakness, rigidity		25	ATSDR, 1990
	Mouse	Single oral dose		Mortality	22		NIOSH, 1985
	Rat	Oral (chronic)	NR	Reduced fertility		0.5	Eisler, 1987
	Rat	Single oral dose		Mortality	18		NIOSH, 1985
	Pig	Oral (subchronic)	Pregnancy	High incidence of stillbirths		0.5	Eisler, 1987
	Mule deer	Single oral dose		Mortality	17.9		Eisler, 1987
	River otter	Single oral dose		Mortality	2		Eisler, 1987
	Mink	Single oral dose		Mortality	1		Eisler, 1987
	Dog	Oral (subchronic)	Pregnancy	High incidence of stillbirths		0.1	Eisler, 1987
	House sparrow	Single oral dose		Mortality	12.6		Eisler, 1987
	Rock dove	Single oral dose		Mortality	22.8		Eisler, 1987
	Chicken	Single oral dose		Mortality	20		Fimreite, 1979
	Bantam chicken	Single oral dose		Mortality	190		Fimreite, 1979

Appendix G
Wildlife Toxicity Data
Baseline Risk Assessment
Assembly E
NSA Memphis – Millington, Tennessee

Chemical	Test Species	Test Type	Duration	Effect	Oral LD_{50} (mg/kg/BW)	LOAEL (mg/kgBW/day)	Reference
Inorganics							
Mercury (continued)	Prairie chicken	Single oral dose		Mortality	11.5		Eisler, 1987
	Chukar	Single oral dose		Mortality	26.9		Eisler, 1987
	Corturnix	Single oral dose		Mortality	11		Eisler, 1987
	Mallard	Oral	NR	Reproduction, behavior		0.064	USEPA, 1993
	Black duck	Oral (subchronic)	28 weeks	Reproduction inhibited		0.22[a]	Eisler, 1987
	Fulvous whistling duck	Single oral dose		Mortality	37.8		Eisler, 1987
	Northern bobwhite	Single oral dose		Mortality	23.8		Eisler, 1987
	Bobwhite quail	Oral (acute)	5 days	Mortality	523		Hill et al., 1975
	Japanese quail	Single oral dose		Mortality	14.4		Eisler, 1987
	Gray partridge	Single oral dose		Mortality	17.6		Eisler, 1987
	Gray pheasant	Oral (subchronic)	30 days	Reduced reproductive ability		0.64	Eisler, 1987
	Ring-necked pheasant	Single oral dose		Mortality	11.5		Eisler, 1987
Nickel	Rat	Oral	NR	Reproductive effects		158	RTECS, 1994
		Single oral dose	NR	Mortality	67		ATSDR, 1987
Selenium	Rat	Oral	NR	Mortality	6,700		RTECS, 1993
		Oral	NR	Reproductive effects		134	RTECS, 1993
	Rat	Oral (subchronic)	3 months	Reduced hatchability		1.75	Eisler, 1985
Vanadium	Rat	Oral (acute)	5 days	Mortality	96		Hill and Camardese, 1986
Zinc	Rat	Single oral dose		Mortality	2,510		RTECS, 1993
	Rat	Oral (subchronic)	NR	Kidney toxicity		160	Llobet, et al., 1988

Notes:
LD50 = Dose resulting in 50% mortality in test population.
BW = Body weight.
LOAEL = Lowest Observed Adverse Effect Level.
NR = Not reported.
a = Converted to dose per kilogram body weight by multiplying by ingestion and dividing by body weight.
b = Estimated by applying a LOAEL-NOAEL ratio of 5 (Newell et al., 1987).

RCRA FACILITY INVESTIGATION REPORT
ASSEMBLY E
SWMUs 2, 9, 14, 38, 59, and 65
NAVAL SUPPORT ACTIVITY MEMPHIS
MILLINGTON, TENNESSEE

REVISION 1

CTO-094
Contract No: N62467-89-D-0318

Volume 2
Appendices A through G

Prepared for:

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Appendix A

Topographic Map — NSA Memphis Southside

Appendix B

DPT Piezocone Soundings and Hydrocone Plots

Table B-1
Summary of Horizontal Hydraulic Conductivity Estimates From Hydrocone Data
Assembly E DPT Investigation
NSA Memphis — Millington, Tennessee

Sample ID	Horizontal Hydraulic Conductivity (cm/sec)	Horizontal Hydraulic Conductivity (feet/day)
SWMU 2 Upper Alluvium DPT Points		
002G001327	6.19e-06	0.01
002G001427	1.59e-05	0.04
002G001527	5.05e-06	0.01
002G001627	2.35e-06	< 0.01
002G001725	5.60e-06	0.01
002G001825	3.35e-06	< 0.01
002G001926	1.36e-05	0.03
002G002130	1.07e-06	< 0.01
002G002323	3.36e-06	< 0.01
002G002527	1.92e-06	< 0.01
002G002627	1.10e-07	< 0.01
002G002727	8.58e-07	< 0.01
AVERAGE	***4.95e-06***	***0.01***
SWMU 2 Deeper Alluvium		
002G001337	7.53e-04	2.13
002G001440	7.22e-06	0.02
002G001540	3.25e-05	0.09
002G001639	6.97e-06	0.01
002G001736	9.25e-05	0.26
002G001836	1.49e-04	0.42
002G001939	1.13e-04	0.32
002G002039	7.90e-06	0.02
002G002149	4.99e-04	1.41
002G002249	1.18e-03	3.34
002G002336	2.90e-04	0.82
002G002436	9.87e-07	< 0.01
002G002540	2.36e-04	0.66
002G002643	2.26e-05	0.06
002G002741	8.81e-05	0.24
AVERAGE	***2.32e-04***	***0.65***

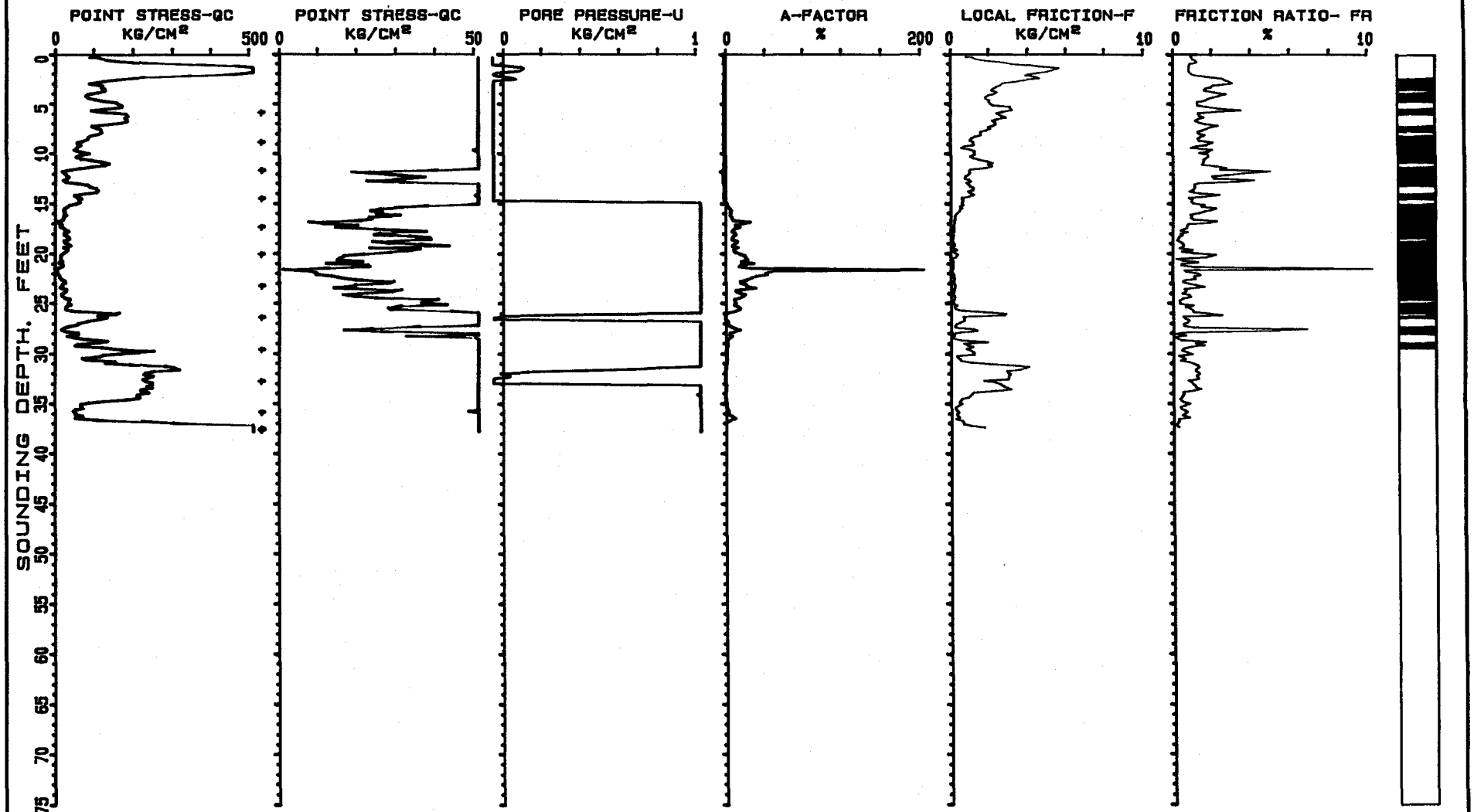
Table B-1
Summary of Horizontal Hydraulic Conductivity Estimates From Hydrocone Data
Assembly E DPT Investigation
NSA Memphis — Millington, Tennessee

Sample ID	Horizontal Hydraulic Conductivity (cm/sec)	Horizontal Hydraulic Conductivity (feet/day)
SWMU 9 Deeper Alluvium DPT Points		
009G000946	2.15e-05	0.06
009G001046	2.39e-04	0.67
009G001150	6.36e-05	0.18
009G001246	9.97e-05	0.28
009G001348	2.19e-05	0.06
009G001445	1.30e-05	0.03
009G001547	1.00e-03	2.85
009G001644	5.43e-05	0.15
009G001747	5.07e-06	0.01
009G001852	1.57e-04	0.44
009G002142	3.47e-06	< 0.01
009G002244	1.63e-05	0.04
009G002347	5.28e-06	0.01
AVERAGE	***1.31e-04***	***0.37***
SWMU 14 Loess DPT Points		
014G000512	1.53e-05	0.04
014G000711	4.88e-05	0.13
014G000811	1.37e-05	0.03
014G000911	2.68e-05	0.07
014G001110	7.83e-06	0.02
014G001211	2.07e-06	0.01
014G001313	2.36e-05	0.06
014G001411	1.37e-04	0.39
AVERAGE	***3.44e-05***	***0.09***
SWMU 14 Upper Fluvial Deposits DPT Points		
014G000545	1.81e-04	0.51
014G000743	2.50e-05	0.07
014G000840	7.36e-06	0.02
014G000943	6.28e-05	0.17
014G001043	2.70e-05	0.07
014G001143	1.22e-05	0.03
014G001239	6.39e-07	< 0.01
014G001543	2.10e-06	< 0.01
AVERAGE	***3.98e-05***	***0.11***

SWMU 2

DPT SCREENING INVESTIGATION RESULTS

PIEZOCONE SOUNDING



* PUSH INTERRUPTED TO ADD ROD
PORE PRESSURE DECAY DATA MAY BE AVAILABLE

FILE #..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
SOUNDING # 02-P13
TEST DATE 11-07-1995 13: 13: 49

IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE
FOR SOUTHEASTERN UNITED STATES SOILS

JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
FILE NAME..... 02-P13

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES #	N'	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	SILTY FINE SAND	196.6	2.62	49	49	.03	>90%	>48	432	--	--	--	--
2	DENSE OR CEMENTED S.	541.7	4.69	90	90	.067	>90%	>48	1191	--	--	--	--
3	SILTY FINE SAND	222.6	3.58	55	55	.098	>90%	>48	489	--	--	--	--
4	SILTY TO CLAYEY F.S.	117	2.3	39	39	.128	>90%	>48	257	--	--	--	--
5	SILTY TO CLAYEY F.S.	112.8	2	37	37	.159	80%-90%	>48	248	--	--	--	--
6	SILTY TO CLAYEY F.S.	148.4	2.76	49	49	.19	>90%	>48	326	--	--	--	--
7	SILTY FINE SAND	183.1	2.46	45	45	.221	>90%	>48	402	--	--	--	--
8	SILTY FINE SAND	123.8	1.92	30	30	.251	80%-90%	46-48	272	--	--	--	--
9	SILTY FINE SAND	89.4	1.24	22	22	.282	70%-80%	44-46	196	--	--	--	--
10	SILTY TO CLAYEY F.S.	64.5	1.03	21	21	.313	60%-70%	44-46	141	--	--	--	--
11	SILTY TO CLAYEY F.S.	91.5	1.55	30	30	.344	70%-80%	44-46	201	--	--	--	--
12	SILTY TO CLAYEY F.S.	73.9	1.38	24	24	.375	70%-80%	42-44	162	--	--	--	--
13	CLAYEY FINE SAND	34.7	.85	13	13	.405	40%-50%	40-42	76	--	--	--	--
14	SILTY FINE SAND	92.4	1.05	23	23	.436	70%-80%	44-46	203	--	--	--	--
15	SILTY TO CLAYEY F.S.	63.1	.73	21	21	.467	60%-70%	42-44	138	--	--	--	--
16	SILTY TO CLAYEY F.S.	32.2	.45	10	10	.498	<40%	38-40	70	--	--	--	--
17	CLAYEY FINE SAND	20.5	.21	8	8	.528	<40%	36-38	45	--	--	--	--
18	SILTY TO CLAYEY F.S.	22.6	.14	7	7	.559	<40%	36-38	49	--	--	--	--
19	SILTY TO CLAYEY F.S.	31.3	.13	10	10	.59	<40%	36-38	68	--	--	--	--
20	SILTY TO CLAYEY F.S.	32	.22	10	10	.621	<40%	36-38	70	--	--	--	--
21	CLAYEY FINE SAND	17.2	.17	6	6	.651	<40%	32-34	37	--	--	--	--
22	CLAYEY FINE SAND	13	.08	5	5	.682	<40%	30-32	28	--	--	--	--
23	CLAYEY FINE SAND	18.4	.17	7	7	.713	<40%	32-34	40	--	--	--	--
24	SILTY TO CLAYEY F.S.	22.8	.17	7	7	.744	<40%	34-36	50	--	--	--	--
25	SILTY TO CLAYEY F.S.	28.2	.14	9	9	.775	<40%	36-38	62	--	--	--	--
26	SILTY TO CLAYEY F.S.	53.9	.84	17	17	.805	40%-50%	38-40	118	--	--	--	--
27	FINE SAND	119.3	1.19	23	23	.838	60%-70%	42-44	262	--	--	--	--
28	SILTY TO CLAYEY F.S.	40.9	.52	13	13	.869	<40%	36-38	89	--	--	--	--
29	SILTY FINE SAND	78	.43	19	19	.9	50%-60%	40-42	171	--	--	--	--
30	FINE SAND	135.6	.98	27	27	.933	70%-80%	42-44	298	--	--	--	--

02-P13 CONTINUED ENSAFE

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES	N'	VERTICAL STRESS	RELATIVE DENSITY	FRICTION ANGLE	YOUNGS MODULUS	UNDRAINED SHEAR ST	SENSITIVITY	COMP.	OCR
31	FINE SAND	121.4	.85	24	24	.966	60%-70%	40-42	267	--	--	--	--
32	FINE SAND	245.6	3.17	49	49	1	>90%	44-46	540	--	--	--	--
33	FINE SAND	237	2.66	47	47	1.033	>90%	44-46	521	--	--	--	--
34	FINE SAND	238.7	2.26	47	47	1.066	>90%	44-46	525	--	--	--	--
35	FINE SAND	182.6	.71	36	36	1.099	70%-80%	42-44	401	--	--	--	--
36	SILTY FINE SAND	64.1	.33	16	16	1.13	40%-50%	38-40	141	--	--	--	--
37	FINE SAND	123.7	.45	24	24	1.163	60%-70%	40-42	272	--	--	--	--

\# N'=POINT STRESS*(.2+.04*FRICTION RATIO)
* NORMALLY CONSOLIDATED SANDS
** FOR OVERCONSOLIDATED SANDS,SLIGHTLY REDUCE ABOVE FRICTION ANGLES
*** FOR OVERCONSOLIDATED SANDS, YOUNG'S MODULUS MAY BE AS MUCH AS 3 TO 6 TIMES HIGHER
**** NK OF 16 USED. FOR OVERCONSOLIDATED CLAYS, AN NK OF 17 IS SUGGESTED

THE ABOVE DATA WAS COMPUTED FOLLOWING 'BASIC' GUIDELINES BY P. K. ROBERTSON AND R. G. CAMPANELLA IN THE HANDBOOK 'GUIDELINES FOR USE AND INTERPERTATION OF THE ELECTRONIC CONE PENETRATION TEST'

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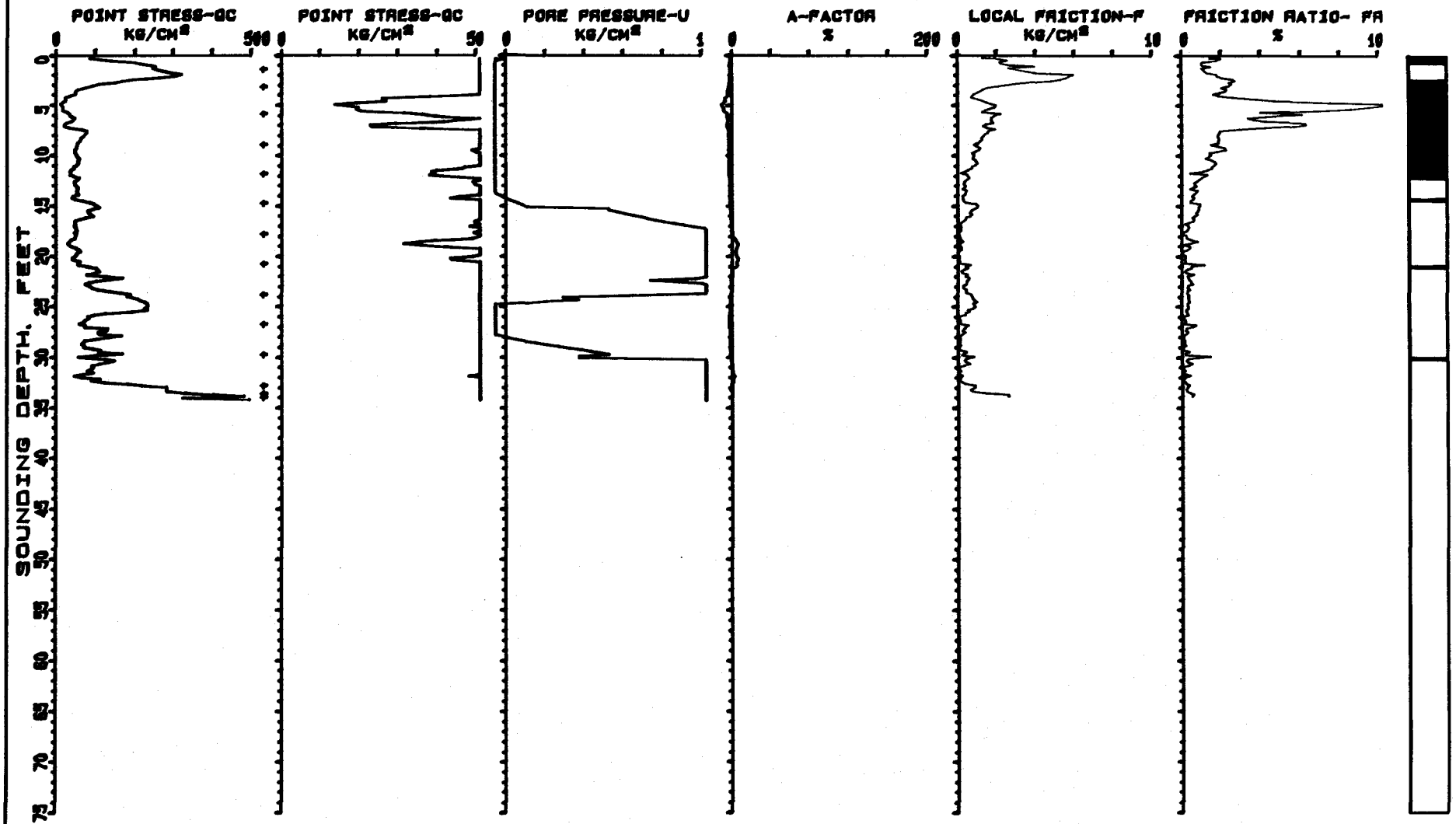
PIEZOCONE SOUNDING



* PUSH INTERRUPTED TO ADD ROD
PORE PRESSURE DECAY DATA MAY BE AVAILABLE

FILE #..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
SOUNDING # 02-P20
TEST DATE 11-08-1995 14:40:57

IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE
FOR SOUTHEASTERN UNITED STATES SOILS

JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
FILE NAME..... 02-P20

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES #	N'	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	SILTY FINE SAND	179.6	2.76	44	44	.03	>90%	>48	395	--	--	--	--
2	SILTY FINE SAND	272	4.23	68	68	.061	>90%	>48	598	--	--	--	--
3	SILTY FINE SAND	219.9	4.35	54	54	.092	>90%	>48	483	--	--	--	--
4	SILTY TO CLAYEY F.S.	70	1.28	23	23	.123	70%-80%	>48	154	--	--	--	--
5	SILTY CLAY TO CLAY	28.9	1.28	19	19	.15	--	--	--	1.78	2.2	UD	>6
6	CLAY	22.7	1.76	22	22	.175	--	--	--	1.39	1.2	UD	>6
7	SILTY CLAY TO CLAY	38.3	1.67	25	25	.202	--	--	--	2.36	2.2	UD	>6
8	CLAYEY FINE SAND	55.1	1.52	22	22	.233	60%-70%	44-46	121	--	--	--	--
9	SILTY TO CLAYEY F.S.	64.3	1.12	21	21	.264	70%-80%	44-46	141	--	--	--	--
10	SILTY TO CLAYEY F.S.	52.9	.94	17	17	.294	60%-70%	42-44	116	--	--	--	--
11	SILTY TO CLAYEY F.S.	57.5	.88	19	19	.325	60%-70%	42-44	126	--	--	--	--
12	SILTY TO CLAYEY F.S.	43.4	.53	14	14	.356	50%-60%	40-42	95	--	--	--	--
13	SILTY FINE SAND	51	.44	12	12	.387	60%-70%	42-44	112	--	--	--	--
14	SILTY FINE SAND	56.1	.37	14	14	.418	60%-70%	42-44	123	--	--	--	--
15	SILTY FINE SAND	70.8	.58	17	17	.448	60%-70%	42-44	155	--	--	--	--
16	SILTY FINE SAND	95.3	.72	23	23	.479	70%-80%	42-44	209	--	--	--	--
17	SILTY FINE SAND	62	.26	15	15	.51	50%-60%	40-42	136	--	--	--	--
18	SILTY FINE SAND	52.5	.04	13	13	.541	50%-60%	40-42	115	--	--	--	--
19	SILTY FINE SAND	40.6	.05	10	10	.571	40%-50%	38-40	89	--	--	--	--
20	SILTY FINE SAND	54	.04	13	13	.602	50%-60%	40-42	118	--	--	--	--
21	SILTY FINE SAND	56.8	.18	14	14	.633	50%-60%	40-42	124	--	--	--	--
22	FINE SAND	101	.41	20	20	.666	60%-70%	42-44	222	--	--	--	--
23	FINE SAND	111.2	.45	22	22	.699	70%-80%	42-44	244	--	--	--	--
24	FINE SAND	138.1	.57	27	27	.733	70%-80%	42-44	303	--	--	--	--
25	DENSE OR CEMENTED S.	220.6	.89	36	36	.769	>90%	44-46	485	--	--	--	--
26	FINE SAND	170.9	.42	34	34	.802	80%-90%	44-46	375	--	--	--	--
27	SILTY FINE SAND	74.3	.26	18	18	.833	50%-60%	40-42	163	--	--	--	--
28	FINE SAND	123.4	.24	24	24	.866	70%-80%	42-44	271	--	--	--	--
29	FINE SAND	85.2	.08	17	17	.9	50%-60%	40-42	187	--	--	--	--
30	FINE SAND	104	.33	20	20	.933	60%-70%	40-42	228	--	--	--	--

02-P20 CONTINUED ENSAFE

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES	N'	VERTICAL STRESS	RELATIVE DENSITY	FRICTION ANGLE	YOUNGS MODULUS	UNDRAINED SHEAR ST	SENSITIVITY	COMP.	OCR
31	FINE SAND	109.9	.29	21	21	.966	60%-70%	40-42	241	--	--	--	--
32	FINE SAND	78.5	.07	15	15	.999	50%-60%	38-40	172	--	--	--	--
33	FINE SAND	154.6	.43	30	30	1.032	70%-80%	42-44	340	--	--	--	--

\# N'=POINT STRESS*(.2+.04*FRICTION RATIO)
* NORMALLY CONSOLIDATED SANDS
** FOR OVERCONSOLIDATED SANDS,SLIGHTLY REDUCE ABOVE FRICTION ANGLES
*** FOR OVERCONSOLIDATED SANDS, YOUNG'S MODULUS MAY BE AS MUCH AS 3 TO 6 TIMES HIGHER
**** NK OF 16 USED. FOR OVERCONSOLIDATED CLAYS, AN NK OF 17 IS SUGGESTED

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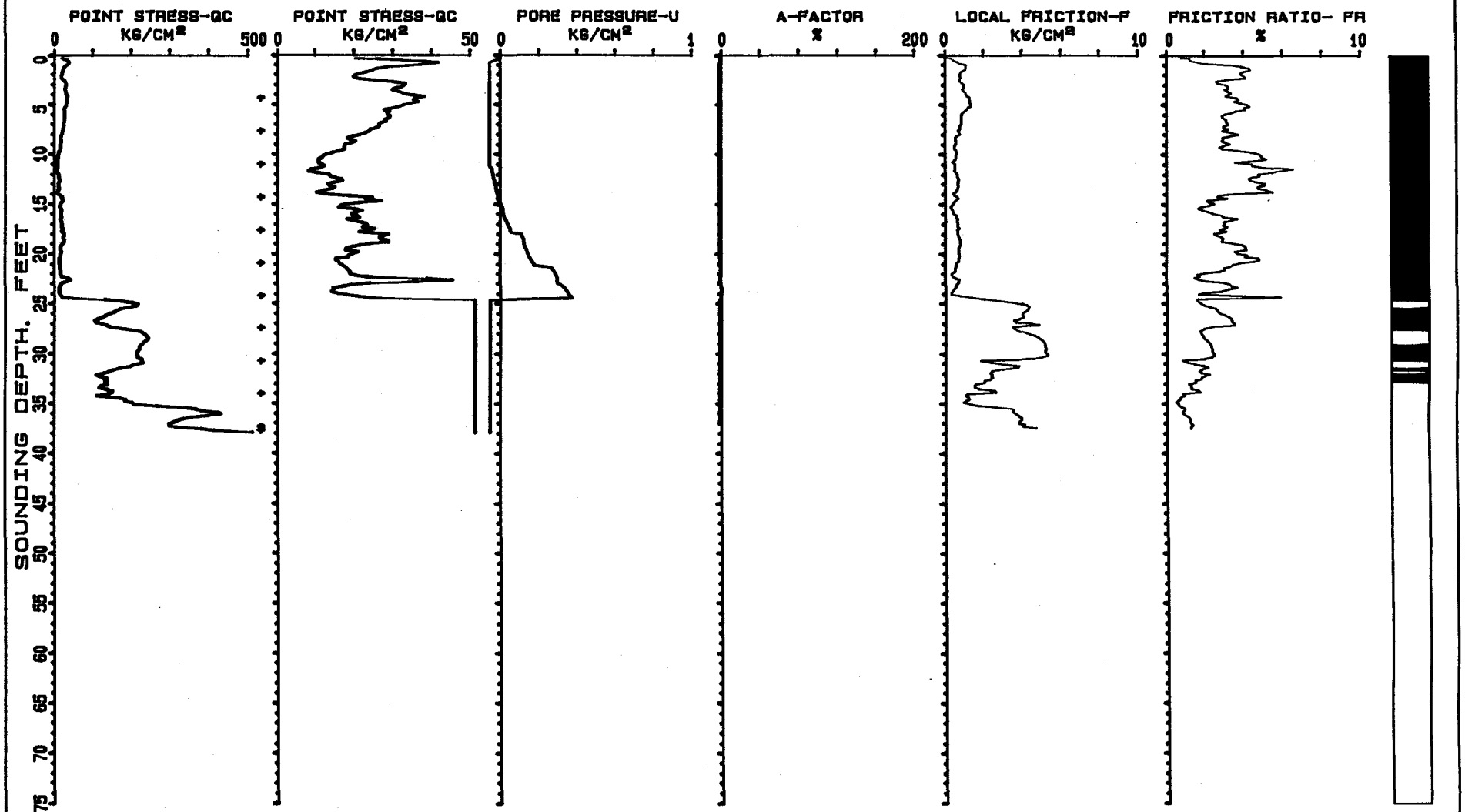
PIEZOCONE SOUNDING



+ PUSH INTERRUPTED TO ADD ROD
PORE PRESSURE DECAY DATA MAY BE AVAILABLE

FILE #..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
SOUNDING # 02-P23
TEST DATE 12-01-1995 10:28:43

IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE
FOR SOUTHEASTERN UNITED STATES SOILS

JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
FILE NAME..... 02-P23

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES #	N'	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	CLAYEY FINE SAND	35.6	.85	14	14	.03	60%-70%	>48	78	.97	3.7	.01	6
2	SANDY CLAY	26.2	.97	13	13	.058	--	--	--	1.63	2.6	.02	>6
3	SANDY CLAY	25.3	.87	12	12	.085	--	--	--	1.57	2.9	.02	>6
4	SANDY CLAY	32	1.05	16	16	.112	--	--	--	1.98	3	.01	>6
5	SANDY CLAY	35.5	1.31	17	17	.14	--	--	--	2.2	2.7	.01	>6
6	SANDY CLAY	29.7	1.06	14	14	.167	--	--	--	1.83	2.7	.01	>6
7	SANDY CLAY	28	.85	14	14	.194	--	--	--	1.72	3.2	.02	>6
8	SANDY CLAY	24.4	.74	12	12	.222	--	--	--	1.49	3.2	.02	>6
9	SANDY CLAY	19.4	.57	9	9	.249	--	--	--	1.17	3.3	.01	>6
10	SILTY CLAY TO CLAY	16.3	.57	10	10	.276	--	--	--	.98	2.8	.01	6
11	CLAY	11.5	.52	11	11	.301	--	--	--	.67	2.1	.02	6
12	CLAY	10.9	.58	10	10	.326	--	--	--	.63	1.8	.02	[illegible]
13	CLAY	15.1	.7	15	15	.351	--	--	--	.89	2.1	.01	[illegible]
14	CLAY	13.1	.61	13	13	.376	--	--	--	.76	2.1	.01	6
15	SANDY CLAY	20.7	.53	10	10	.403	--	--	--	1.23	3.8	.02	6
16	SANDY CLAY	18.9	.41	9	9	.431	--	--	--	1.12	4.5	.01	6
17	SANDY CLAY	20.7	.66	10	10	.458	--	--	--	1.23	3.1	.02	6
18	SANDY CLAY	24.1	.7	12	12	.485	--	--	--	1.44	3.4	.02	6
19	SANDY CLAY	27.5	.8	13	13	.513	--	--	--	1.65	3.4	.02	6
20	SILTY CLAY TO CLAY	20.2	.76	13	13	.54	--	--	--	1.19	2.6	UD	6
21	SILTY CLAY TO CLAY	17.2	.7	11	11	.567	--	--	--	.99	2.4	.01	6
22	SANDY CLAY	18.1	.5	9	9	.595	--	--	--	1.05	3.5	.01	6
23	CLAYEY FINE SAND	29.7	.6	11	11	.626	<40%	36-38	65	--	--	--	--
24	SANDY CLAY	17	.45	8	8	.653	--	--	--	.97	3.7	.01	6
25	SILTY TO CLAYEY F.S.	101.3	2.4	33	33	.684	60%-70%	42-44	222	--	--	--	--
26	SILTY TO CLAYEY F.S.	179.6	4.2	59	59	.714	80%-90%	44-46	395	--	--	--	--
27	CLAYEY FINE SAND	121.8	4.06	48	48	.745	70%-80%	42-44	267	--	--	--	--
28	SILTY TO CLAYEY F.S.	175.7	4.06	58	58	.776	80%-90%	44-46	386	--	--	--	--
29	SILTY FINE SAND	239.7	4.87	59	59	.807	>90%	44-46	527	--	--	--	--
30	SILTY TO CLAYEY F.S.	222.5	5.22	74	74	.838	>90%	44-46	489	--	--	--	--

J2-P23 CONTINUED ENSAFE

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES	N'	VERTICAL STRESS	RELATIVE DENSITY	FRICTION ANGLE	YOUNGS MODULUS	UNDRAINED SHEAR ST	SENSITIVITY	COMP.	OCR
31	SILTY FINE SAND	222.2	3.92	55	55	.868	>90%	44-46	488	--	--	--	--
32	SILTY FINE SAND	176.1	2.93	44	44	.899	80%-90%	42-44	387	--	--	--	--
33	SILTY FINE SAND	127.5	2.17	31	31	.93	70%-80%	42-44	280	--	--	--	--
34	SILTY FINE SAND	135.1	1.81	33	33	.961	70%-80%	42-44	297	--	--	--	--
35	FINE SAND	169.2	1.19	33	33	.994	70%-80%	42-44	372	--	--	--	--
36	FINE SAND	347.2	3.18	69	69	1.027	>90%	46-48	763	--	--	--	--
37	FINE SAND	350.3	3.93	70	70	1.06	>90%	46-48	770	--	--	--	--

\# N'=POINT STRESS*(.2+.04*FRICTION RATIO)
* NORMALLY CONSOLIDATED SANDS
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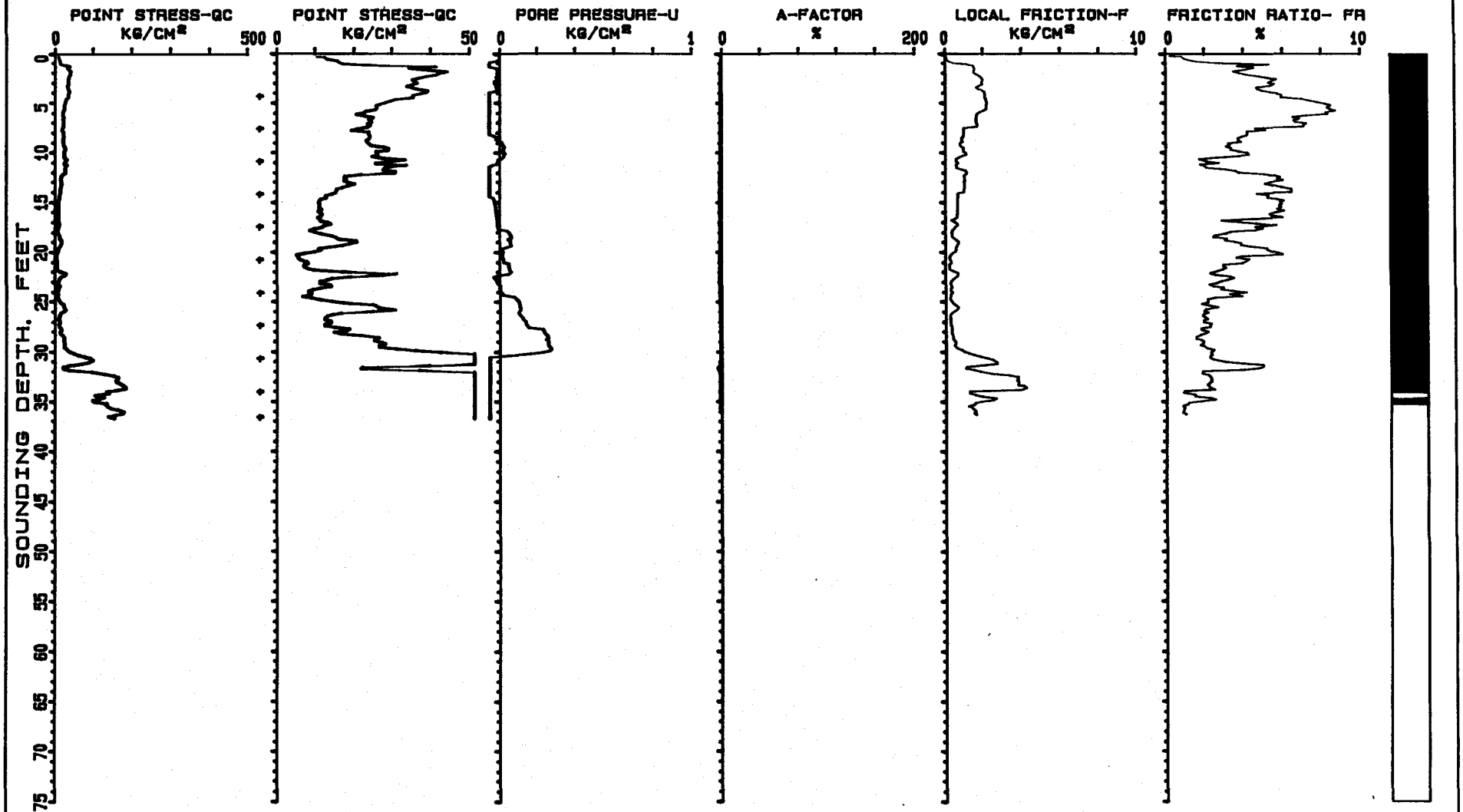
PIEZOCONE SOUNDING



* PUSH INTERRUPTED TO ADD ROD
PORE PRESSURE DECAY DATA MAY BE AVAILABLE

FILE #..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
SOUNDING # 02-P24
TEST DATE 12-01-1995 17:50:46

IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE
FOR SOUTHEASTERN UNITED STATES SOILS

JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
FILE NAME..... 02-P24

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES #	N'	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	SANDY CLAY	15	.45	7	7	.027	--	--	--	.93	3.3	.01	>6
2	SILTY CLAY TO CLAY	34.5	1.52	23	23	.054	--	--	--	2.14	2.2	UD	>6
3	CLAY	38	1.91	38	38	.079	--	--	--	2.36	1.9	UD	>6
4	CLAY	36.6	1.9	36	36	.104	--	--	--	2.27	1.9	UD	>6
5	CLAY	33.5	2.15	33	33	.129	--	--	--	2.07	1.5	UD	>6
6	CLAY	25.3	2.02	25	25	.154	--	--	--	1.56	1.2	UD	>6
7	CLAY	23.3	1.64	23	23	.179	--	--	--	1.43	1.4	UD	>6
8	CLAY	22.8	1.28	22	22	.204	--	--	--	1.39	1.7	UD	>6
9	SILTY CLAY TO CLAY	23.7	.9	15	15	.231	--	--	--	1.44	2.6	UD	>6
10	SANDY CLAY	26.2	.91	13	13	.258	--	--	--	1.6	2.8	.02	>6
11	SANDY CLAY	27.4	.81	13	13	.286	--	--	--	1.67	3.3	.02	>6
12	CLAYEY FINE SAND	29.1	.8	11	11	.316	40%-50%	40-42	64	--	--	--	--
13	CLAY	21.5	1.04	21	21	.341	--	--	--	1.29	2	UD	6
14	CLAY	17.1	.95	17	17	.366	--	--	--	1.01	1.7	.01	6
15	CLAY	12.5	.65	12	12	.391	--	--	--	.72	1.9	.02	6
16	CLAY	11.1	.65	11	11	.416	--	--	--	.63	1.7	.02	6
17	CLAY	11.6	.55	11	11	.441	--	--	--	.66	2	.02	6
18	CLAY	11.3	.49	11	11	.466	--	--	--	.64	2.3	.02	6
19	SILTY CLAY TO CLAY	15.5	.52	10	10	.493	--	--	--	.9	2.9	.01	6
20	SILTY CLAY TO CLAY	14.7	.59	9	9	.521	--	--	--	.84	2.4	.01	6
21	CLAY	6.8	.29	6	6	.545	--	--	--	.35	2.2	.03	3
22	CLAY	9.3	.34	9	9	.57	--	--	--	.5	2.6	.02	3
23	SANDY CLAY	19.1	.51	9	9	.598	--	--	--	1.11	3.7	.01	6
24	SANDY CLAY	11.3	.31	5	5	.625	--	--	--	.62	3.6	.02	3
25	SILTY CLAY TO CLAY	9.7	.29	6	6	.652	--	--	--	.51	3.2	.02	3
26	CLAYEY FINE SAND	23.6	.51	9	9	.683	<40%	34-36	51	--	--	--	--
27	CLAYEY FINE SAND	15.3	.27	6	6	.714	<40%	32-34	33	--	--	--	--
28	SANDY CLAY	15	.3	7	7	.741	--	--	--	.83	4.8	.01	6
29	CLAYEY FINE SAND	22	.42	8	8	.772	<40%	34-36	48	--	--	--	--
30	CLAYEY FINE SAND	31.2	.75	12	12	.803	<40%	36-38	68	--	--	--	--

02-P24 CONTINUED ENSAFE

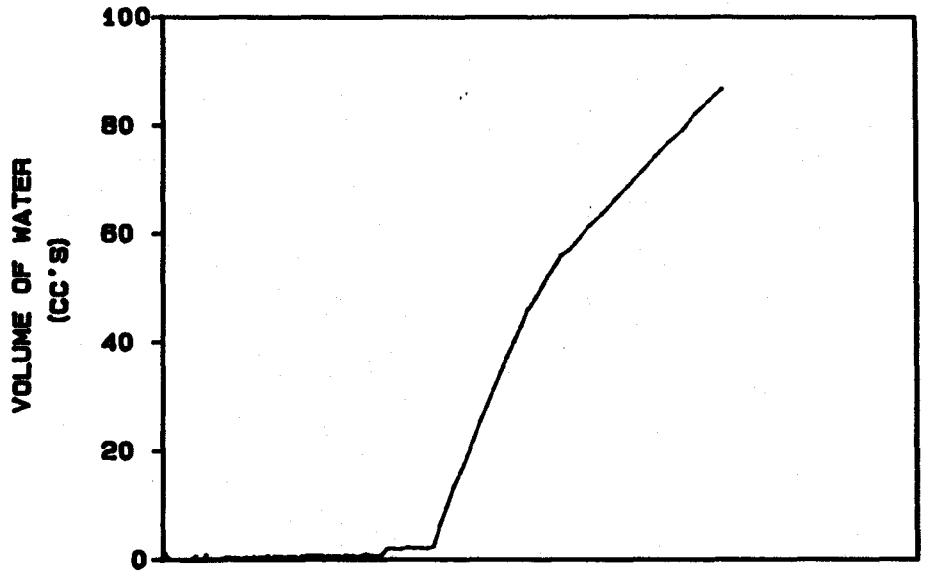
DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES	N'	VERTICAL STRESS	RELATIVE DENSITY	FRICTION ANGLE	YOUNGS MODULUS	UNDRAINED SHEAR ST	SENSITIVITY	COMP.	OCR
31	CLAYEY FINE SAND	75.3	2.08	30	30	.834	50%-60%	40-42	165	--	--	--	--
32	CLAYEY FINE SAND	53.8	1.78	21	21	.864	40%-50%	38-40	118	--	--	--	--
33	SILTY TO CLAYEY F.S.	148.7	3.52	49	49	.895	70%-80%	42-44	327	--	--	--	--
34	SILTY FINE SAND	169.3	3.19	42	42	.926	80%-90%	42-44	372	--	--	--	--
35	SILTY FINE SAND	118.9	1.9	29	29	.957	60%-70%	40-42	261	--	--	--	--
36	FINE SAND	144.9	1.43	28	28	.99	70%-80%	42-44	318	--	--	--	--

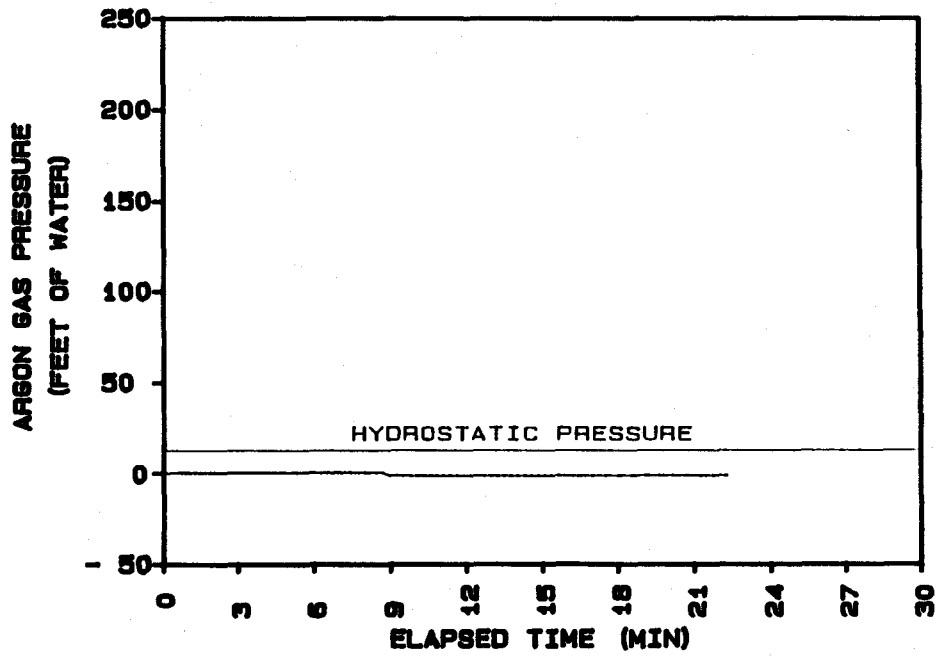
\# N'=POINT STRESS*(.2+.04*FRICTION RATIO)
* NORMALLY CONSOLIDATED SANDS
** FOR OVERCONSOLIDATED SANDS,SLIGHTLY REDUCE ABOVE FRICTION ANGLES
*** FOR OVERCONSOLIDATED SANDS, YOUNG'S MODULUS MAY BE AS MUCH AS 3 TO 6 TIMES HIGHER
**** NK OF 16 USED. FOR OVERCONSOLIDATED CLAYS, AN NK OF 17 IS SUGGESTED

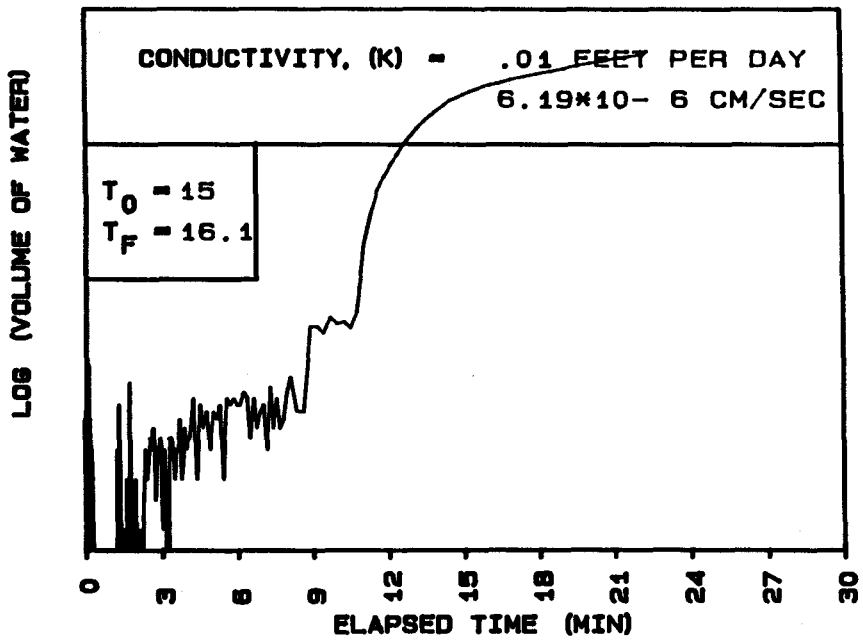
THE ABOVE DATA WAS COMPUTED FOLLOWING 'BASIC' GUIDELINES BY P. K. ROBERTSON AND R. G. CAMPANELLA IN THE HANDBOOK 'GUIDELINES FOR USE AND INTERPERTATION OF THE ELECTRONIC CONE PENETRATION TEST'

ADDITIONAL LOCAL CORRELATIONS DEVELOPED BY IN-SITU TECHNOLOGY HAVE ALSO BEEN USED IN COMPUTING THE ABOVE DATA. IT IS THE POLICY OF IN-SITU TECHNOLOGY TO CONTINUALLY UPGRADE AND MODIFY C.P.T CORRELATIONS AS PUBLISHED RESEARCH AND LOCAL EXPERIENCE GROWS.

HYDROCONE TEST



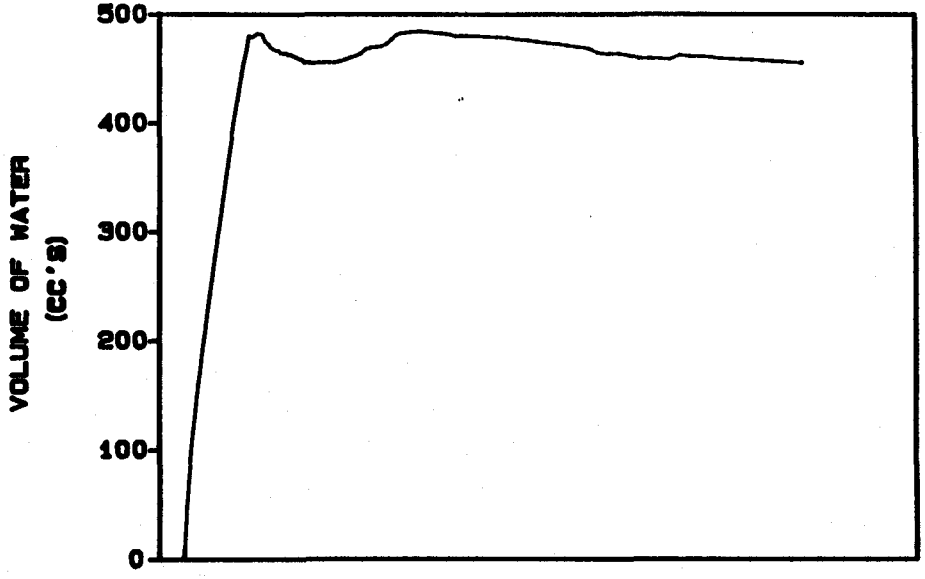


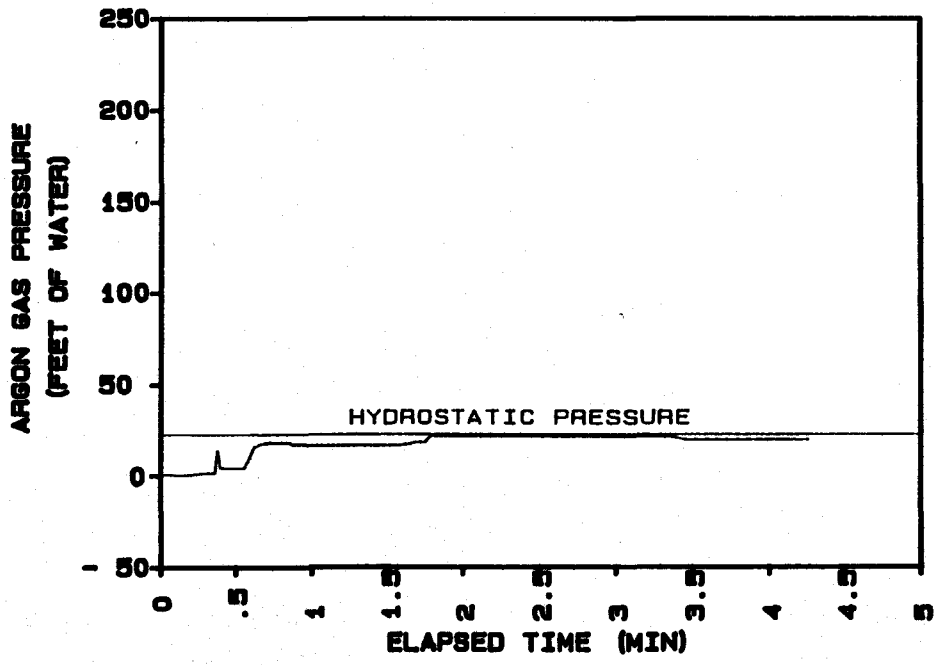


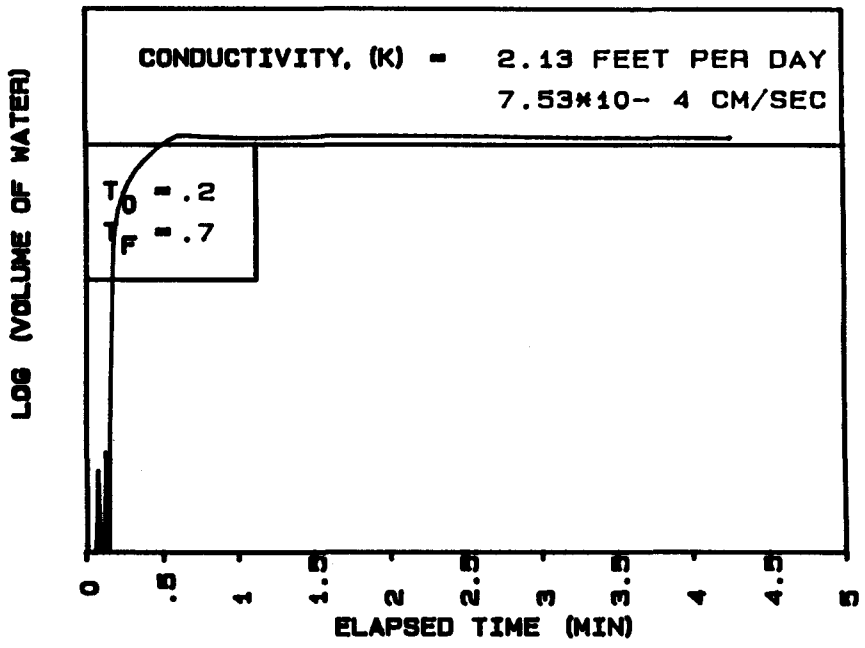
ENSAFE MEMPHIS NSA
LOCATION... 02H1327
TEST DATE
18: 12: 10 12-11-1995

SAMPLE DEPTH (FT) 27
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



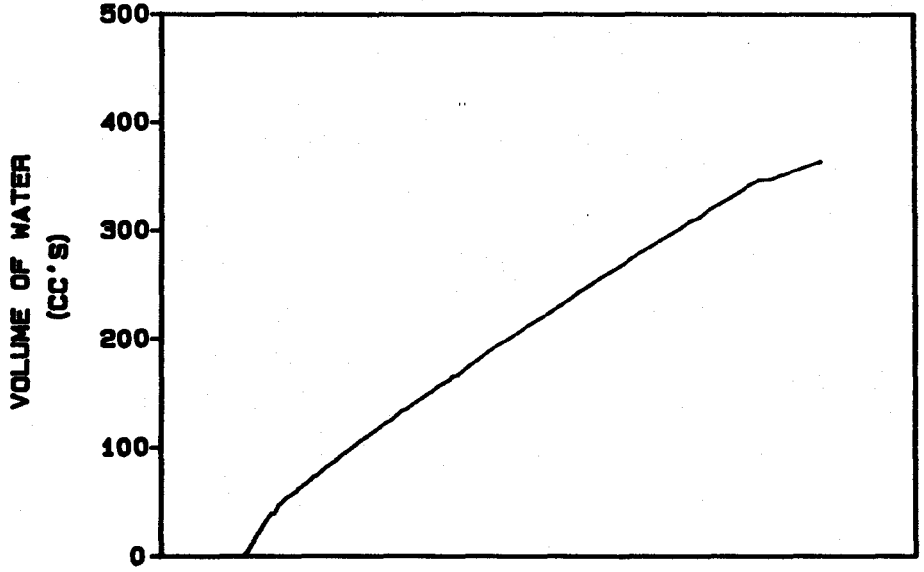


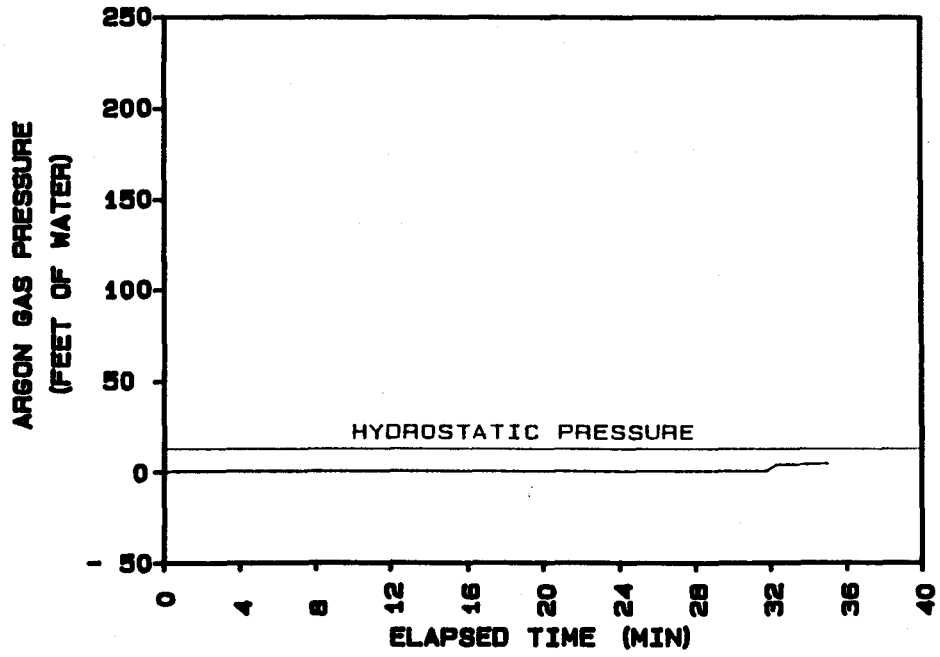


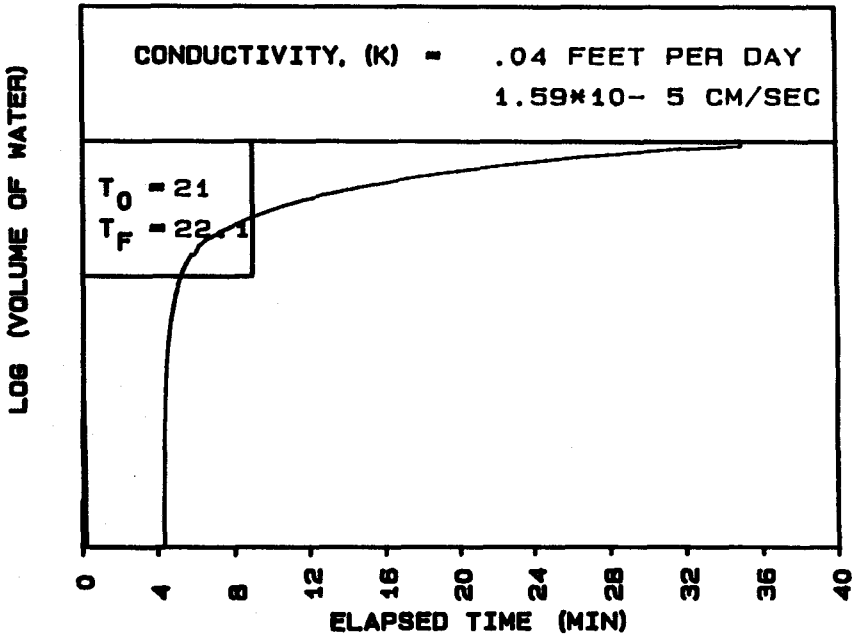
ENSAFE MEMPHIS NSA
LOCATION... 02H1337
TEST DATE
10: 05: 34 12-12-1995

SAMPLE DEPTH (FT) 37
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



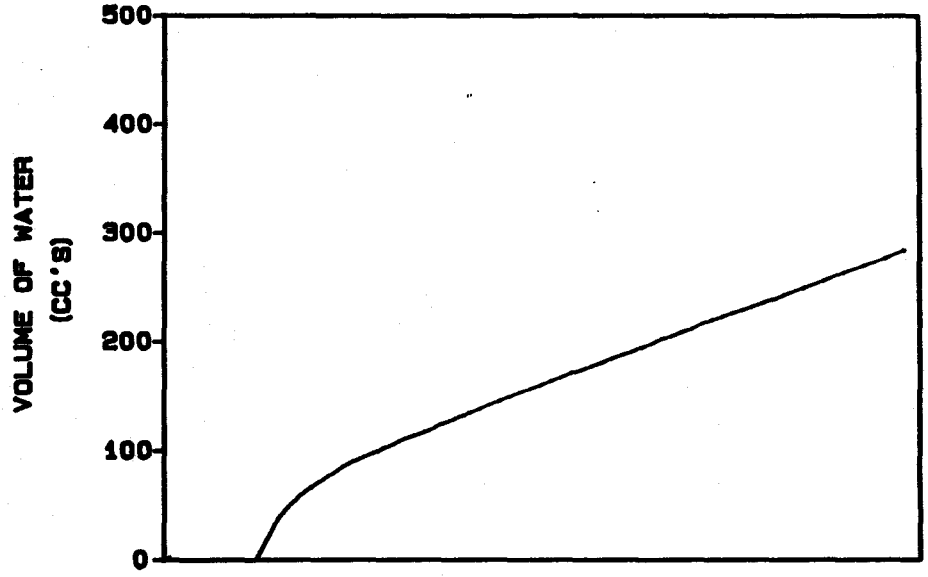


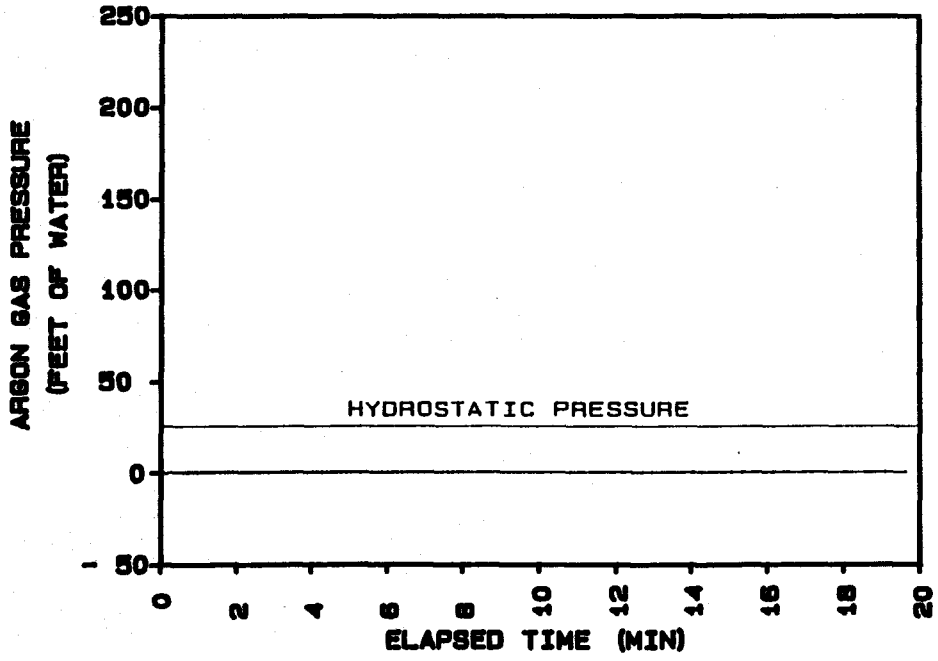


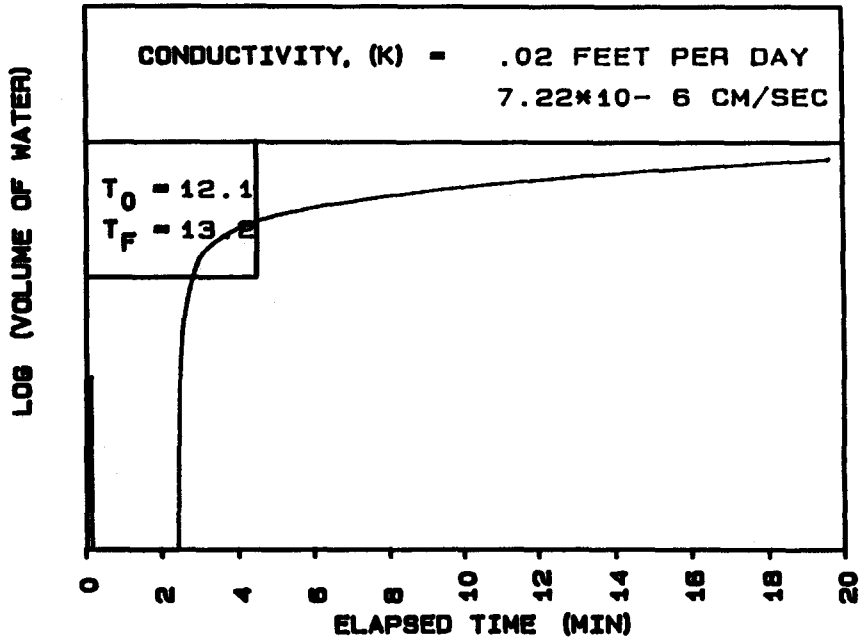
ENSAFE MEMPHIS NSA
LOCATION... 02H1427
TEST DATE
15: 59: 18 12-12-1995

SAMPLE DEPTH (FT) 27
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



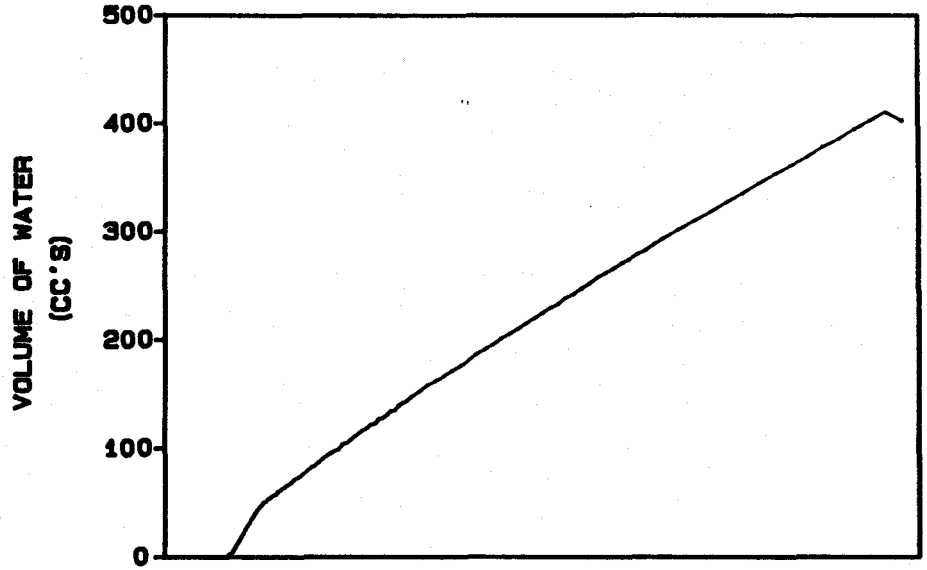


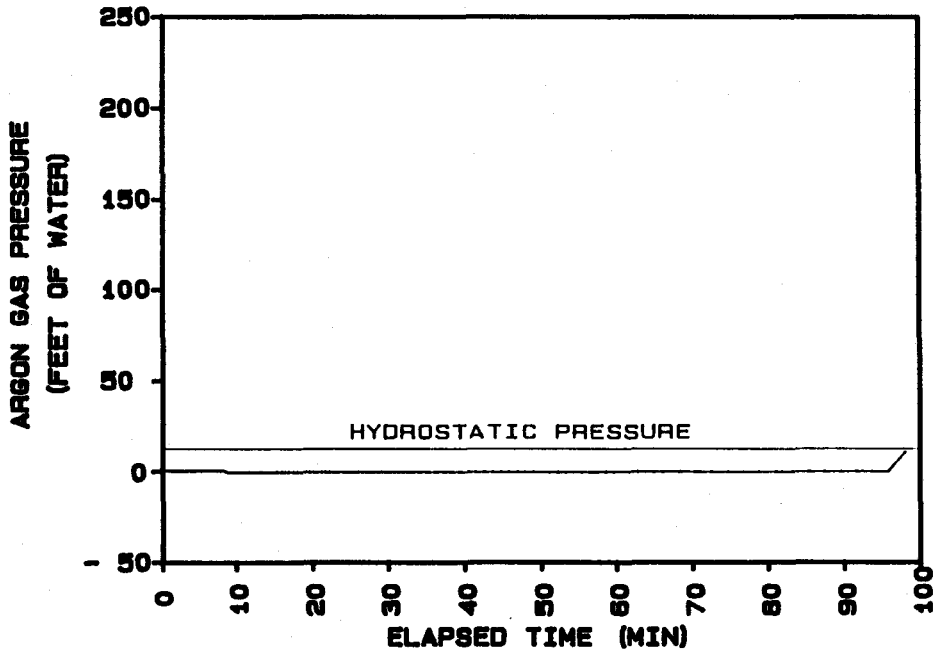


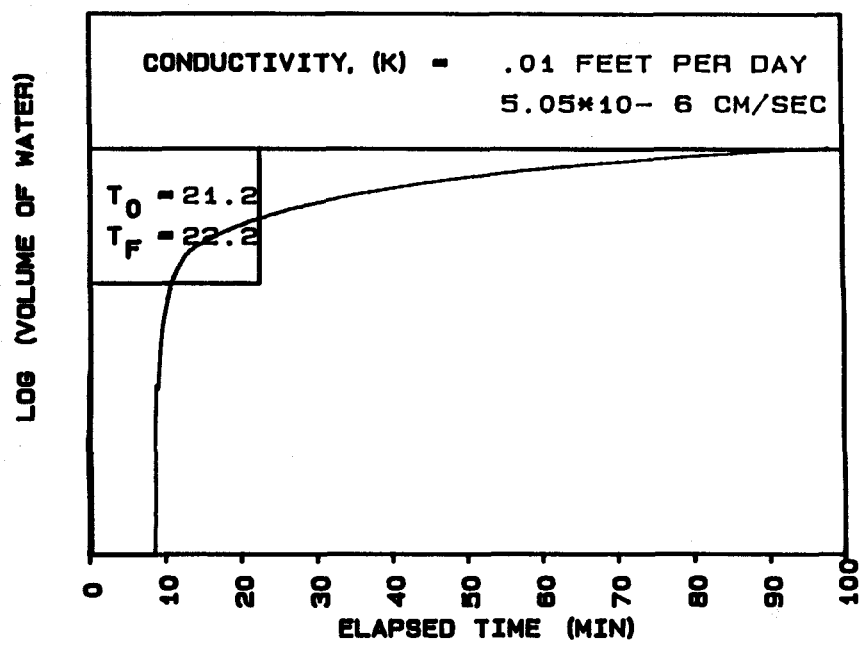
ENSAFE MEMPHIS NSA
LOCATION... 02H1440
TEST DATE
17: 28: 15 12-12-1995

SAMPLE DEPTH (FT) 40
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



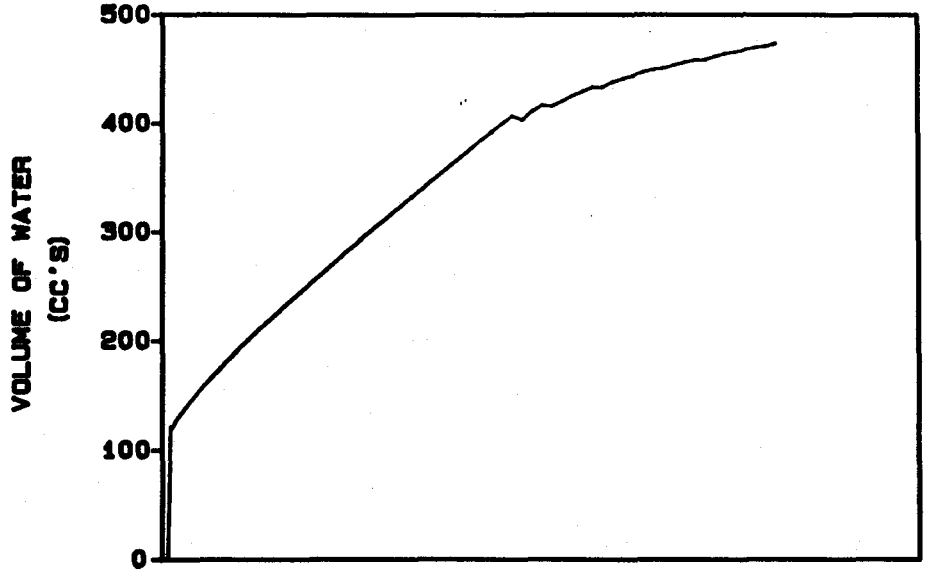


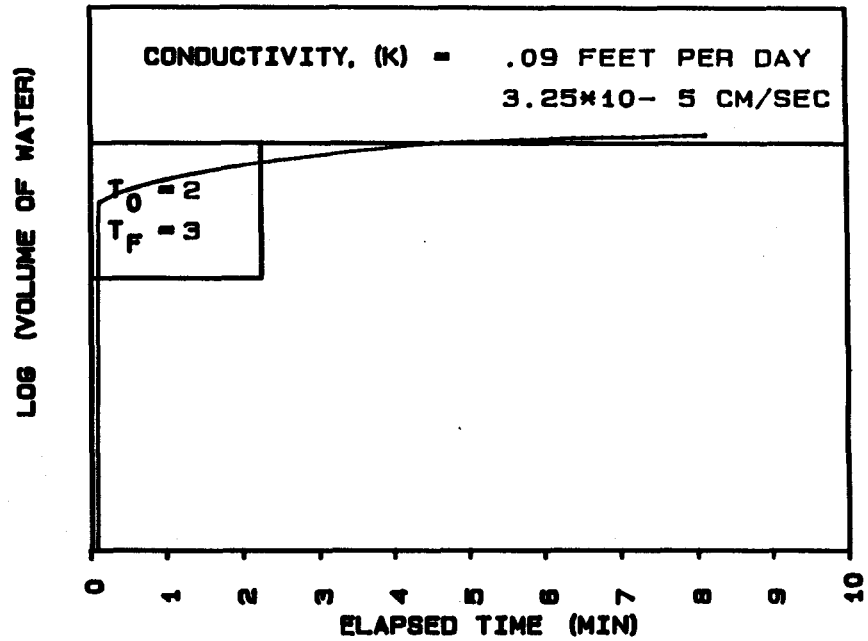


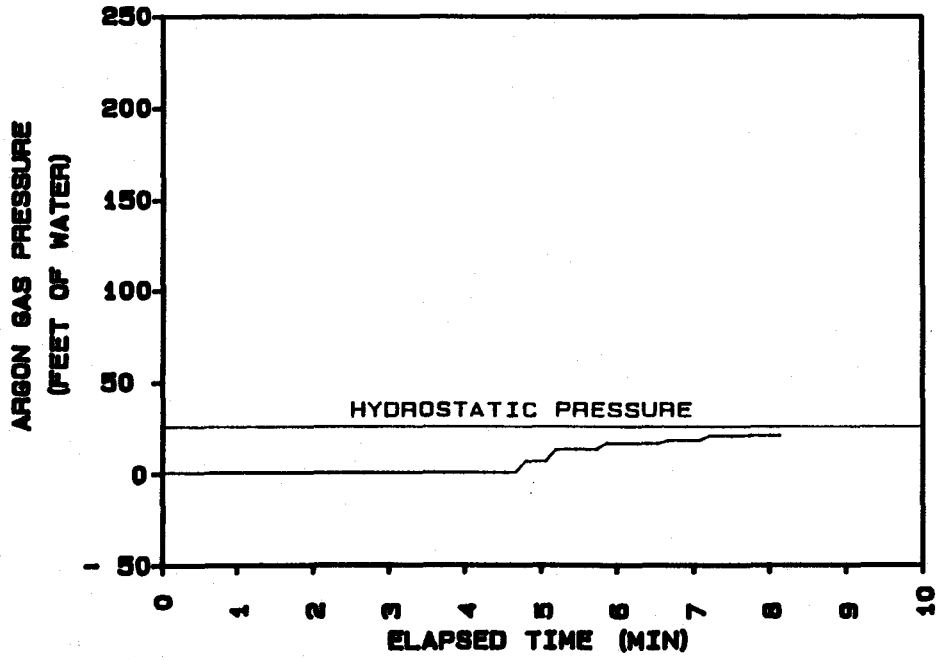
ENSAFE MEMPHIS NSA
LOCATION... 02H1527
TEST DATE
11:01:55 12-13-1995

SAMPLE DEPTH (FT) 27
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



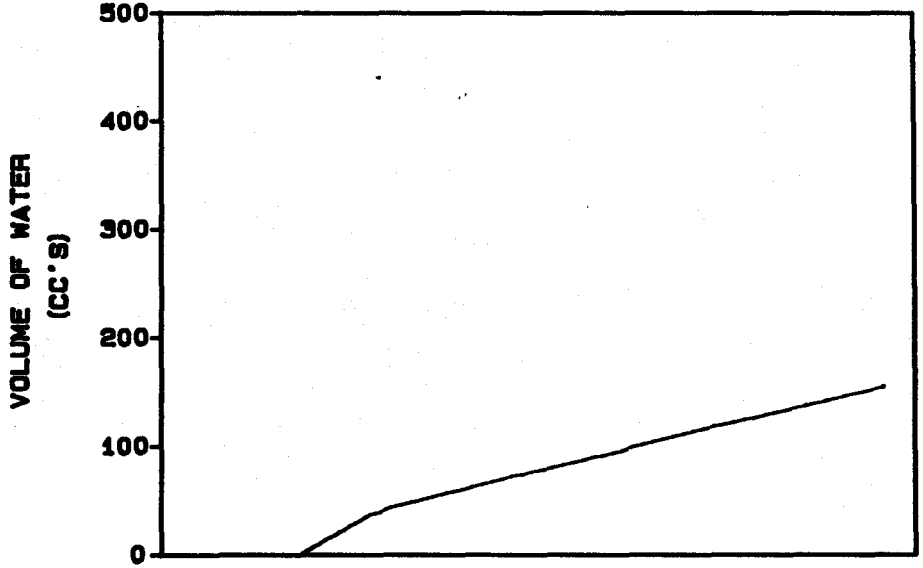


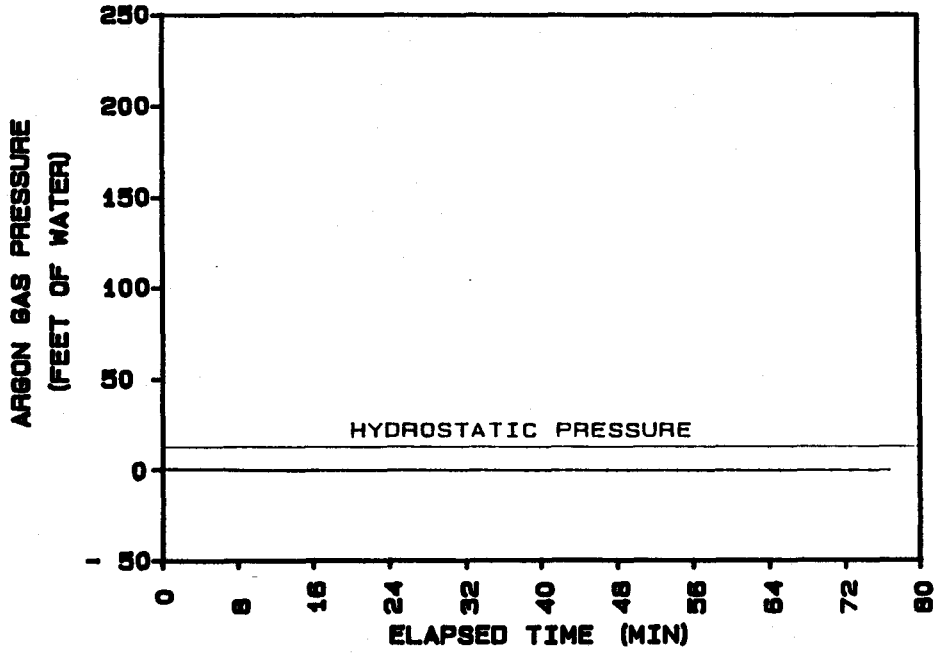


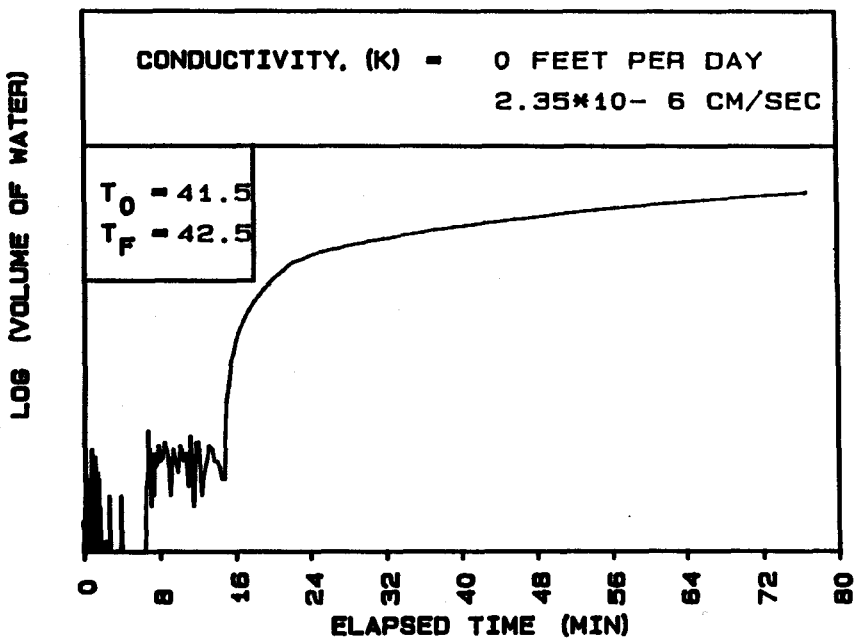
ENSAFE MEMPHIS NSA
LOCATION... 02H1540
TEST DATE
15: 26: 45 12-13-1995

SAMPLE DEPTH (FT) 40
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



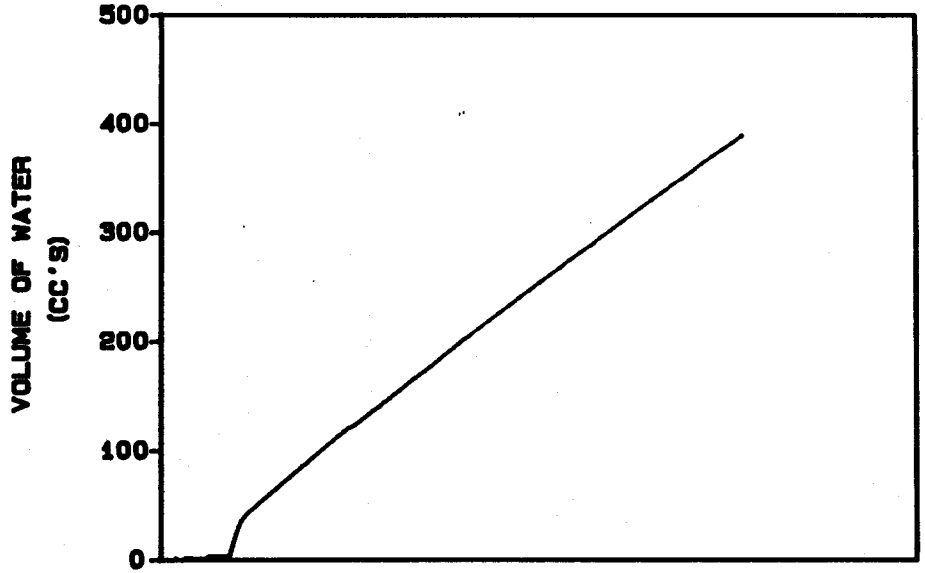


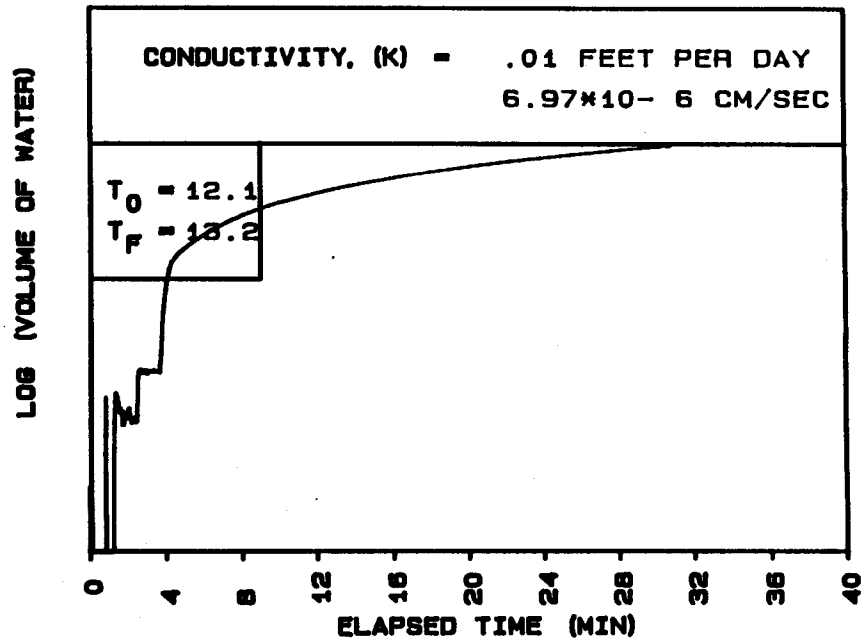


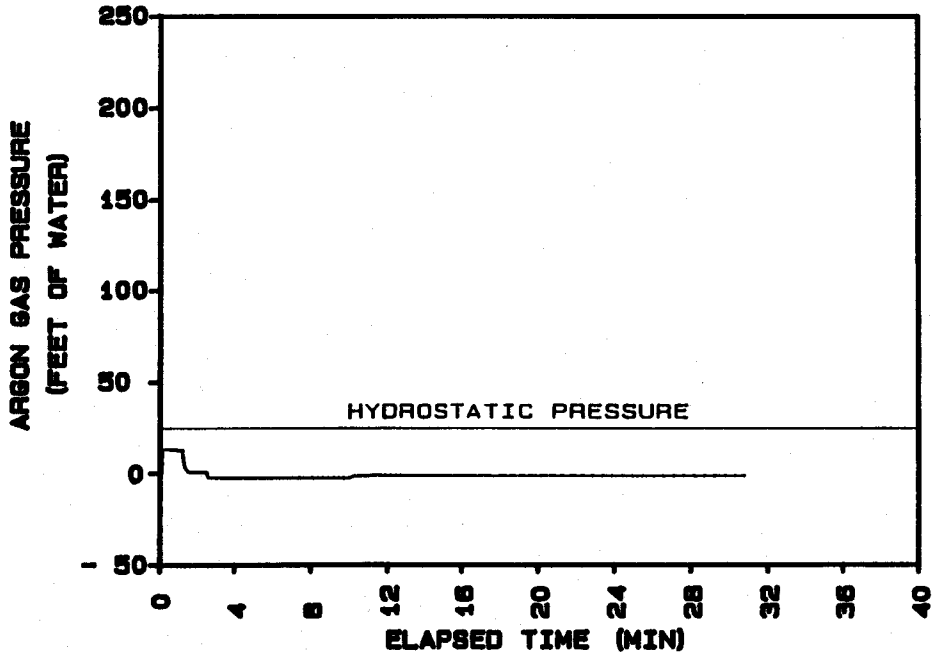
ENSAFE MEMPHIS NSA
LOCATION... 02H1627
TEST DATE
08: 31: 33 12-14-1995

SAMPLE DEPTH (FT) 27
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



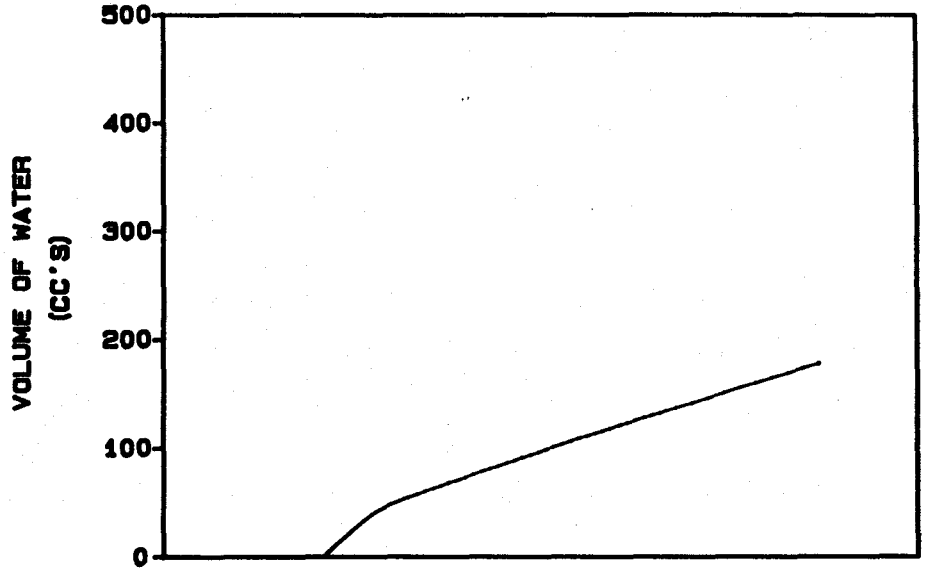


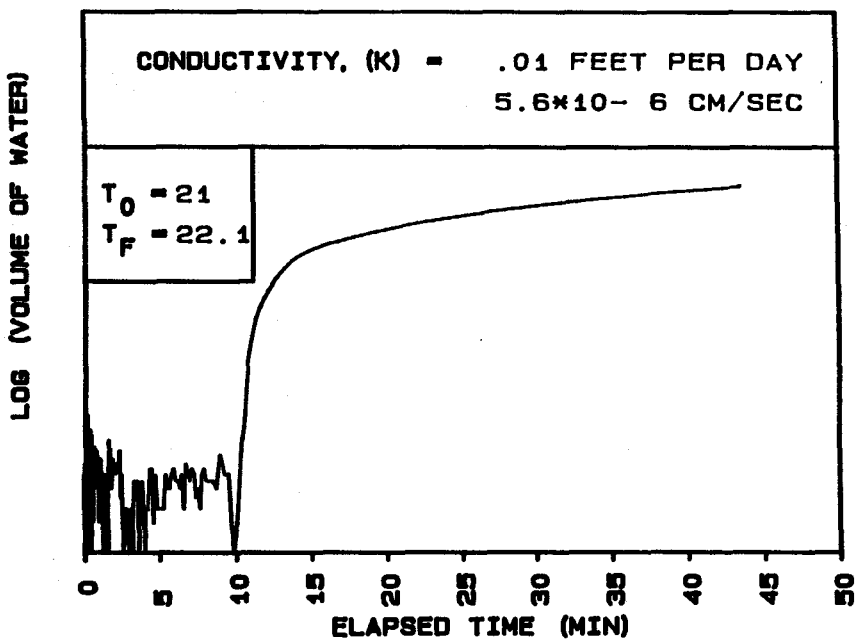


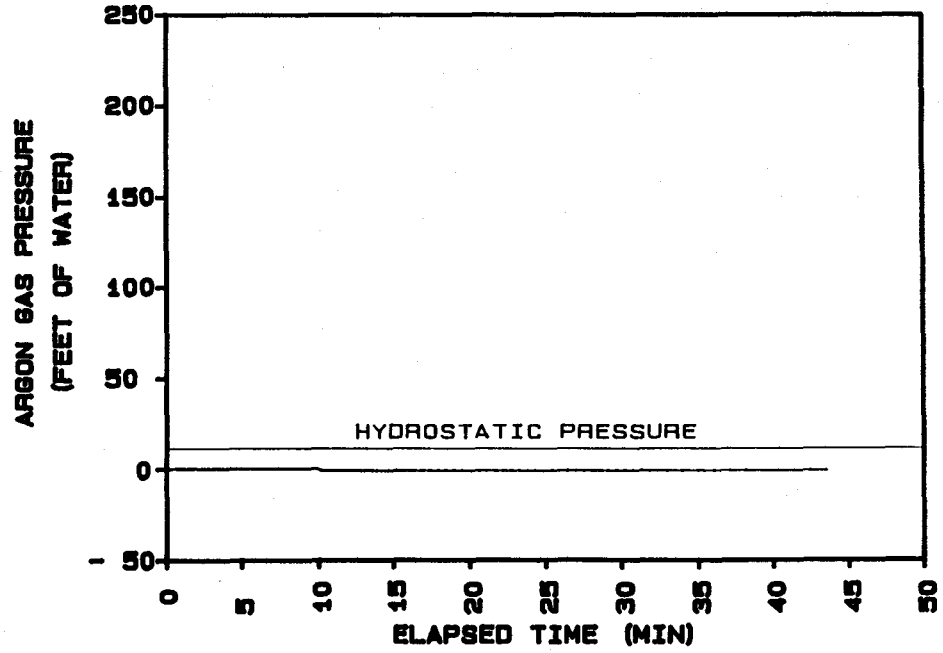
ENSAFE MEMPHIS NSA
LOCATION... 02H1639
TEST DATE
17: 14: 51 12-13-1995

SAMPLE DEPTH (FT) 39
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



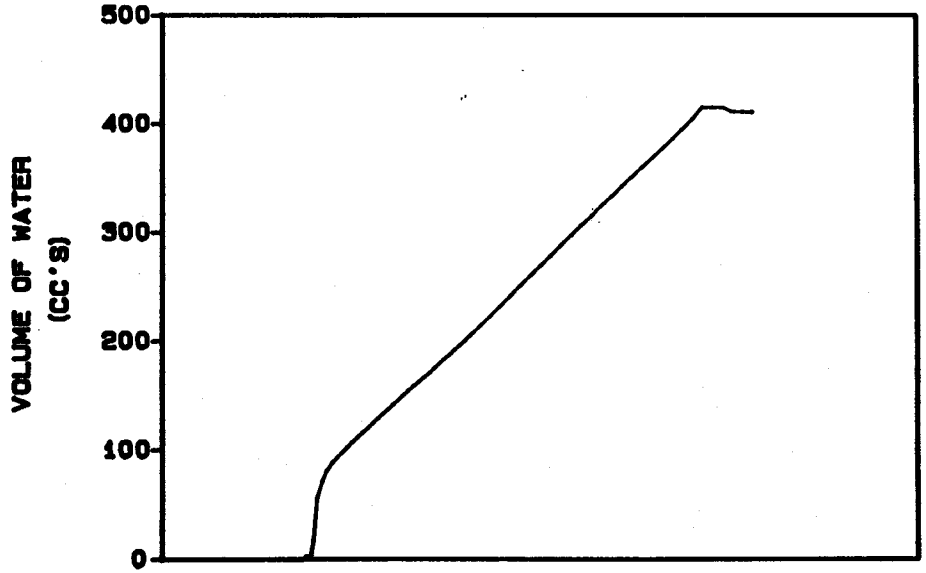


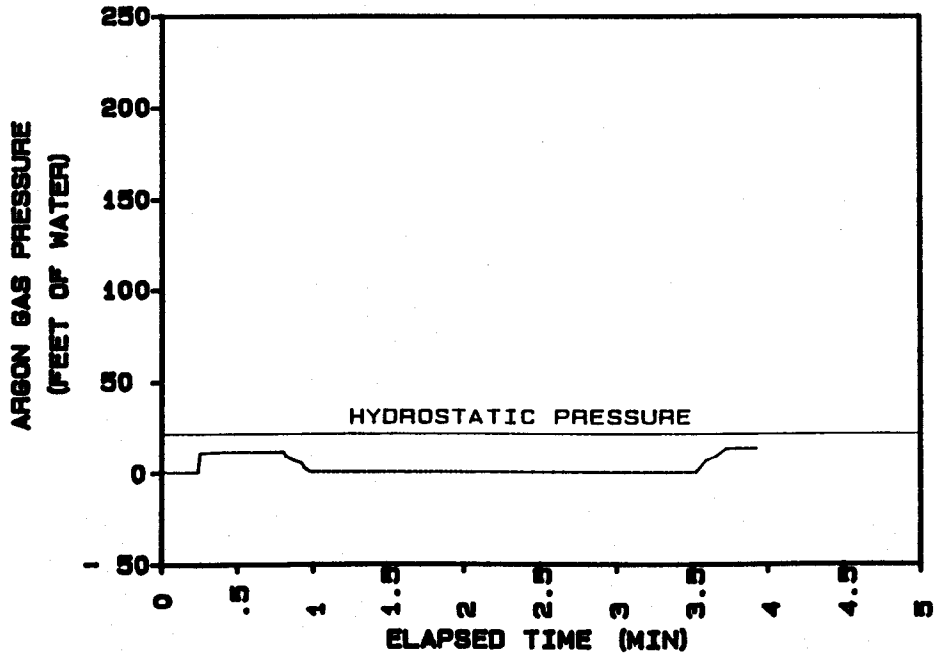


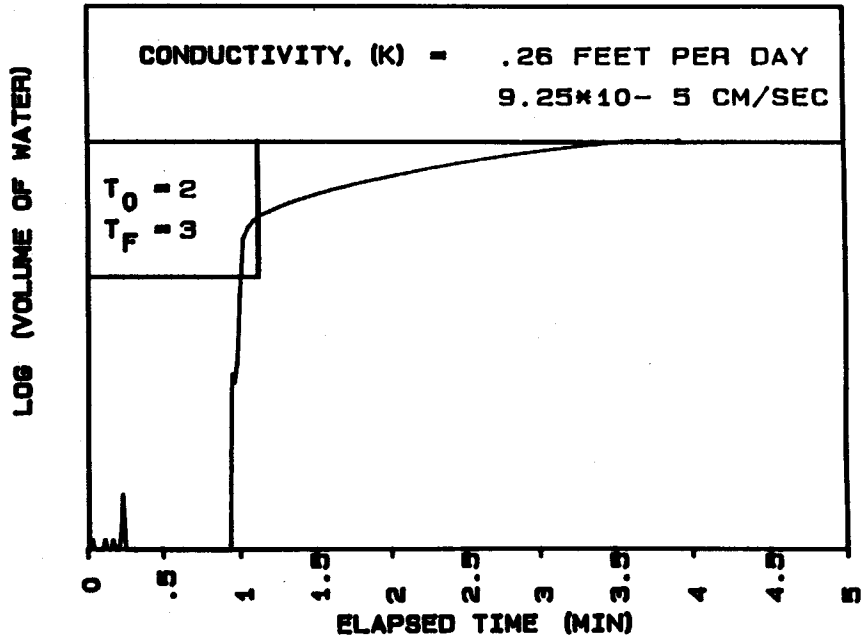
ENSAFE MEMPHIS NSA
LOCATION... 02H1726
TEST DATE
16: 59: 26 12-15-1995

SAMPLE DEPTH (FT) 26
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



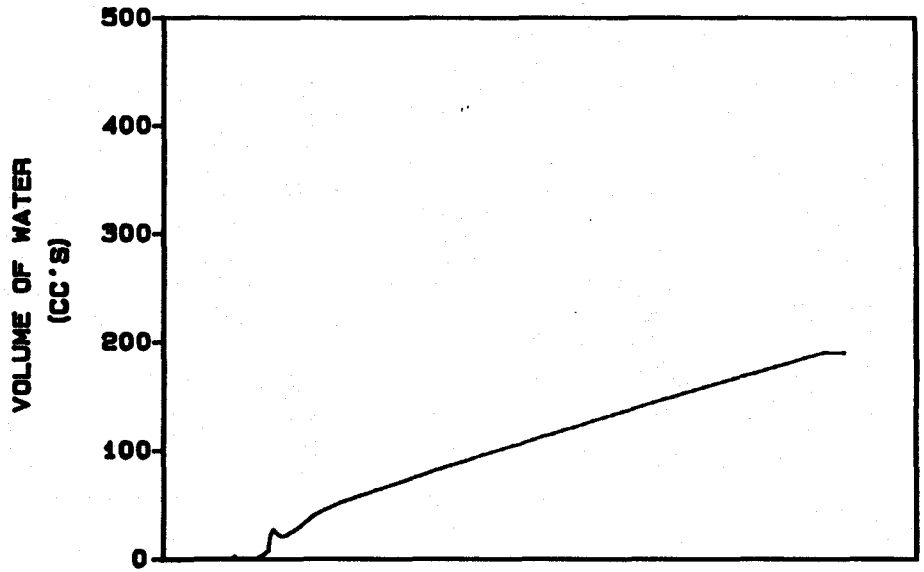


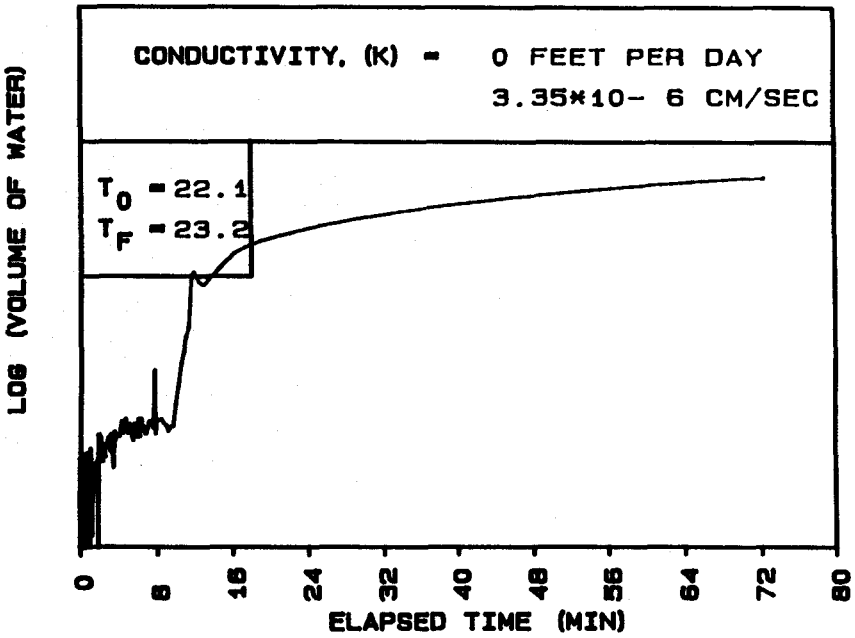


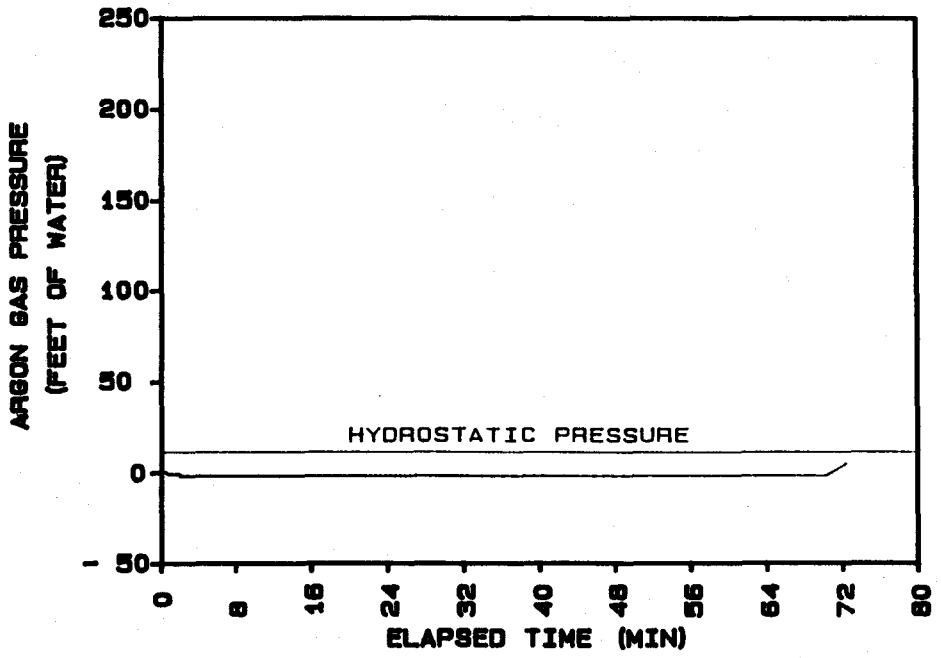
ENSAFE MEMPHIS NSA
LOCATION... 02H1736
TEST DATE
18: 44: 27 12-15-1995

SAMPLE DEPTH (FT) 36
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



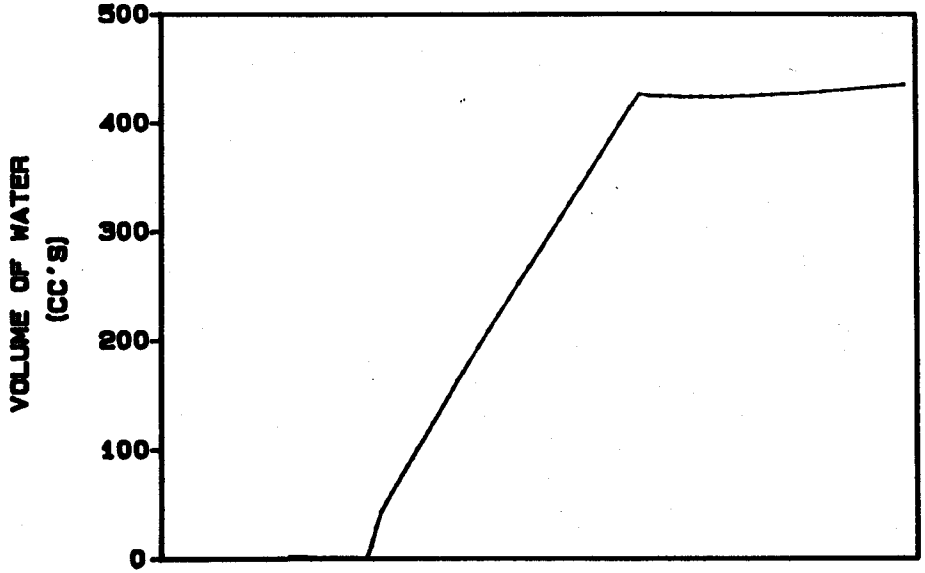


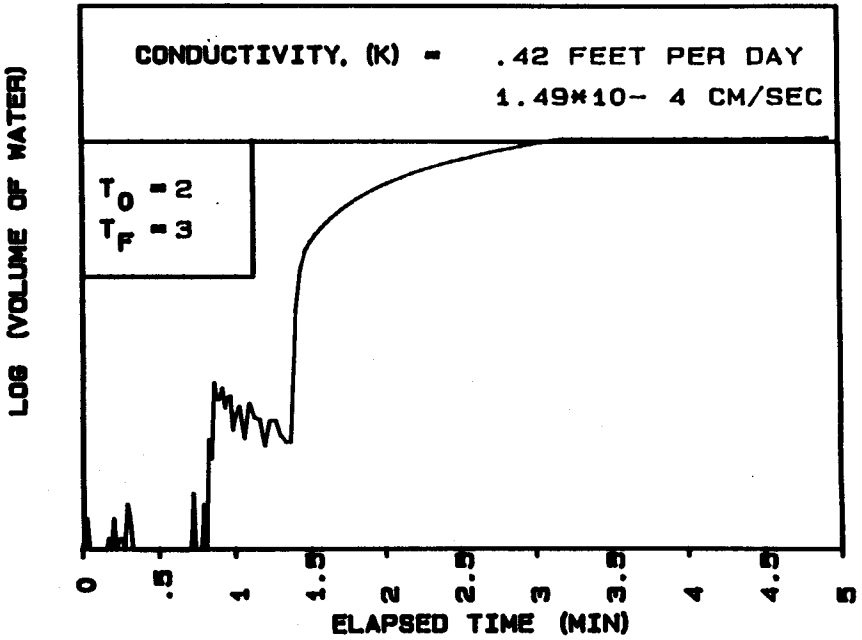


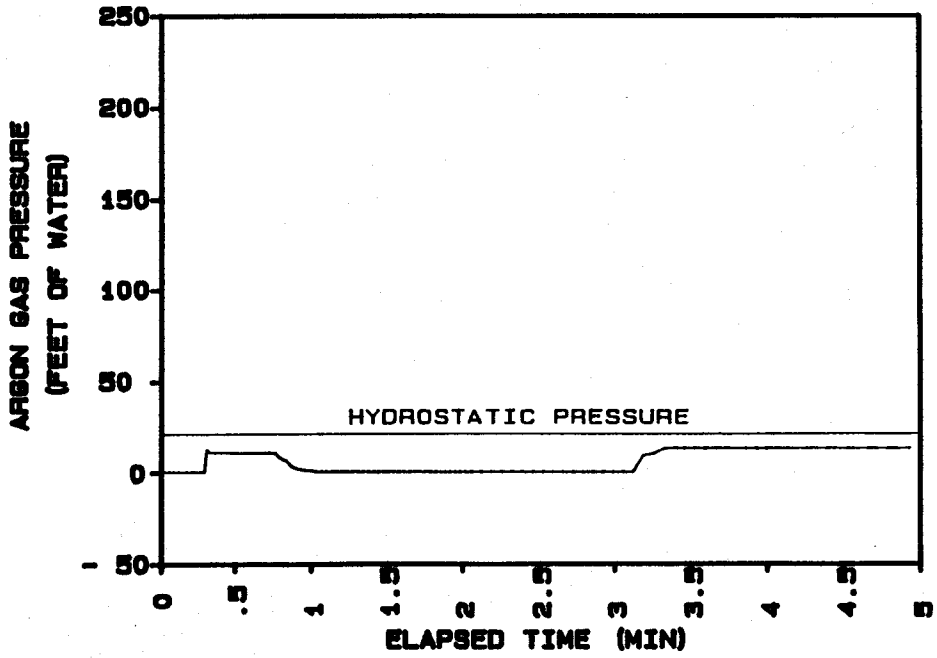
ENSAFE MEMPHIS NSA
LOCATION... 02H1826
TEST DATE
09: 10: 31 12-16-1995

SAMPLE DEPTH (FT) 28
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



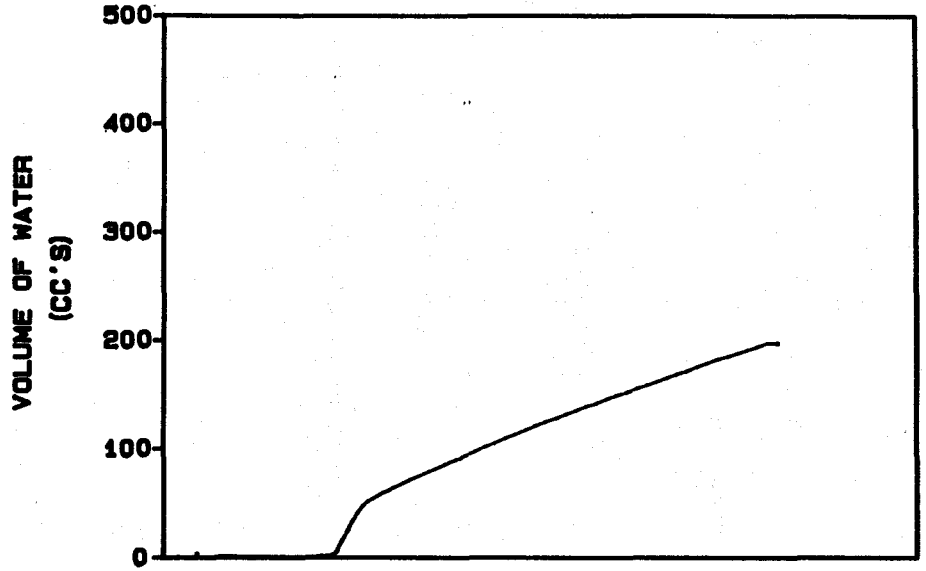


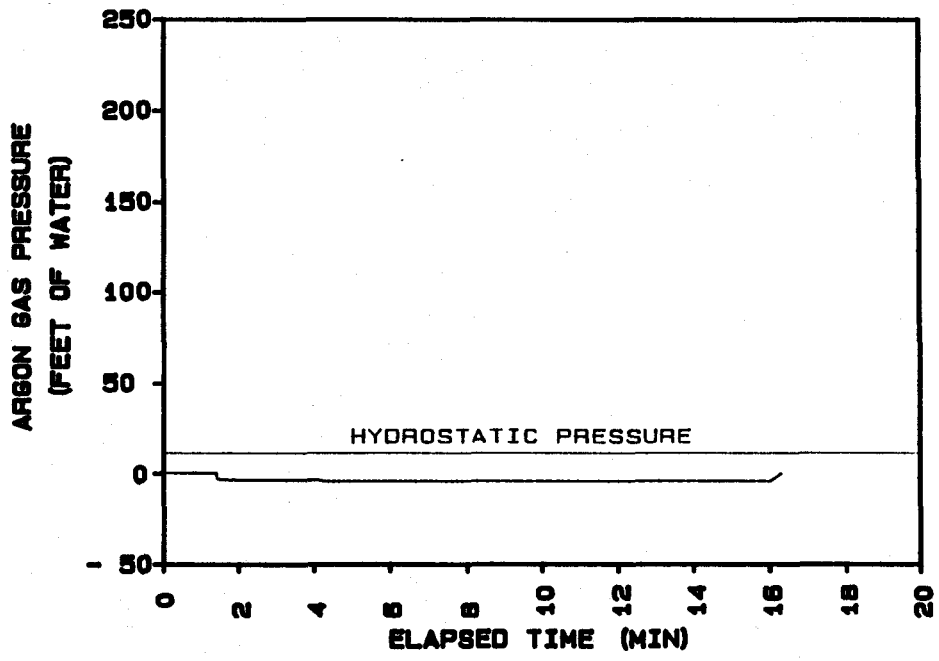


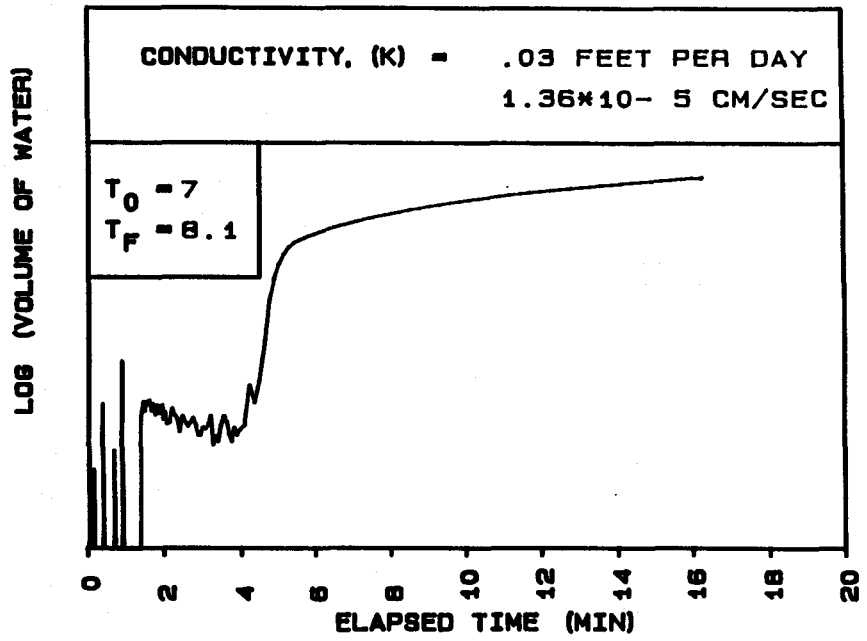
ENSAFE MEMPHIS NSA
LOCATION... 02H1636
TEST DATE
11:37:04 12-16-1995

SAMPLE DEPTH (FT) 36
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



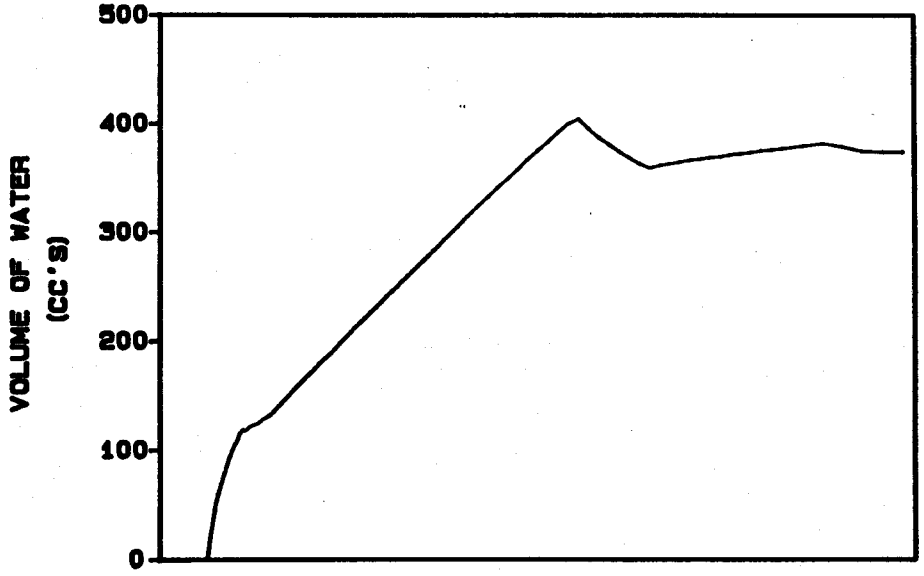


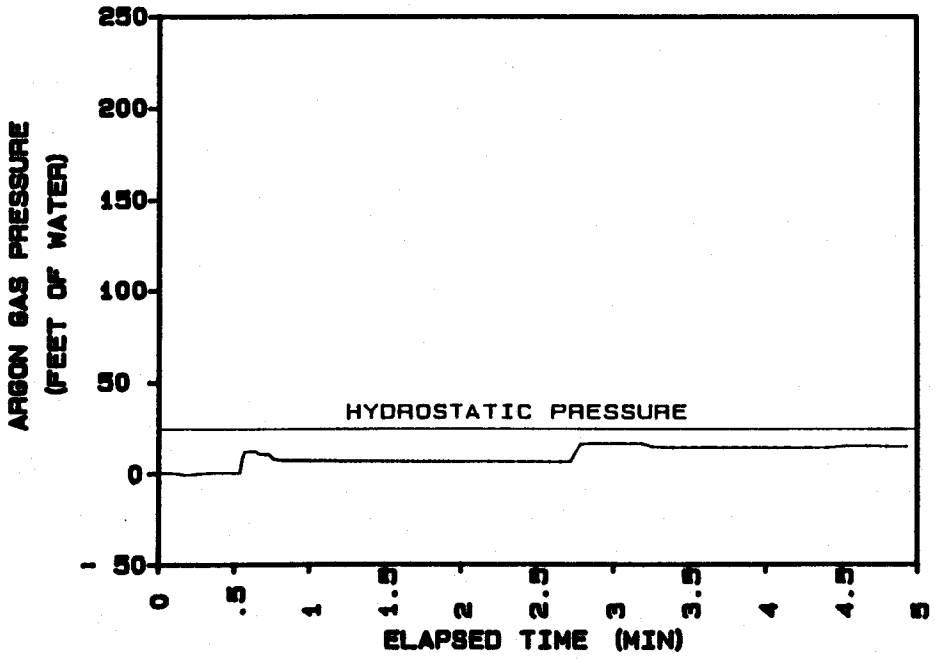


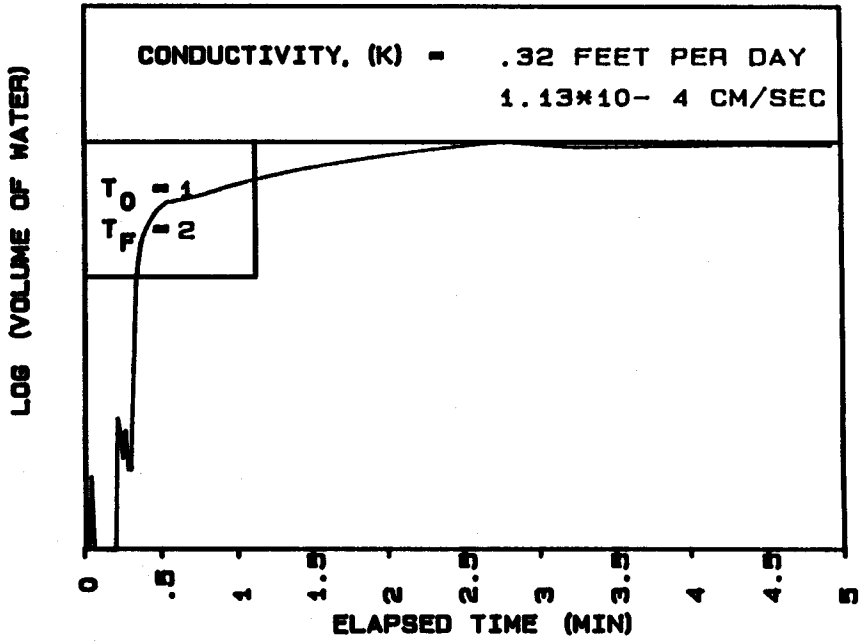
ENSAFE MEMPHIS NSA
LOCATION... 02H1926
TEST DATE
13: 14: 16 12-16-1995

SAMPLE DEPTH (FT) 26
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



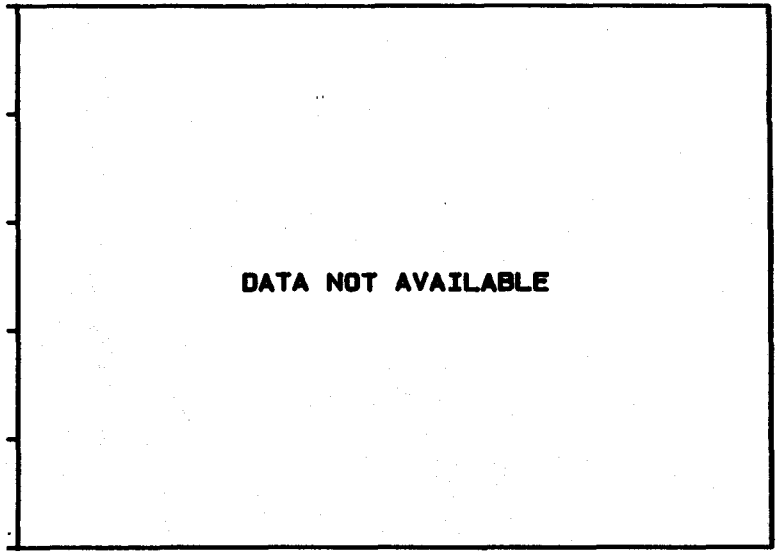


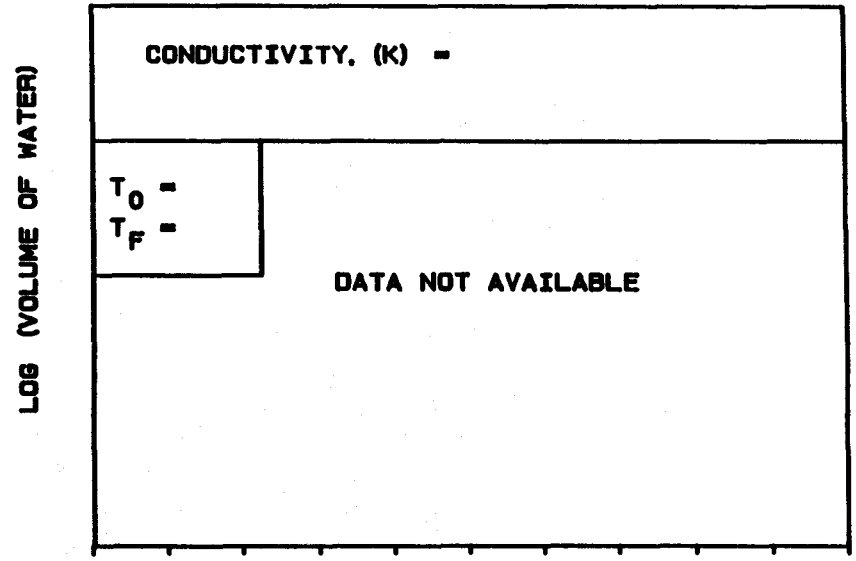


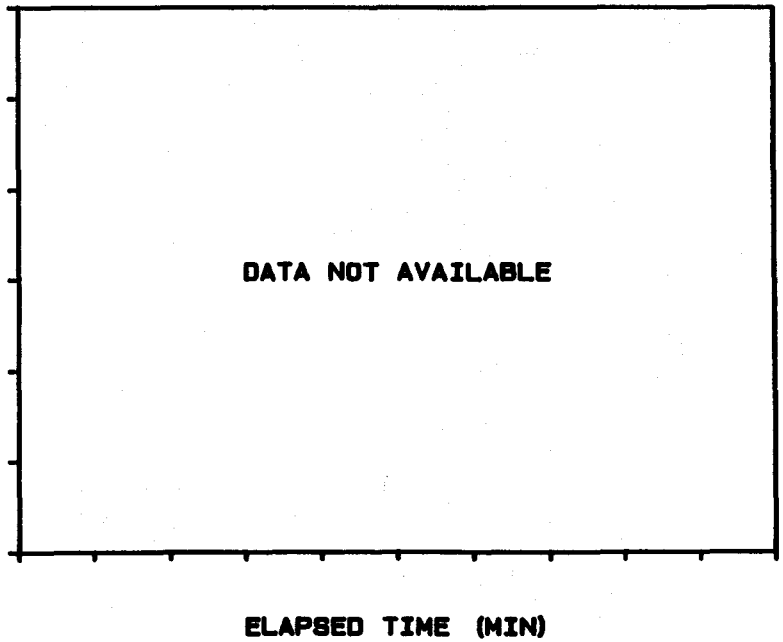
ENSAFE MEMPHIS NSA
LOCATION... 02H1939
TEST DATE
14: 52: 42 12-16-1995

SAMPLE DEPTH (FT) 39
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



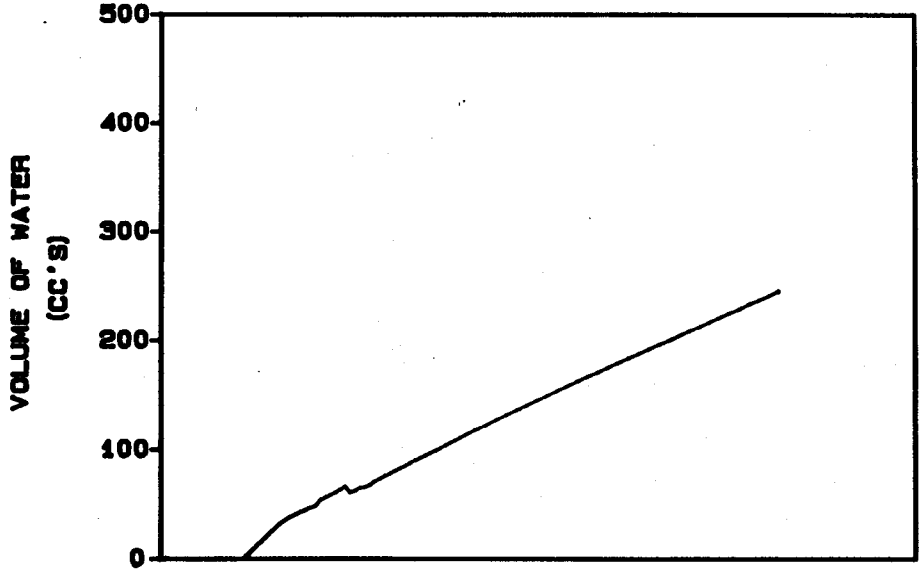


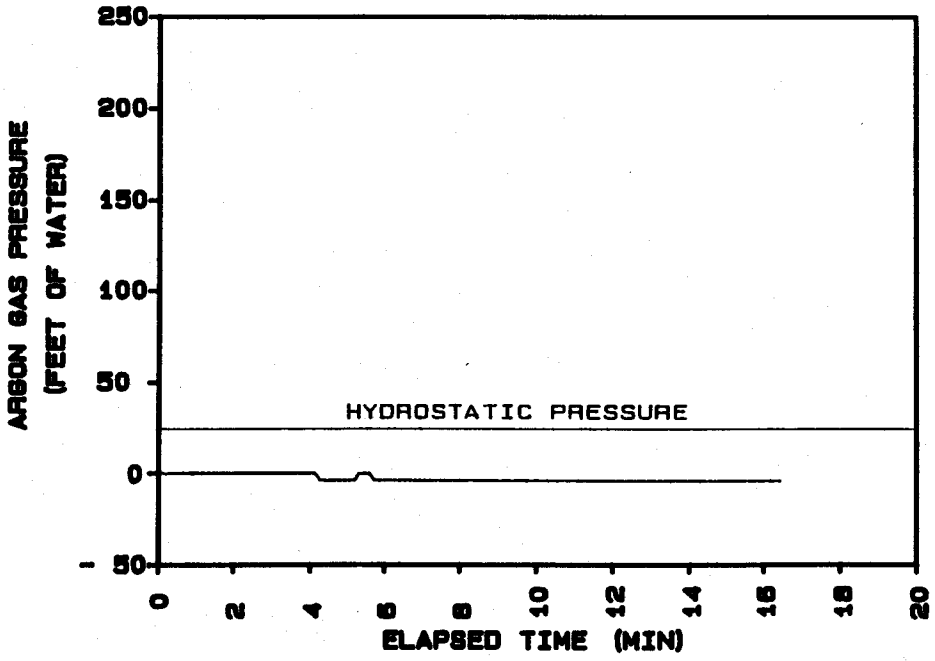


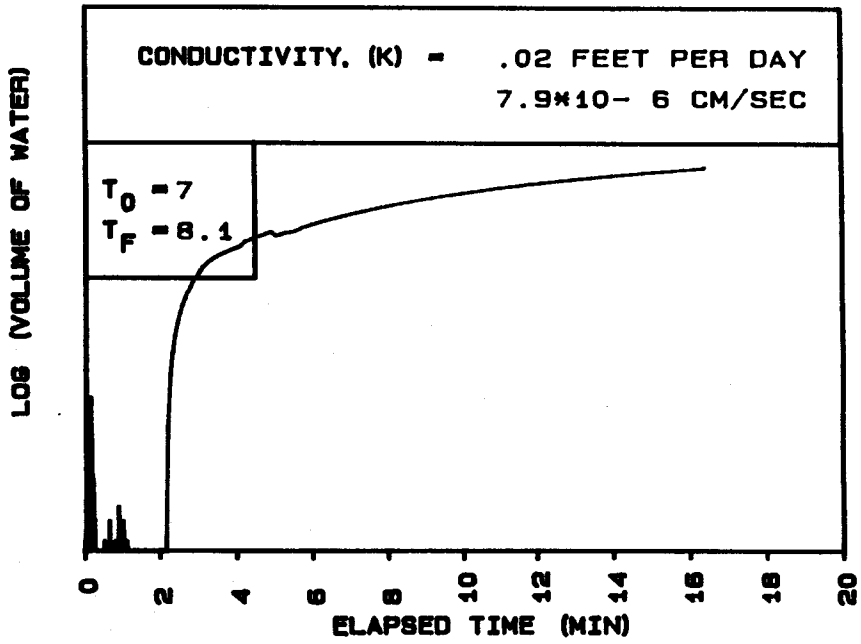
ENSAFE MEMPHIS NSA
LOCATION... 02H2022

DATA NOT AVAILABLE

HYDROCONE TEST



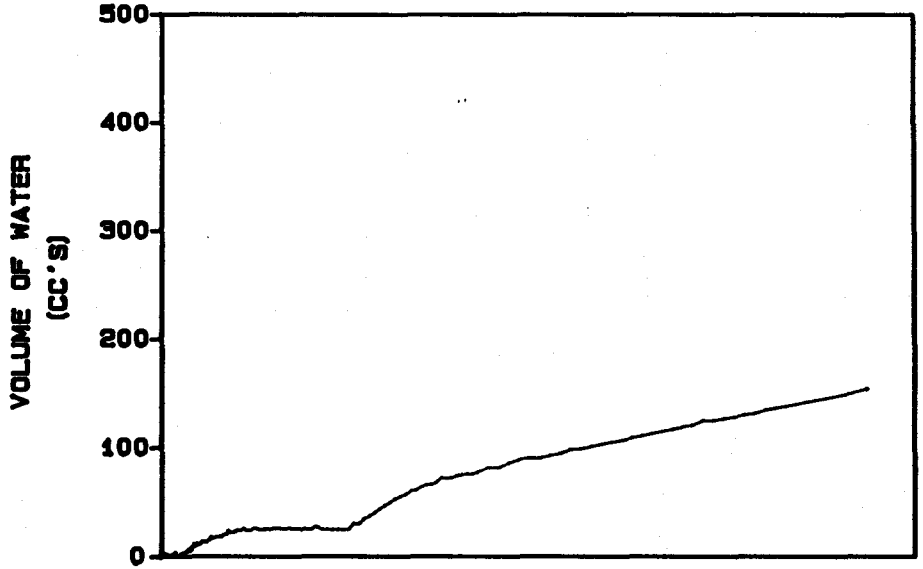


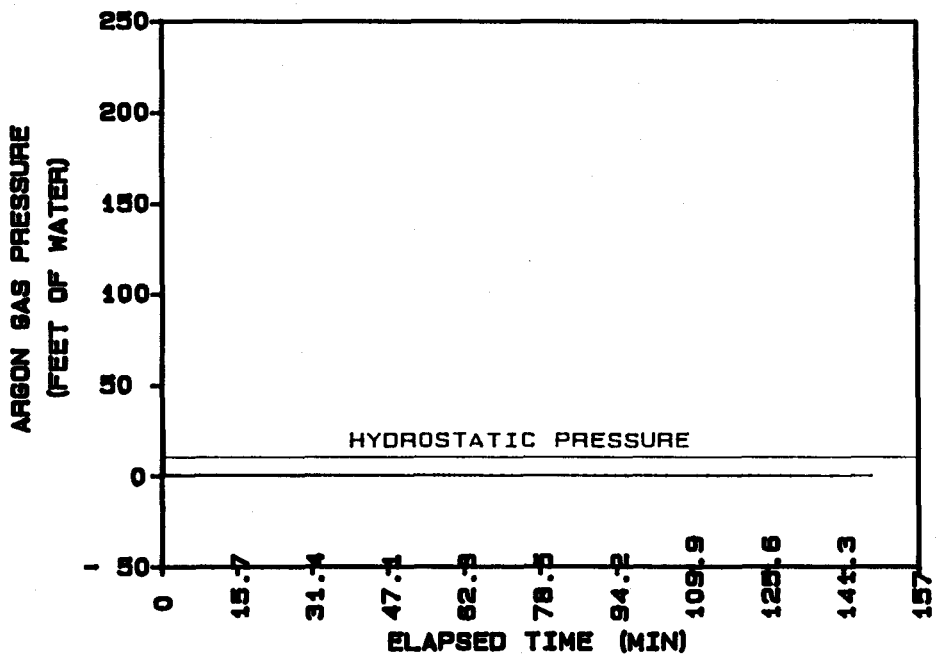


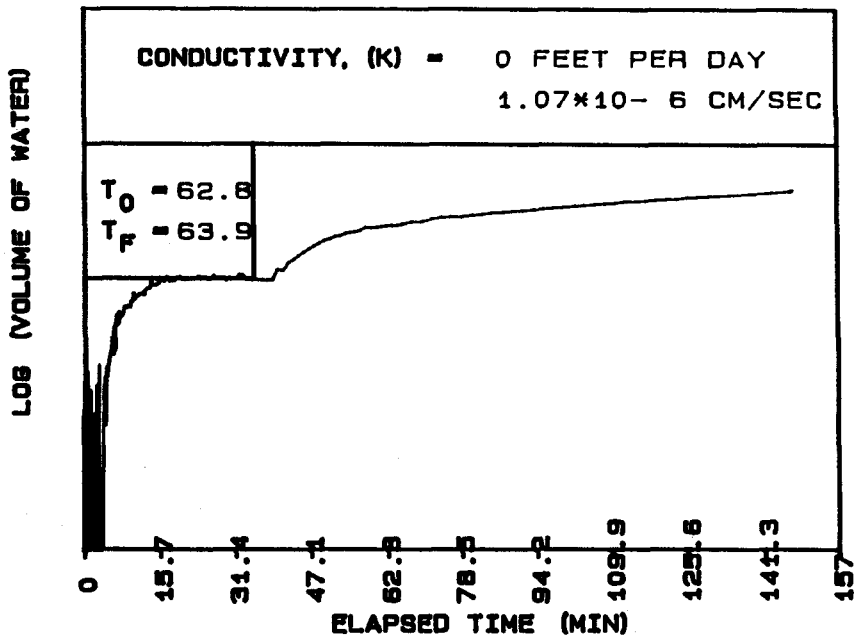
ENSAFE MEMPHIS NSA
LOCATION... 02H2039
TEST DATE
16: 58: 12 12-16-1995

SAMPLE DEPTH (FT) 39
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



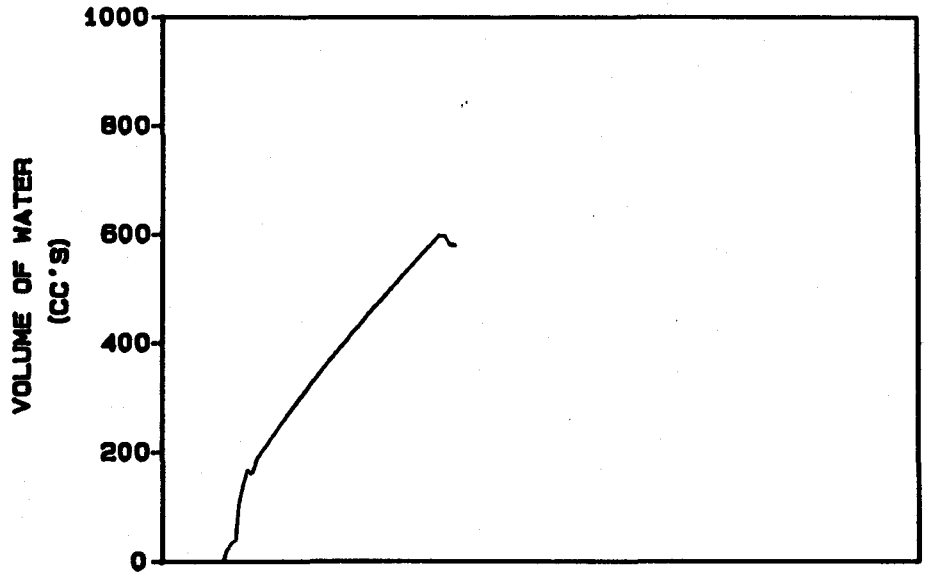


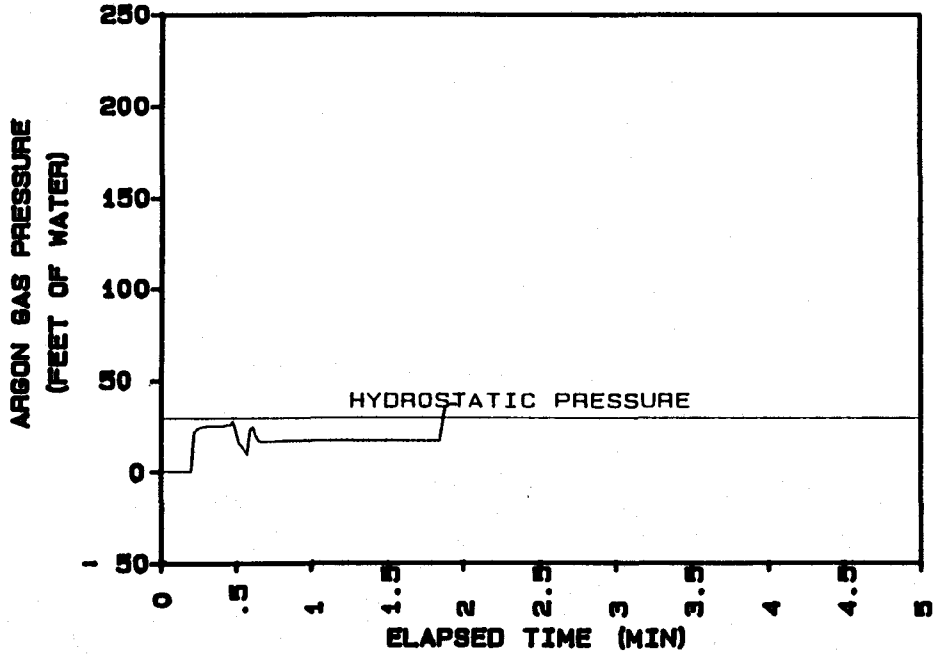


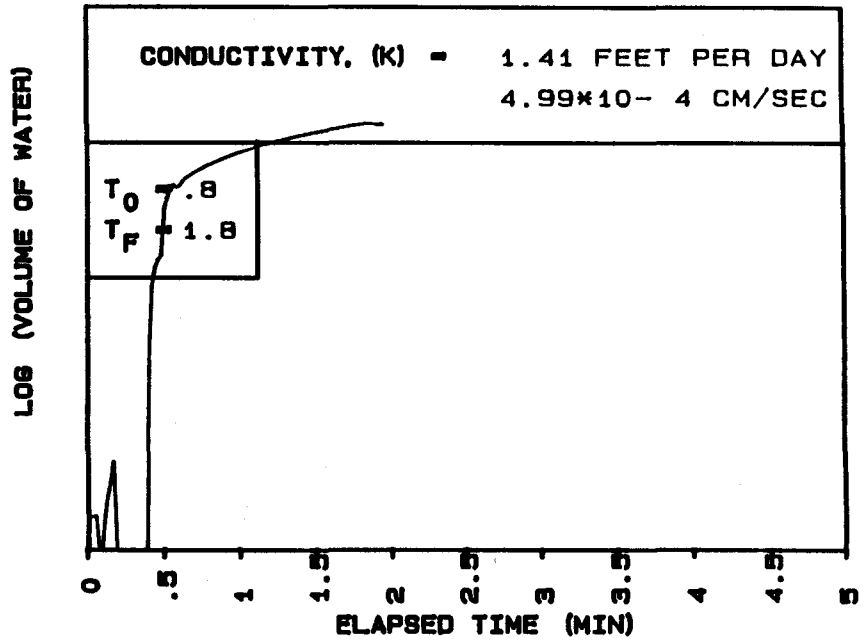
ENSAFE MEMPHIS NSA
LOCATION... 02H2130
TEST DATE
14: 55: 42 12-05-1995

SAMPLE DEPTH (FT) 30
GROUNDWATER DEPTH (FT) 20

HYDROCONE TEST







ENSAFE MEMPHIS NSA
LOCATION... 02H2149
TEST DATE
18: 24: 50 12-05-1995

SAMPLE DEPTH (FT) 49
GROUNDWATER DEPTH (FT) 20

HYDROCONE TEST

VOLUME OF WATER (CC'S)

DATA NOT AVAILABLE

LOG (VOLUME OF WATER)

CONDUCTIVITY, (K) =

T_0 =

T_F =

DATA NOT AVAILABLE

ELAPSED TIME (MIN)

ARGON GAS PRESSURE (FEET OF WATER)

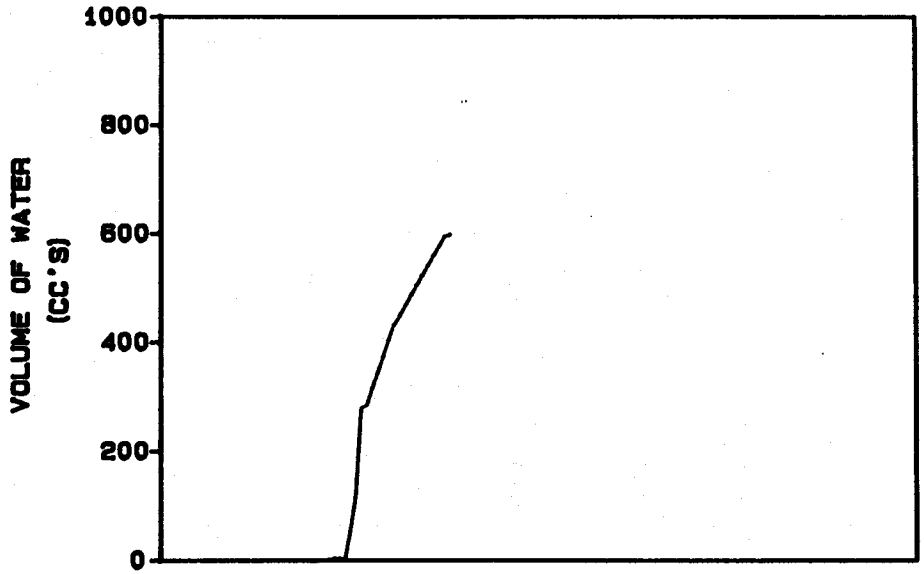
DATA NOT AVAILABLE

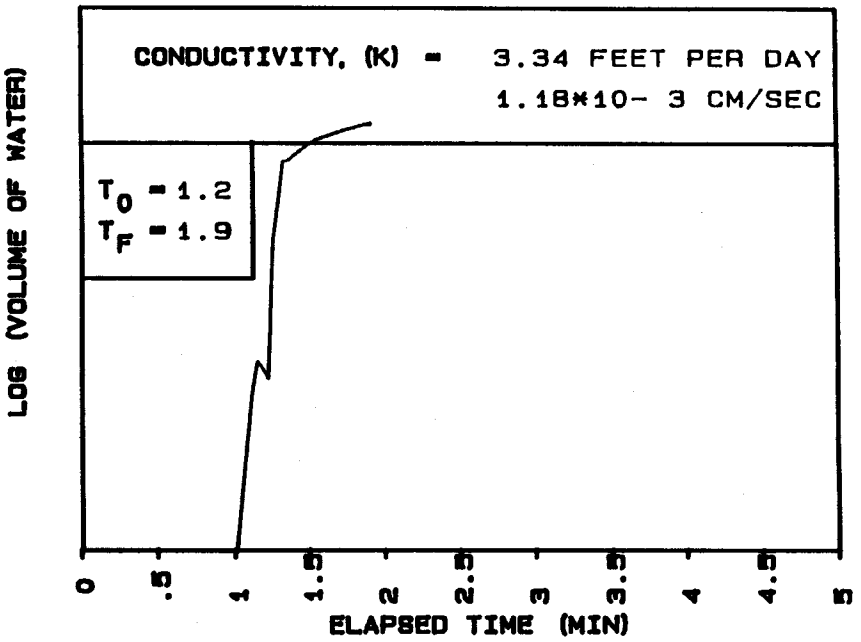
ELAPSED TIME (MIN)

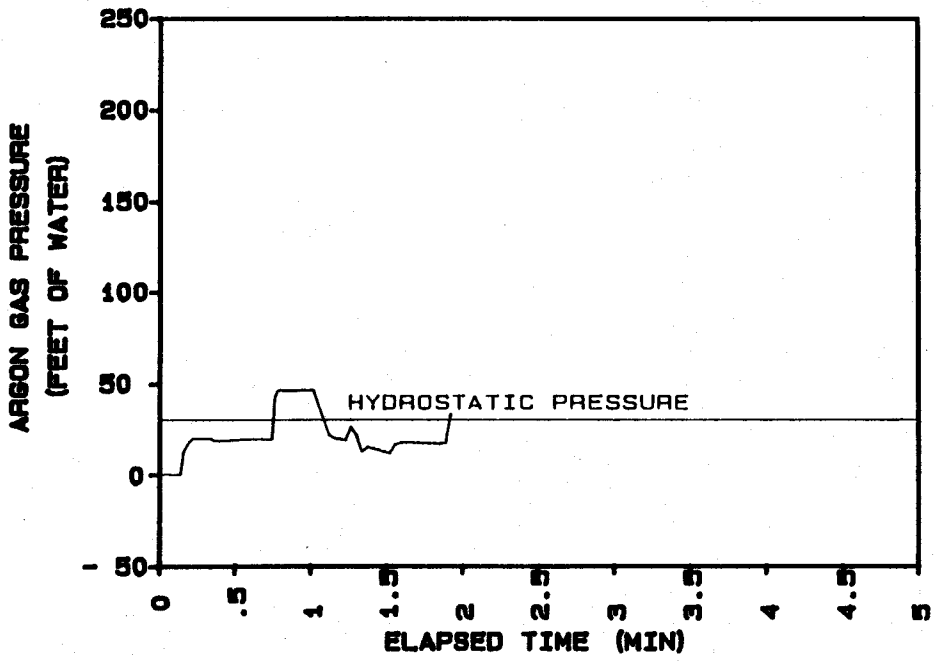
ENSAFE MEMPHIS NSA
LOCATION... 02H2229

DATA NOT AVAILABLE

HYDROCONE TEST



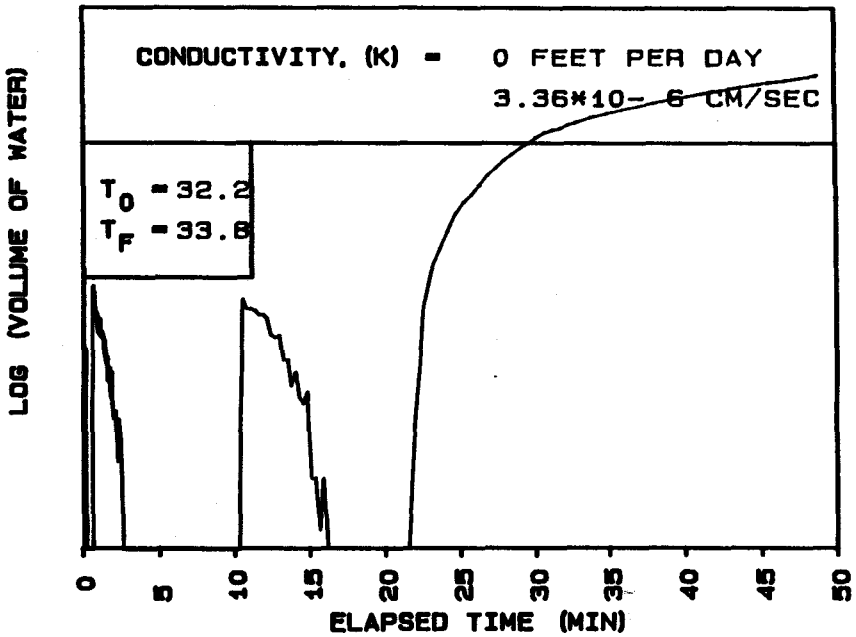


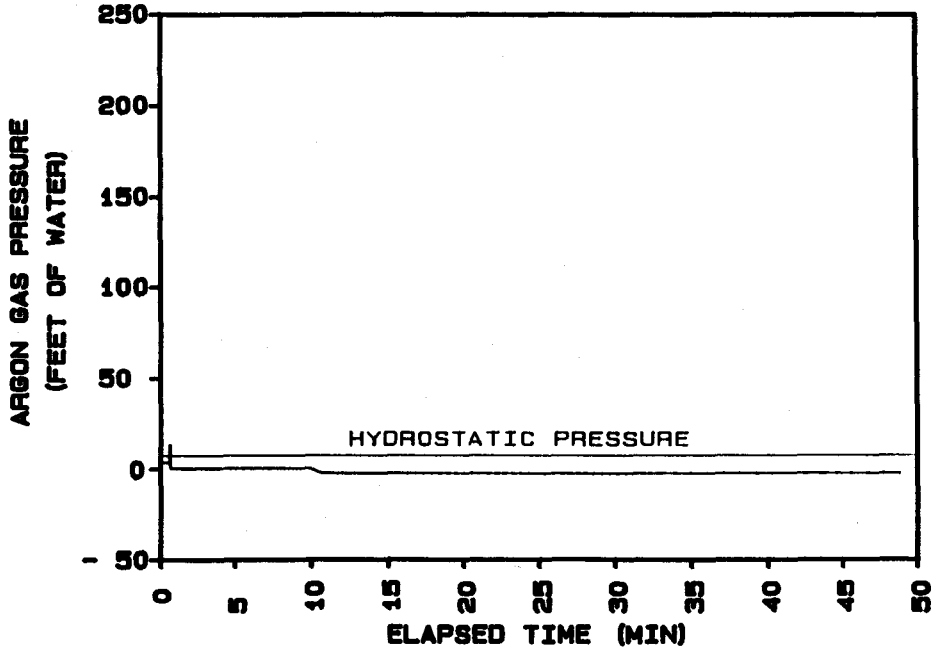


ENSAFE MEMPHIS NSA
LOCATION... 02H2249
TEST DATE
14: 14: 24 12-06-1995

SAMPLE DEPTH (FT) 49
GROUNDWATER DEPTH (FT) 19

HYDROCONE TEST

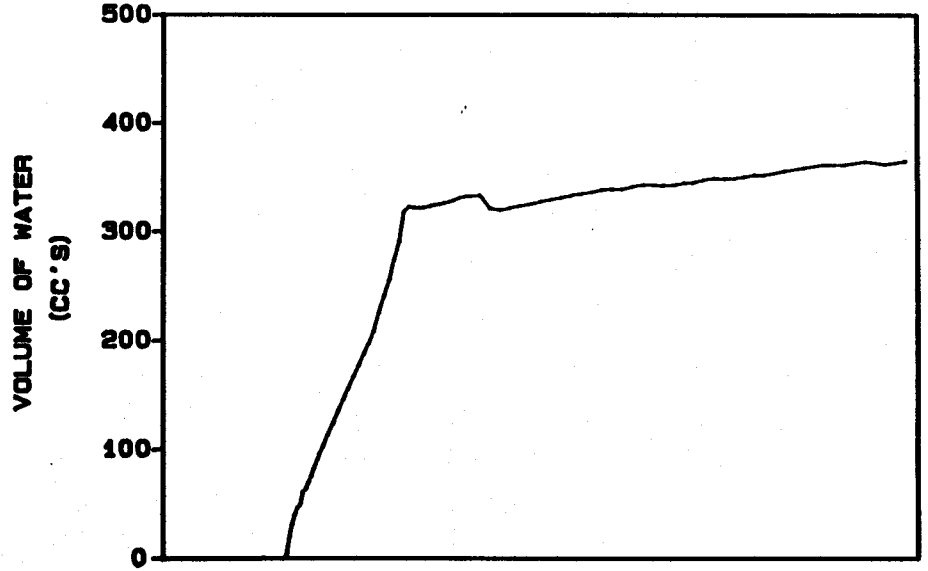


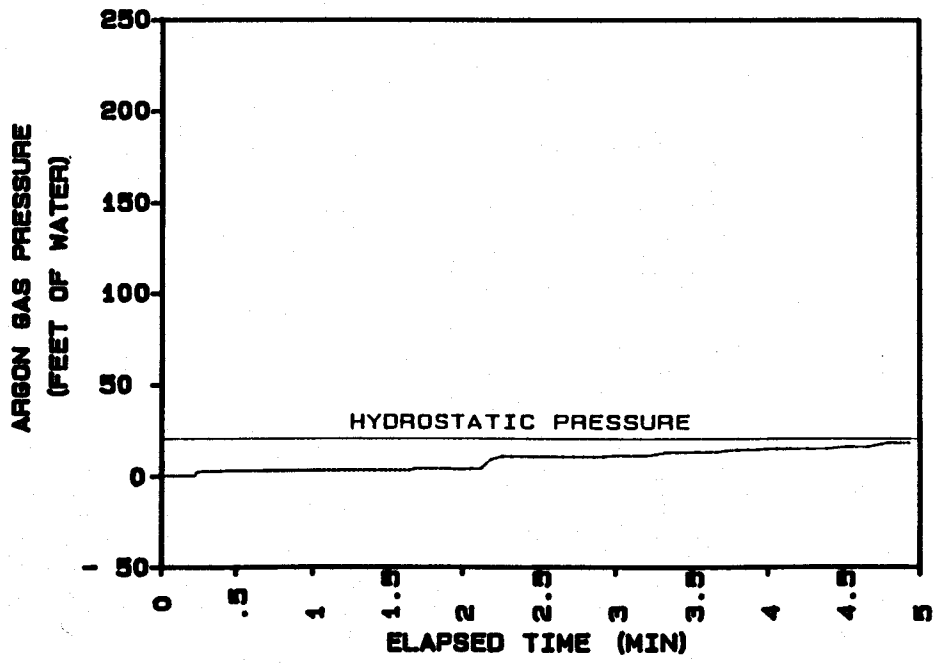


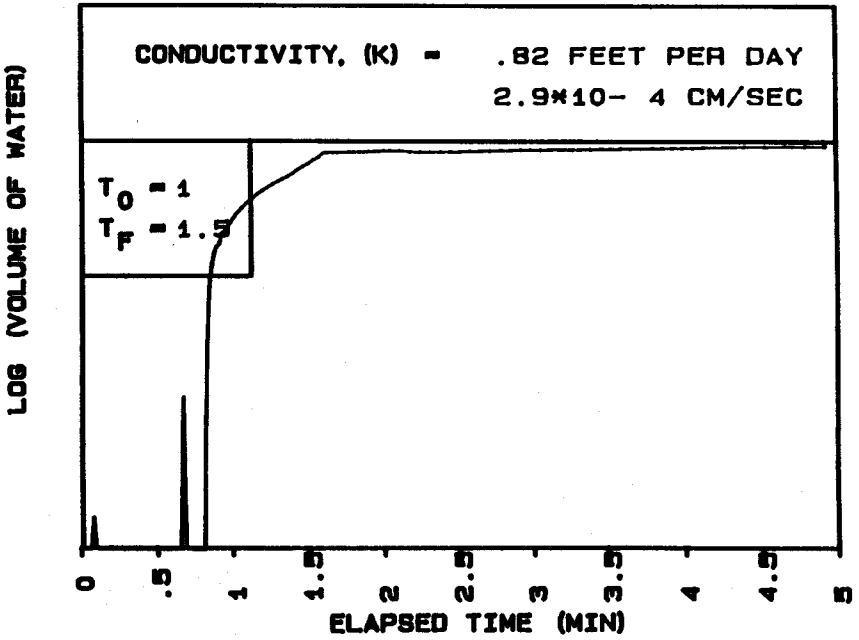
ENSAFE MEMPHIS NSA
LOCATION... 02H2323
TEST DATE
13: 25: 32 12-01-1995

SAMPLE DEPTH (FT) 23
GROUNDWATER DEPTH (FT) 16

HYDROCONE TEST



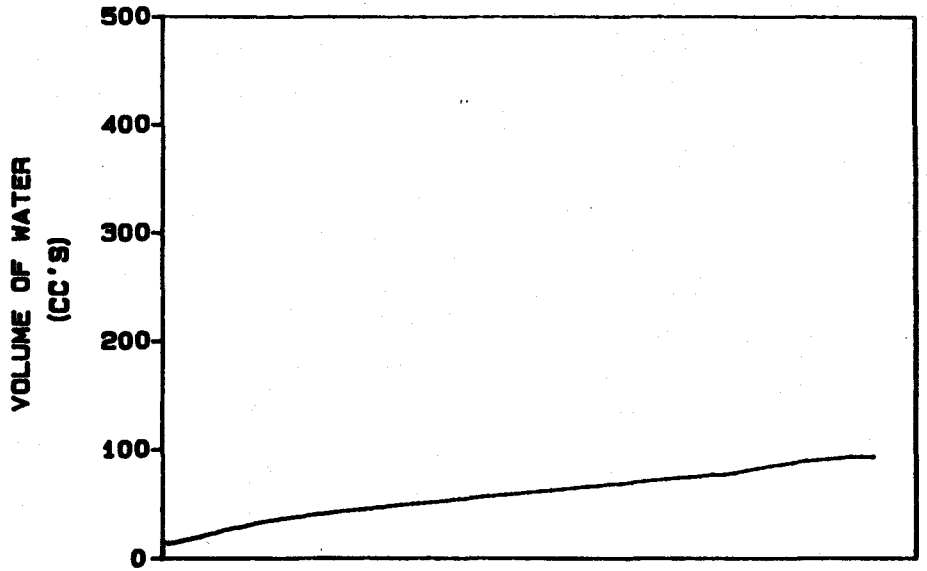


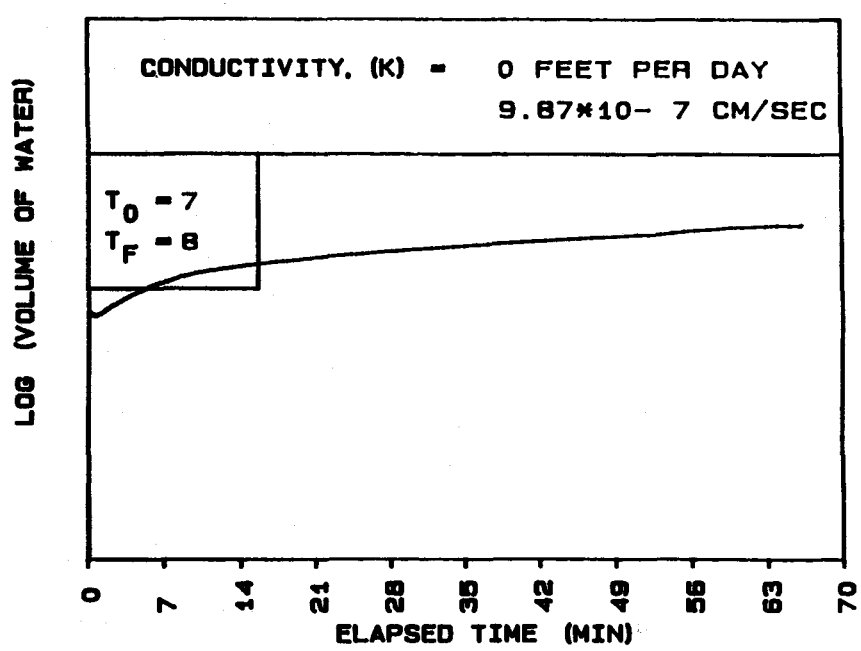


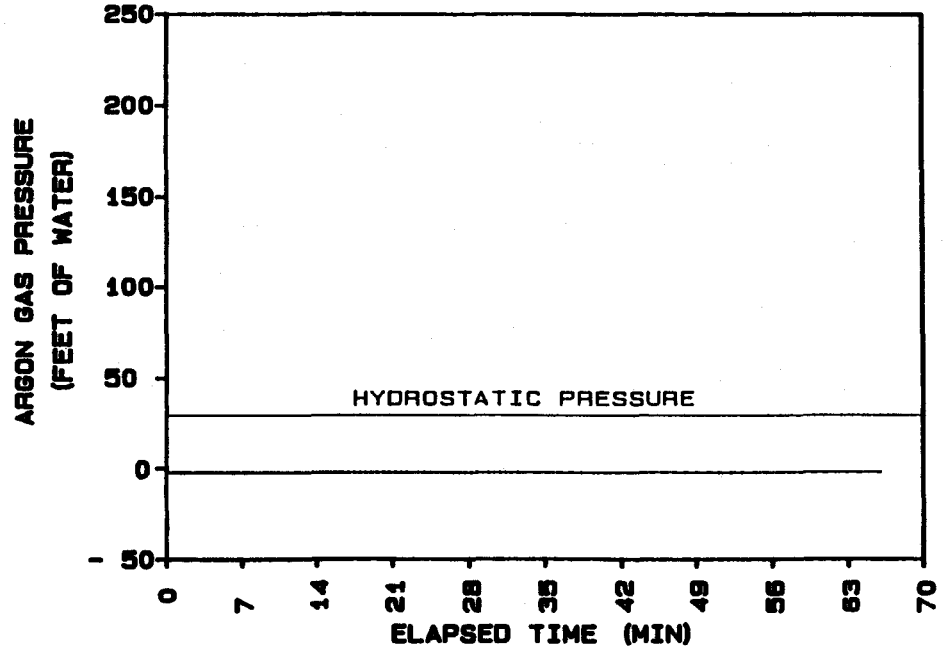
ENSAFE MEMPHIS NSA
LOCATION... 02H2336
TEST DATE
15: 35: 12 12-01-1995

SAMPLE DEPTH (FT) 36
GROUNDWATER DEPTH (FT) 16

HYDROCONE TEST



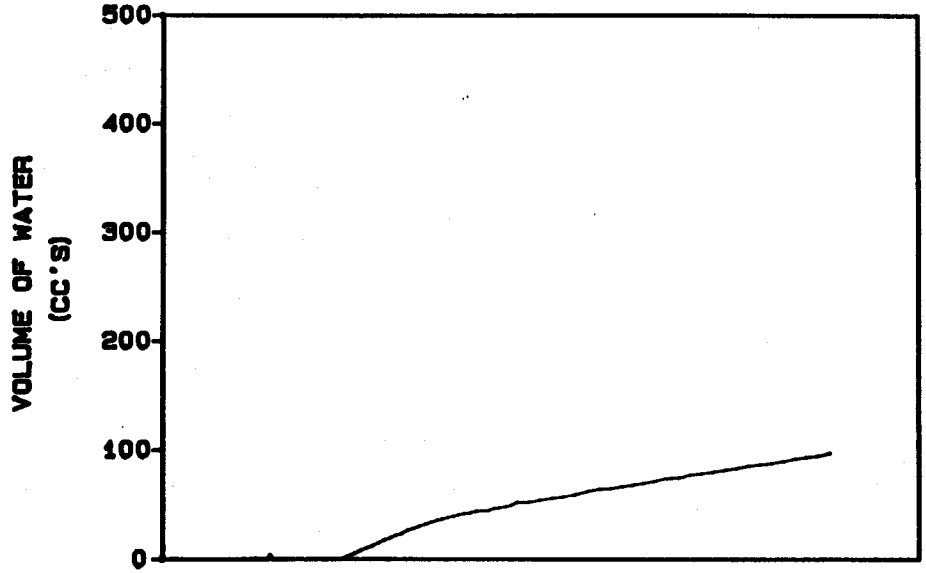


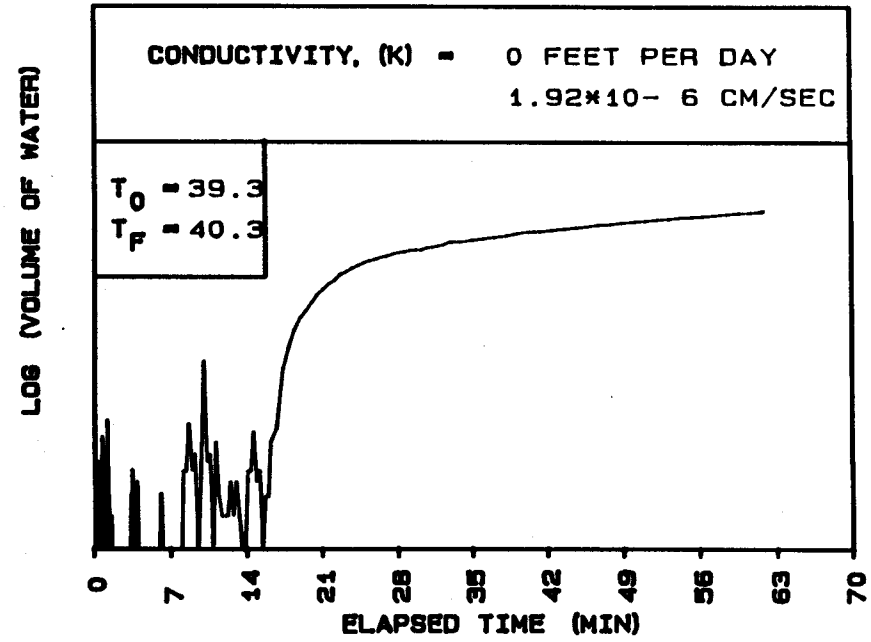


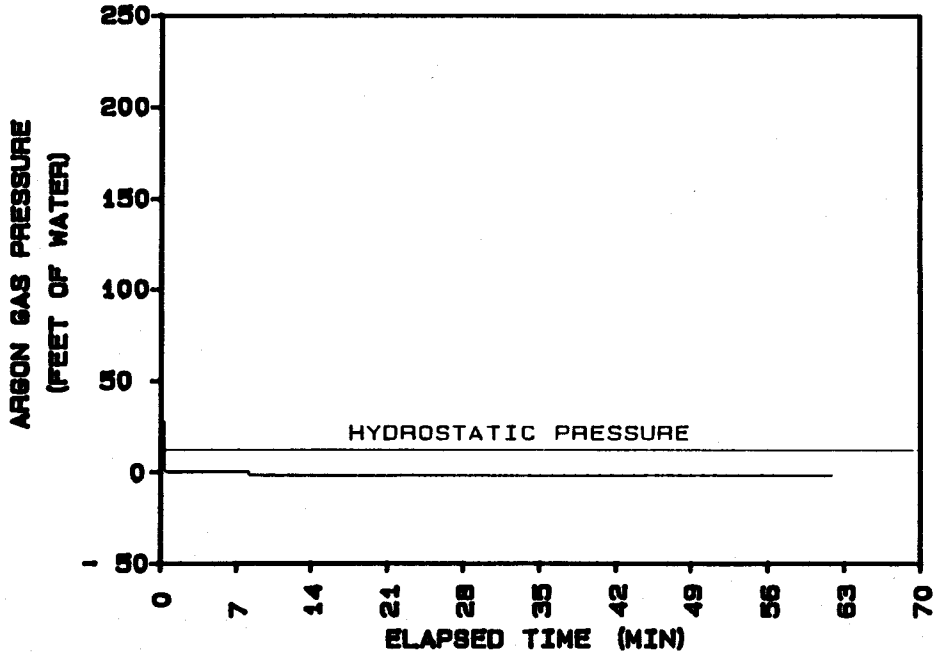
ENSAFE MEMPHIS NSA
LOCATION... 02H2436
TEST DATE
10: 23: 14 12-02-1995

SAMPLE DEPTH (FT) 37
GROUNDWATER DEPTH (FT) 8

HYDROCONE TEST



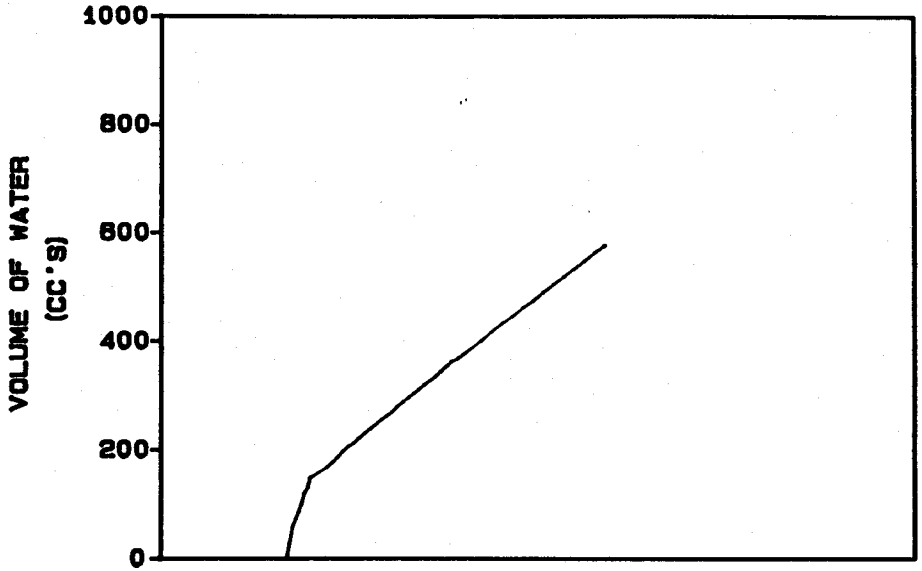


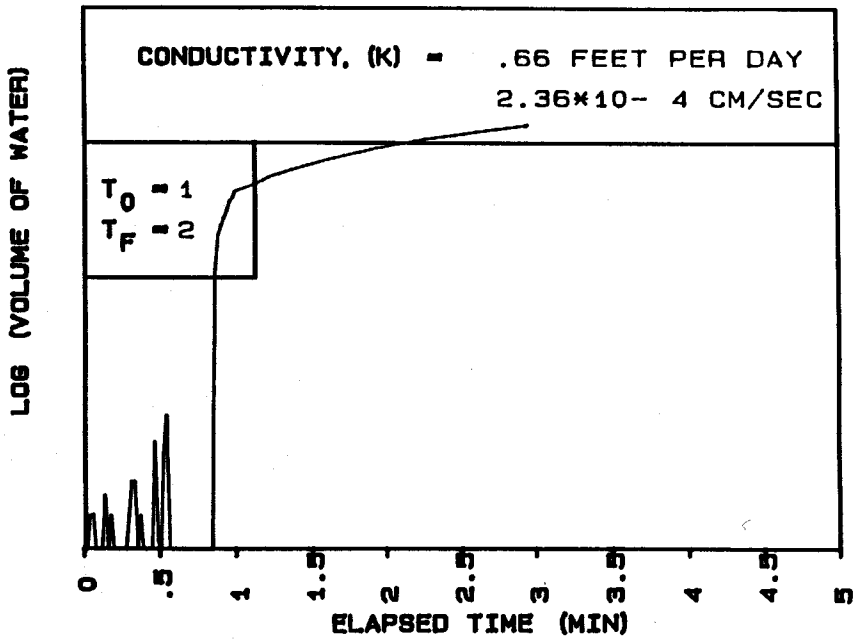


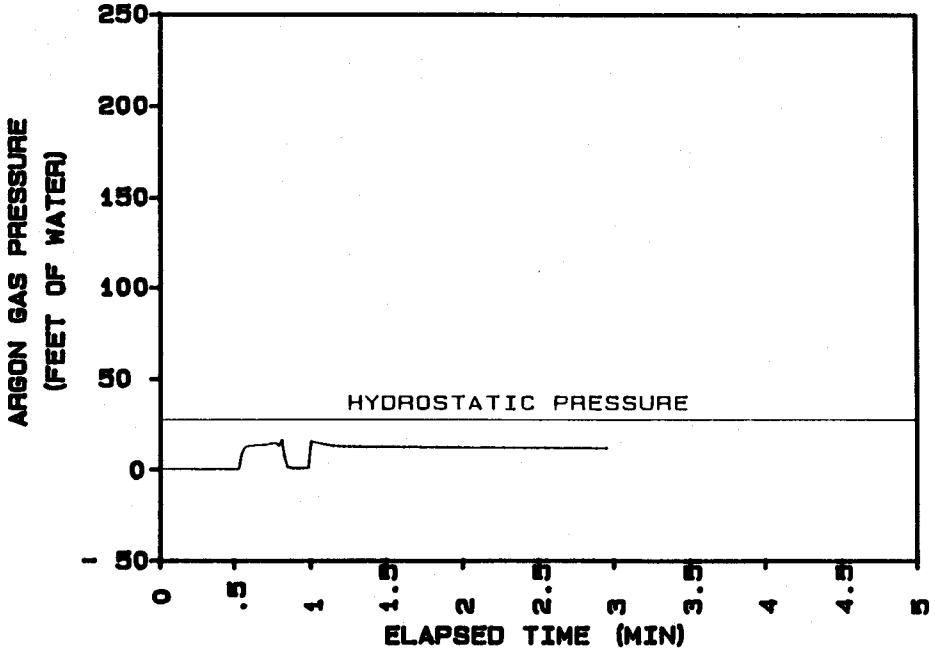
ENSAFE MEMPHIS NSA
LOCATION... 02H2527
TEST DATE
19: 19: 10 12-04-1995

SAMPLE DEPTH (FT) 27
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



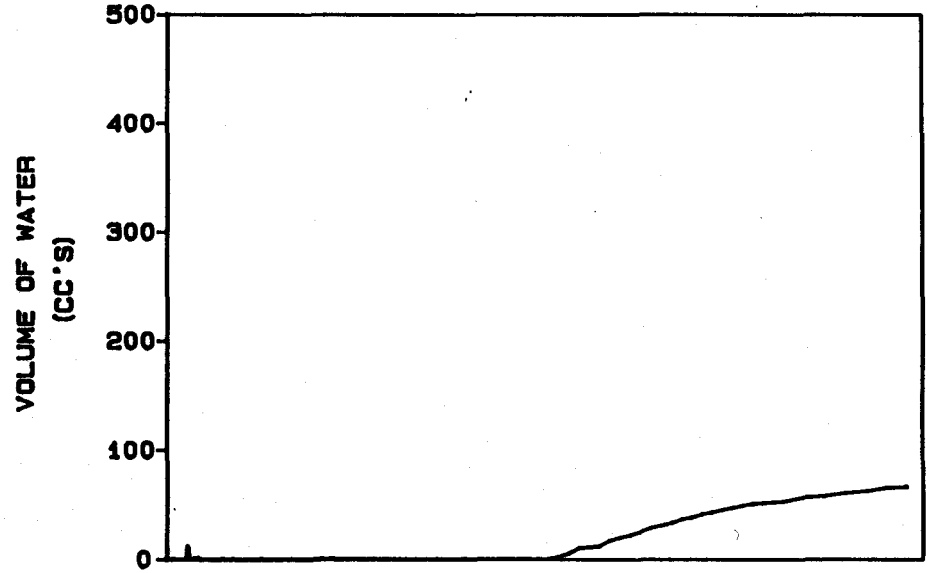


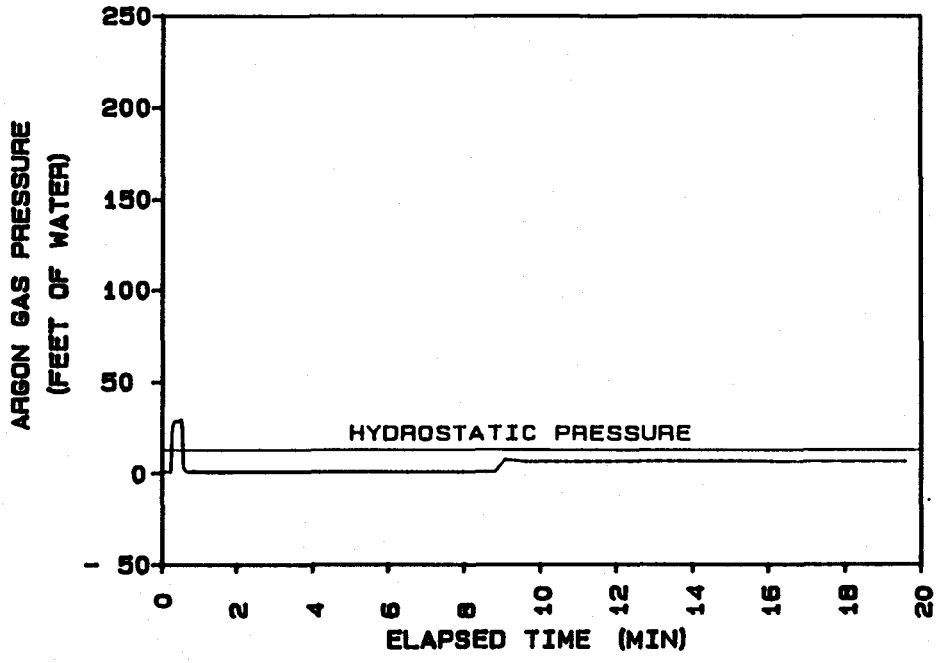


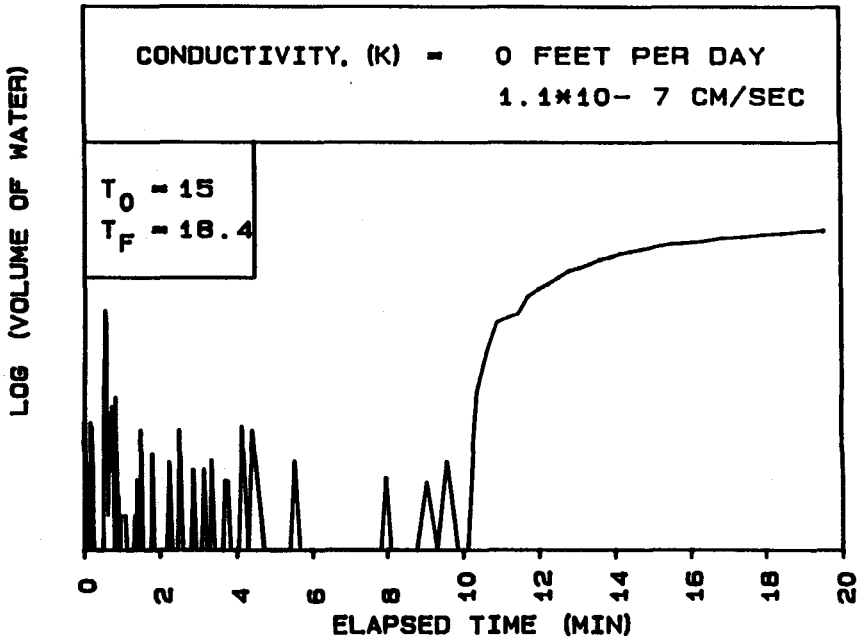
ENSAFE MEMPHIS NSA
LOCATION... 02H2540
TEST DATE
12: 47: 38 12-05-1995

SAMPLE DEPTH (FT) 40
GROUNDWATER DEPTH (FT) 13

HYDROCONE TEST



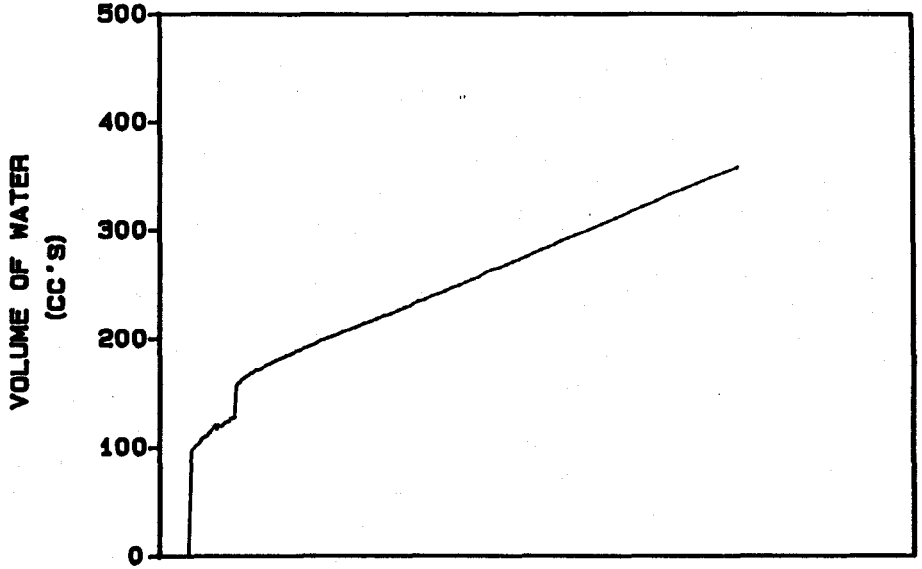


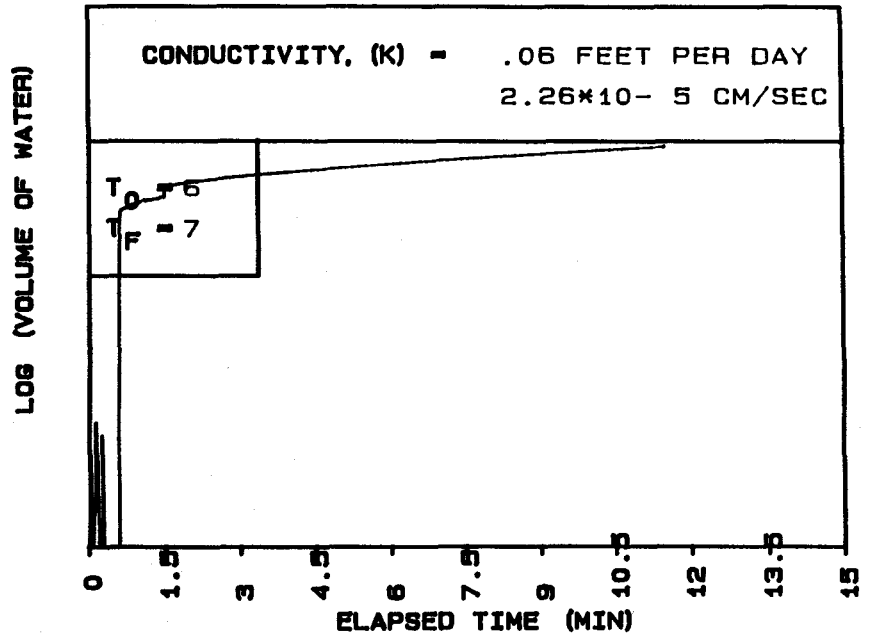


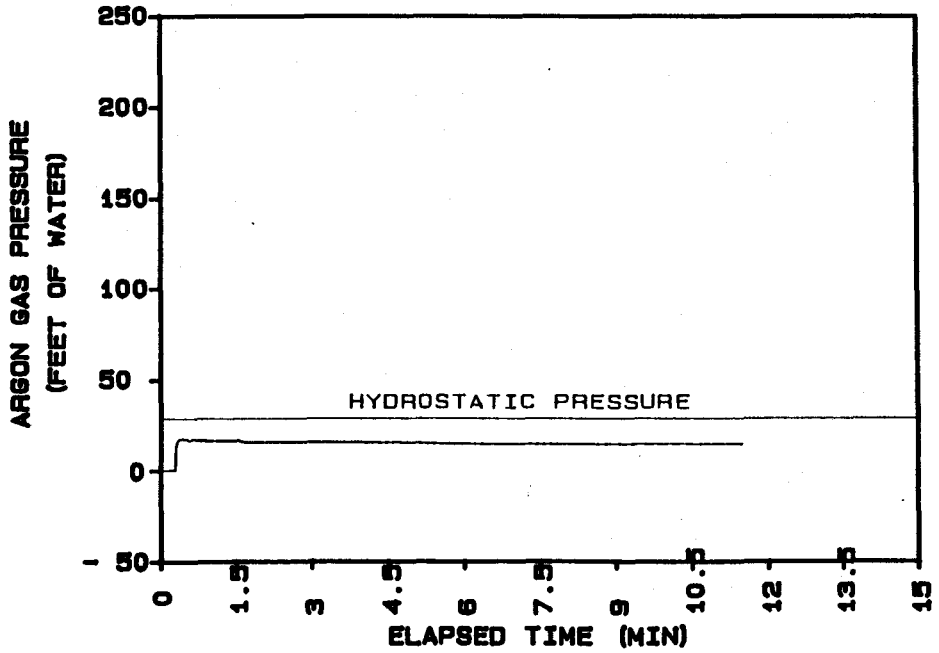
ENSAFE MEMPHIS NSA
LOCATION... 02H2627
TEST DATE
12: 35: 47 12-03-1995

SAMPLE DEPTH (FT) 27
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



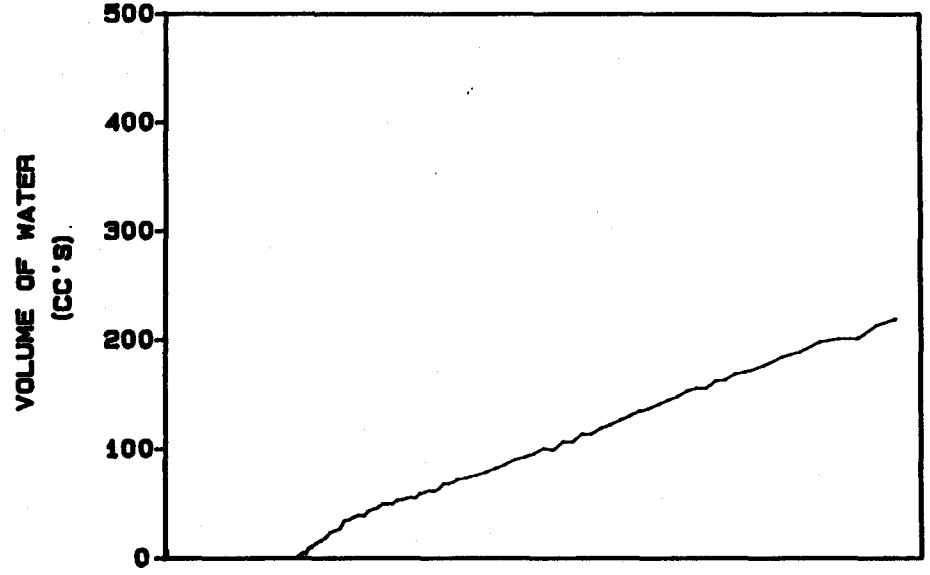


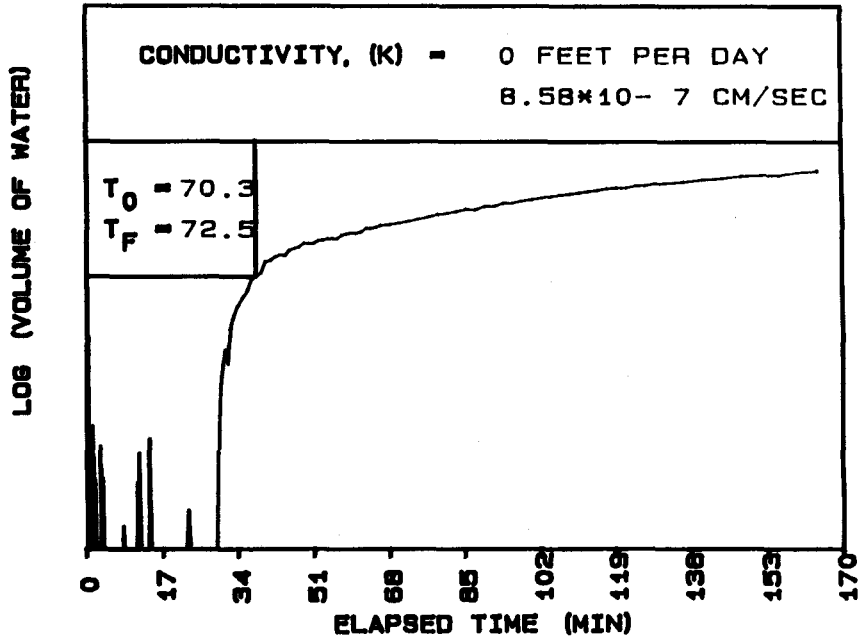


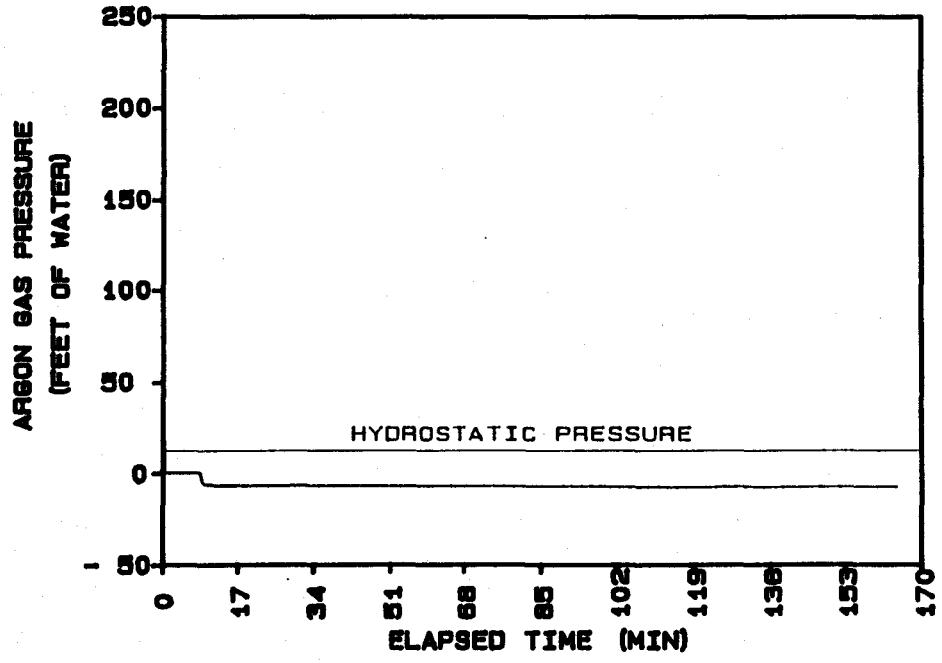
ENSAFE MEMPHIS NSA
LOCATION... 02H2643
TEST DATE
14: 44: 15 12-03-1995

SAMPLE DEPTH (FT) 43
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



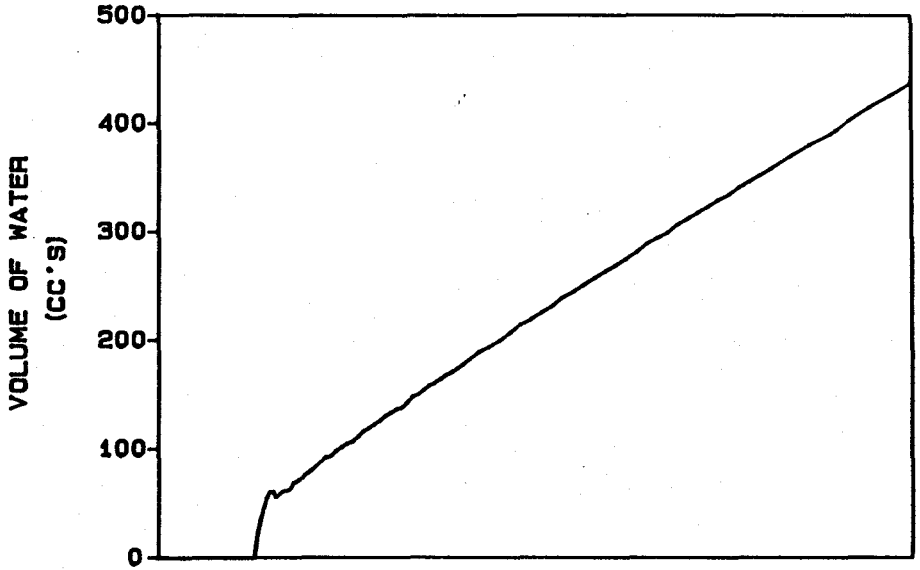


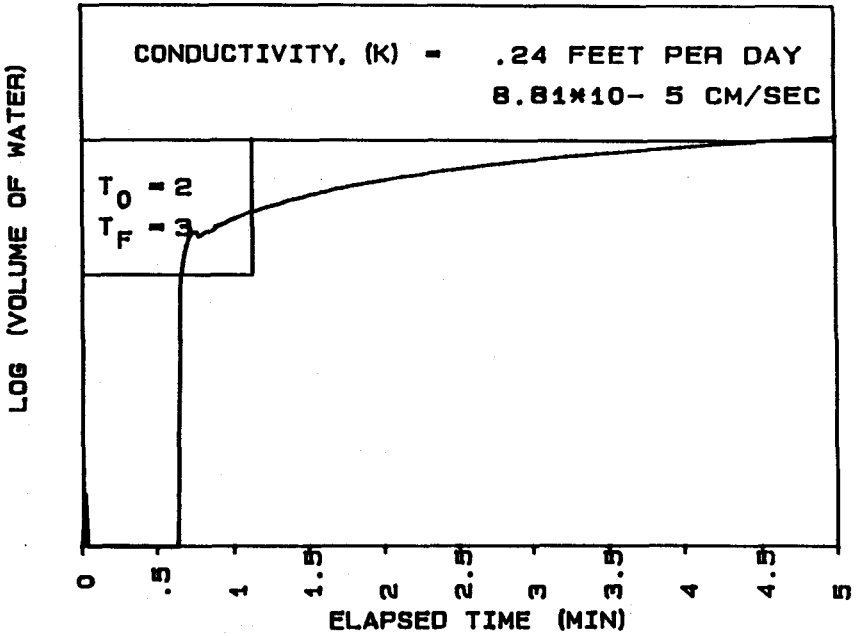


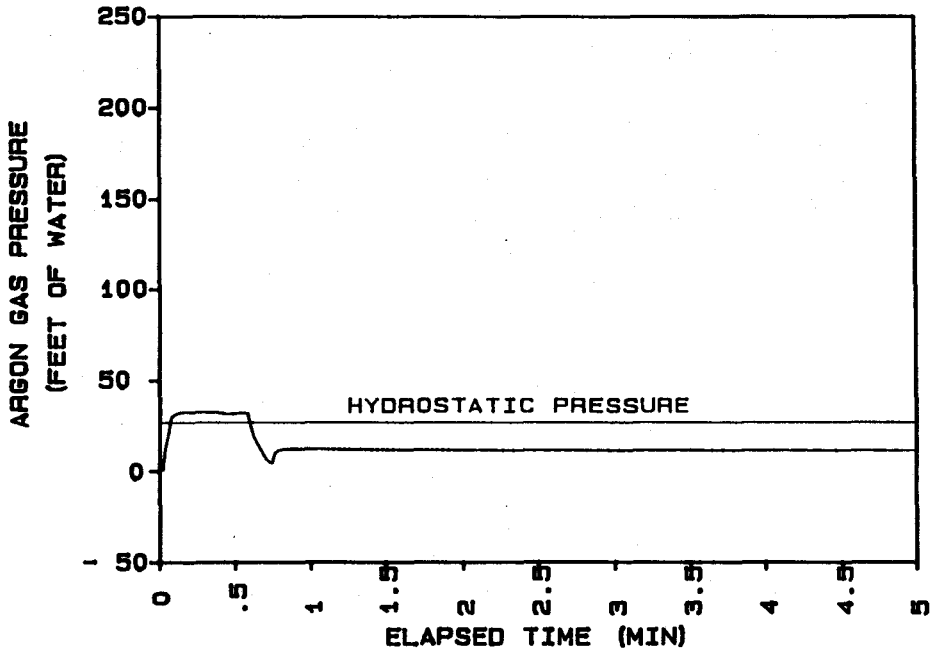
ENSAFE MEMPHIS NSA
LOCATION... 02H2727
TEST DATE
17: 31: 01 12-03-1995

SAMPLE DEPTH (FT) 27
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST







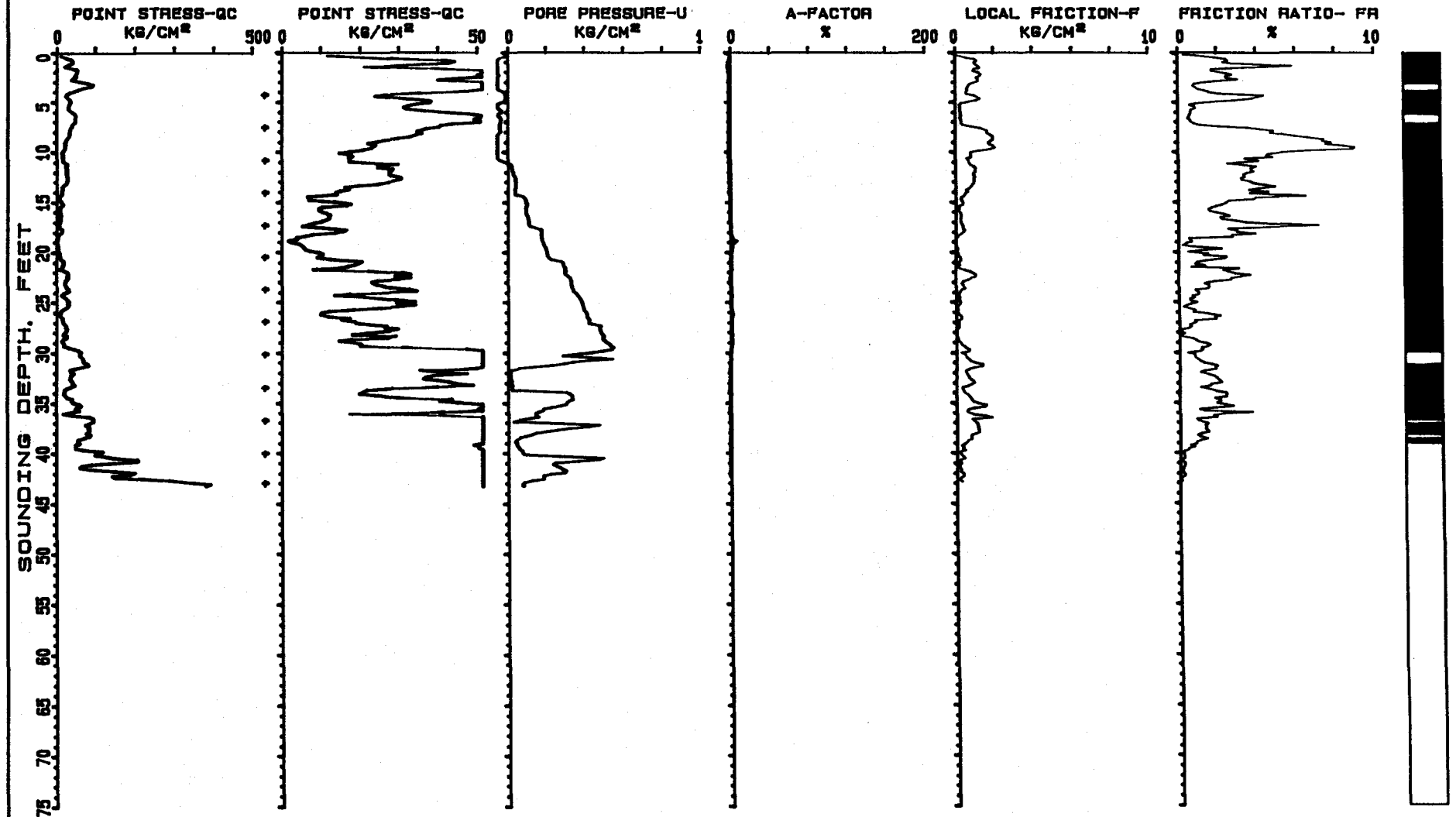
ENSAFE MEMPHIS NSA
LOCATION... 02H2741
TEST DATE
16: 07: 39 12-04-1995

SAMPLE DEPTH (FT) 41
GROUNDWATER DEPTH (FT) 15

SWMU 9

DPT SCREENING INVESTIGATION RESULTS

PIEZOCONE SOUNDING



* PUSH INTERRUPTED TO ADD ROD
PORE PRESSURE DECAY DATA MAY BE AVAILABLE

FILE #..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
SOUNDING # 09-P09
TEST DATE 12-17-1995 13: 49: 14

IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE
FOR SOUTHEASTERN UNITED STATES SOILS

JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
FILE NAME..... 09-P09

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES #	N'	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	CLAYEY FINE SAND	34	.95	13	13	.03	60%-70%	>48	74	--	--	--	--
2	CLAYEY FINE SAND	41.9	1.11	16	16	.061	60%-70%	>48	92	--	--	--	--
3	CLAYEY FINE SAND	51.1	1.2	20	20	.092	60%-70%	>48	112	--	--	--	--
4	SILTY FINE SAND	73.1	.69	18	18	.123	70%-80%	>48	160	--	--	--	--
5	CLAYEY FINE SAND	34.8	.79	13	13	.153	50%-60%	44-46	76	--	--	--	--
6	SILTY TO CLAYEY F.S.	35	.26	11	11	.184	50%-60%	42-44	77	--	--	--	--
7	SILTY FINE SAND	49	.3	12	12	.215	60%-70%	44-46	107	--	--	--	--
8	CLAYEY FINE SAND	41.1	1.05	16	16	.246	60%-70%	42-44	90	--	--	--	--
9	CLAY	31.1	1.85	31	31	.271	--	--	--	1.9	1.6	UD	>6
10	CLAY	22.2	1.63	22	22	.295	--	--	--	1.34	1.3	UD	[illegible]
11	CLAY	17.1	.75	17	17	.32	--	--	--	1.02	2.2	.01	[illegible]
12	SANDY CLAY	25.7	.94	12	12	.348	--	--	--	1.56	2.7	.02	[illegible]
13	SANDY CLAY	28.5	.96	14	14	.375	--	--	--	1.73	2.9	.02	>6
14	SILTY CLAY TO CLAY	19	.71	12	12	.402	--	--	--	1.13	2.6	.01	6
15	SILTY CLAY TO CLAY	10.3	.37	6	6	.43	--	--	--	.58	2.7	.02	6
16	SANDY CLAY	12.5	.23	6	6	.457	--	--	--	.72	5.2	.02	6
17	SANDY CLAY	11.5	.27	5	5	.484	--	--	--	.65	4.1	.02	6
18	SILTY CLAY TO CLAY	11	.37	7	7	.512	--	--	--	.62	2.9	.02	6
19	SANDY CLAY	5.6	.08	2	2	.539	--	--	--	.28	6.3	.03	3
20	SENSITIVE FINE GRAIN	6	0	3	3	.561	--	--	--	.3	80.8	.03	3
21	CLAYEY FINE SAND	13.2	.2	5	5	.592	<40%	32-34	29	--	--	--	--
22	SANDY CLAY	18.9	.42	9	9	.619	--	--	--	1.1	4.4	.01	6
23	CLAYEY FINE SAND	29.1	.74	11	11	.65	<40%	36-38	64	--	--	--	--
24	SILTY TO CLAYEY F.S.	28	.35	9	9	.681	<40%	36-38	61	--	--	--	--
25	SILTY TO CLAYEY F.S.	25.5	.18	8	8	.712	<40%	34-36	56	--	--	--	--
26	SILTY TO CLAYEY F.S.	22.8	.1	7	7	.742	<40%	34-36	50	--	--	--	--
27	CLAYEY FINE SAND	14.5	.2	5	5	.773	<40%	30-32	31	--	--	--	--
28	SILTY TO CLAYEY F.S.	25.2	.08	8	8	.804	<40%	34-36	55	--	--	--	--
29	SILTY TO CLAYEY F.S.	21	.11	7	7	.835	<40%	32-34	46	--	--	--	--
30	SILTY TO CLAYEY F.S.	37.3	.45	12	12	.865	<40%	36-38	82	--	--	--	--

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES	N'	VERTICAL STRESS	RELATIVE DENSITY	FRICTION ANGLE	YOUNGS MODULUS	UNDRAINED SHEAR ST	SENSITIVITY	COMP.	OCR
31	SILTY FINE SAND	69.5	.74	17	17	.896	40%-50%	38-40	152	--	--	--	--
32	SILTY TO CLAYEY F.S.	58.4	.84	19	19	.927	40%-50%	38-40	128	--	--	--	--
33	CLAYEY FINE SAND	40.8	.76	16	16	.958	<40%	36-38	89	--	--	--	--
34	SILTY TO CLAYEY F.S.	33.9	.47	11	11	.988	<40%	34-36	74	--	--	--	--
35	CLAYEY FINE SAND	35.5	.88	14	14	1.019	<40%	34-36	78	--	--	--	--
36	SILTY TO CLAYEY F.S.	50.3	.95	16	16	1.05	<40%	36-38	110	--	--	--	--
37	SILTY TO CLAYEY F.S.	72.9	1.16	24	24	1.081	40%-50%	38-40	160	--	--	--	--
38	SILTY FINE SAND	84.8	1.11	21	21	1.111	50%-60%	38-40	186	--	--	--	--
39	SILTY FINE SAND	71.7	.68	17	17	1.142	40%-50%	38-40	157	--	--	--	--
40	SILTY FINE SAND	73.3	.3	18	18	1.173	40%-50%	38-40	161	--	--	--	--
41	FINE SAND	155.1	.25	31	31	1.206	70%-80%	42-44	341	--	--	--	--
42	FINE SAND	123.9	.22	24	24	1.239	60%-70%	40-42	272	--	--	--	--

\# N'=POINT STRESS*(.2+.04*FRICTION RATIO)

* NORMALLY CONSOLIDATED SANDS

** FOR OVERCONSOLIDATED SANDS,SLIGHTLY REDUCE ABOVE FRICTION ANGLES

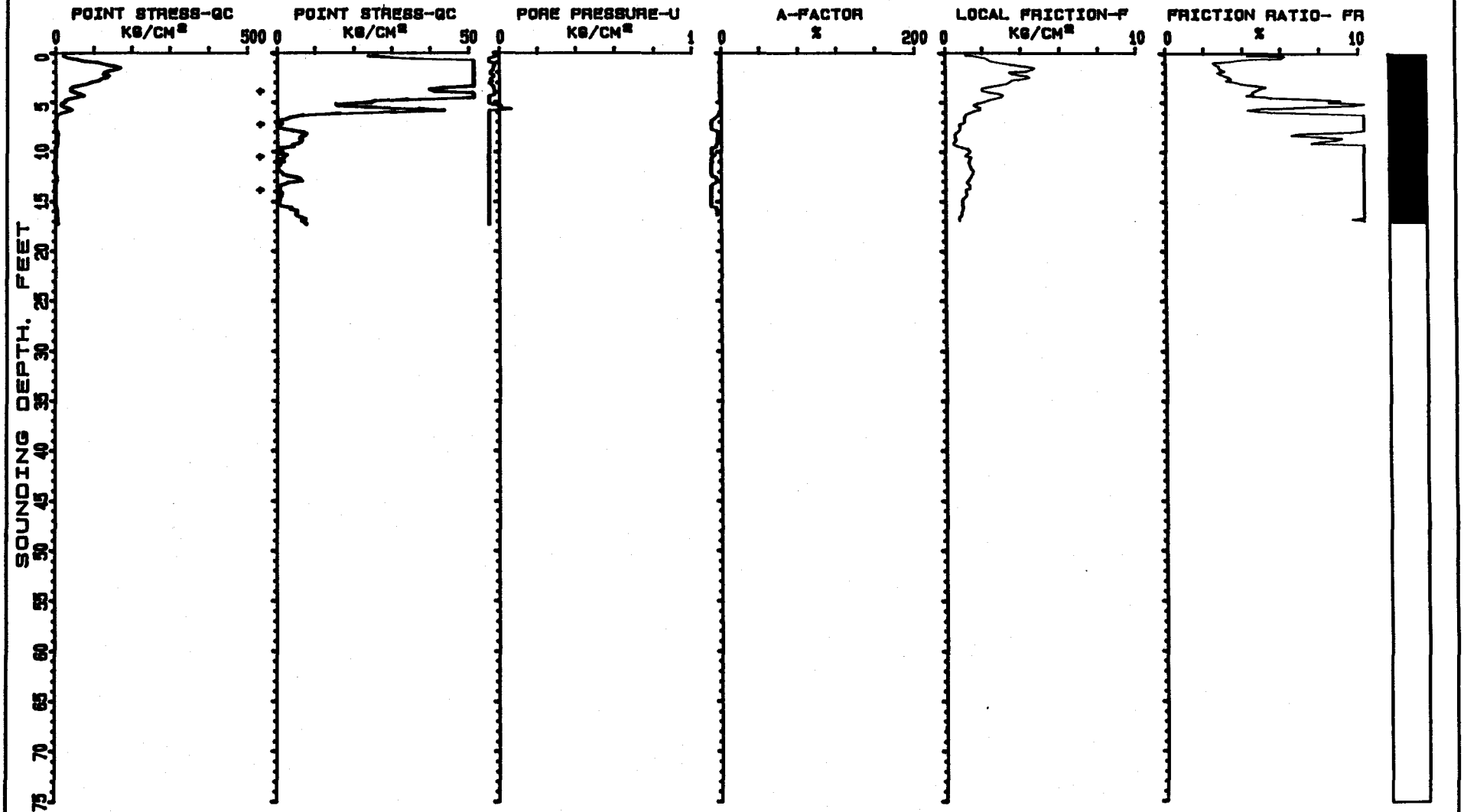
*** FOR OVERCONSOLIDATED SANDS, YOUNG'S MODULUS MAY BE AS MUCH AS 3 TO 6 TIMES HIGHER

**** NK OF 16 USED. FOR OVERCONSOLIDATED CLAYS, AN NK OF 17 IS SUGGESTED

THE ABOVE DATA WAS COMPUTED FOLLOWING 'BASIC' GUIDELINES BY P. K. ROBERTSON AND R. G. CAMPANELLA IN THE HANDBOOK 'GUIDELINES FOR USE AND INTERPERTATION OF THE ELECTRONIC CONE PENETRATION TEST'

ADDITIONAL LOCAL CORRELATIONS DEVELOPED BY IN-SITU TECHNOLOGY HAVE ALSO BEEN USED IN COMPUTING THE ABOVE DATA. IT IS THE POLICY OF IN-SITU TECHNOLOGY TO CONTINUALLY UPGRADE AND MODIFY C.P.T CORRELATIONS AS PUBLISHED RESEARCH AND LOCAL EXPERIENCE GROWS.

PIEZOCONE SOUNDING



• PUSH INTERRUPTED TO ADD ROD
PORE PRESSURE DECAY DATA MAY BE AVAILABLE

FILE #..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
SOUNDING # 09-P14
TEST DATE 11-21-1995 16:21:26

IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE
FOR SOUTHEASTERN UNITED STATES SOILS

JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
FILE NAME..... 09-P14

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES	N' #	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	CLAY	46.4	2.37	46	46	.024	--	--	--	2.89	1.9	UD	>6
2	SILTY TO CLAYEY F.S.	134.8	3.94	44	44	.055	>90%	>48	296	--	--	--	--
3	SILTY TO CLAYEY F.S.	128.2	3.79	42	42	.086	>90%	>48	282	--	--	--	--
4	CLAYEY FINE SAND	67.2	2.54	26	26	.117	70%-80%	>48	147	--	--	--	--
5	CLAY	45.8	2.48	45	45	.142	--	--	--	2.84	1.8	UD	>6
6	CLAY	27	1.61	27	27	.167	--	--	--	1.66	1.6	UD	>6
7	SOFT CLAY	8.7	1.04	8	8	.183	--	--	--	.51	.8	UD	6
8	SOFT CLAY	1.4	.73	1	1	.199	--	--	--	.05	.1	UD	1-1.5
9	CLAY	6.7	.5	6	6	.224	--	--	--	.38	1.3	.03	6
10	SOFT CLAY	2.6	.87	2	2	.24	--	--	--	.12	.3	UD	1-1.5
[illegible]	SOFT CLAY	1.3	1.25	1	1	.256	--	--	--	.04	.1	UD	1
[illegible]	SOFT CLAY	.4	1.39	0	0	.272	--	--	--	-.02	0	UD	<1
13	SOFT CLAY	3.5	1.35	3	3	.288	--	--	--	.17	.2	UD	3
14	SOFT CLAY	2.1	1.21	2	2	.304	--	--	--	.08	.1	UD	1-1.5
15	SOFT CLAY	.2	1.01	0	0	.32	--	--	--	-.04	0	UD	<1
16	SOFT CLAY	2.2	.9	2	2	.336	--	--	--	.08	.2	UD	1

\# N'=POINT STRESS*(.2+.04*FRICTION RATIO)
* NORMALLY CONSOLIDATED SANDS
** FOR OVERCONSOLIDATED SANDS,SLIGHTLY REDUCE ABOVE FRICTION ANGLES
*** FOR OVERCONSOLIDATED SANDS, YOUNG'S MODULUS MAY BE AS MUCH AS 3 TO 6 TIMES HIGHER
**** NK OF 16 USED. FOR OVERCONSOLIDATED CLAYS, AN NK OF 17 IS SUGGESTED

THE ABOVE DATA WAS COMPUTED FOLLOWING 'BASIC' GUIDELINES BY P. K. ROBERTSON AND R. G. CAMPANELLA IN THE HANDBOOK 'GUIDELINES FOR USE AND INTERPERTATION OF THE ELECTRONIC CONE PENETRATION TEST'

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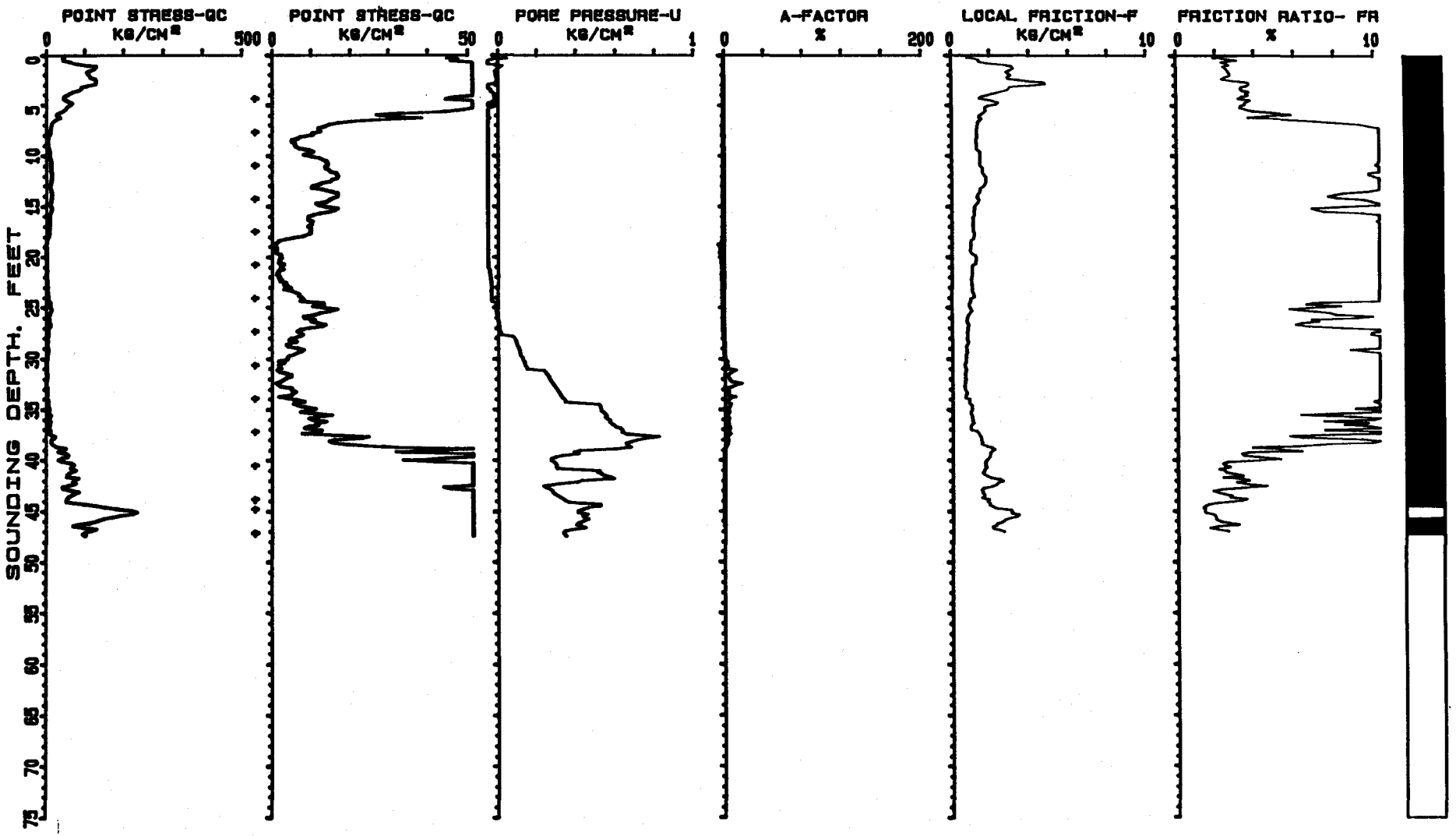
PIEZOCONE SOUNDING



* PUSH INTERRUPTED TO ADD ROD
PORE PRESSURE DECAY DATA MAY BE AVAILABLE

FILE #..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
SOUNDING # 09-P14A
TEST DATE 11-27-1995 12:13:33

IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE
FOR SOUTHEASTERN UNITED STATES SOILS

JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
FILE NAME..... 09-P14A

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES #	N'	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	CLAYEY FINE SAND	66.7	2.15	26	26	.03	70%-80%	>48	146	--	--	--	--
2	SILTY TO CLAYEY F.S.	114.3	3.04	38	38	.061	>90%	>48	251	--	--	--	--
3	CLAYEY FINE SAND	121.5	3.73	48	48	.092	>90%	>48	267	--	--	--	--
4	CLAYEY FINE SAND	90	2.74	36	36	.123	70%-80%	>48	198	--	--	--	--
5	CLAYEY FINE SAND	55.4	1.91	22	22	.153	60%-70%	46-48	121	--	--	--	--
6	SANDY CLAY	47.1	1.66	23	23	.181	--	--	--	2.92	2.8	.01	>6
7	CLAY	24.9	1.38	24	24	.206	--	--	--	1.53	1.7	UD	>6
8	CLAY	12	1.27	12	12	.23	--	--	--	.72	.9	.02	6
9	SOFT CLAY	6.5	1.26	6	6	.247	--	--	--	.37	.5	UD	6
10	SOFT CLAY	8	1.36	8	8	.263	--	--	--	.46	.5	UD	6
11	SOFT CLAY	12.2	1.44	12	12	.279	--	--	--	.72	.8	UD	6
12	CLAY	14.8	1.59	14	14	.304	--	--	--	.88	.9	.01	6
13	SOFT CLAY	14.4	1.71	14	14	.32	--	--	--	.85	.8	UD	6
14	CLAY	14.1	1.39	14	14	.345	--	--	--	.83	1	.01	6
15	CLAY	13.9	1.26	13	13	.37	--	--	--	.81	1	.01	6
16	CLAY	13.3	1.11	13	13	.395	--	--	--	.77	1.1	.01	6
17	SOFT CLAY	9.6	1.06	9	9	.411	--	--	--	.54	.9	UD	6
18	SOFT CLAY	9.4	1.1	9	9	.427	--	--	--	.52	.8	UD	6
19	SOFT CLAY	3.1	.99	3	3	.443	--	--	--	.12	.3	UD	1-1.5
20	SOFT CLAY	1.4	1.03	1	1	.459	--	--	--	.02	.1	UD	<1
21	SOFT CLAY	2.3	1.16	2	2	.475	--	--	--	.07	.2	UD	1
22	SOFT CLAY	1.9	1.01	1	1	.491	--	--	--	.04	.1	UD	<1
23	SOFT CLAY	3.1	1	3	3	.507	--	--	--	.11	.3	UD	1
24	SOFT CLAY	5.8	1.08	5	5	.524	--	--	--	.28	.5	UD	3
25	CLAY	10.5	.91	10	10	.548	--	--	--	.57	1.1	.02	6
26	CLAY	12	.87	12	12	.573	--	--	--	.66	1.3	.02	6
27	CLAY	11	.77	11	11	.598	--	--	--	.59	1.4	.02	3
28	SOFT CLAY	7.3	.76	7	7	.614	--	--	--	.36	.9	UD	3
29	SOFT CLAY	4.9	.74	4	4	.63	--	--	--	.21	.6	UD	1-1.5
30	SOFT CLAY	6.1	.7	6	6	.647	--	--	--	.28	.8	UD	1-1.5

09-P14A CONTINUED ENSAFE

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES	N'	VERTICAL STRESS	RELATIVE DENSITY	FRICTION ANGLE	YOUNGS MODULUS	UNDRAINED SHEAR ST	SENSITIVITY	COMP.	OCR
31	SOFT CLAY	2.7	.65	2	2	.663	--	--	--	.06	.4	UD	<1
32	SOFT CLAY	3.2	.65	3	3	.679	--	--	--	.09	.5	UD	1
33	SOFT CLAY	3	.62	3	3	.695	--	--	--	.08	.4	UD	1
34	SOFT CLAY	4.8	.73	4	4	.711	--	--	--	.19	.6	UD	1-1.5
35	SOFT CLAY	7.9	.93	7	7	.727	--	--	--	.38	.8	UD	3
36	CLAY	10.6	.98	10	10	.752	--	--	--	.54	1	.02	3
37	CLAY	11.1	1.02	11	11	.777	--	--	--	.57	1	.02	3
38	CLAY	16.1	1.4	16	16	.802	--	--	--	.88	1.1	.01	6
39	CLAY	26.9	1.78	26	26	.827	--	--	--	1.55	1.5	UD	6
40	SILTY CLAY TO CLAY	46	1.87	30	30	.854	--	--	--	2.74	2.4	UD	6
41	CLAYEY FINE SAND	61.5	1.66	24	24	.885	40%-50%	38-40	135	--	--	--	--
42	CLAYEY FINE SAND	68.1	1.93	27	27	.916	40%-50%	38-40	149	--	--	--	--
43	CLAYEY FINE SAND	63	1.95	25	25	.946	40%-50%	38-40	138	--	--	--	--
44	CLAYEY FINE SAND	66.4	1.62	26	26	.977	40%-50%	38-40	146	--	--	--	--
45	SILTY TO CLAYEY F.S.	127.3	2.27	42	42	1.008	60%-70%	42-44	280	--	--	--	--
46	SILTY FINE SAND	189.1	2.97	47	47	1.039	80%-90%	42-44	416	--	--	--	--

\# N'=POINT STRESS*(.2+.04*FRICTION RATIO)
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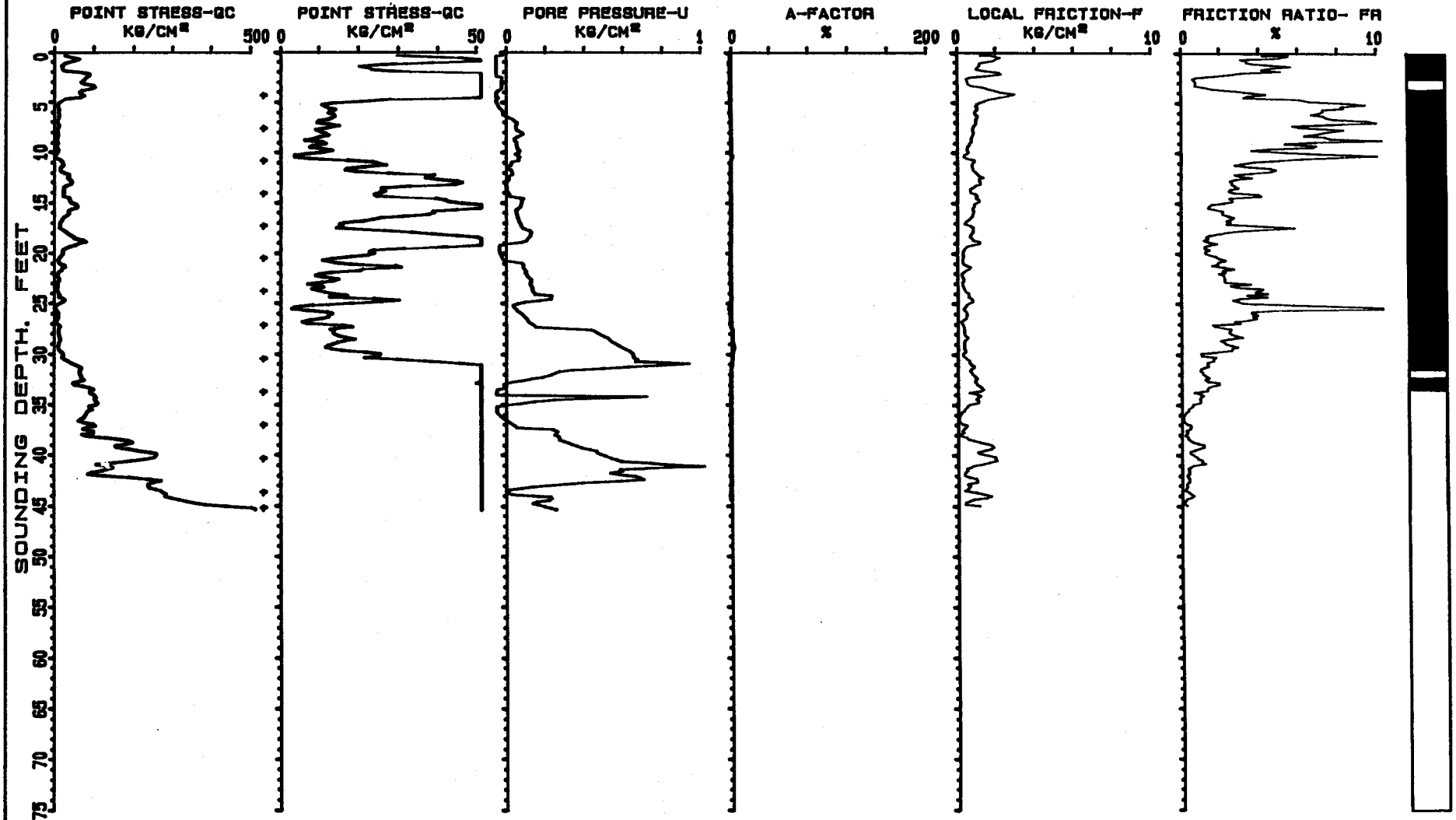
PIEZOCONE SOUNDING



* PUSH INTERRUPTED TO ADD ROD
PORE PRESSURE DECAY DATA MAY BE AVAILABLE

FILE #..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
SOUNDING # 09-P17
TEST DATE 12-17-1995 09:16:17

IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE
FOR SOUTHEASTERN UNITED STATES SOILS

JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE

FILE NAME..... 09-P17

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES #	N'	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	SANDY CLAY	47.5	1.72	23	23	.027	--	--	--	2.96	2.7	.01	>6
2	CLAY	27	1.31	27	27	.052	--	--	--	1.68	2	UD	>6
3	SILTY TO CLAYEY F.S.	73.4	1.15	24	24	.083	70%-80%	>48	161	--	--	--	--
4	SILTY TO CLAYEY F.S.	83.9	1.28	27	27	.113	70%-80%	>48	184	--	--	--	--
5	CLAYEY FINE SAND	56.3	2.04	22	22	.144	60%-70%	46-48	123	--	--	--	--
6	CLAY	13.6	.98	13	13	.169	--	--	--	.82	1.3	.01	>6
7	CLAY	12.2	.95	12	12	.194	--	--	--	.73	1.2	.02	6
8	CLAY	11.6	.82	11	11	.219	--	--	--	.69	1.4	.02	6
9	CLAY	10.1	.72	10	10	.244	--	--	--	.59	1.4	.02	6
10	CLAY	10.6	.53	10	10	.269	--	--	--	.62	1.9	.02	6
11	CLAY	10.5	.58	10	10	.293	--	--	--	.61	1.8	.02	6
12	SILTY CLAY TO CLAY	20.9	.82	13	13	.321	--	--	--	1.26	2.5	UD	[illegible]
13	CLAYEY FINE SAND	36.5	1.13	14	14	.352	50%-60%	40-42	80	--	--	--	[illegible]
14	CLAYEY FINE SAND	32.5	.82	13	13	.382	40%-50%	40-42	71	--	--	--	--
15	CLAYEY FINE SAND	34.9	.99	13	13	.413	40%-50%	40-42	76	--	--	--	--
16	SILTY TO CLAYEY F.S.	48.9	.82	16	16	.444	50%-60%	40-42	107	--	--	--	--
17	CLAYEY FINE SAND	27.8	.58	11	11	.475	<40%	38-40	61	--	--	--	--
18	SANDY CLAY	20.3	.71	10	10	.502	--	--	--	1.2	2.8	.02	6
19	SILTY TO CLAYEY F.S.	54.9	.84	18	18	.533	50%-60%	40-42	120	--	--	--	--
20	SILTY TO CLAYEY F.S.	37.1	.41	12	12	.564	<40%	38-40	81	--	--	--	--
21	CLAYEY FINE SAND	17.1	.29	6	6	.594	<40%	34-36	37	--	--	--	--
22	CLAYEY FINE SAND	21	.42	8	8	.625	<40%	34-36	46	--	--	--	--
23	SANDY CLAY	11.3	.25	5	5	.652	--	--	--	.62	4.4	.02	3
24	CLAY	10.1	.41	10	10	.677	--	--	--	.54	2.4	.02	3
25	SANDY CLAY	20.2	.63	10	10	.705	--	--	--	1.17	3.1	.02	6
26	CLAY	9.3	.41	9	9	.73	--	--	--	.48	2.2	.02	3
27	SILTY CLAY TO CLAY	9.8	.31	6	6	.757	--	--	--	.51	3.1	.02	3
28	SANDY CLAY	13.7	.33	6	6	.784	--	--	--	.75	4	.02	3
29	SANDY CLAY	15.7	.38	7	7	.812	--	--	--	.87	4.1	.01	6
30	SANDY CLAY	16.3	.32	8	8	.839	--	--	--	.9	4.9	.01	6

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES	N'	VERTICAL STRESS	RELATIVE DENSITY	FRICTION ANGLE	YOUNGS MODULUS	UNDRAINED SHEAR ST	SENSITIVITY	COMP.	OCR
31	CLAYEY FINE SAND	34.1	.55	13	13	.87	<40%	36-38	75	--	--	--	--
32	SILTY TO CLAYEY F.S.	65	.75	21	21	.901	40%-50%	38-40	143	--	--	--	--
33	SILTY TO CLAYEY F.S.	64.9	.97	21	21	.931	40%-50%	38-40	142	--	--	--	--
34	SILTY FINE SAND	86	1.09	21	21	.962	50%-60%	40-42	189	--	--	--	--
35	FINE SAND	105.7	.9	21	21	.995	60%-70%	40-42	232	--	--	--	--
36	FINE SAND	91	.27	18	18	1.028	50%-60%	40-42	200	--	--	--	--
37	FINE SAND	77.5	.15	15	15	1.062	40%-50%	38-40	170	--	--	--	--
38	FINE SAND	90.4	.28	18	18	1.095	50%-60%	40-42	198	--	--	--	--
39	FINE SAND	145.3	.9	29	29	1.128	70%-80%	42-44	319	--	--	--	--
40	FINE SAND	199.2	1.47	39	39	1.161	80%-90%	42-44	438	--	--	--	--
41	FINE SAND	207.1	1.59	41	41	1.195	80%-90%	42-44	455	--	--	--	--
42	FINE SAND	118.3	.48	23	23	1.228	60%-70%	40-42	260	--	--	--	--
43	DENSE OR CEMENTED S.	220.1	.73	36	36	1.264	80%-90%	42-44	484	--	--	--	--
44	DENSE OR CEMENTED S.	262.9	.96	43	43	1.301	>90%	44-46	578	--	--	--	--

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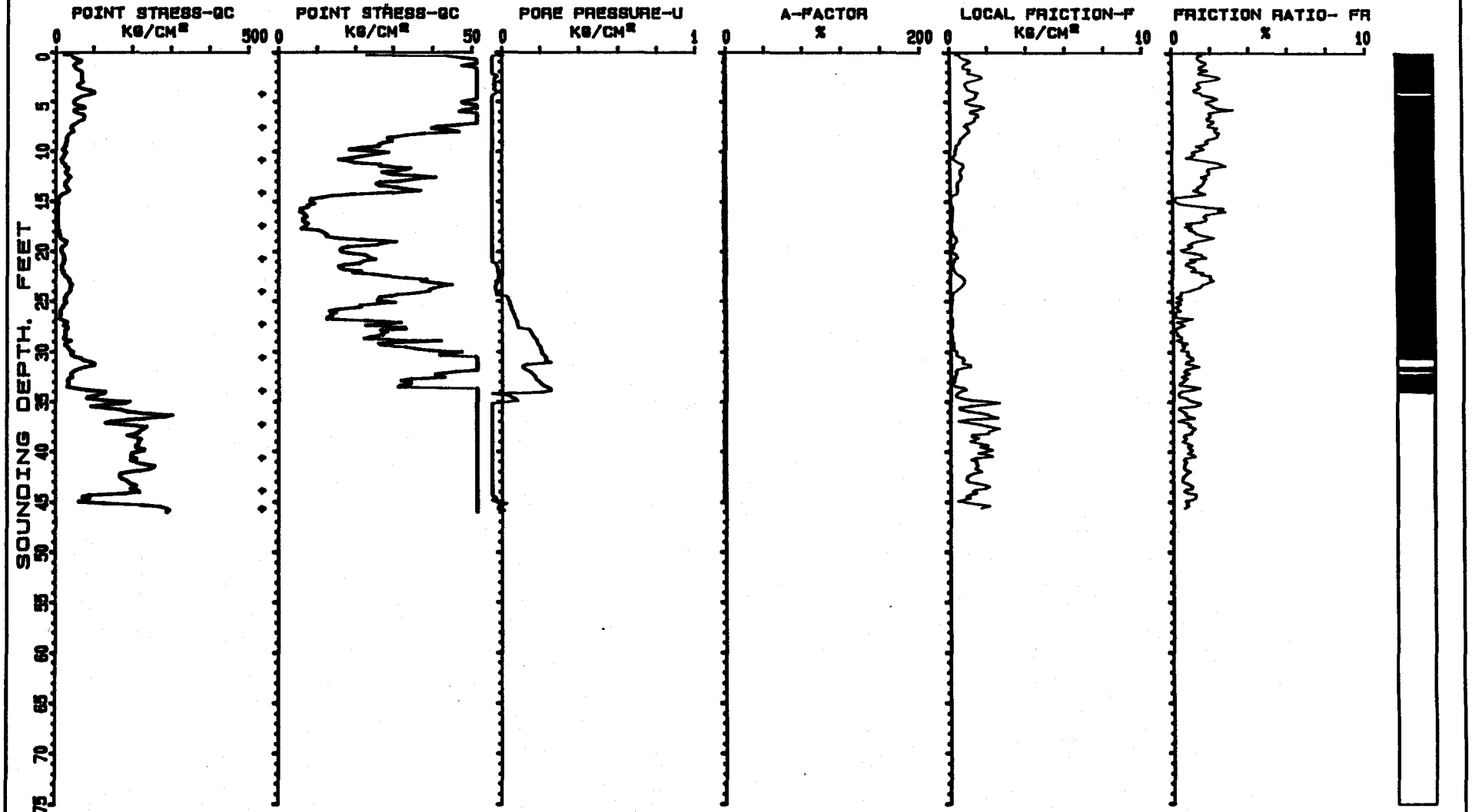

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PORE PRESSURE DECAY DATA MAY BE AVAILABLE

FILE #..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
SOUNDING # 09-P21
TEST DATE 11-30-1995 14:27:51

IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE
FOR SOUTHEASTERN UNITED STATES SOILS

JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
FILE NAME..... 09-P21

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES #	N'	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	SILTY TO CLAYEY F.S.	56.1	.89	18	18	.03	70%-80%	>48	123	--	--	--	--
2	SILTY TO CLAYEY F.S.	54.8	.88	18	18	.061	70%-80%	>48	120	--	--	--	--
3	SILTY TO CLAYEY F.S.	69	1.23	23	23	.092	70%-80%	>48	151	--	--	--	--
4	SILTY TO CLAYEY F.S.	72.7	.98	24	24	.123	70%-80%	>48	159	--	--	--	--
5	SILTY TO CLAYEY F.S.	73.5	1.17	24	24	.153	70%-80%	46-48	161	--	--	--	--
6	CLAYEY FINE SAND	56.7	1.28	22	22	.184	60%-70%	44-46	124	--	--	--	--
7	SILTY TO CLAYEY F.S.	65.9	1.28	21	21	.215	70%-80%	44-46	144	--	--	--	--
8	SILTY TO CLAYEY F.S.	47.2	.93	15	15	.246	60%-70%	42-44	103	--	--	--	--
9	CLAYEY FINE SAND	33.5	.64	13	13	.276	50%-60%	40-42	73	--	--	--	--
10	CLAYEY FINE SAND	24.6	.34	9	9	.307	40%-50%	38-40	54	--	--	--	--
11	CLAYEY FINE SAND	21.7	.27	8	8	.338	<40%	38-40	47	--	--	--	--
12	CLAYEY FINE SAND	27	.61	10	10	.369	40%-50%	38-40	59	--	--	--	--
13	CLAYEY FINE SAND	32.8	.54	13	13	.399	40%-50%	40-42	72	--	--	--	--
14	SILTY TO CLAYEY F.S.	30	.4	10	10	.43	40%-50%	38-40	66	--	--	--	--
15	CLAYEY FINE SAND	18.2	.12	7	7	.461	<40%	36-38	40	--	--	--	--
16	SANDY CLAY	7.5	.09	3	3	.488	--	--	--	.4	7.7	.03	3
17	SANDY CLAY	6.4	.1	3	3	.516	--	--	--	.33	5.8	.02	3
18	SENSITIVE FINE GRAIN	7.9	.04	3	3	.538	--	--	--	.42	17.1	.02	3
19	CLAYEY FINE SAND	16.3	.26	6	6	.568	<40%	34-36	35	--	--	--	--
20	SILTY TO CLAYEY F.S.	21.4	.15	7	7	.599	<40%	34-36	47	--	--	--	--
21	CLAYEY FINE SAND	21.3	.26	8	8	.63	<40%	34-36	46	--	--	--	--
22	CLAYEY FINE SAND	18.3	.17	7	7	.661	<40%	34-36	40	--	--	--	--
23	CLAYEY FINE SAND	28.7	.59	11	11	.692	<40%	36-38	63	--	--	--	--
24	SILTY TO CLAYEY F.S.	40.5	.5	13	13	.722	<40%	38-40	89	--	--	--	--
25	SILTY TO CLAYEY F.S.	30.4	.11	10	10	.753	<40%	36-38	66	--	--	--	--
26	SILTY TO CLAYEY F.S.	21.7	.01	7	7	.784	<40%	34-36	47	--	--	--	--
27	CLAYEY FINE SAND	14.5	.04	5	5	.815	<40%	30-32	31	--	--	--	--
28	SILTY TO CLAYEY F.S.	28.1	.07	9	9	.845	<40%	34-36	61	--	--	--	--
29	SILTY TO CLAYEY F.S.	28.5	.09	9	9	.876	<40%	34-36	62	--	--	--	--
30	SILTY TO CLAYEY F.S.	34.2	.21	11	11	.907	<40%	36-38	75	--	--	--	--

09-P21 CONTINUED ENSAFE

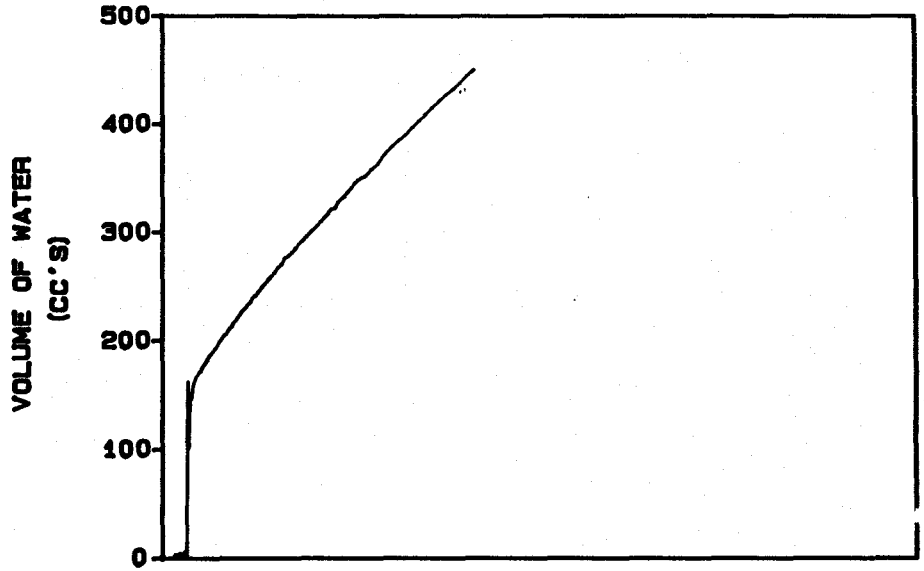
DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES	N'	VERTICAL STRESS	RELATIVE DENSITY	FRICTION ANGLE	YOUNGS MODULUS	UNDRAINED SHEAR ST	SENSITIVITY	COMP.	OCR
31	SILTY FINE SAND	59.2	.53	14	14	.938	40%-50%	38-40	130	--	--	--	--
32	SILTY FINE SAND	77.8	.61	19	19	.968	50%-60%	40-42	171	--	--	--	--
33	SILTY TO CLAYEY F.S.	38.6	.21	12	12	.999	<40%	36-38	84	--	--	--	--
34	SILTY FINE SAND	57	.42	14	14	1.03	<40%	38-40	125	--	--	--	--
35	FINE SAND	121.9	.99	24	24	1.063	60%-70%	40-42	268	--	--	--	--
36	FINE SAND	156	1.28	31	31	1.096	70%-80%	42-44	343	--	--	--	--
37	FINE SAND	226.6	1.49	45	45	1.13	80%-90%	44-46	498	--	--	--	--
38	FINE SAND	190.4	1.86	38	38	1.163	80%-90%	42-44	418	--	--	--	--
39	FINE SAND	211.5	1.43	42	42	1.196	80%-90%	42-44	465	--	--	--	--
40	FINE SAND	217.4	1.79	43	43	1.229	80%-90%	42-44	478	--	--	--	--
41	FINE SAND	201.6	1.56	40	40	1.262	80%-90%	42-44	443	--	--	--	--
42	FINE SAND	225.4	1.39	45	45	1.296	80%-90%	42-44	495	--	--	--	--
43	FINE SAND	177.5	1.01	35	35	1.329	70%-80%	42-44	390	--	--	--	--
44	FINE SAND	204.3	1.55	40	40	1.362	70%-80%	42-44	449	--	--	--	--
45	FINE SAND	111.7	.88	22	22	1.395	50%-60%	40-42	245	--	--	--	--

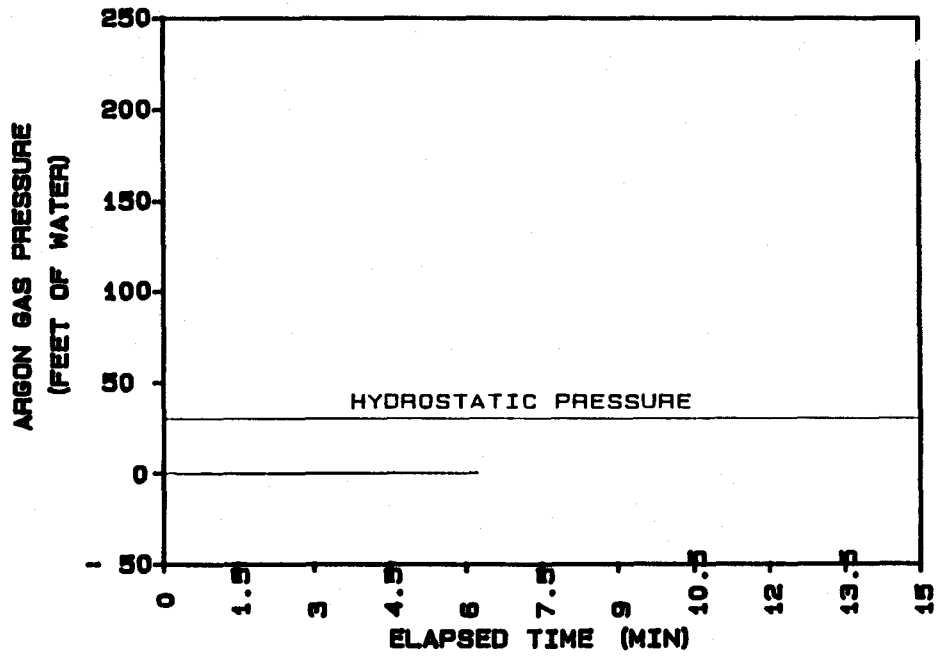
\# N'=POINT STRESS*(.2+.04*FRICTION RATIO)
* NORMALLY CONSOLIDATED SANDS
** FOR OVERCONSOLIDATED SANDS,SLIGHTLY REDUCE ABOVE FRICTION ANGLES
*** FOR OVERCONSOLIDATED SANDS, YOUNG'S MODULUS MAY BE AS MUCH AS 3 TO 6 TIMES HIGHER
**** NK OF 16 USED. FOR OVERCONSOLIDATED CLAYS, AN NK OF 17 IS SUGGESTED

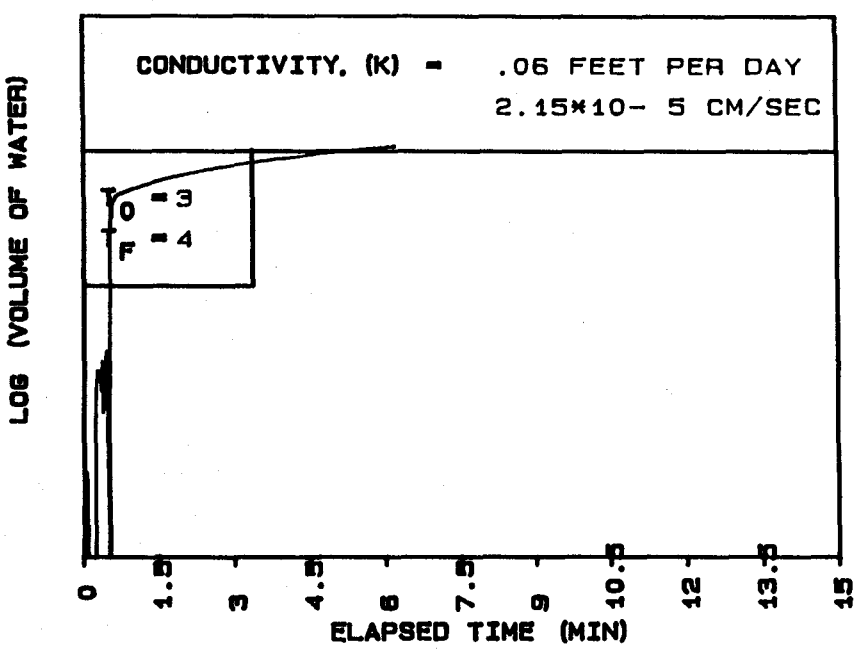
THE ABOVE DATA WAS COMPUTED FOLLOWING 'BASIC' GUIDELINES BY P. K. ROBERTSON AND R. G. CAMPANELLA IN THE HANDBOOK 'GUIDELINES FOR USE AND INTERPERTATION OF THE ELECTRONIC CONE PENETRATION TEST'

ADDITIONAL LOCAL CORRELATIONS DEVELOPED BY IN-SITU TECHNOLOGY HAVE ALSO BEEN USED IN COMPUTING THE ABOVE DATA. IT IS THE POLICY OF IN-SITU TECHNOLOGY TO CONTINUALLY UPGRADE AND MODIFY C.P.T CORRELATIONS AS PUBLISHED RESEARCH AND LOCAL EXPERIENCE GROWS.

HYDROCONE TEST



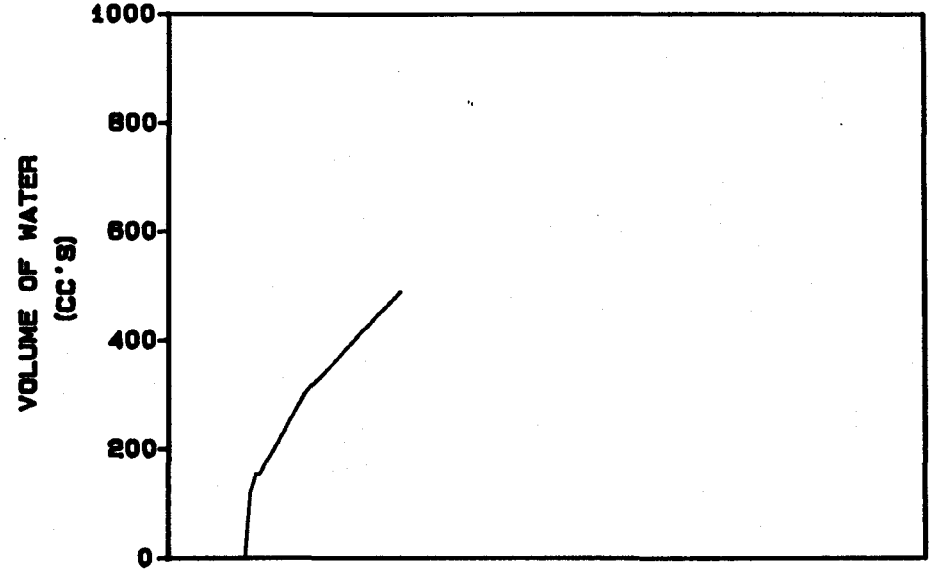


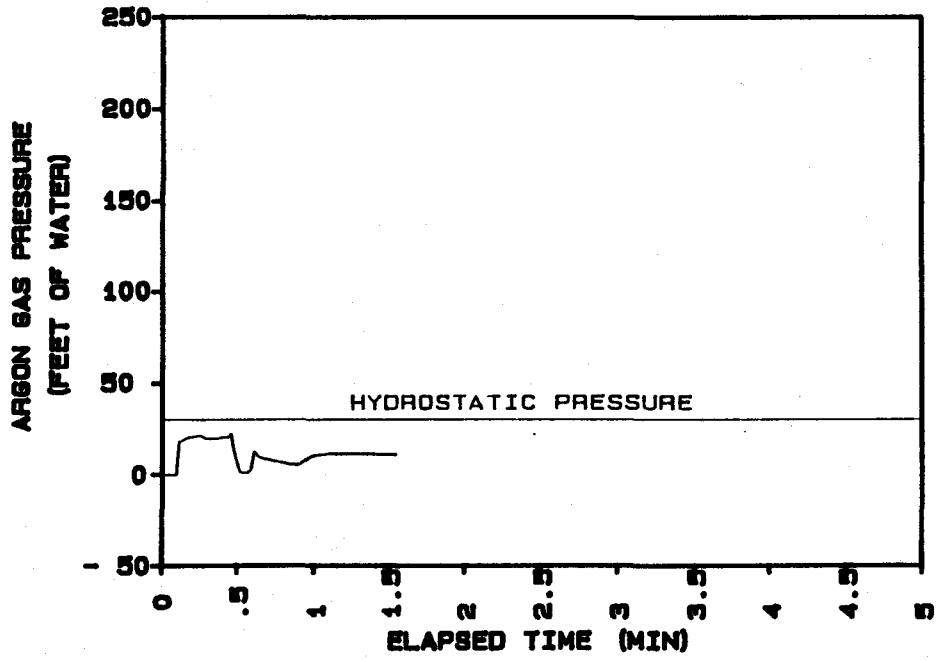


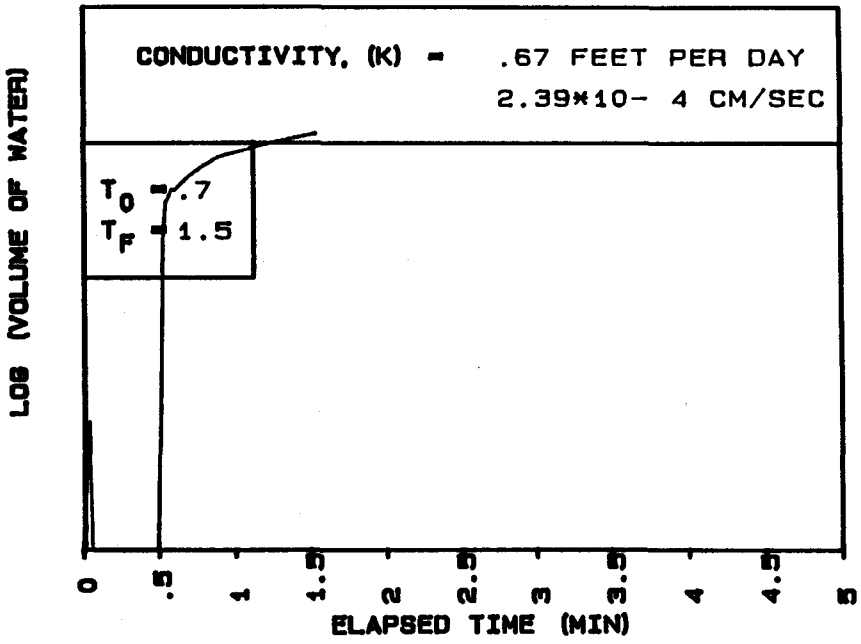
ENSAFE MEMPHIS NSA
LOCATION... 09H0946
TEST DATE
20: 37: 54 12-01-1995

SAMPLE DEPTH (FT) 45
GROUNDWATER DEPTH (FT) 15

HYDROCONE TEST



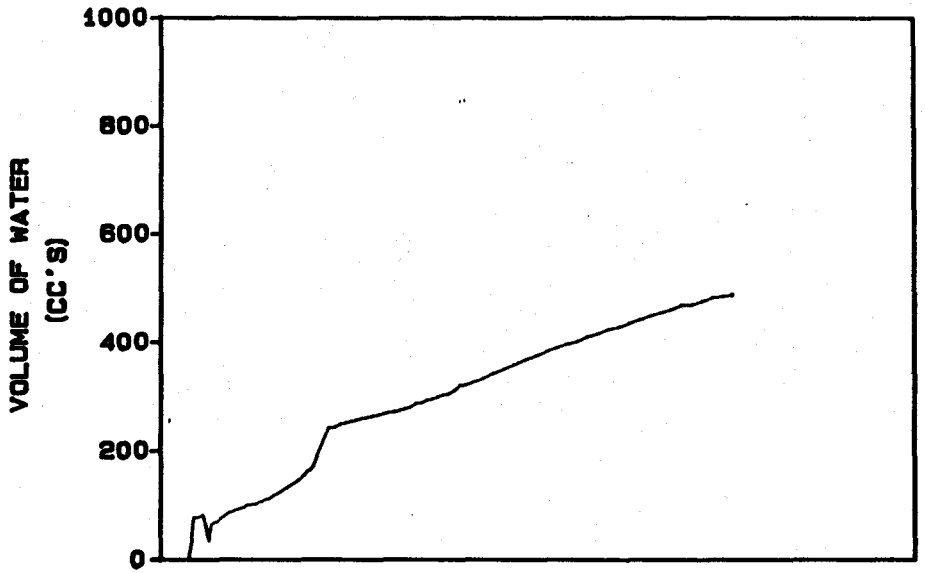


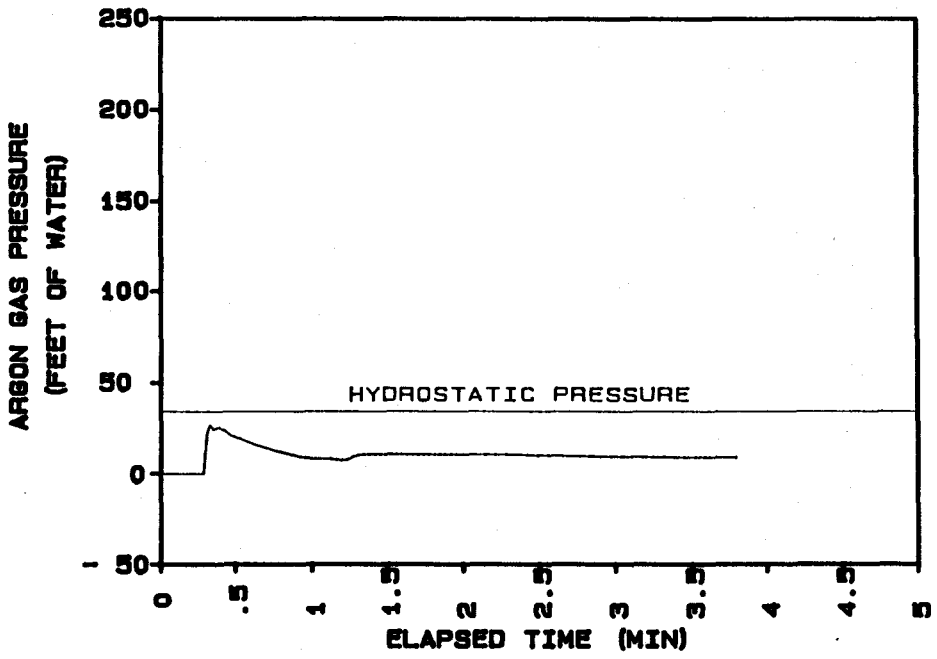


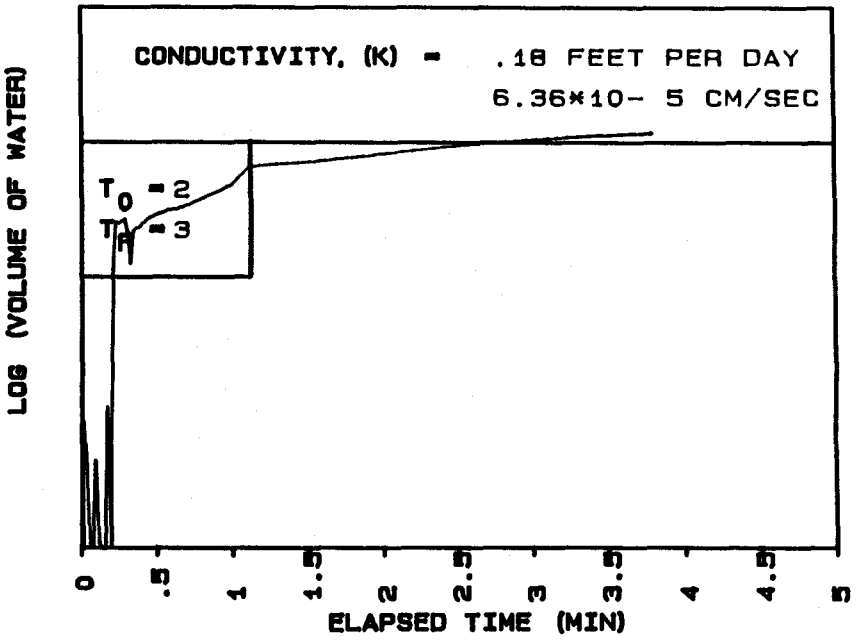
ENSAFE MEMPHIS NSA
LOCATION... 09H1046
TEST DATE
13: 01: 36 12-02-1995

SAMPLE DEPTH (FT) 46
GROUNDWATER DEPTH (FT) 16

HYDROCONE TEST



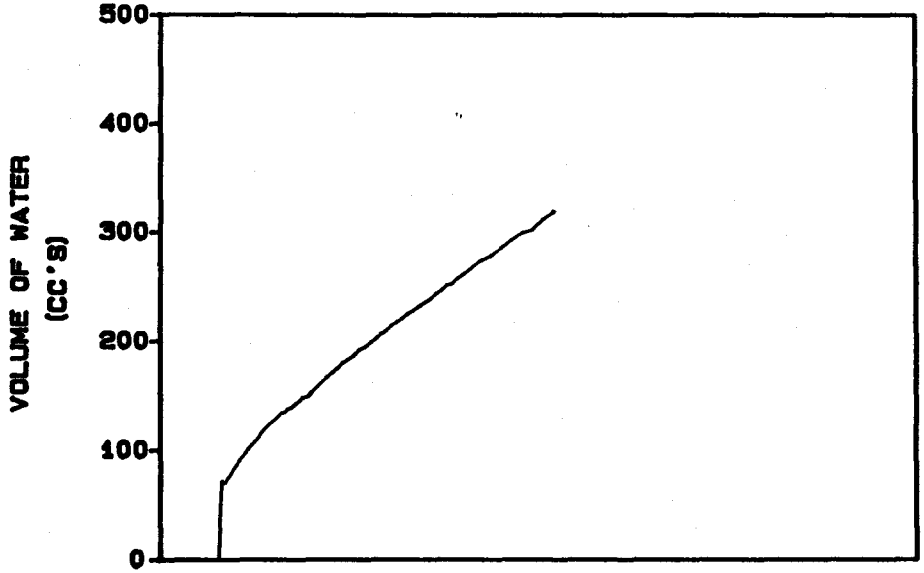


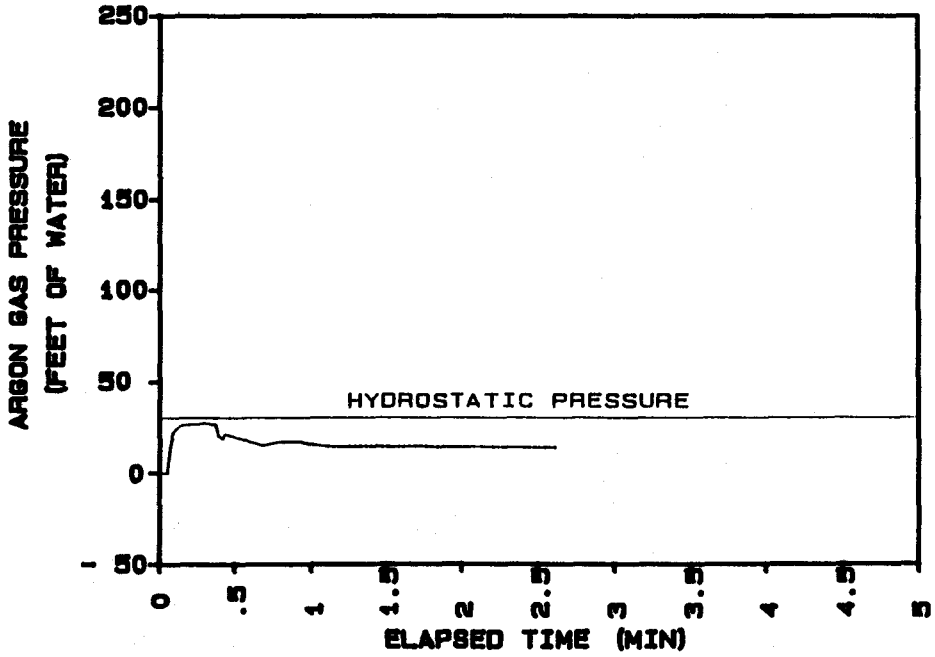


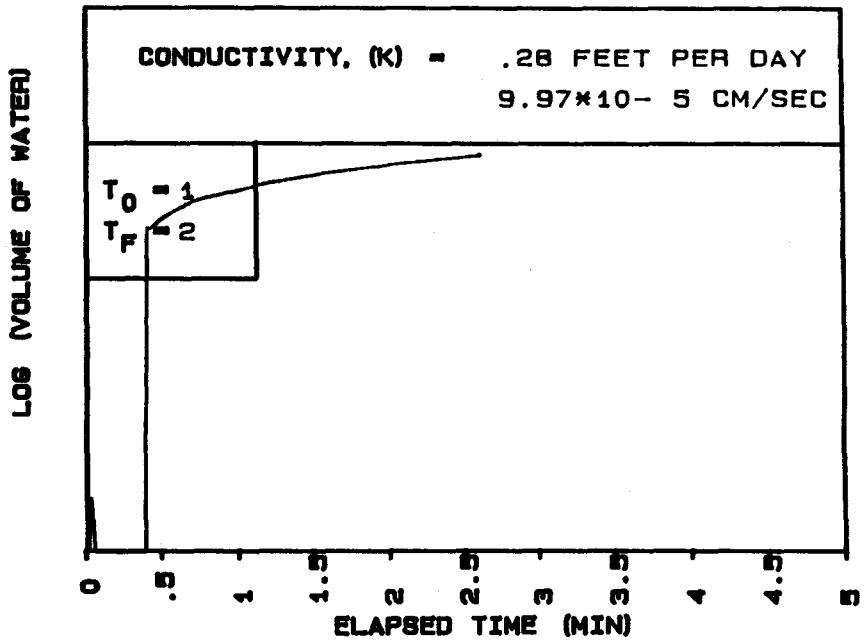
ENSAFE MEMPHIS NSA
LOCATION... 09H1150
TEST DATE
15: 38: 51 12-02-1995

SAMPLE DEPTH (FT) 50
GROUNDWATER DEPTH (FT) 16

HYDROCONE TEST



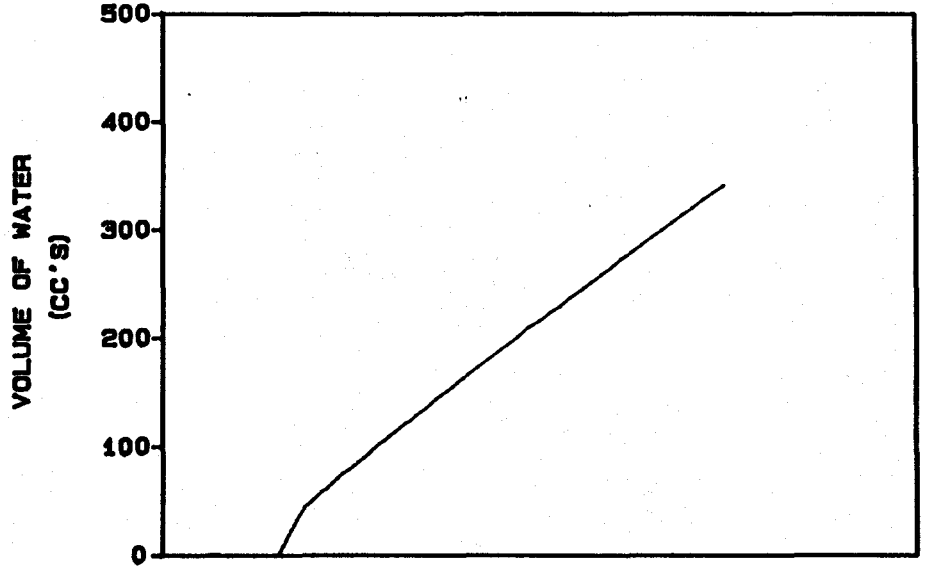


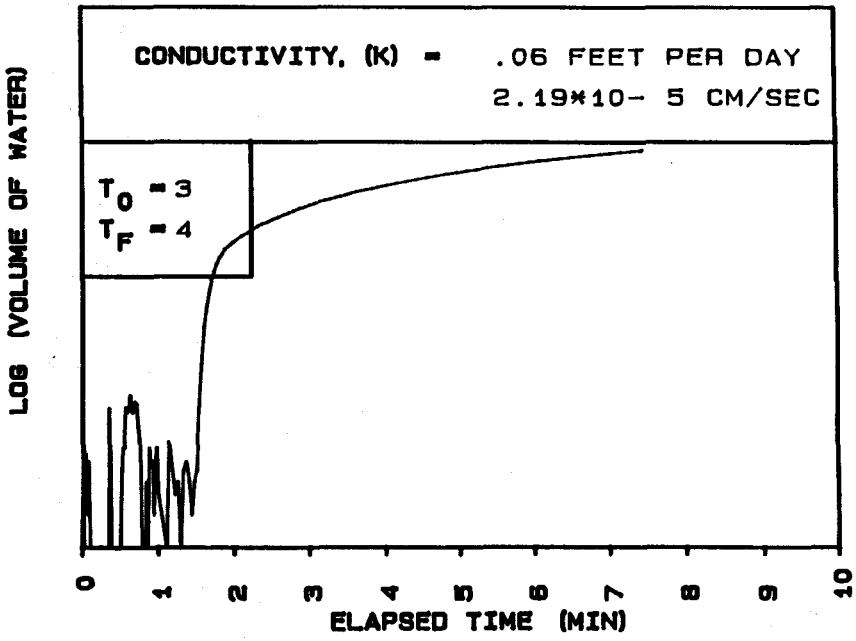


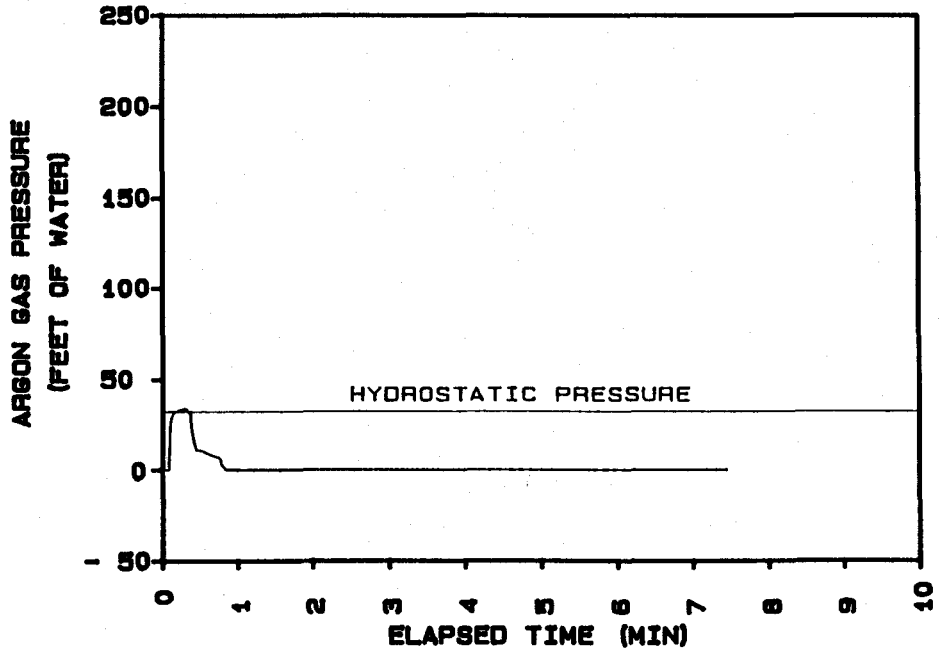
ENSAFE MEMPHIS NSA
LOCATION... 09H1246
TEST DATE
17: 44: 45 12-02-1995

SAMPLE DEPTH (FT) 46
GROUNDWATER DEPTH (FT) 16

HYDROCONE TEST



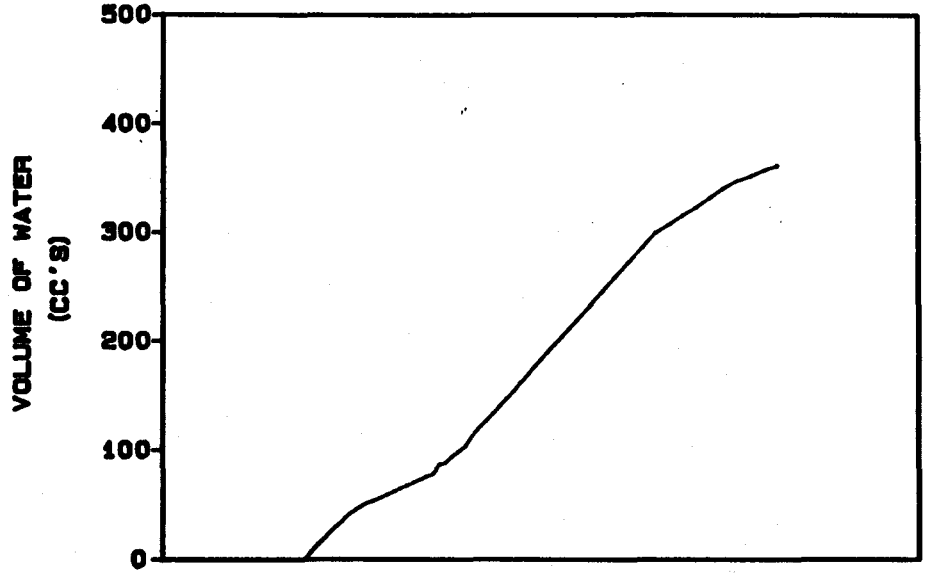


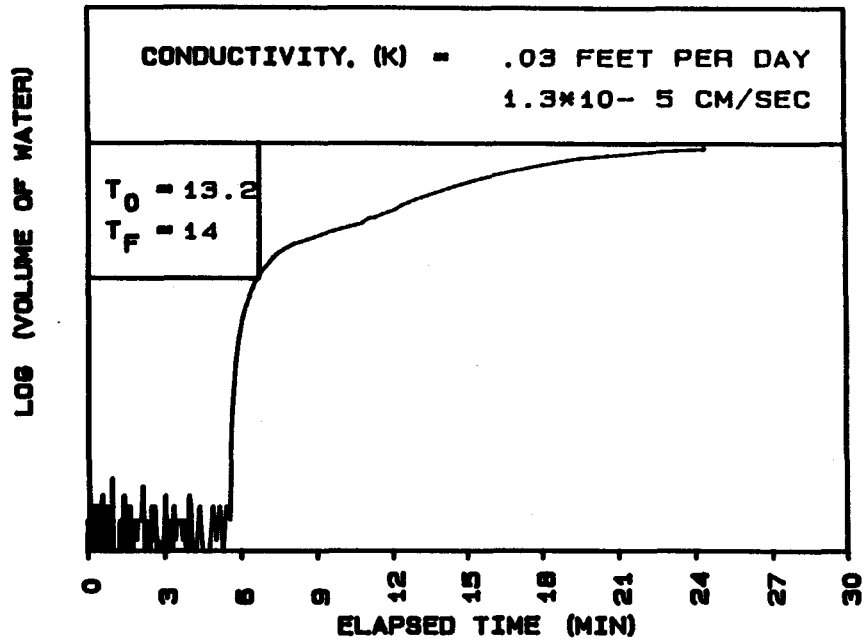


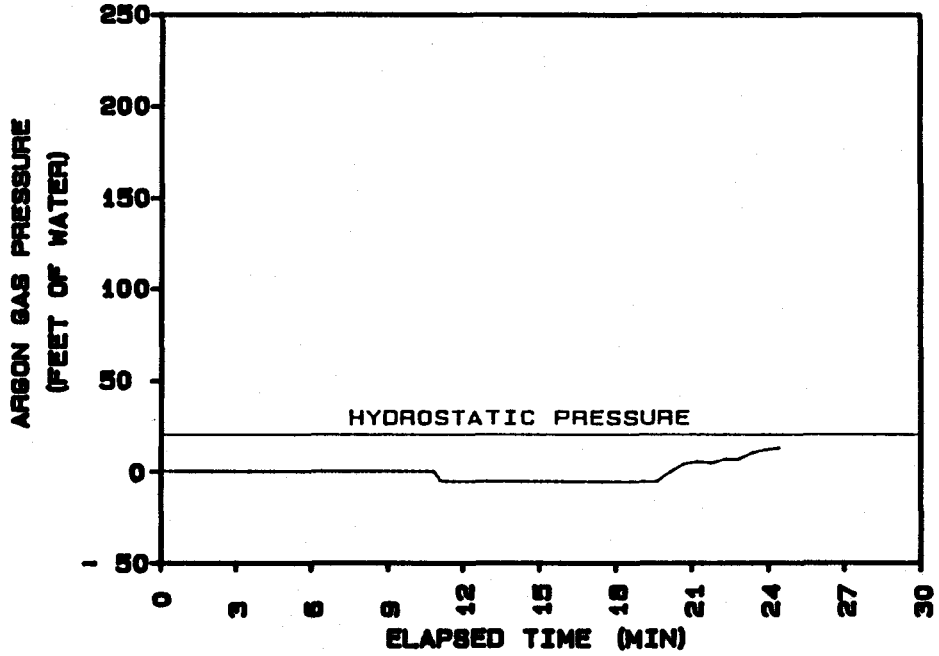
ENSAFE MEMPHIS NSA
LOCATION... 09H1348
TEST DATE
18: 44: 13 12-02-1995

SAMPLE DEPTH (FT) 48
GROUNDWATER DEPTH (FT) 16

HYDROCONE TEST



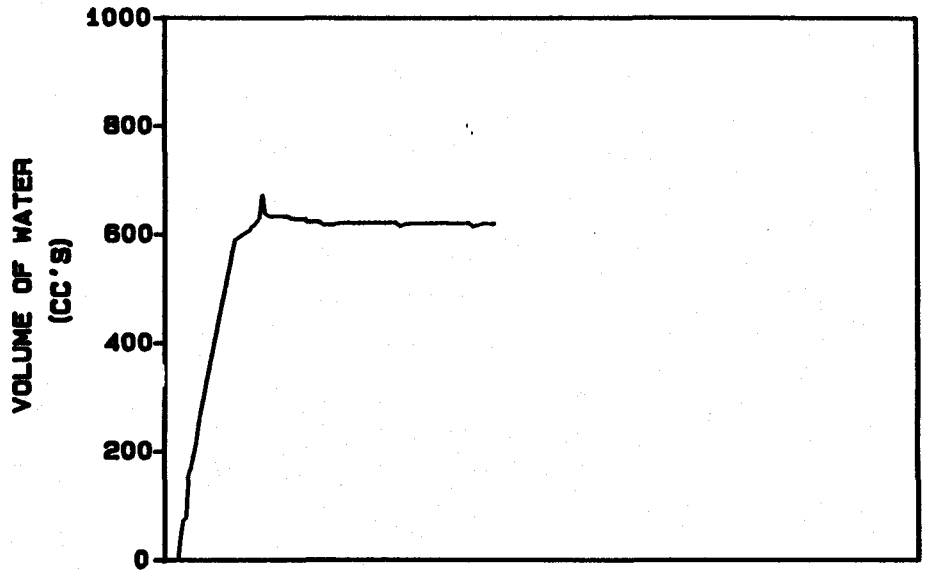


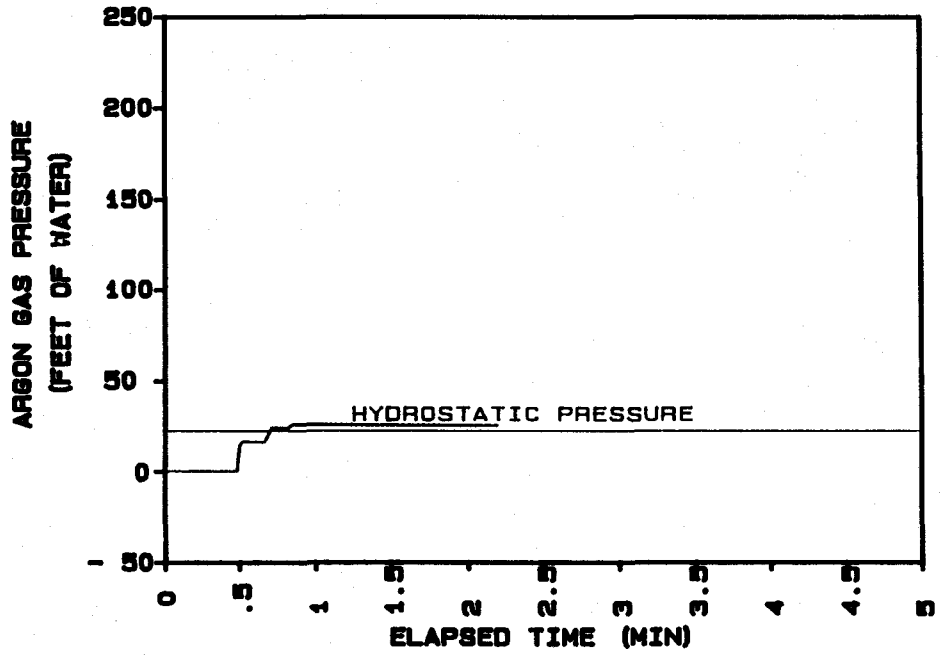


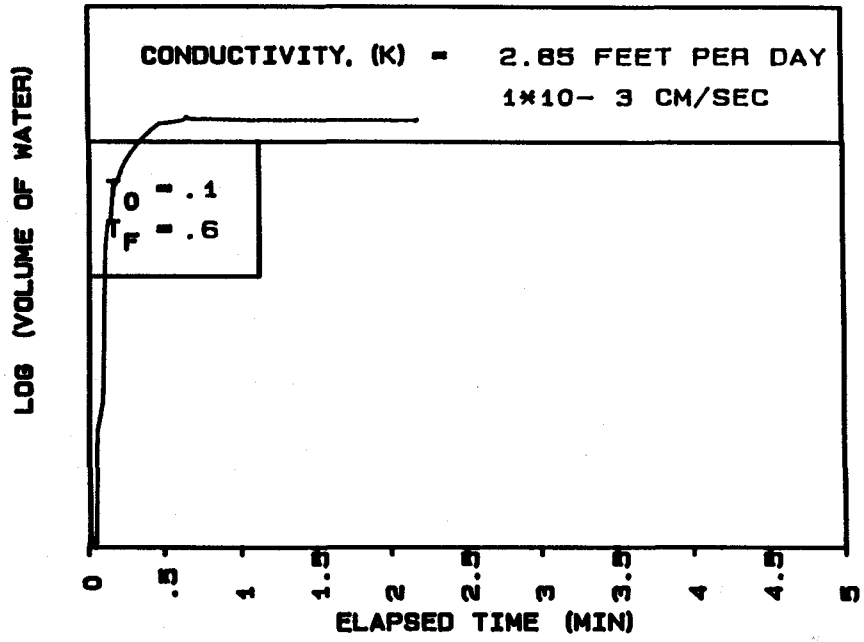
ENSAFE MEMPHIS NSA
LOCATION... 09H1445
TEST DATE
18: 12: 04 11-27-1995

SAMPLE DEPTH (FT) 45
GROUNDWATER DEPTH (FT) 25

HYDROCONE TEST



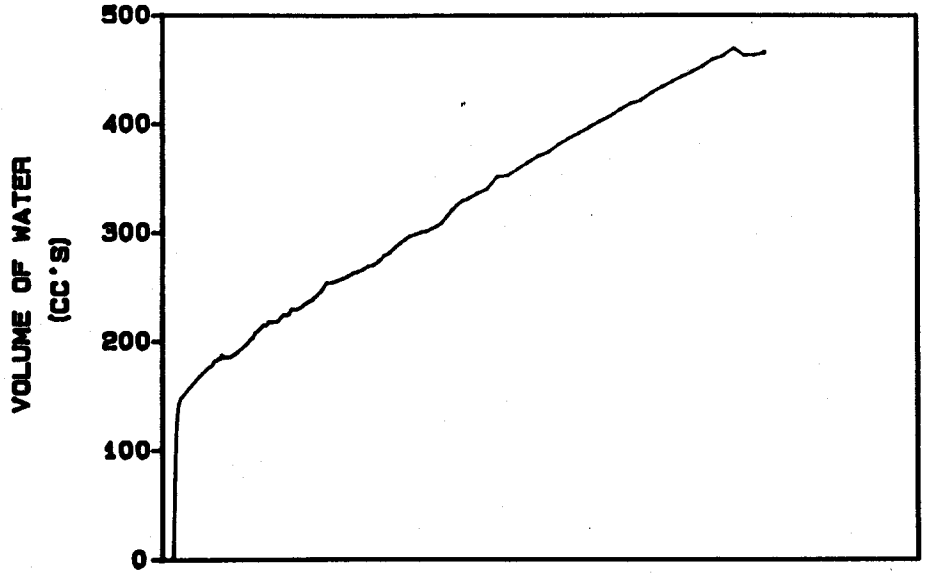


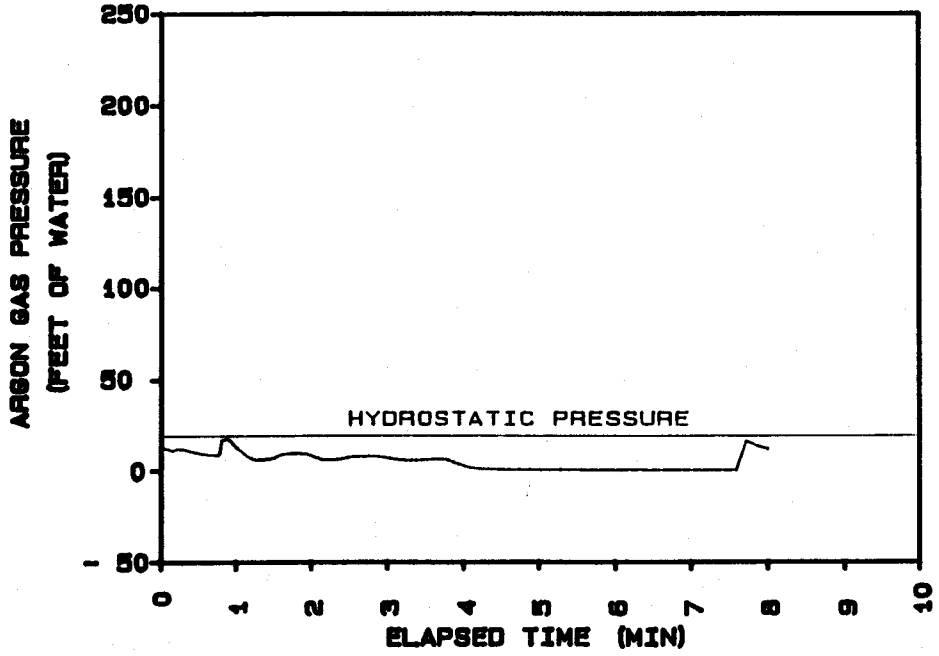


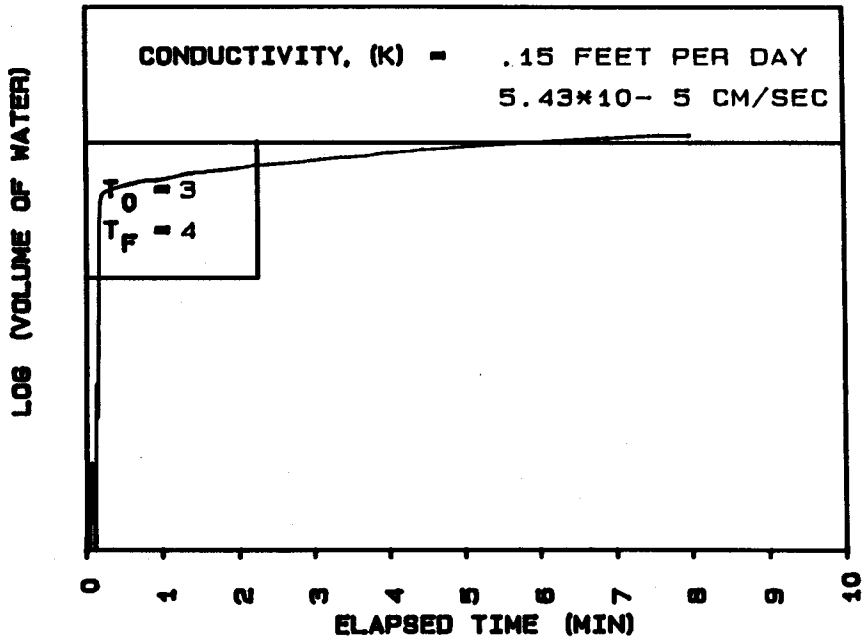
ENSAFE MEMPHIS NSA
LOCATION... 09H1547
TEST DATE
10: 49: 26 11-28-1995

SAMPLE DEPTH (FT) 47
GROUNDWATER DEPTH (FT) 25

HYDROCONE TEST



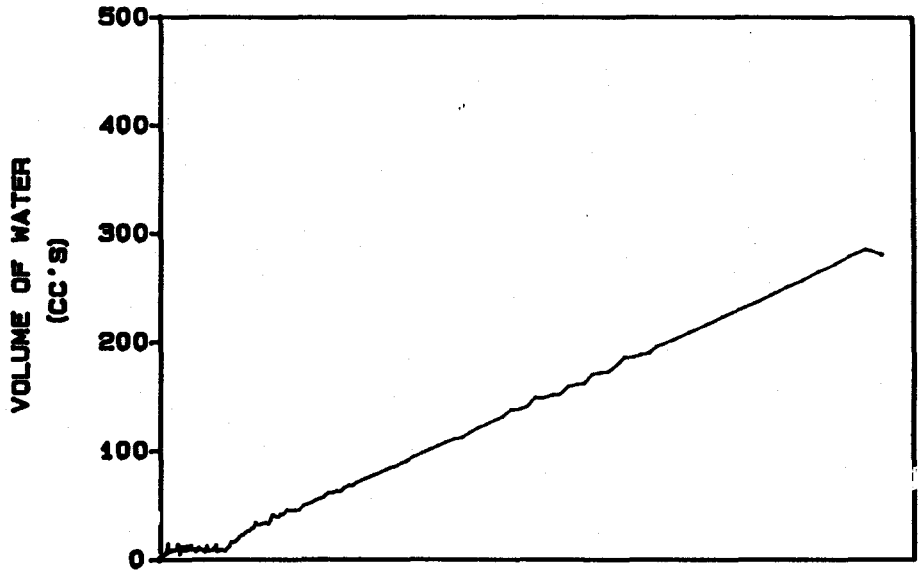


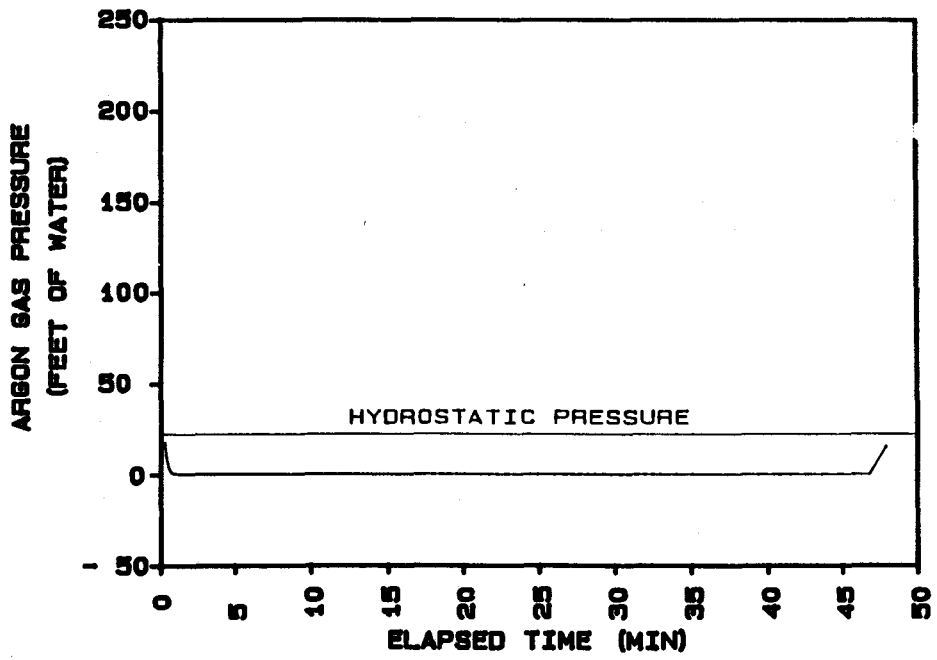


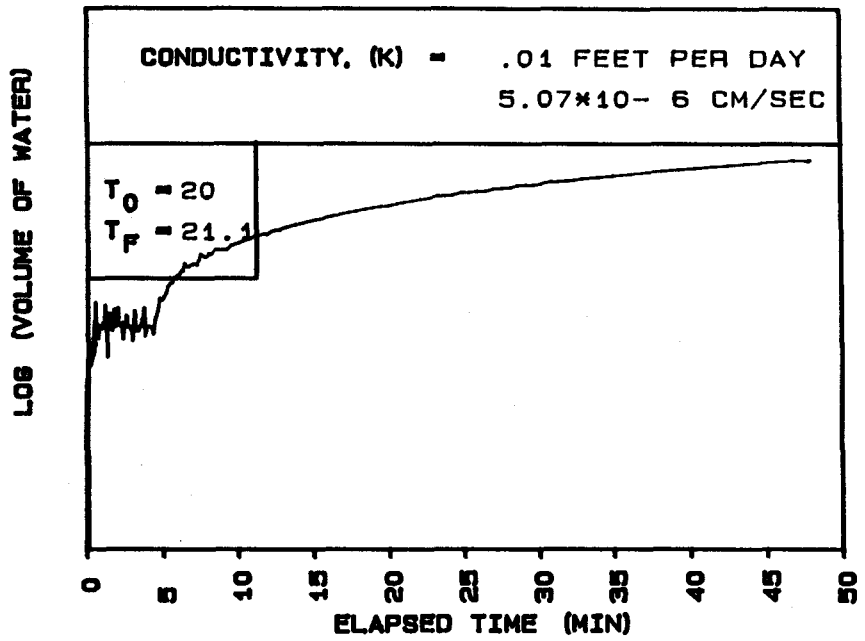
ENSAFE MEMPHIS NSA
LOCATION... 09H1644
TEST DATE
14:51:31 11-29-1995

SAMPLE DEPTH (FT) 44
GROUNDWATER DEPTH (FT) 25

HYDROCONE TEST



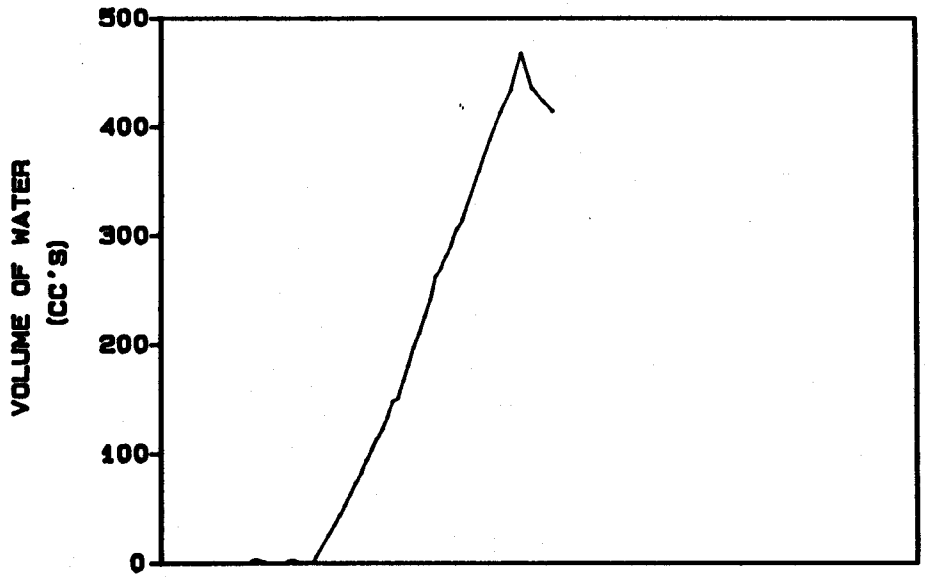


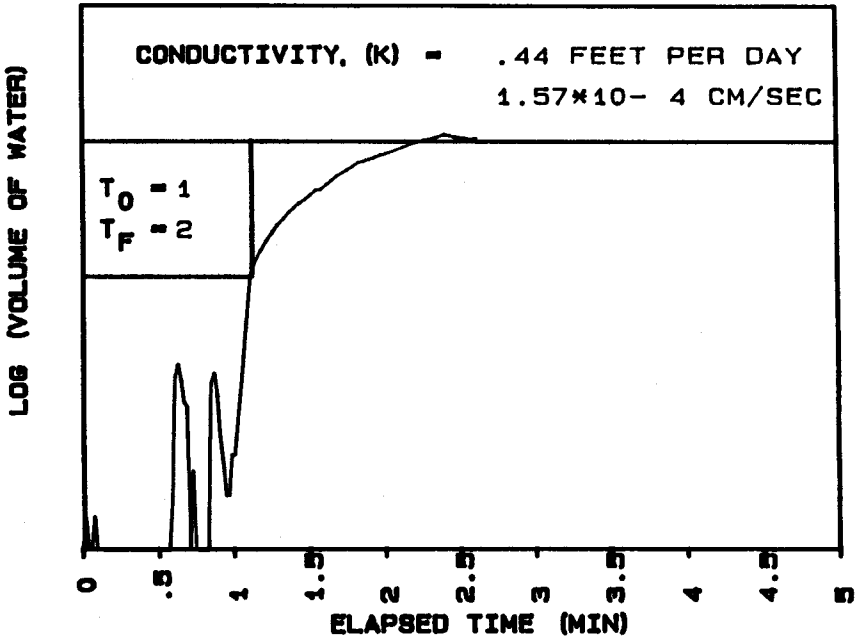


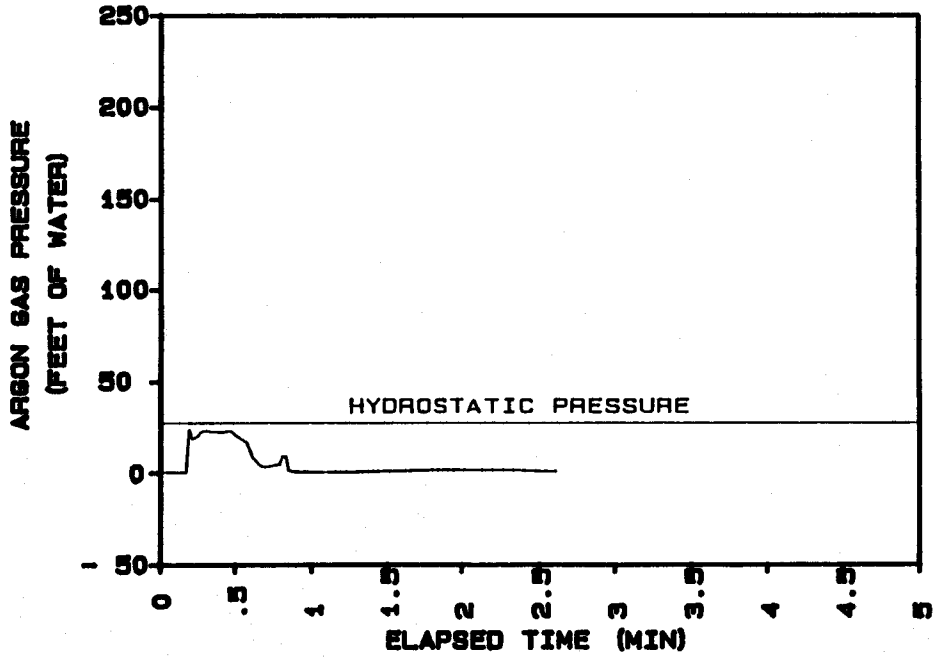
ENSAFE MEMPHIS NSA
LOCATION... 09H1747
TEST DATE
17: 19: 10 11-29-1995

SAMPLE DEPTH (FT) 47
GROUNDWATER DEPTH (FT) 25

HYDROCONE TEST



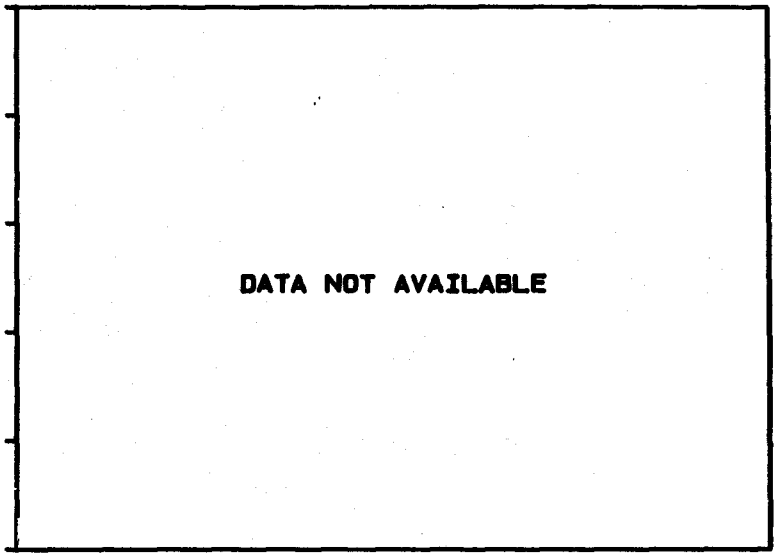


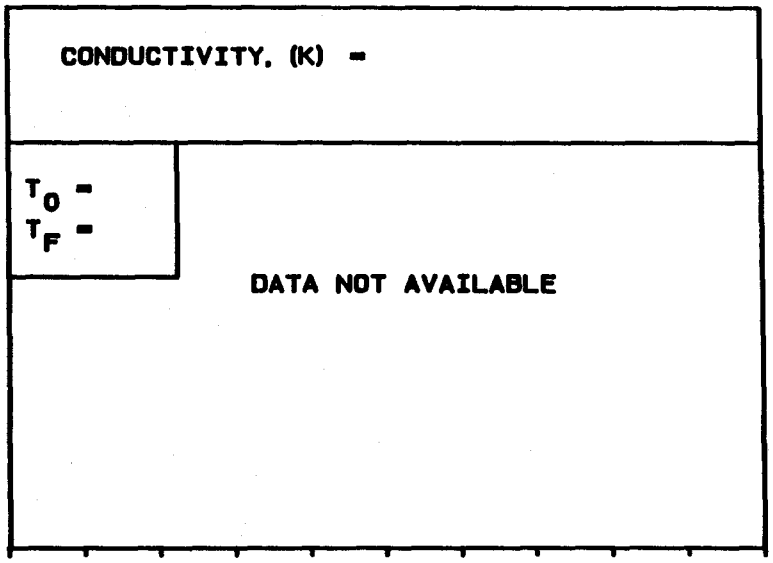


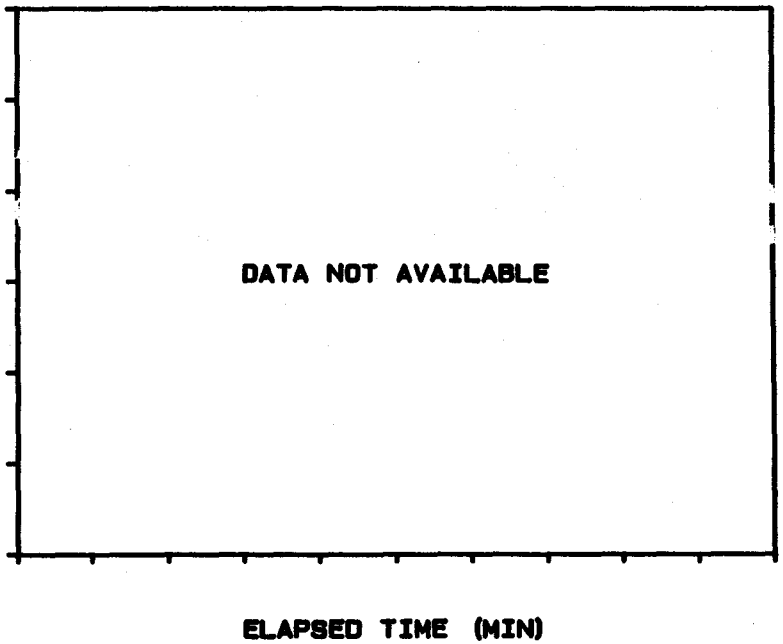
ENSAFE MEMPHIS NSA
LOCATION... 09H1852
TEST DATE
20: 17: 48 11-29-1995

SAMPLE DEPTH (FT) 52
GROUNDWATER DEPTH (FT) 25

HYDROCONE TEST



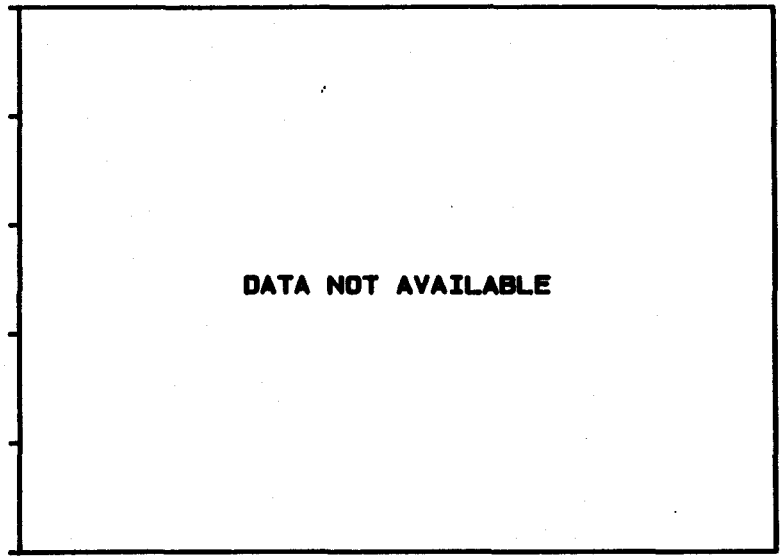


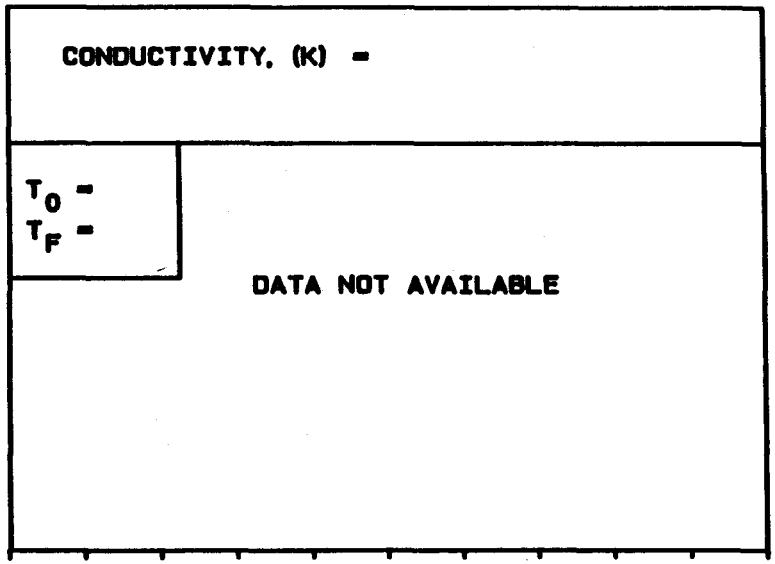


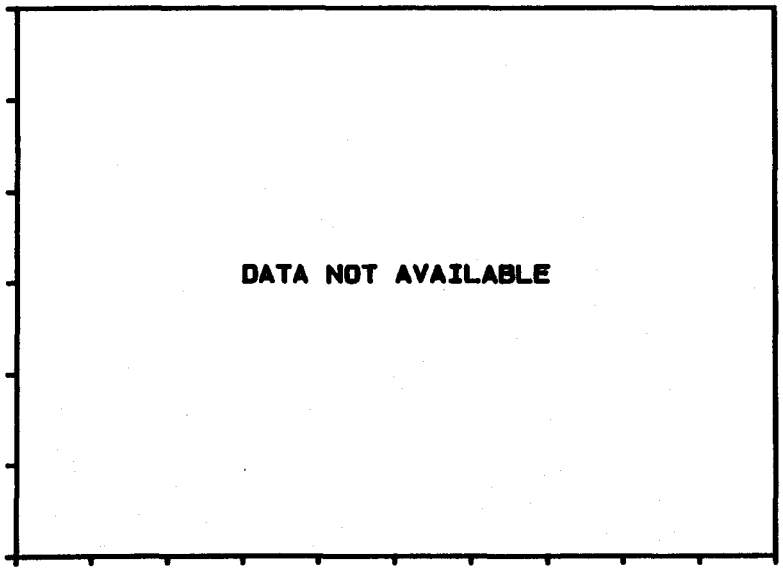
ENSAFE MEMPHIS NSA
LOCATION... 09H1946

DATA NOT AVAILABLE

HYDROCONE TEST



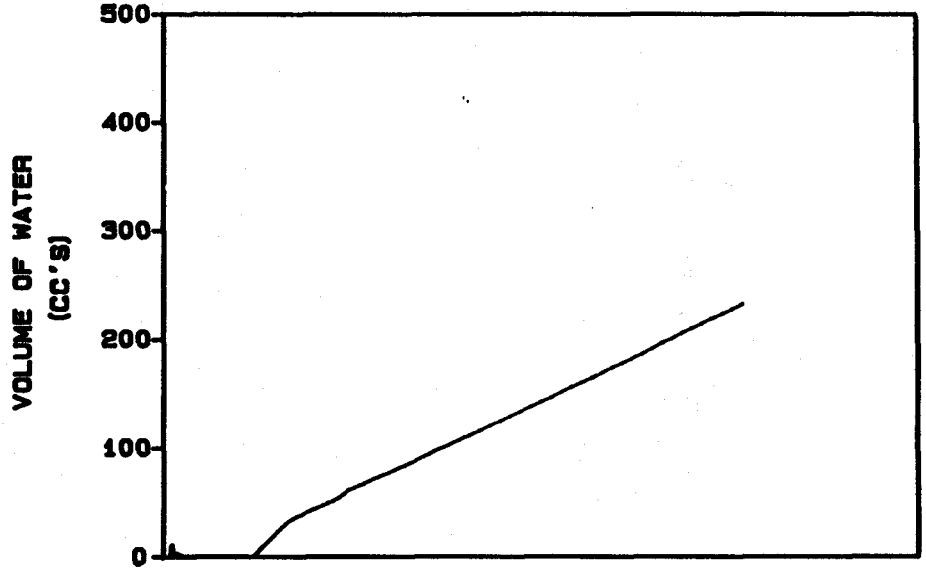


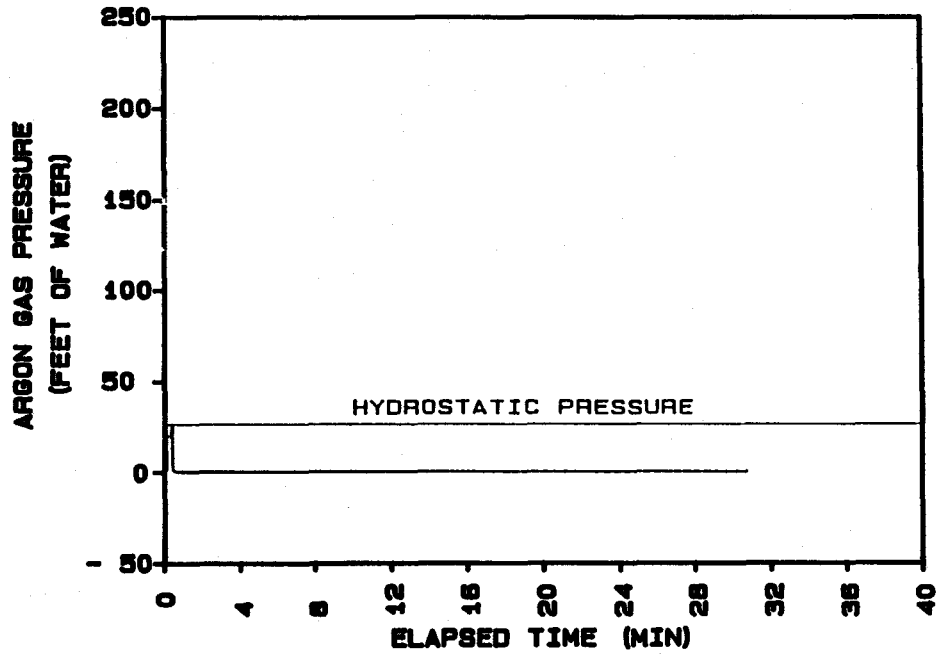


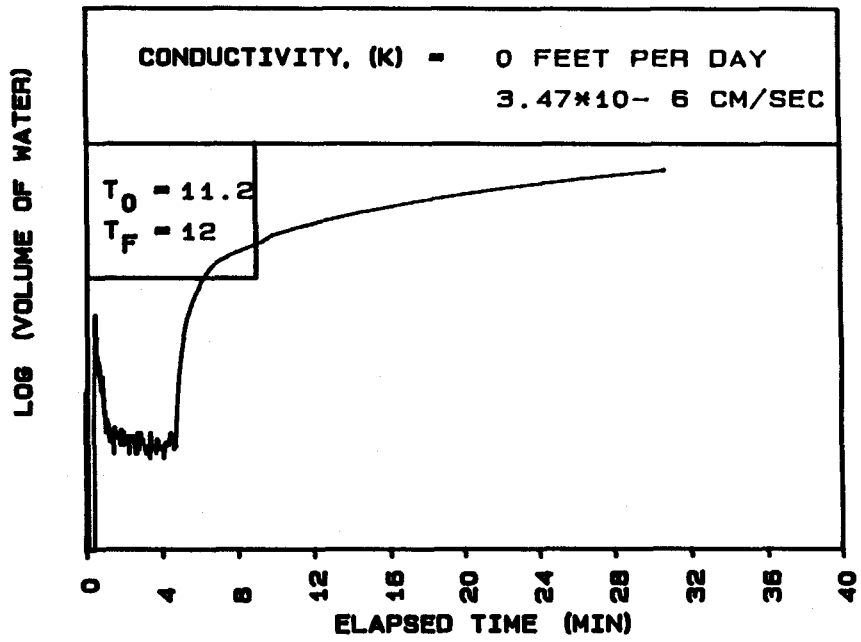
ENSAFE MEMPHIS NSA
LOCATION... 09H2052

DATA NOT AVAILABLE

HYDROCONE TEST



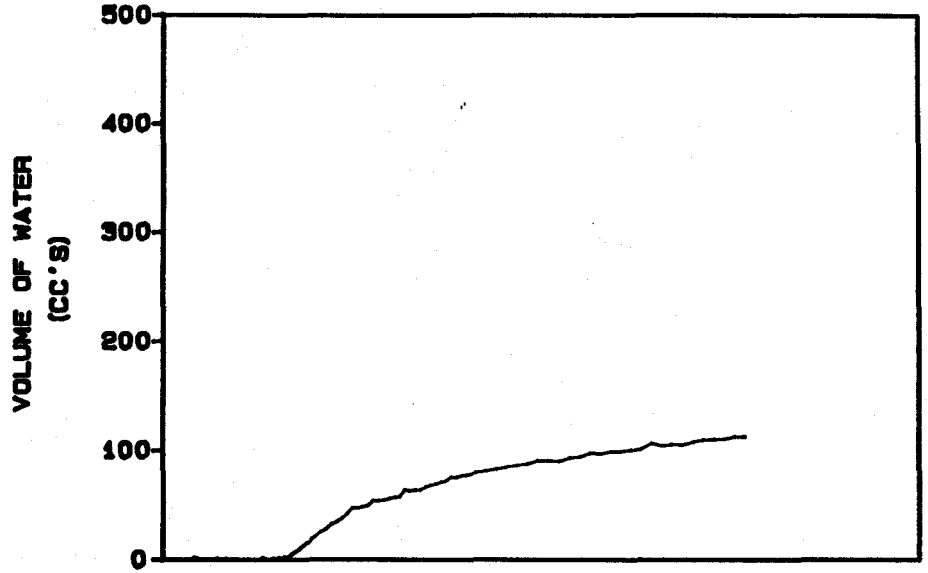


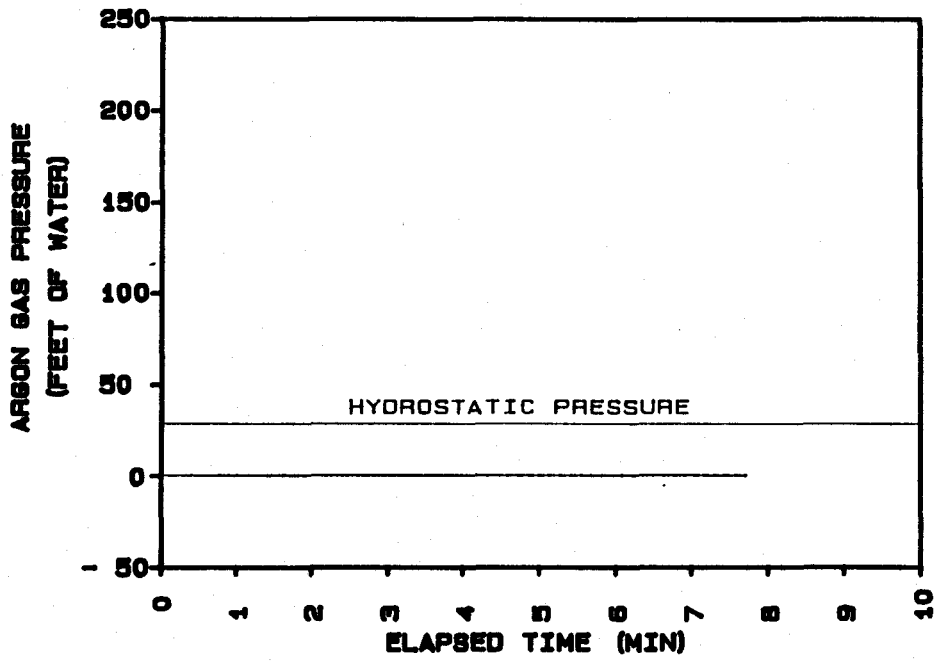


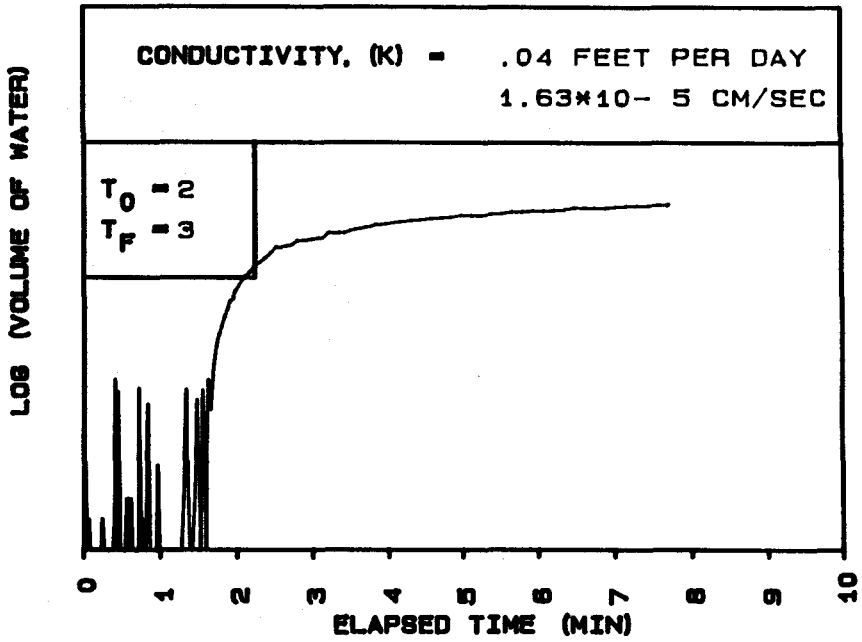
ENSAFE MEMPHIS NSA
LOCATION... 09H2142
TEST DATE
18: 30: 33 11-30-1995

SAMPLE DEPTH (FT) 42
GROUNDWATER DEPTH (FT) 18

HYDROCONE TEST



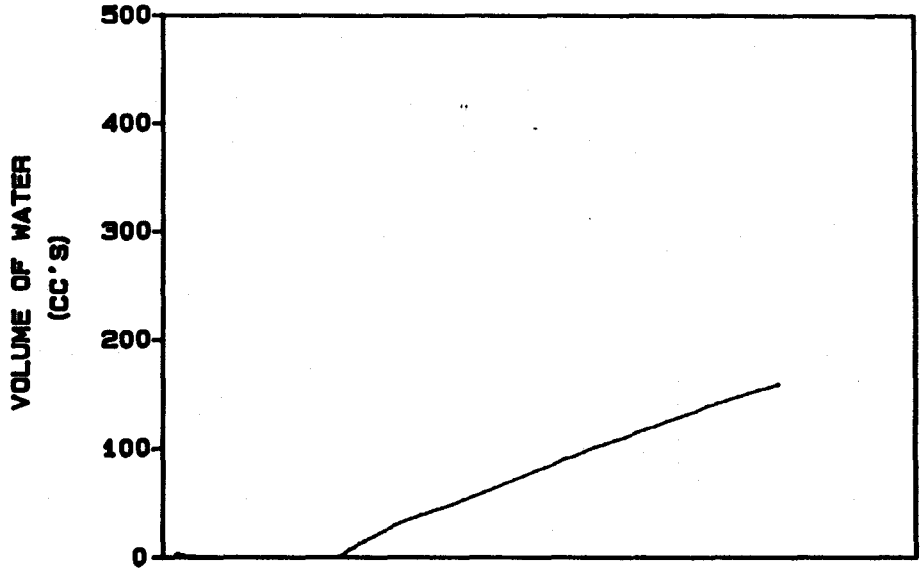


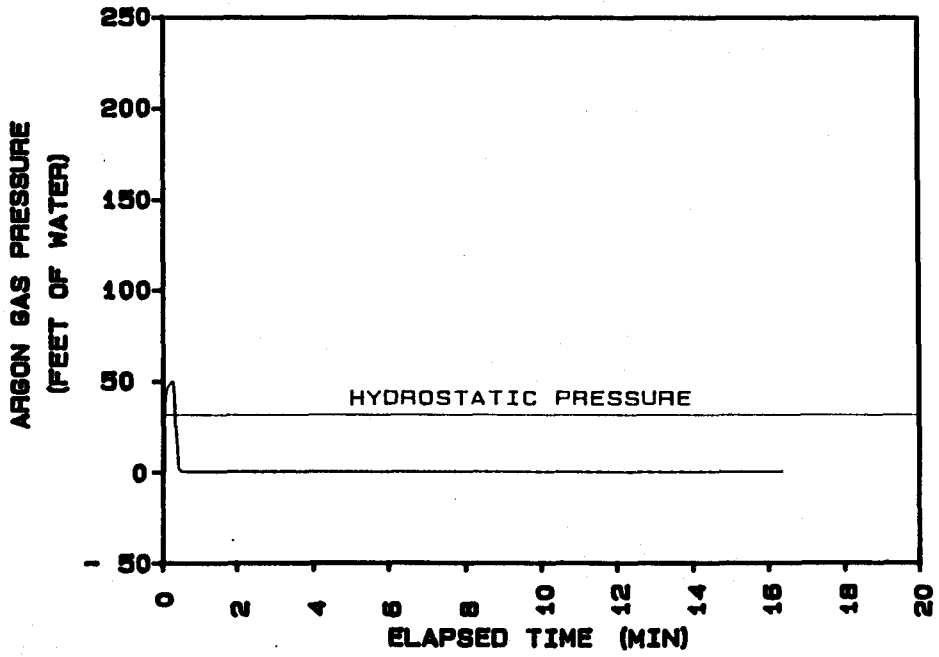


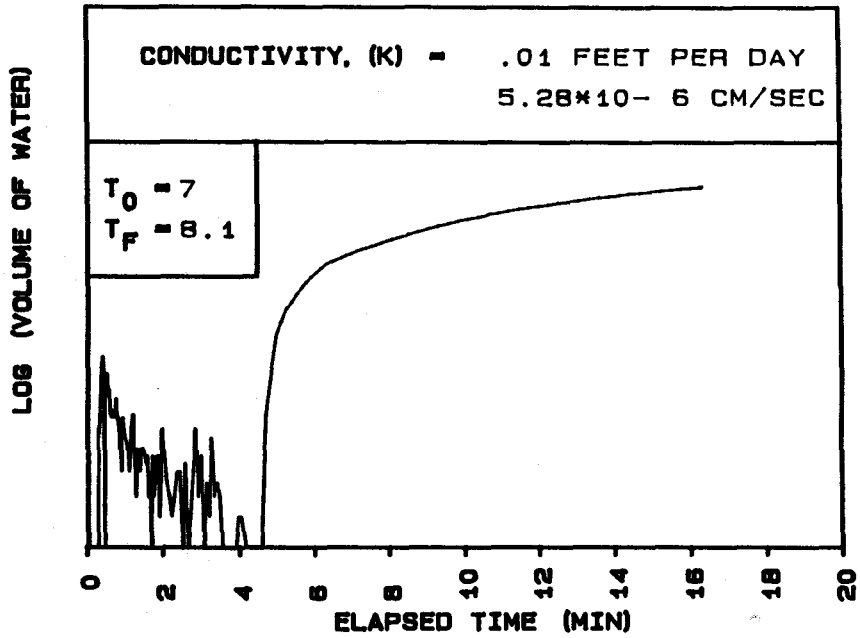
ENSAFE MEMPHIS NSA
LOCATION... 09H2244
TEST DATE
15: 01: 42 12-01-1995

SAMPLE DEPTH (FT) 44
GROUNDWATER DEPTH (FT) 16

HYDROCONE TEST







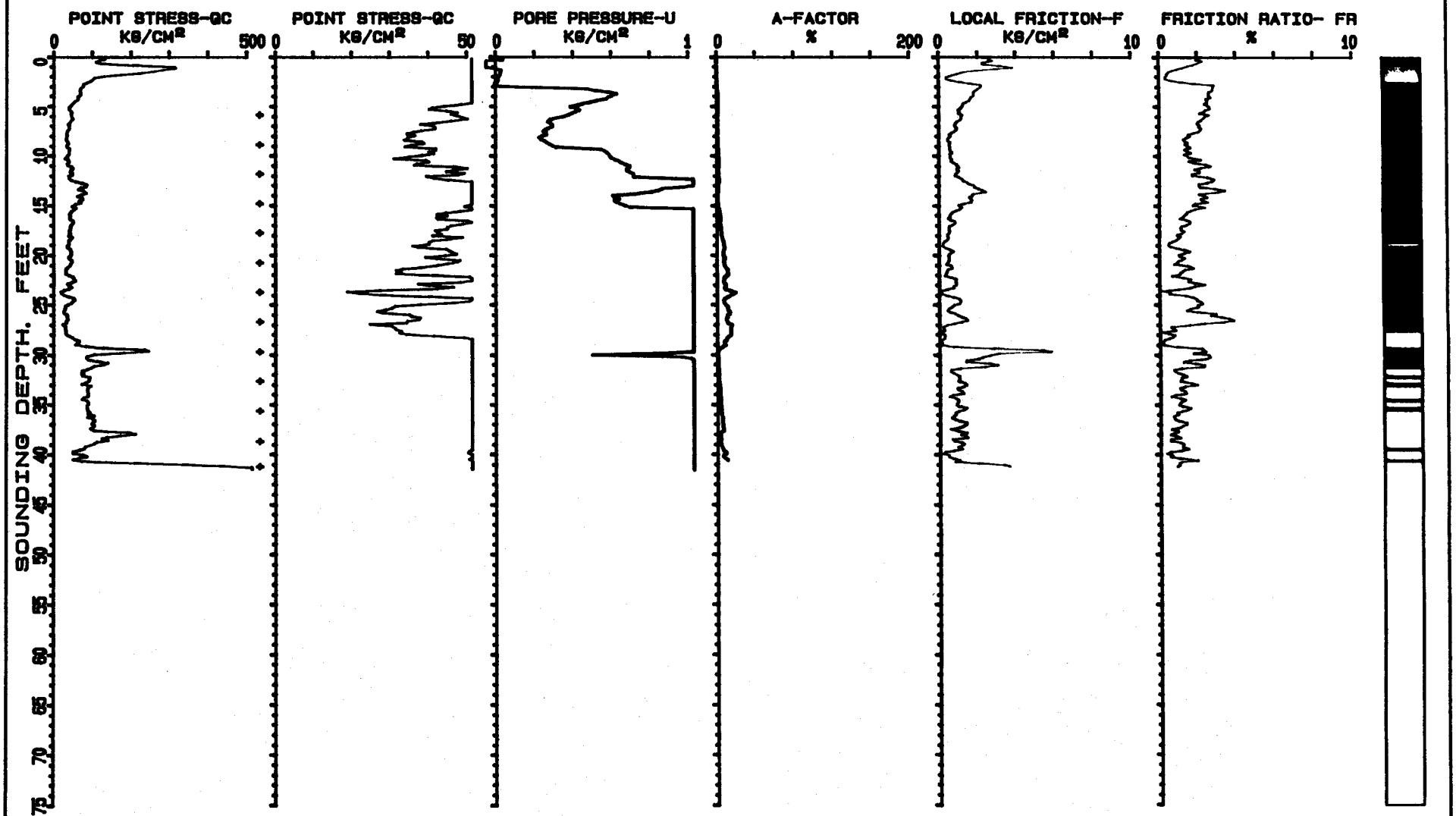
ENSAFE MEMPHIS NSA
LOCATION... 09H2347
TEST DATE
17: 35: 56 12-01-1995

SAMPLE DEPTH (FT) 47
GROUNDWATER DEPTH (FT) 16

SWMU 14

DPT SCREENING INVESTIGATION RESULTS

PIEZOCONE SOUNDING



◆ PUSH INTERRUPTED TO ADD ROD
PORE PRESSURE DECAY DATA MAY BE AVAILABLE

FILE #..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
SOUNDING # 14-P05
TEST DATE 11-07-1995 16:06:55

IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE
FOR SOUTHEASTERN UNITED STATES SOILS

JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
FILE NAME..... 14-P05

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES #	N'	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	SILTY FINE SAND	175.2	2.9	43	43	.03	>90%	>48	385	--	--	--	--
2	DENSE OR CEMENTED S.	246	1.23	41	41	.067	>90%	>48	541	--	--	--	--
3	SILTY FINE SAND	96.1	1.38	24	24	.098	80%-90%	>48	211	--	--	--	--
4	CLAYEY FINE SAND	70.2	1.8	28	28	.128	70%-80%	>48	154	--	--	--	--
5	CLAYEY FINE SAND	57.1	1.35	22	22	.159	60%-70%	46-48	125	--	--	--	--
6	CLAYEY FINE SAND	44.4	1.07	17	17	.19	60%-70%	44-46	97	--	--	--	--
7	CLAYEY FINE SAND	44.2	.9	17	17	.221	60%-70%	42-44	97	--	--	--	--
8	CLAYEY FINE SAND	38.5	.68	15	15	.251	50%-60%	42-44	84	--	--	--	--
9	SILTY TO CLAYEY F.S.	36	.49	12	12	.282	50%-60%	42-44	79	--	--	--	--
10	SILTY TO CLAYEY F.S.	39.1	.56	13	13	.313	50%-60%	40-42	86	--	--	--	--
11	CLAYEY FINE SAND	36.7	.77	14	14	.344	50%-60%	40-42	80	--	--	--	--
12	SILTY TO CLAYEY F.S.	45.9	.92	15	15	.375	50%-60%	40-42	100	--	--	--	--
13	CLAYEY FINE SAND	55.9	1.42	22	22	.405	60%-70%	42-44	122	--	--	--	--
14	SILTY TO CLAYEY F.S.	77	1.9	25	25	.436	70%-80%	42-44	169	--	--	--	--
15	SILTY TO CLAYEY F.S.	67.8	1.41	22	22	.467	60%-70%	42-44	149	--	--	--	--
16	SILTY TO CLAYEY F.S.	50.4	.79	16	16	.498	50%-60%	40-42	110	--	--	--	--
17	SILTY TO CLAYEY F.S.	46	.62	15	15	.528	40%-50%	40-42	101	--	--	--	--
18	SILTY TO CLAYEY F.S.	44.6	.47	14	14	.559	40%-50%	38-40	98	--	--	--	--
19	SILTY TO CLAYEY F.S.	42.9	.3	14	14	.59	40%-50%	38-40	94	--	--	--	--
20	SILTY TO CLAYEY F.S.	42.4	.47	14	14	.621	40%-50%	38-40	93	--	--	--	--
21	SILTY TO CLAYEY F.S.	44.6	.49	14	14	.651	40%-50%	38-40	98	--	--	--	--
22	SILTY TO CLAYEY F.S.	35	.4	11	11	.682	<40%	36-38	77	--	--	--	--
23	SILTY TO CLAYEY F.S.	44.9	.72	14	14	.713	40%-50%	38-40	98	--	--	--	--
24	SILTY TO CLAYEY F.S.	32.1	.31	10	10	.744	<40%	36-38	70	--	--	--	--
25	CLAYEY FINE SAND	44.4	.89	17	17	.775	<40%	38-40	97	--	--	--	--
26	CLAYEY FINE SAND	31.2	.69	12	12	.805	<40%	36-38	68	--	--	--	--
27	CLAYEY FINE SAND	34.1	.91	13	13	.836	<40%	36-38	75	--	--	--	--
28	SILTY FINE SAND	31	0	7	7	.867	<40%	34-36	68	--	--	--	--
29	SILTY FINE SAND	51.9	0	12	12	.898	<40%	38-40	114	--	--	--	--
30	SILTY TO CLAYEY F.S.	148.4	3.21	49	49	.928	70%-80%	42-44	326	--	--	--	--

14-P05 CONTINUED ENSAFE

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES	N'	VERTICAL STRESS	RELATIVE DENSITY	FRICTION ANGLE	YOUNGS MODULUS	UNDRAINED SHEAR ST	SENSITIVITY	COMP.	OCR
31	SILTY TO CLAYEY F.S.	107	2.12	35	35	.959	60%-70%	40-42	235	--	--	--	--
32	SILTY FINE SAND	92	1.01	23	23	.99	50%-60%	40-42	202	--	--	--	--
33	SILTY TO CLAYEY F.S.	82.8	1.12	27	27	1.021	50%-60%	40-42	182	--	--	--	--
34	SILTY FINE SAND	87.6	.92	21	21	1.051	50%-60%	40-42	192	--	--	--	--
35	SILTY FINE SAND	85.7	.82	21	21	1.082	50%-60%	38-40	188	--	--	--	--
36	SILTY FINE SAND	88.4	.96	22	22	1.113	50%-60%	38-40	194	--	--	--	--
37	SILTY FINE SAND	99.2	.99	24	24	1.144	50%-60%	40-42	218	--	--	--	--
38	FINE SAND	130.6	1.05	26	26	1.177	60%-70%	40-42	287	--	--	--	--
39	FINE SAND	144.5	1.04	28	28	1.21	60%-70%	40-42	317	--	--	--	--
40	SILTY FINE SAND	73.4	.57	18	18	1.241	40%-50%	38-40	161	--	--	--	--

\# N'=POINT STRESS*(.2+.04*FRICTION RATIO)
* NORMALLY CONSOLIDATED SANDS
** FOR OVERCONSOLIDATED SANDS,SLIGHTLY REDUCE ABOVE FRICTION ANGLES
*** FOR OVERCONSOLIDATED SANDS, YOUNG'S MODULUS MAY BE AS MUCH AS 3 TO 6 TIMES HIGHER
**** NK OF 16 USED. FOR OVERCONSOLIDATED CLAYS, AN NK OF 17 IS SUGGESTED

THE ABOVE DATA WAS COMPUTED FOLLOWING 'BASIC' GUIDELINES BY P. K. ROBERTSON AND R. G. CAMPANELLA IN THE HANDBOOK 'GUIDELINES FOR USE AND INTERPERTATION OF THE ELECTRONIC CONE PENETRATION TEST'

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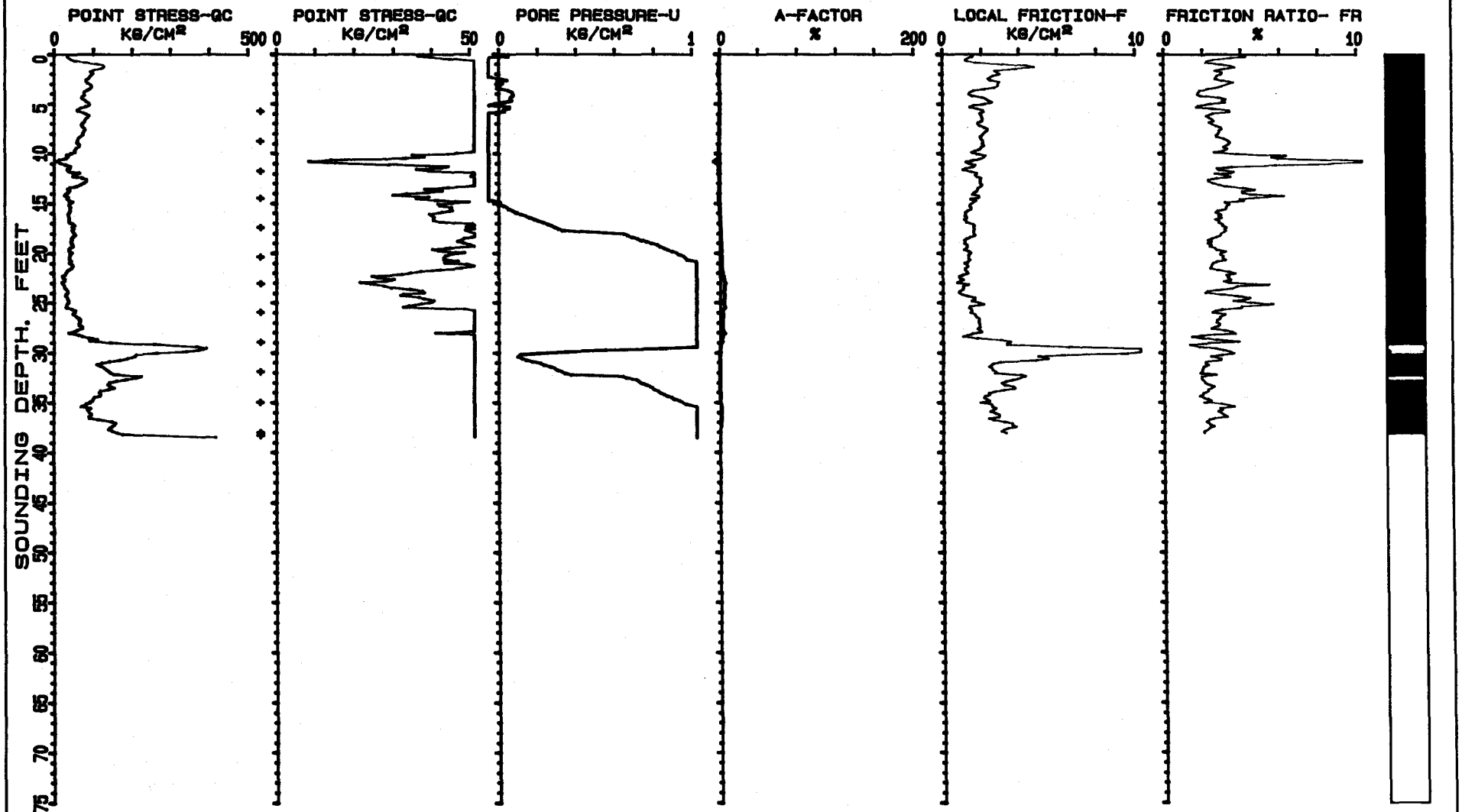
PIEZOCONE SOUNDING



* PUSH INTERRUPTED TO ADD ROD
PORE PRESSURE DECAY DATA MAY BE AVAILABLE

FILE #..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
SOUNDING # 14-P06
TEST DATE 11-07-1995 17:29:26

IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE
FOR SOUTHEASTERN UNITED STATES SOILS

JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
FILE NAME..... 14-P06

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES #	N'	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	CLAYEY FINE SAND	63.7	2.28	25	25	.03	70%-80%	>48	140	--	--	--	--
2	CLAYEY FINE SAND	112	3.46	44	44	.061	>90%	>48	246	--	--	--	--
3	CLAYEY FINE SAND	89.8	2.68	35	35	.092	80%-90%	>48	197	--	--	--	--
4	SILTY TO CLAYEY F.S.	89.4	2.02	29	29	.123	70%-80%	>48	196	--	--	--	--
5	SILTY TO CLAYEY F.S.	78	1.97	26	26	.153	70%-80%	46-48	171	--	--	--	--
6	SILTY TO CLAYEY F.S.	75.6	1.81	25	25	.184	70%-80%	46-48	166	--	--	--	--
7	SILTY TO CLAYEY F.S.	81.7	1.96	27	27	.215	70%-80%	46-48	179	--	--	--	--
8	CLAYEY FINE SAND	75.8	2.12	30	30	.246	70%-80%	44-46	166	--	--	--	--
9	CLAYEY FINE SAND	68.3	2.06	27	27	.276	70%-80%	44-46	150	--	--	--	--
10	CLAYEY FINE SAND	61	1.84	24	24	.307	60%-70%	42-44	134	--	--	--	--
11	CLAY	31	1.71	31	31	.332	--	--	--	1.89	1.8	UD	--
12	SANDY CLAY	40.3	1.49	20	20	.359	--	--	--	2.47	2.6	.01	>6
13	CLAYEY FINE SAND	69.3	1.88	27	27	.39	60%-70%	42-44	152	--	--	--	--
14	CLAYEY FINE SAND	53.8	1.78	21	21	.421	60%-70%	42-44	118	--	--	--	--
15	SILTY CLAY TO CLAY	38.4	1.62	25	25	.448	--	--	--	2.34	2.3	UD	>6
16	CLAYEY FINE SAND	44.6	1.32	17	17	.479	50%-60%	40-42	98	--	--	--	--
17	CLAYEY FINE SAND	40.8	1.2	16	16	.51	40%-50%	38-40	89	--	--	--	--
18	CLAYEY FINE SAND	49.3	1.57	19	19	.541	40%-50%	40-42	108	--	--	--	--
19	CLAYEY FINE SAND	50.3	1.3	20	20	.571	40%-50%	40-42	110	--	--	--	--
20	CLAYEY FINE SAND	46.5	1.25	18	18	.602	40%-50%	38-40	102	--	--	--	--
21	CLAYEY FINE SAND	44.8	1.28	17	17	.633	40%-50%	38-40	98	--	--	--	--
22	CLAYEY FINE SAND	43.8	1.19	17	17	.664	40%-50%	38-40	96	--	--	--	--
23	SANDY CLAY	28.2	.95	14	14	.691	--	--	--	1.67	2.9	.02	6
24	SANDY CLAY	30.3	.99	15	15	.718	--	--	--	1.8	3	.01	6
25	SILTY CLAY TO CLAY	36.8	1.53	24	24	.746	--	--	--	2.2	2.4	UD	6
26	SANDY CLAY	43.5	1.53	21	21	.773	--	--	--	2.62	2.8	.01	6
27	CLAYEY FINE SAND	61.1	1.79	24	24	.804	40%-50%	38-40	134	--	--	--	--
28	CLAYEY FINE SAND	66.5	1.84	26	26	.835	40%-50%	38-40	146	--	--	--	--
29	CLAYEY FINE SAND	74.8	2.19	29	29	.865	50%-60%	40-42	164	--	--	--	--
30	DENSE CLAYEY F. S.	281.6	8.01	140	140	.899	>90%	44-46	619	--	--	--	--

14-P06 CONTINUED ENSAFE

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES	N'	VERTICAL STRESS	RELATIVE DENSITY	FRICTION ANGLE	YOUNGS MODULUS	UNDRAINED SHEAR ST	SENSITIVITY	COMP.	OCR
31	SILTY TO CLAYEY F.S.	218.4	5.26	72	72	.929	>90%	44-46	480	--	--	--	--
32	SILTY TO CLAYEY F.S.	127.3	2.56	42	42	.96	60%-70%	42-44	280	--	--	--	--
33	SILTY TO CLAYEY F.S.	170.6	3.54	56	56	.991	70%-80%	42-44	375	--	--	--	--
34	SILTY TO CLAYEY F.S.	136.6	3.05	45	45	1.022	70%-80%	42-44	300	--	--	--	--
35	SILTY TO CLAYEY F.S.	107.8	2.25	35	35	1.052	60%-70%	40-42	237	--	--	--	--
36	CLAYEY FINE SAND	86.1	2.56	34	34	1.083	50%-60%	38-40	189	--	--	--	--
37	CLAYEY FINE SAND	102.2	2.88	40	40	1.114	50%-60%	40-42	224	--	--	--	--
38	SILTY TO CLAYEY F.S.	148.4	3.41	49	49	1.145	70%-80%	42-44	326	--	--	--	--

\# N'=POINT STRESS*(.2+.04*FRICTION RATIO)
* NORMALLY CONSOLIDATED SANDS
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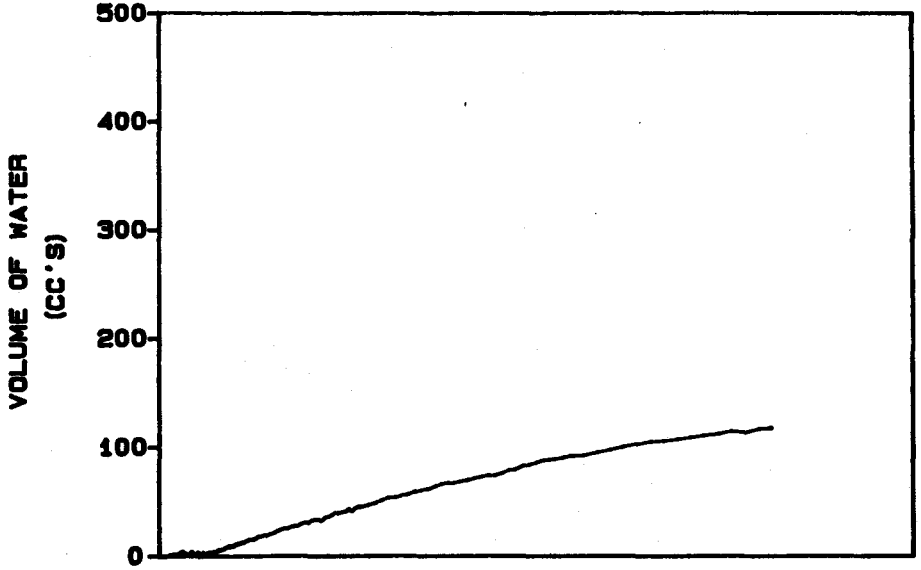
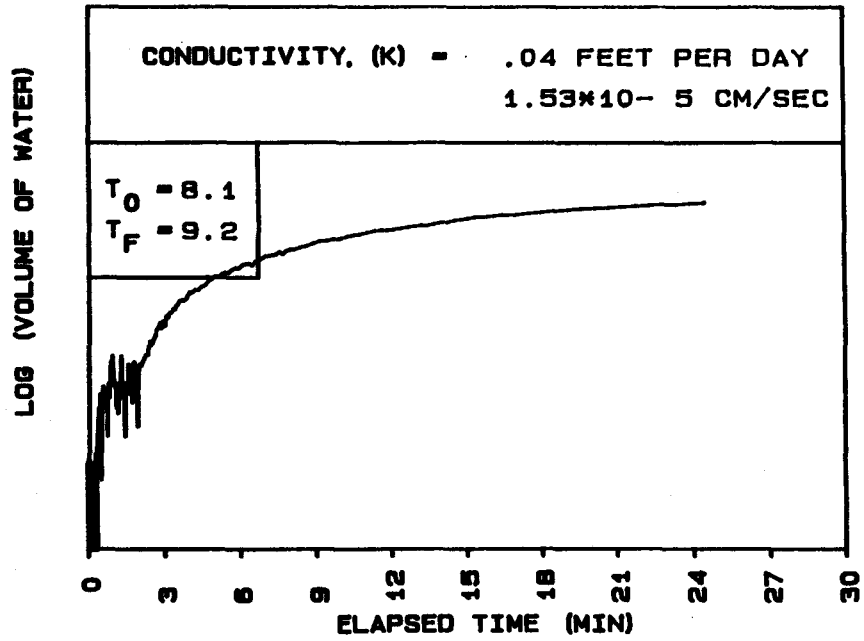
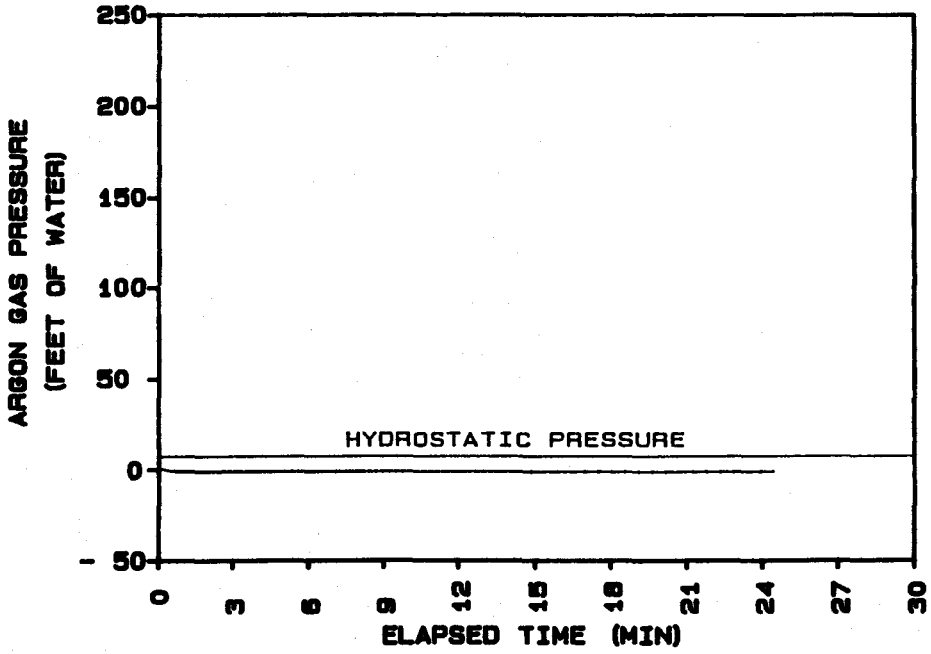
HYDROCONE TEST



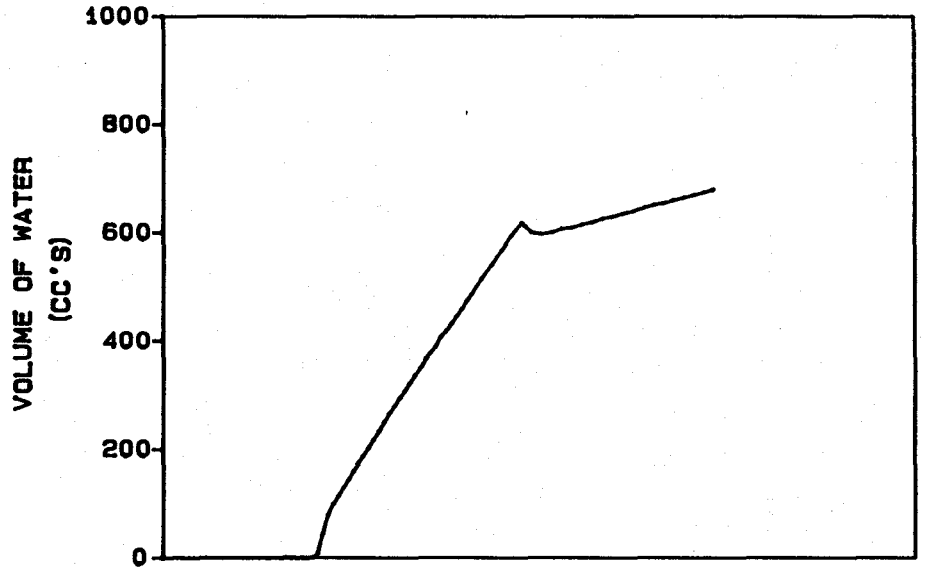


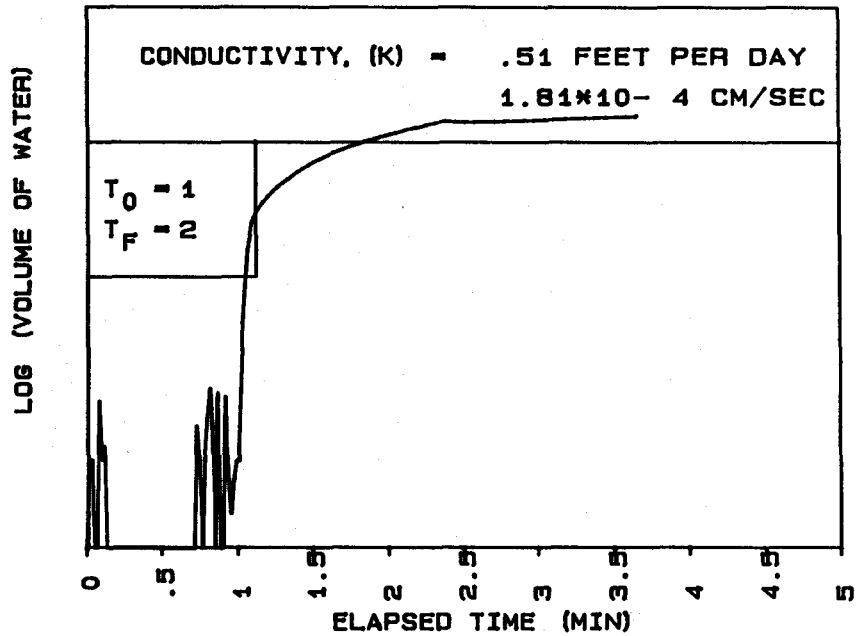


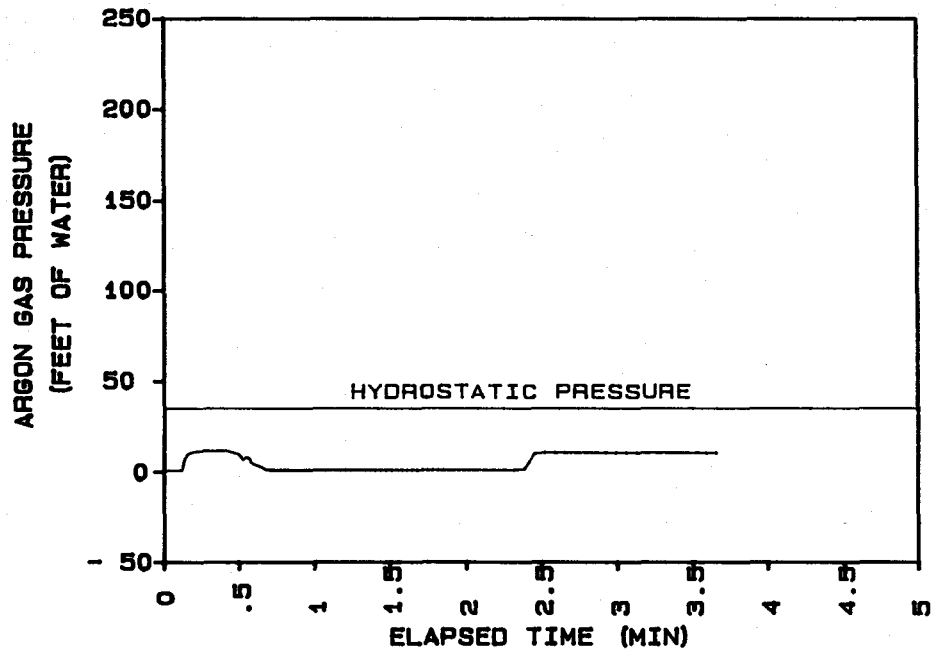
ENSAFE MEMPHIS NSA
LOCATION... 14H0512
TEST DATE
14: 49: 58 11-13-1995

SAMPLE DEPTH (FT) 12
GROUNDWATER DEPTH (FT) 5

HYDROCONE TEST







ENSAFE MEMPHIS NSA
LOCATION... 14H0545
TEST DATE
16: 41: 24 11-13-1995

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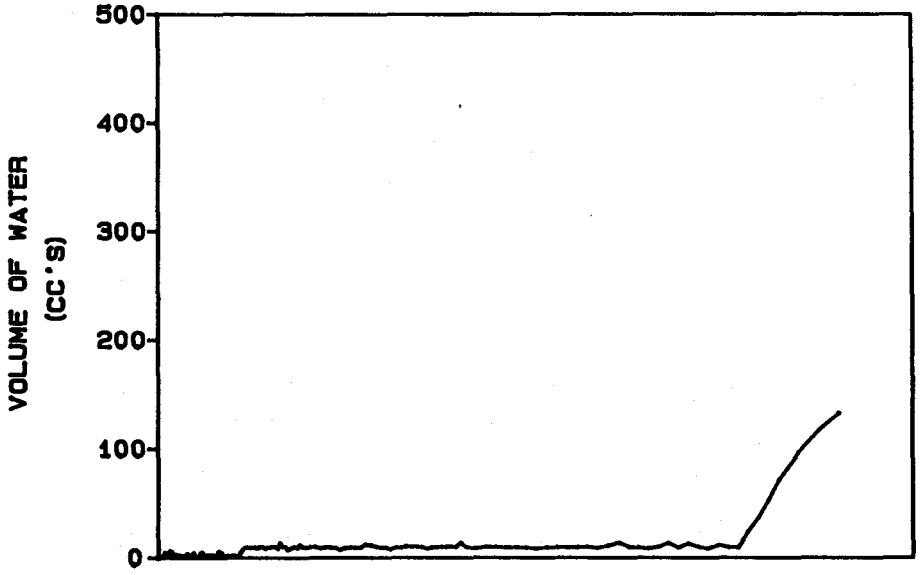
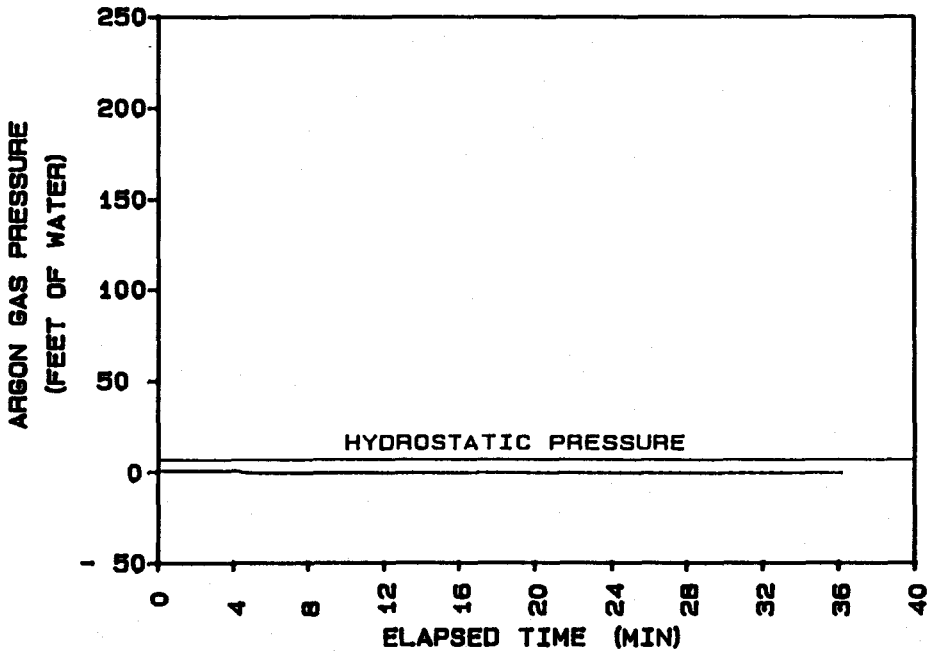
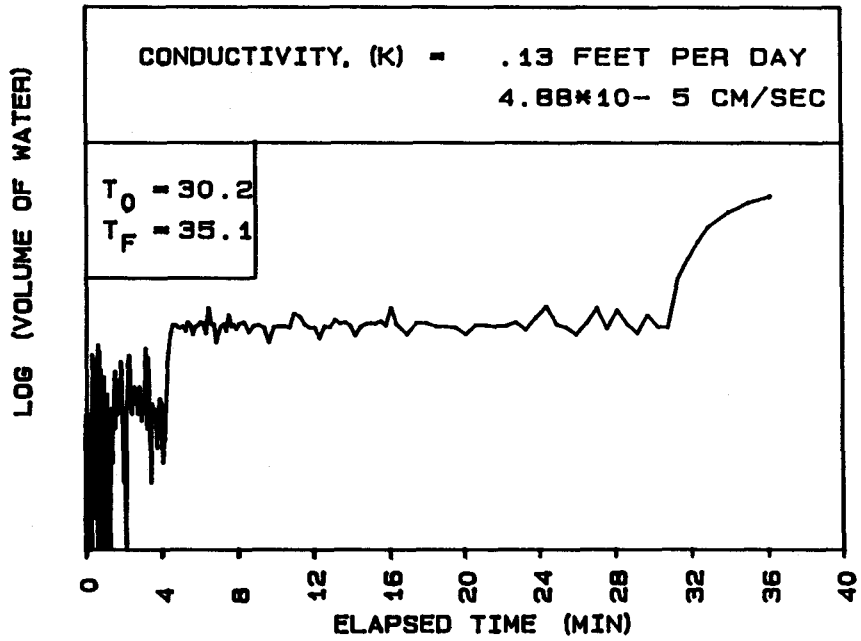
GROUNDWATER DEPTH (FT) 11

HYDROCONE TEST



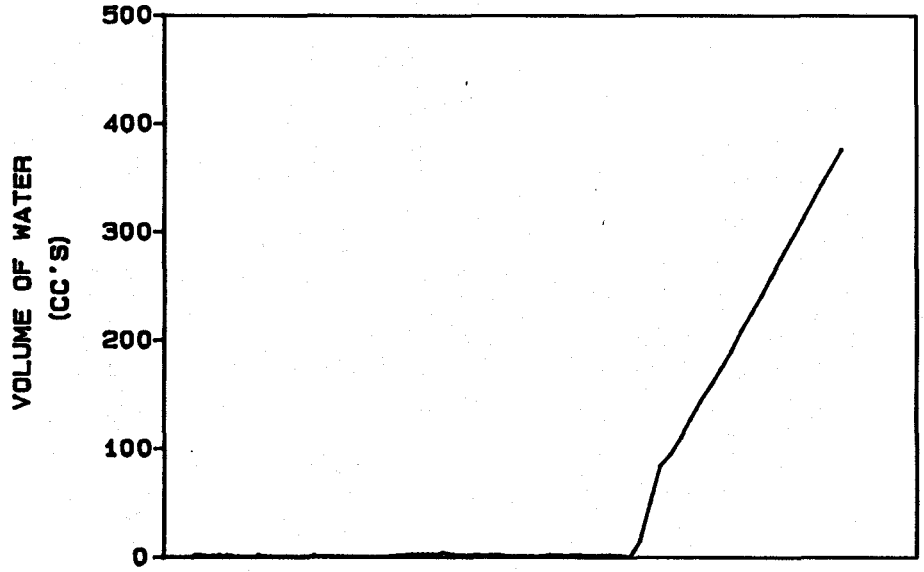


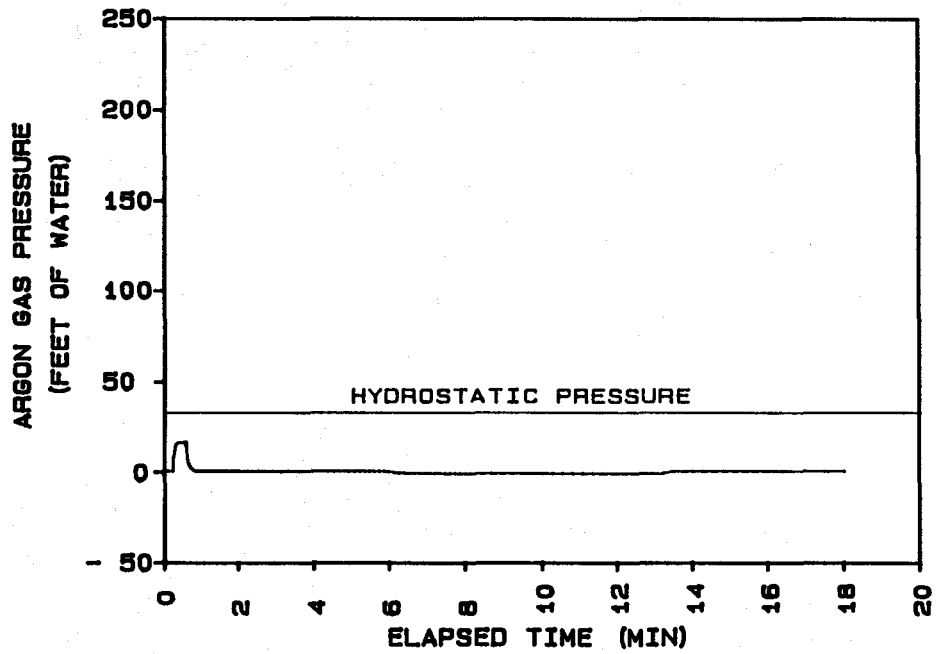


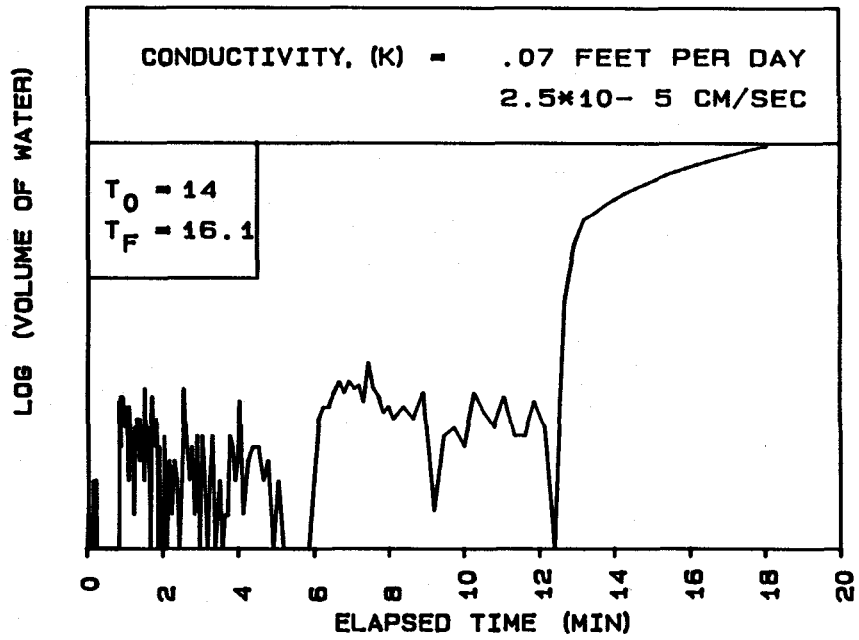
ENSAFE MEMPHIS NSA
LOCATION... 14H0711
TEST DATE
15: 41: 32 11-14-1995

SAMPLE DEPTH (FT) 11
GROUNDWATER DEPTH (FT) 5

HYDROCONE TEST



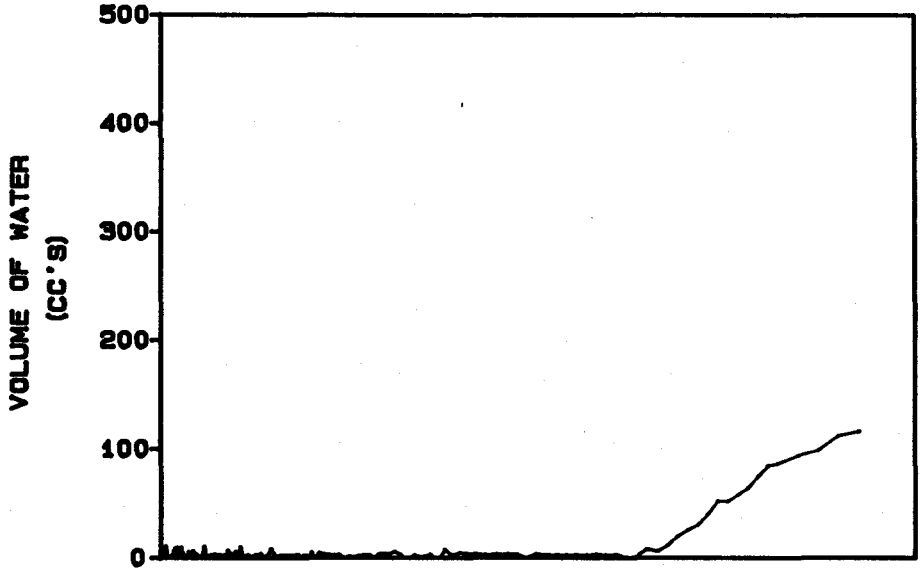


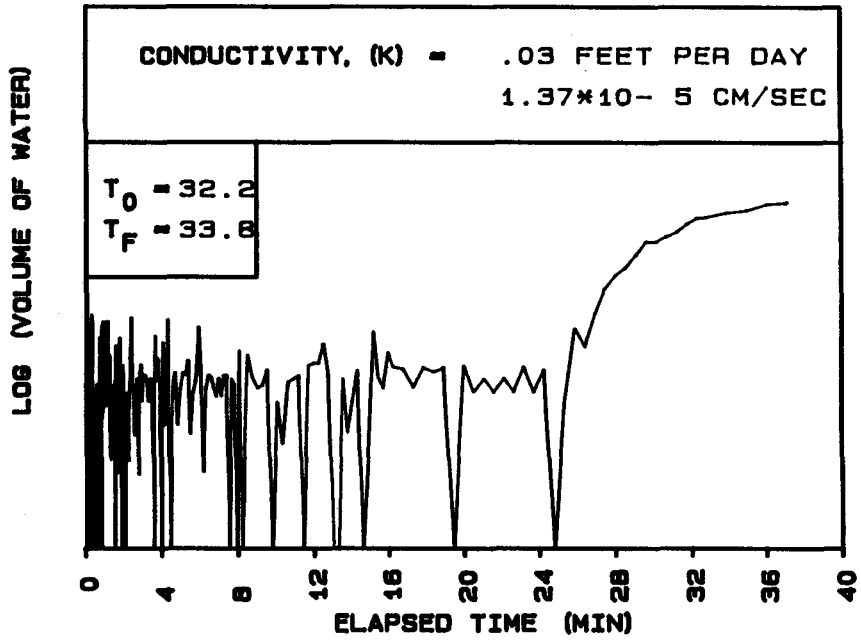


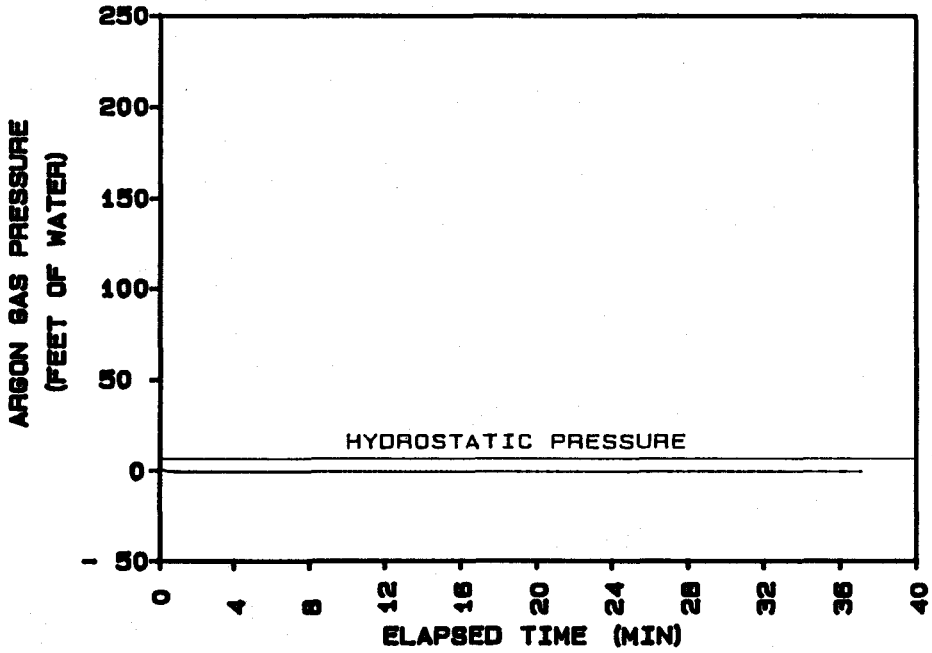
ENSAFE MEMPHIS NSA
LOCATION... 14H0743
TEST DATE
17: 39: 31 11-14-1995

SAMPLE DEPTH (FT) 43
GROUNDWATER DEPTH (FT) 11

HYDROCONE TEST



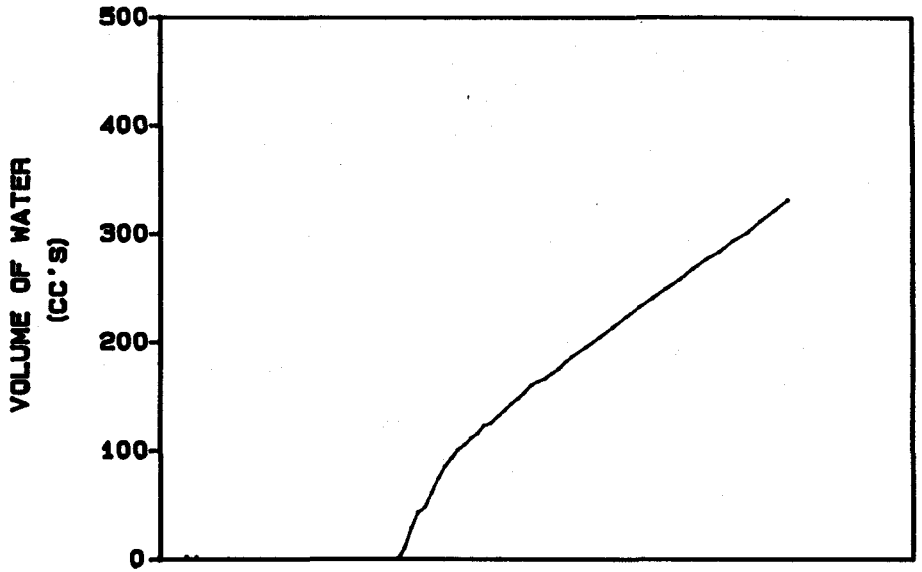


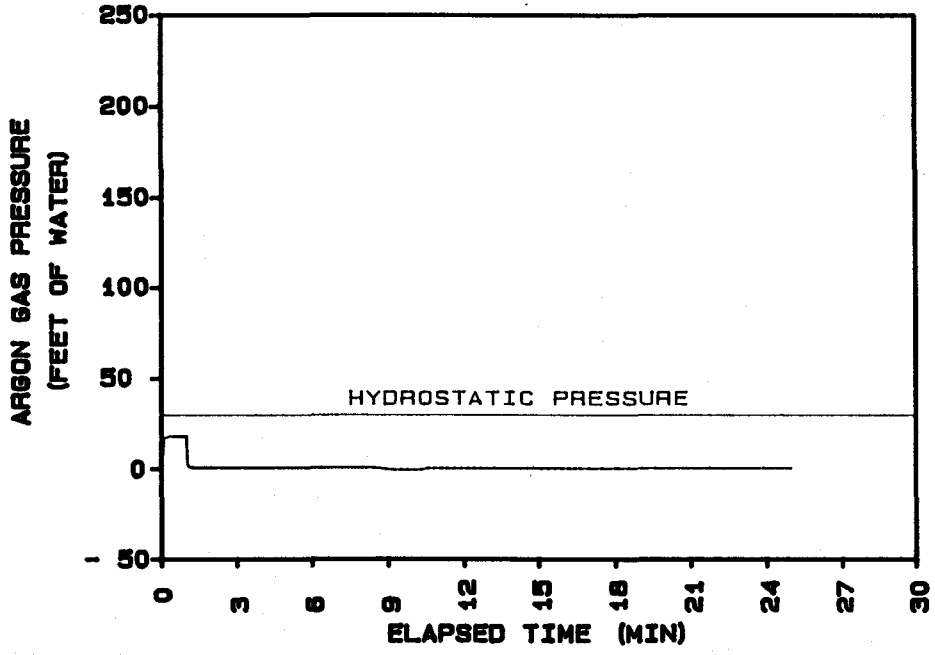


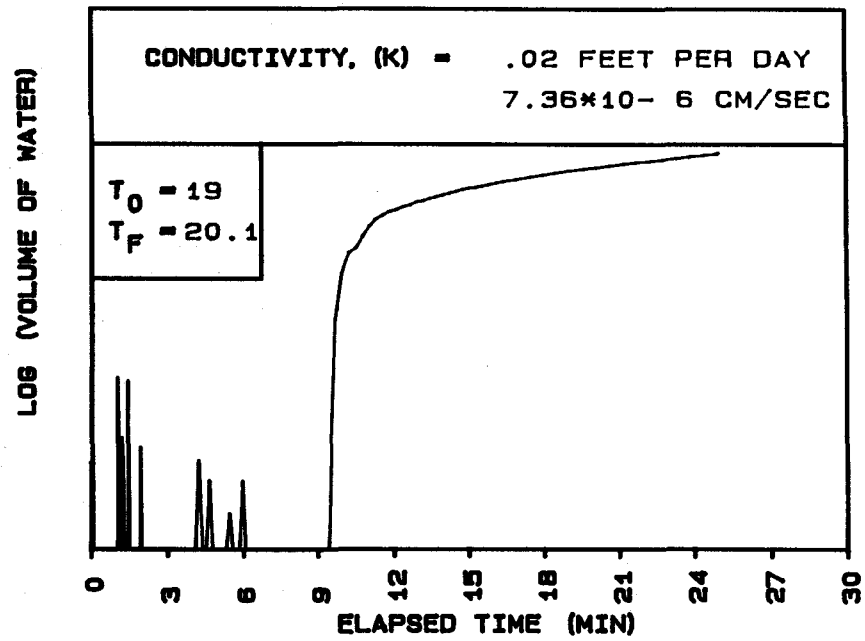
ENSAFE MEMPHIS NSA
LOCATION... 14H0811
TEST DATE
10: 23: 43 11-15-1995

SAMPLE DEPTH (FT) 11
GROUNDWATER DEPTH (FT) 5

HYDROCONE TEST



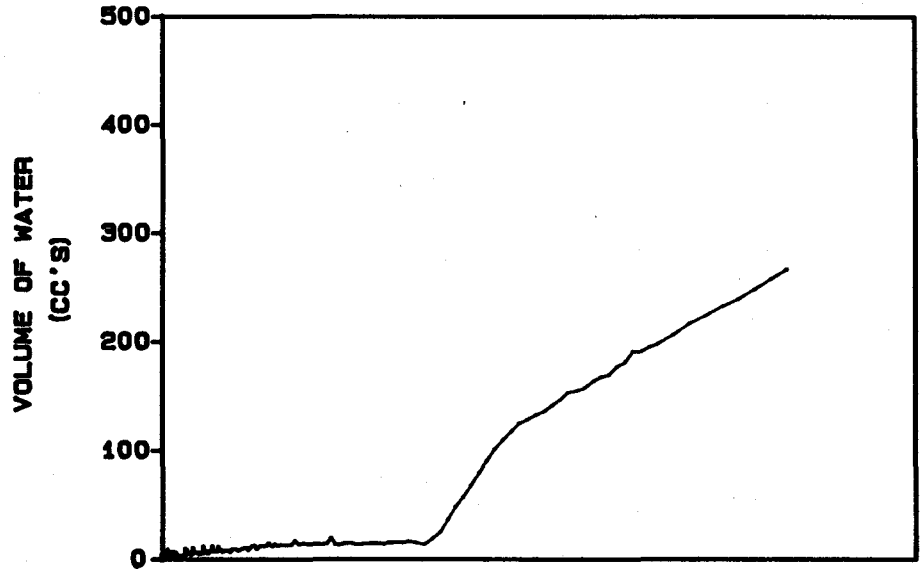


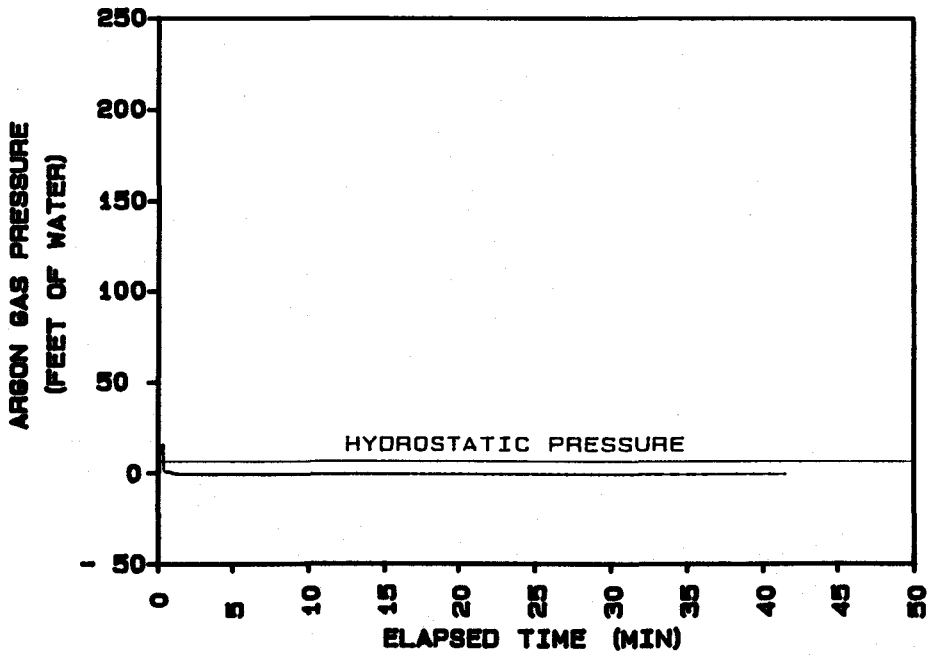


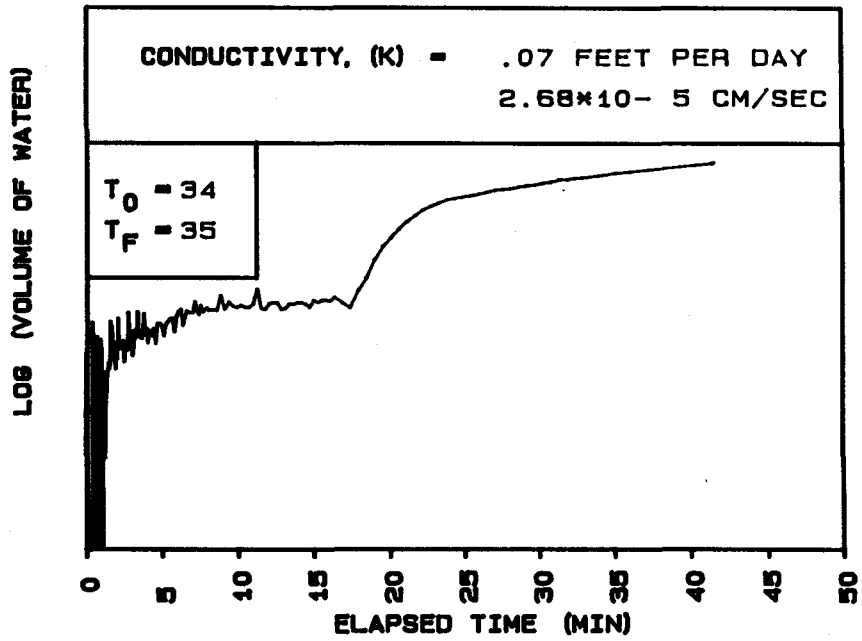
ENSAFE MEMPHIS NSA
LOCATION... 14H0840
TEST DATE
12: 44: 58 11-15-1995

SAMPLE DEPTH (FT) 40
GROUNDWATER DEPTH (FT) 11

HYDROCONE TEST



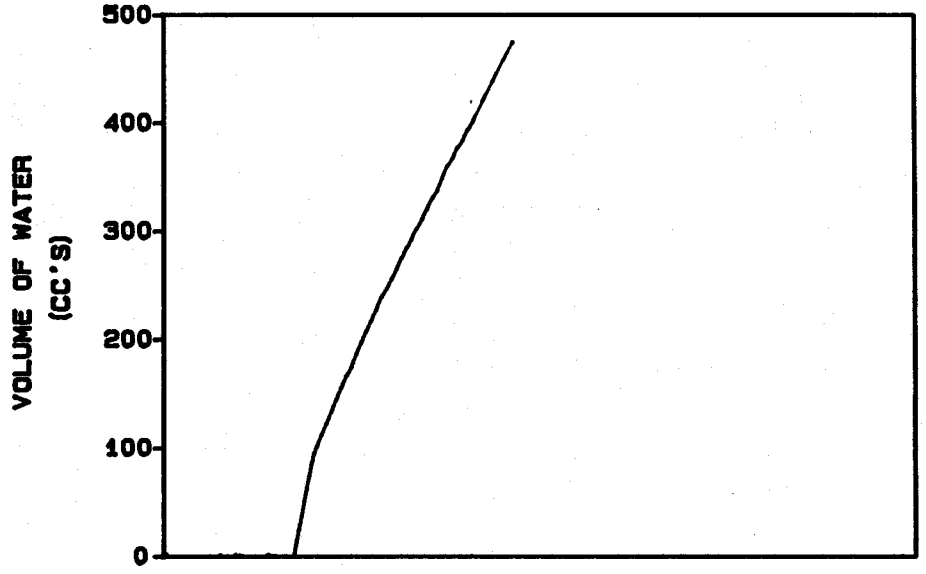


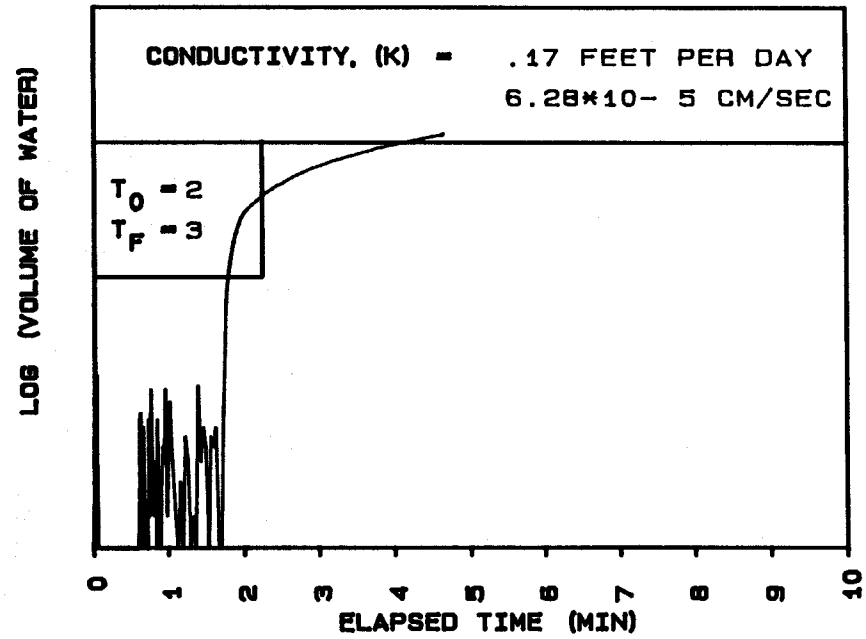


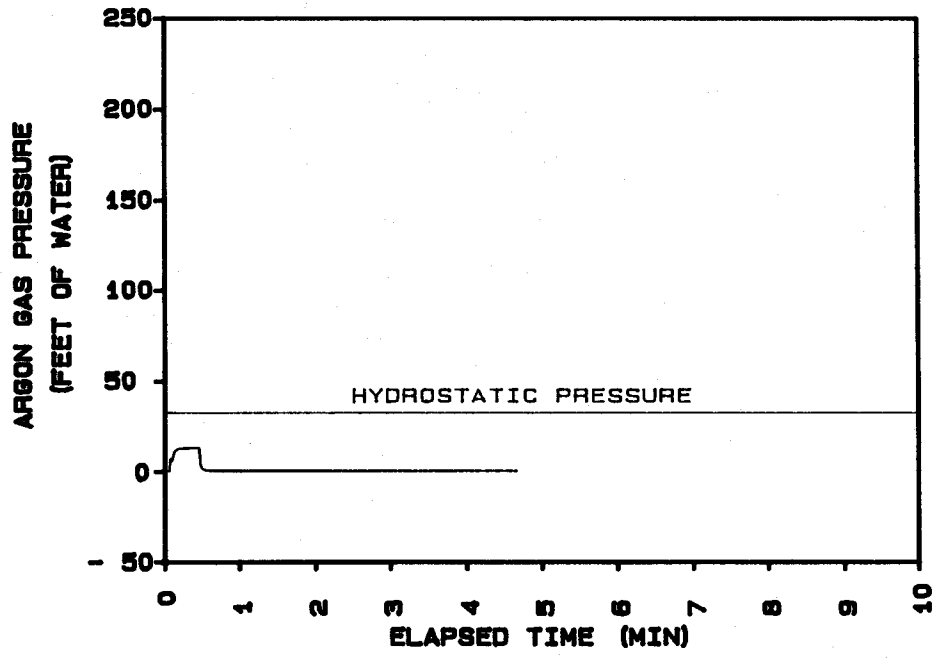
ENSAFE MEMPHIS NSA
LOCATION... 14H0911
TEST DATE
15: 00: 13 11-15-1995

SAMPLE DEPTH (FT) 11
GROUNDWATER DEPTH (FT) 5

HYDROCONE TEST







ENSAFE MEMPHIS NSA
LOCATION... 14H0943
TEST DATE
17: 08: 48 11-15-1995

SAMPLE DEPTH (FT) 43
GROUNDWATER DEPTH (FT) 11

HYDROCONE TEST

VOLUME OF WATER (CC'S)

DATA NOT AVAILABLE

LOG (VOLUME OF WATER)

CONDUCTIVITY, (K) =

T_0 =

T_F =

DATA NOT AVAILABLE

ELAPSED TIME (MIN)

ARGON GAS PRESSURE (FEET OF WATER)

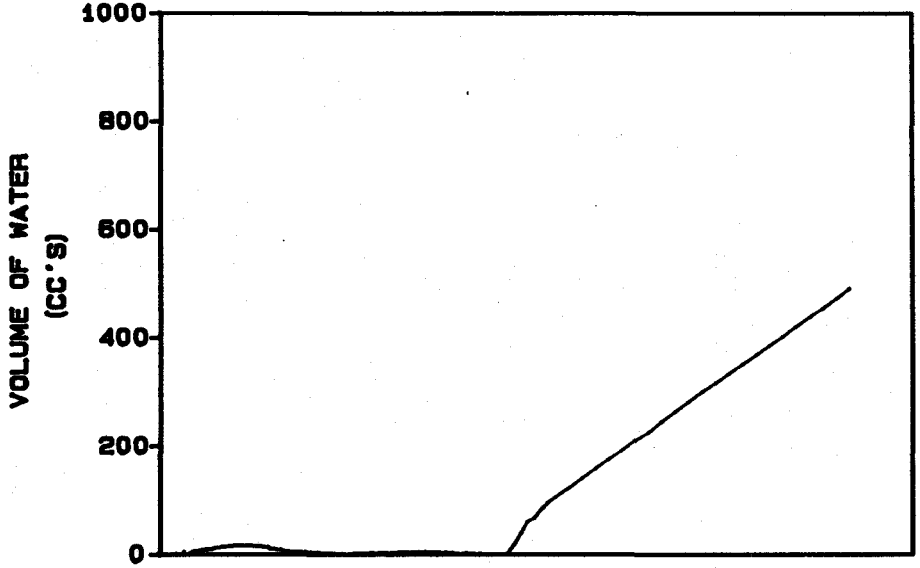
DATA NOT AVAILABLE

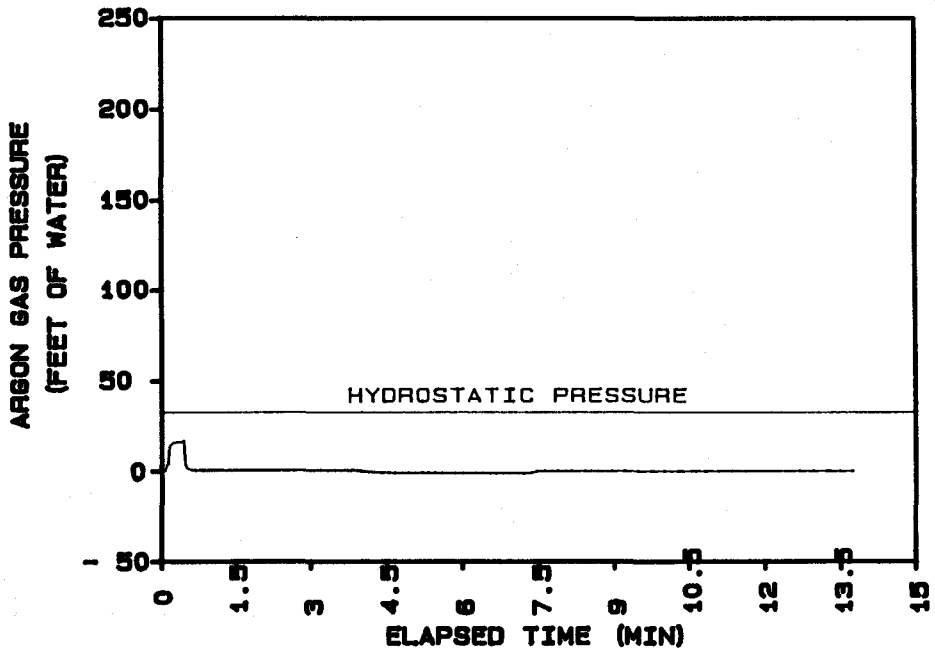
ELAPSED TIME (MIN)

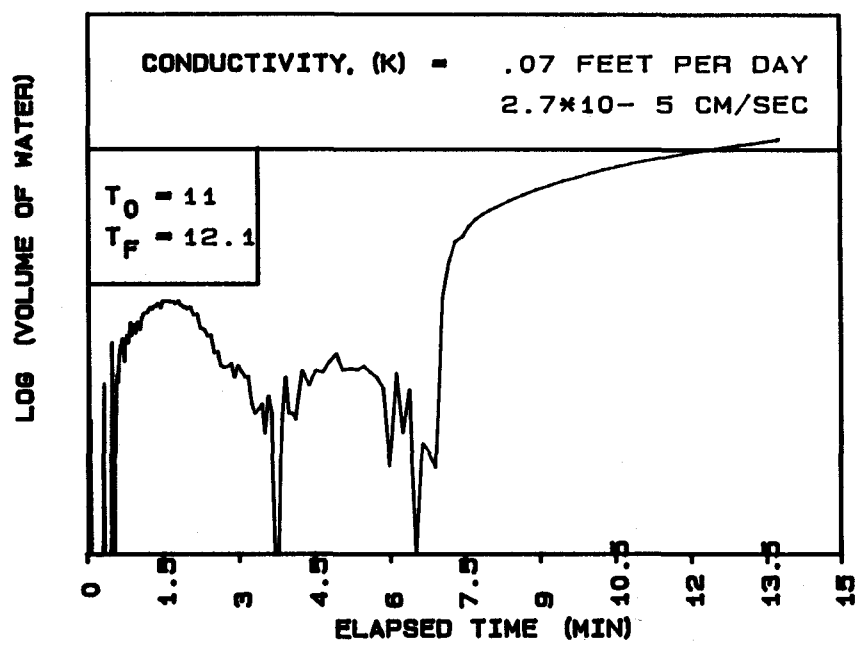
ENSAFE MEMPHIS NSA
LOCATION... 14H1011

DATA NOT AVAILABLE

HYDROCONE TEST



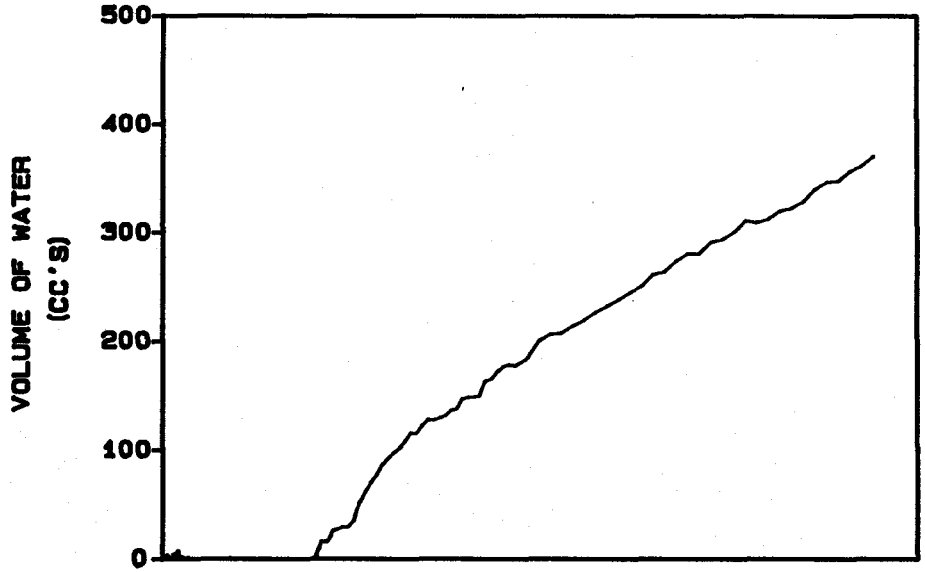


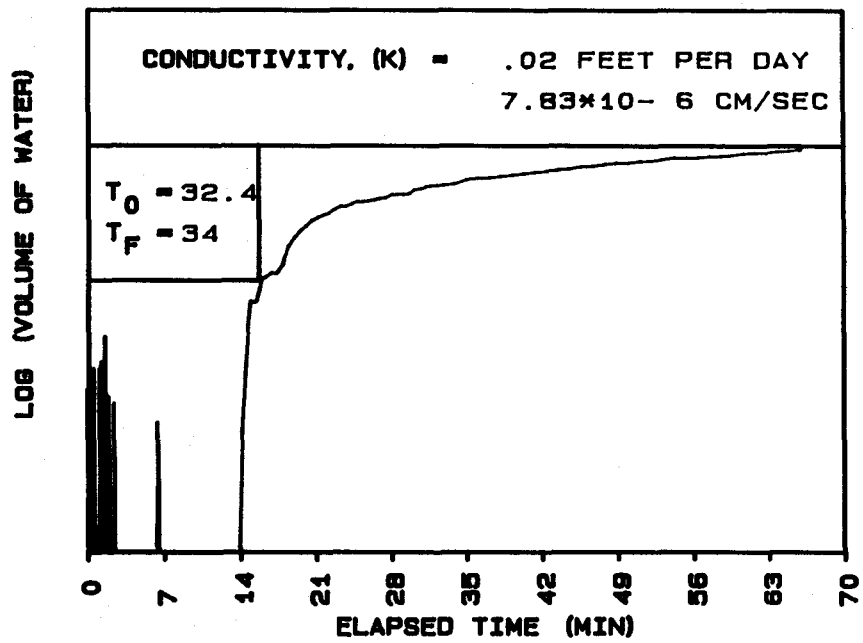


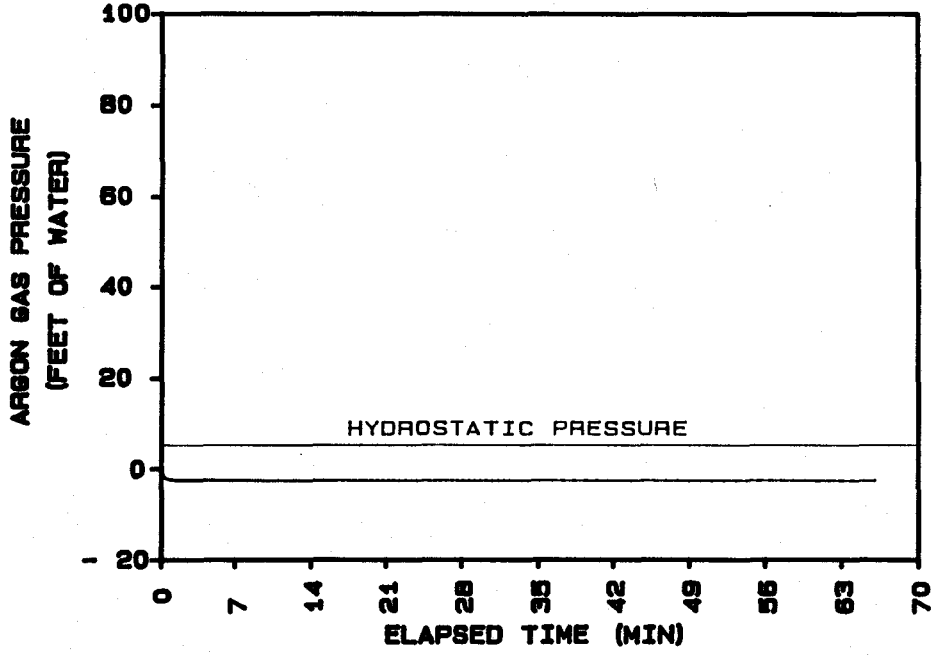
ENSAFE MEMPHIS NSA
LOCATION... 14H1043
TEST DATE
11: 23: 29 11-16-1995

SAMPLE DEPTH (FT) 43
GROUNDWATER DEPTH (FT) 11

HYDROCONE TEST



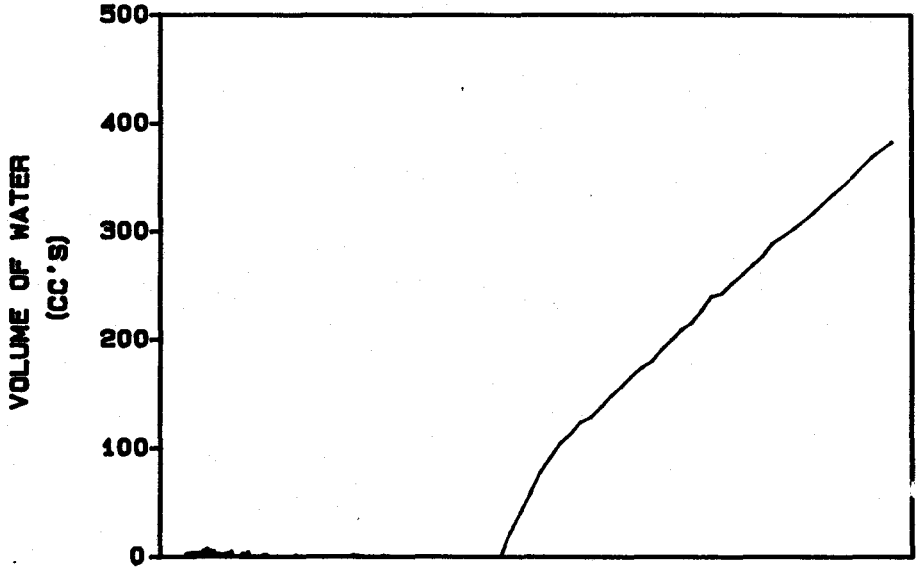


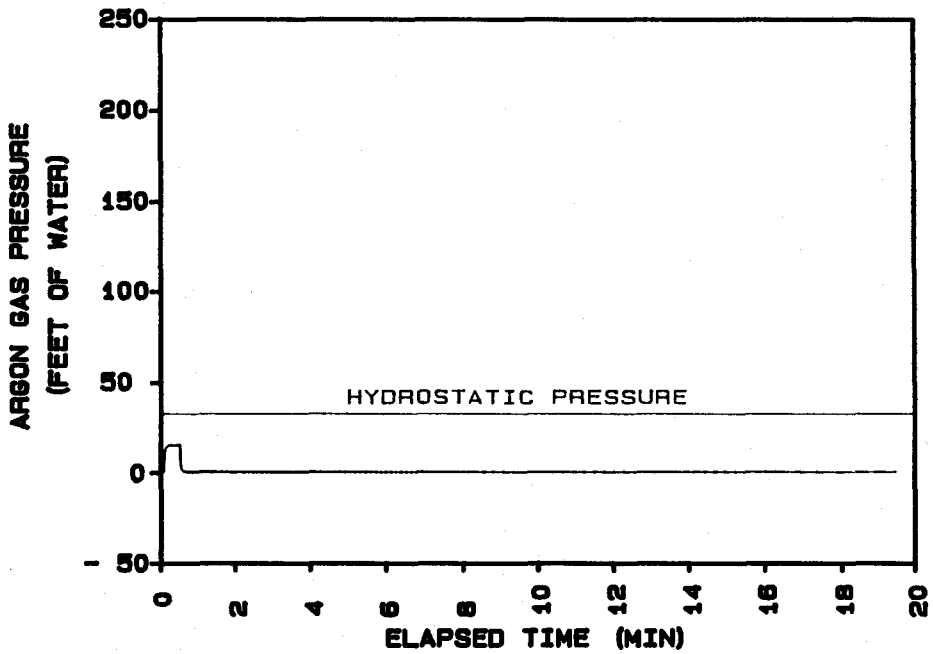


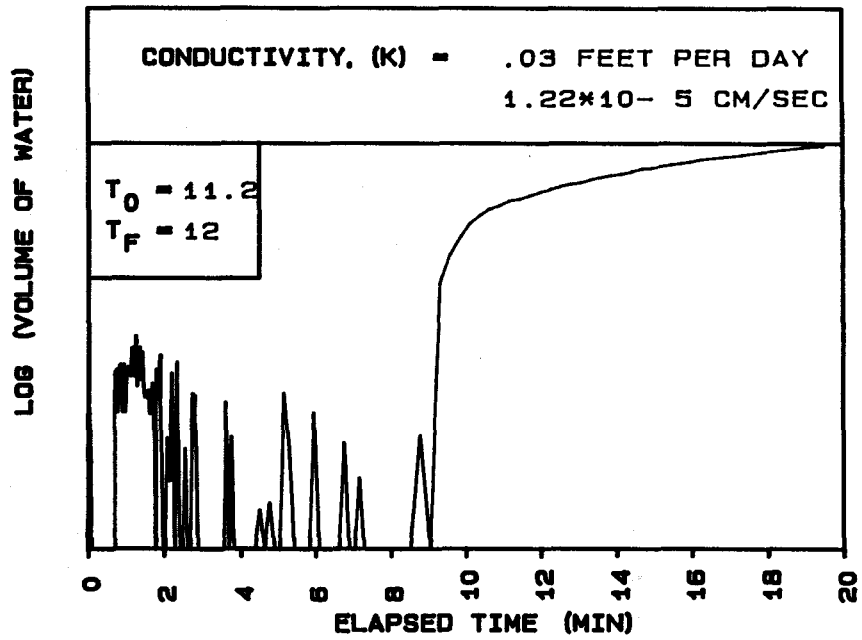
ENSAFE MEMPHIS NSA
LOCATION... 14H1110
TEST DATE
14: 17: 00 11-16-1995

SAMPLE DEPTH (FT) 10
GROUNDWATER DEPTH (FT) 5

HYDROCONE TEST



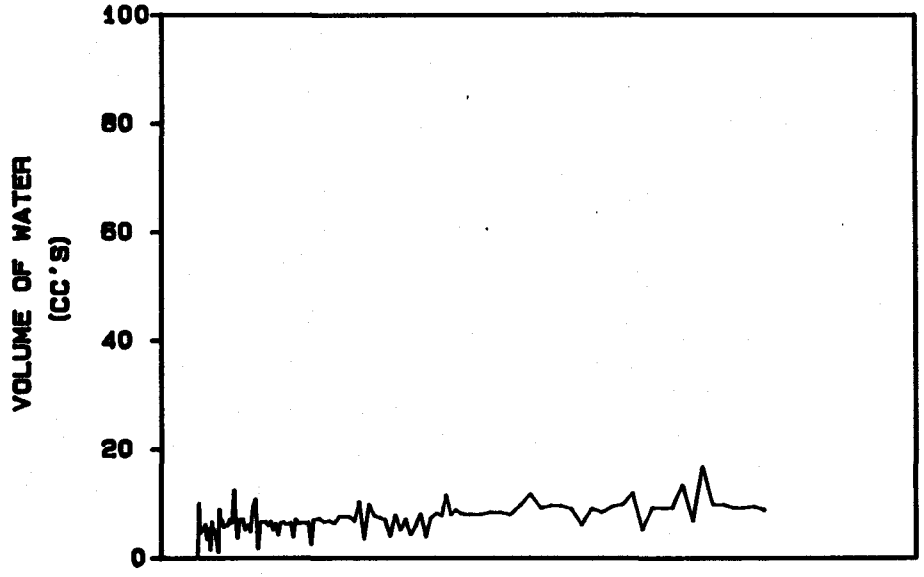


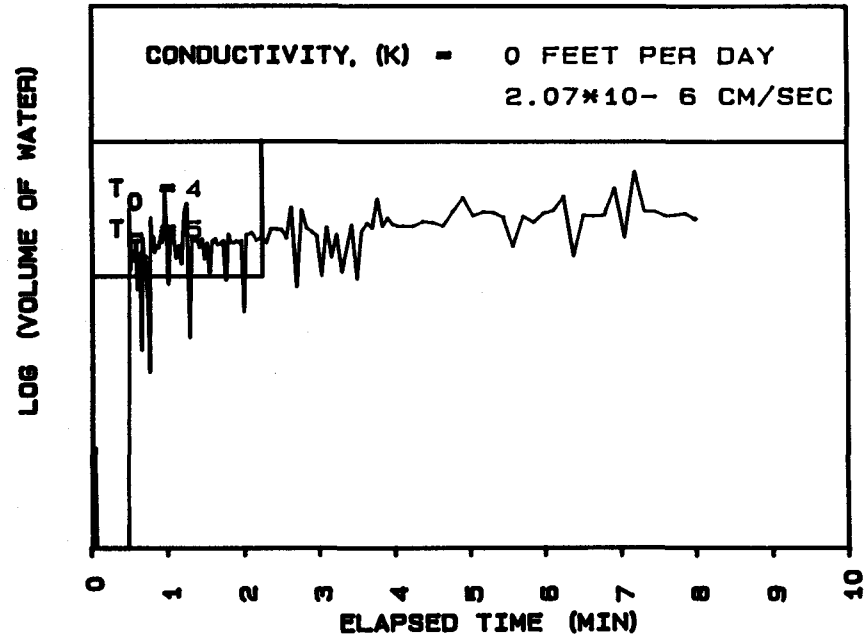


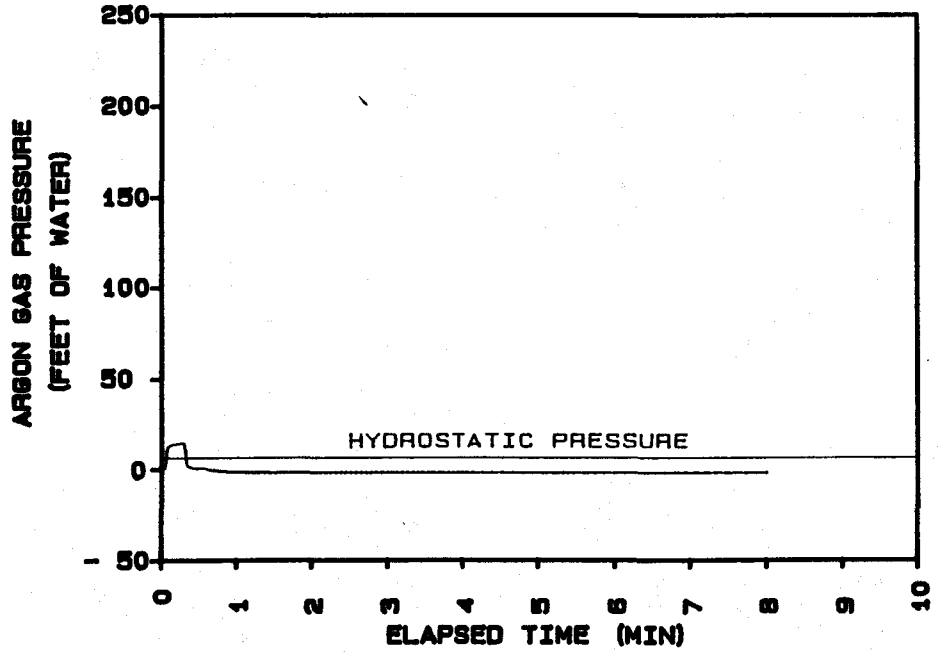
ENSAFE MEMPHIS NSA
LOCATION... 14H1143
TEST DATE
16: 15: 32 11-16-1995

SAMPLE DEPTH (FT) 43
GROUNDWATER DEPTH (FT) 11

HYDROCONE TEST



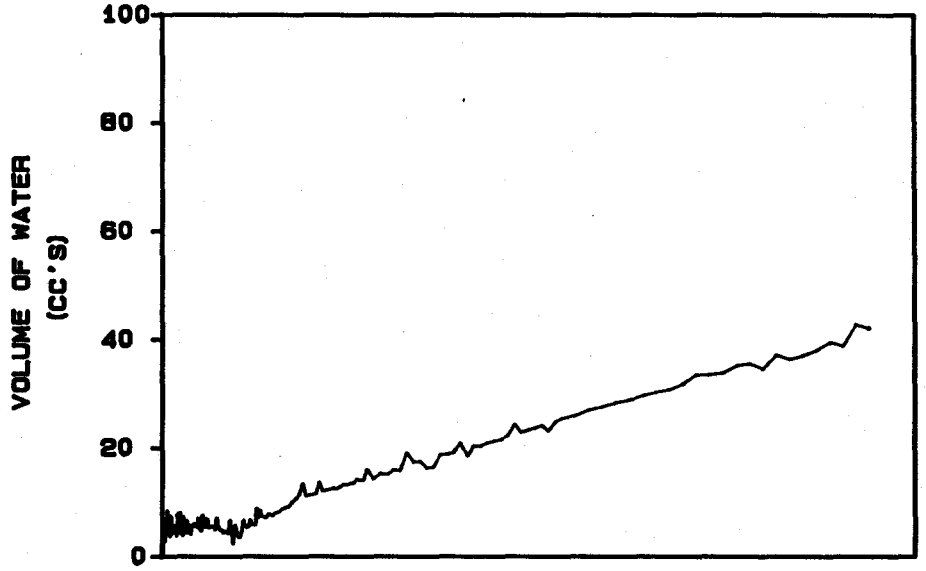


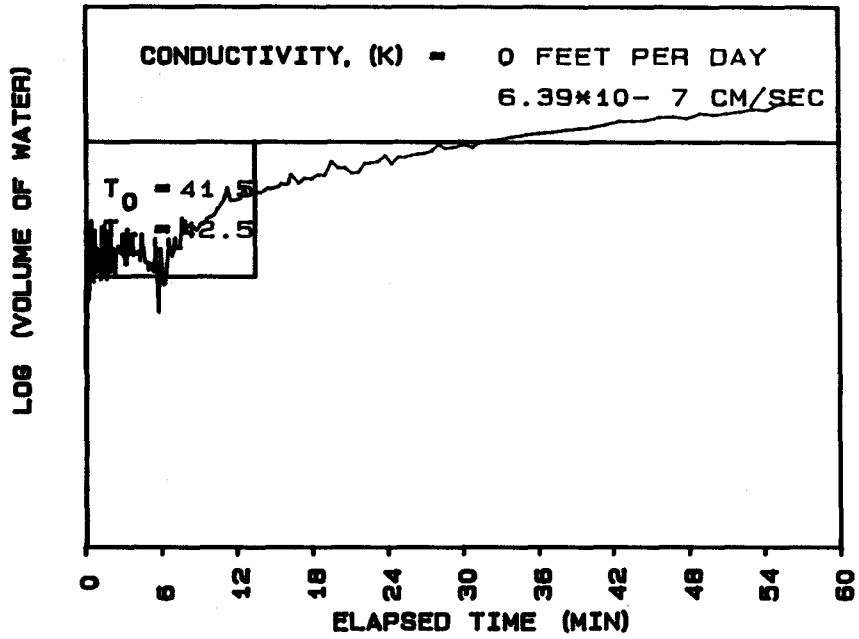


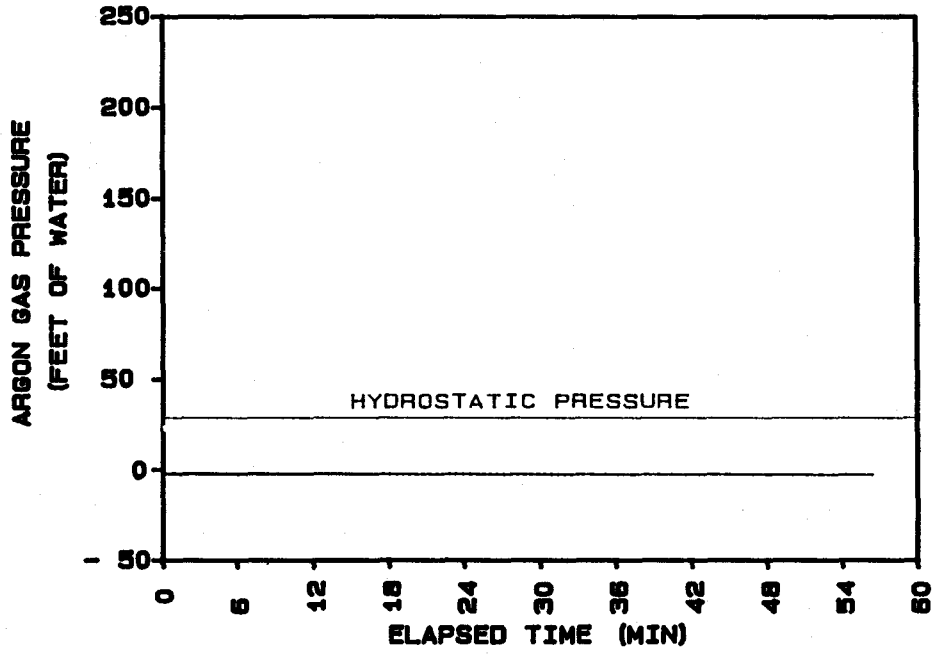
ENSAFE MEMPHIS NSA
LOCATION... 14H1211
TEST DATE
17: 51: 51 11-16-1995

SAMPLE DEPTH (FT) 11
GROUNDWATER DEPTH (FT) 5

HYDROCONE TEST



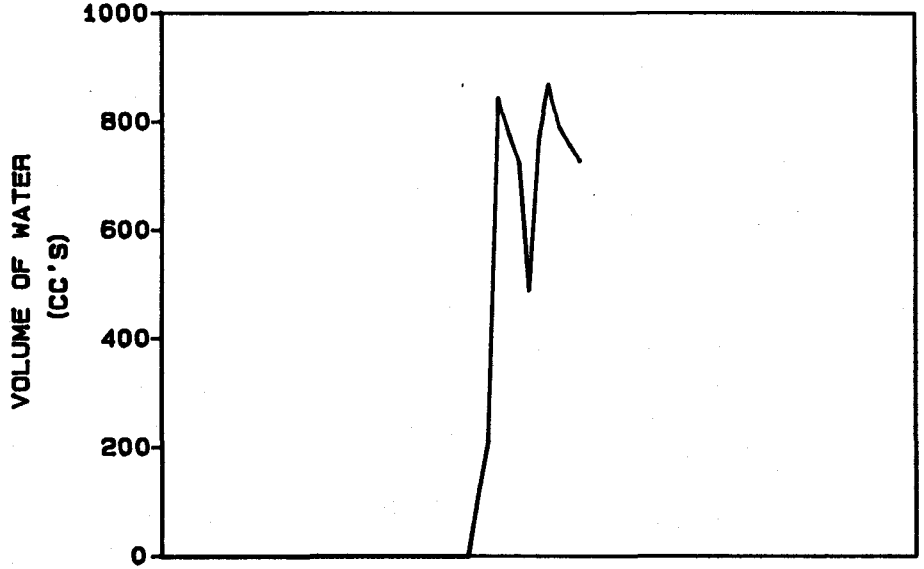


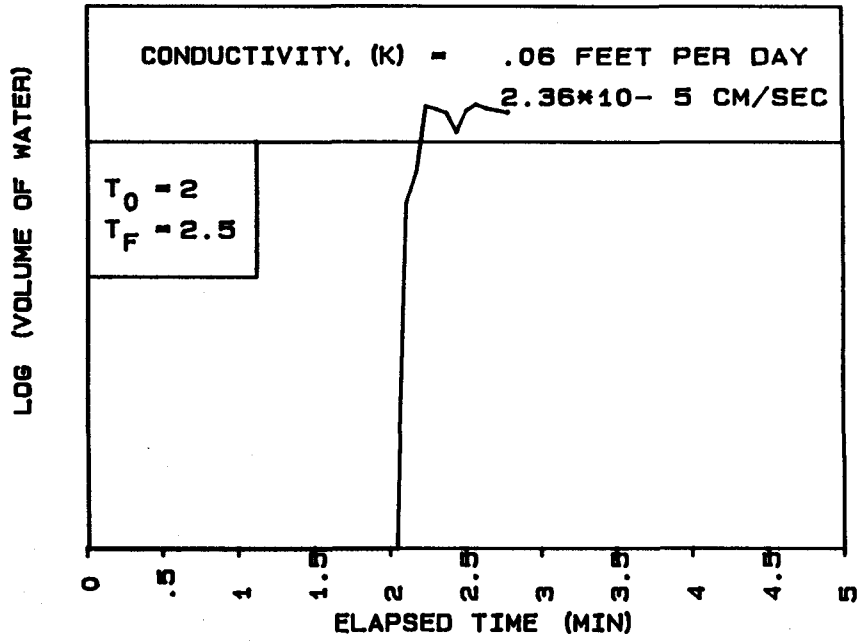


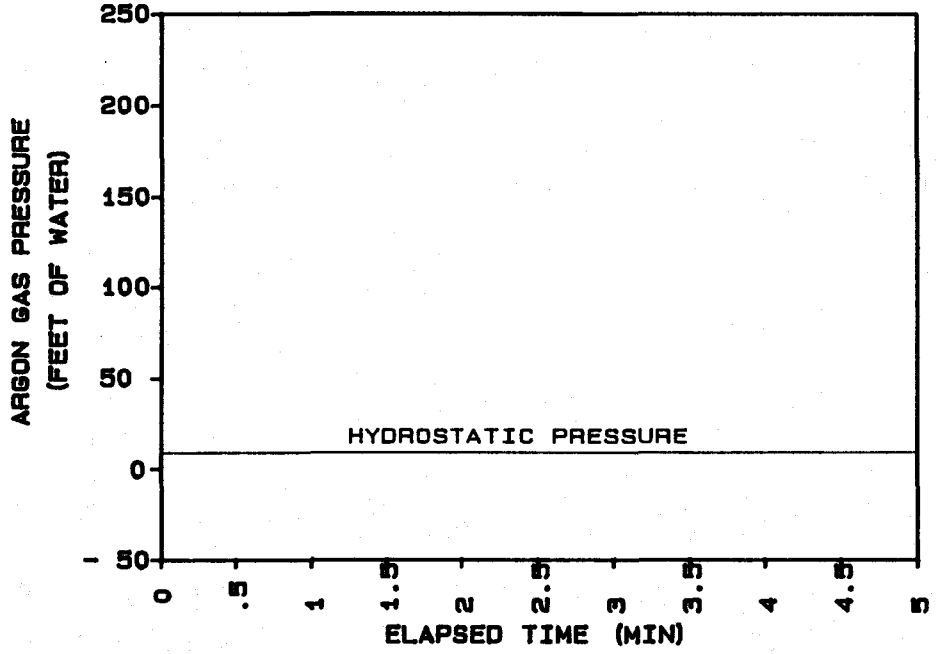
ENSAFE MEMPHIS NSA
LOCATION... 14H1239
TEST DATE
10: 28: 03 11-17-1995

SAMPLE DEPTH (FT) 39
GROUNDWATER DEPTH (FT) 11

HYDROCONE TEST



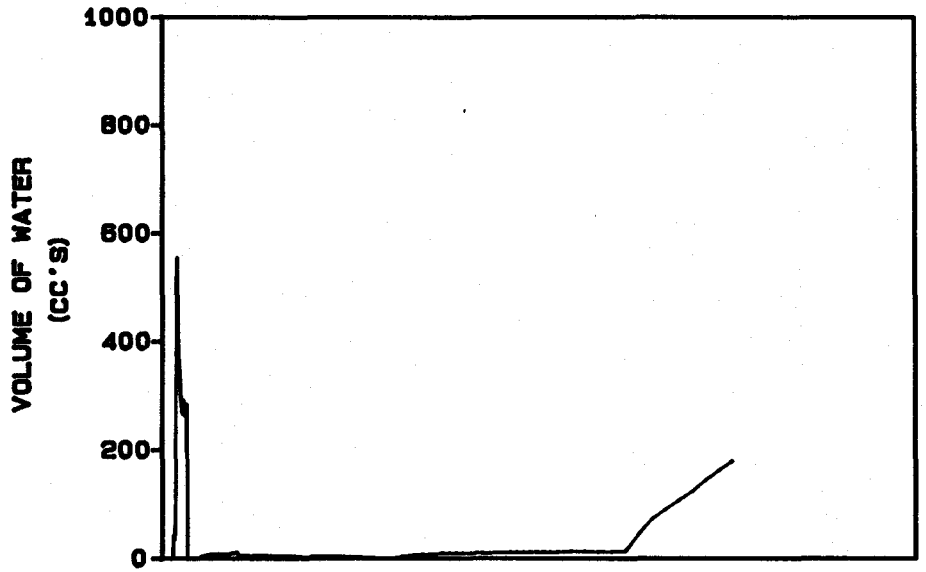


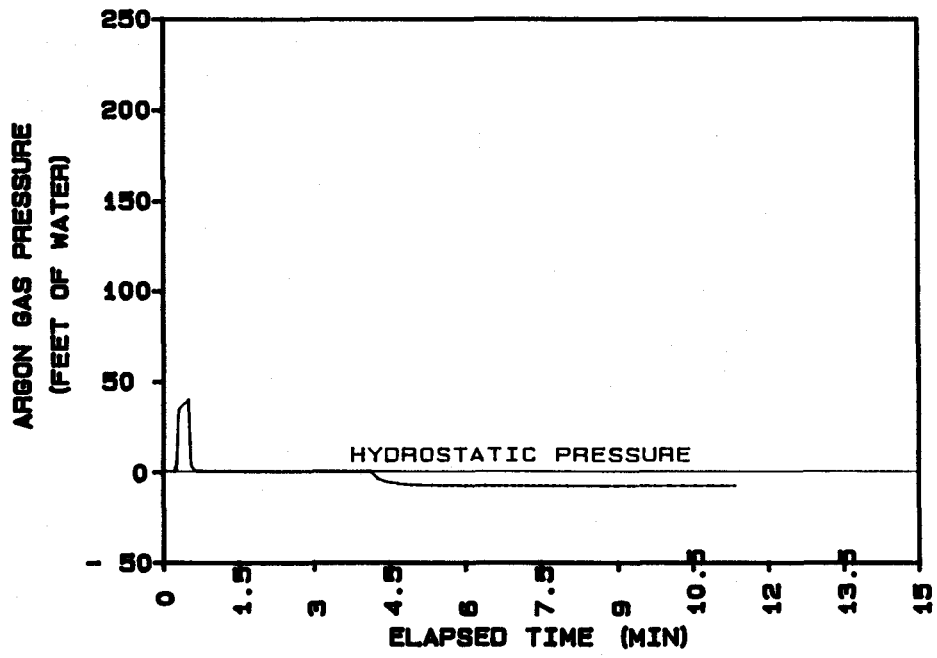


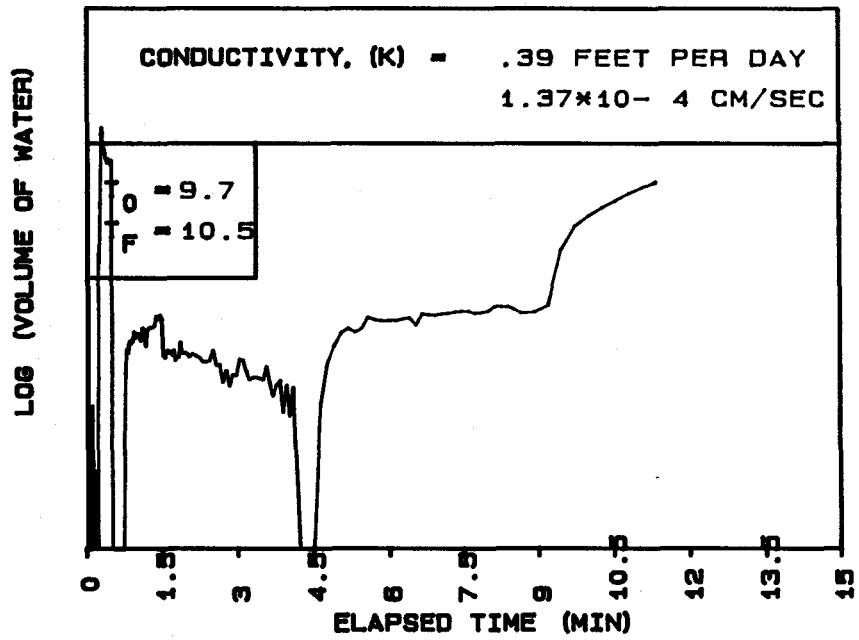
ENSAFE MEMPHIS NSA
LOCATION... 14H1313
TEST DATE
12: 24: 01 11-19-1995

SAMPLE DEPTH (FT) 13
GROUNDWATER DEPTH (FT) 5

HYDROCONE TEST



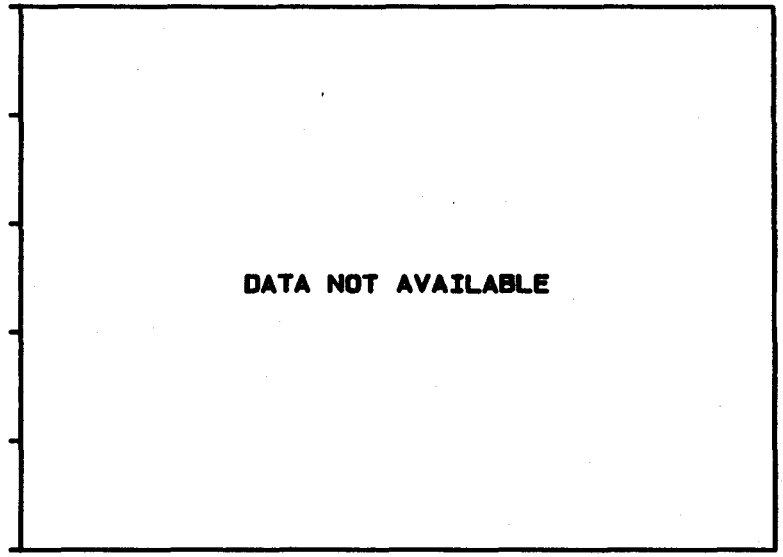


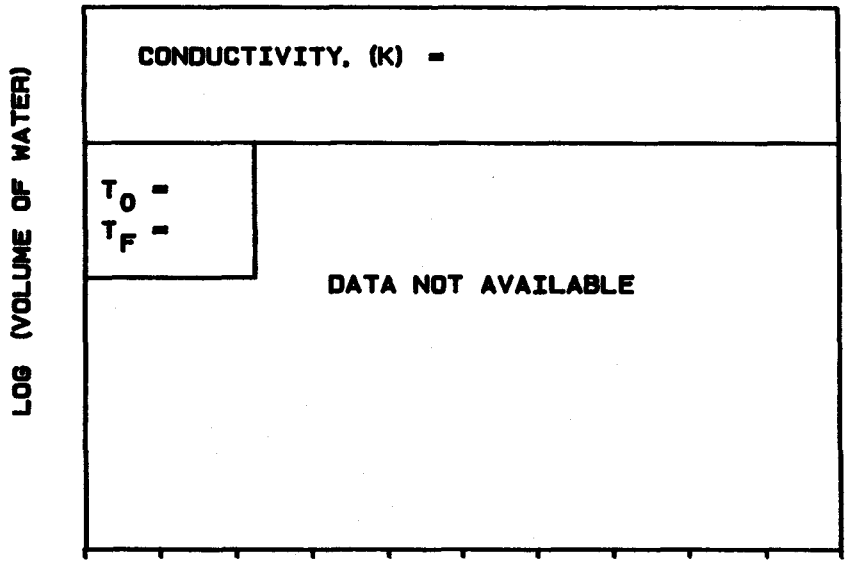


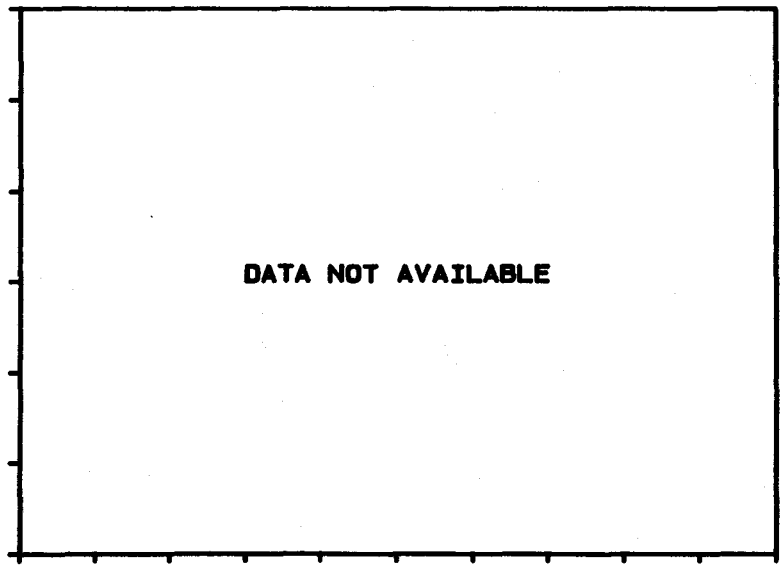
ENSAFE MEMPHIS NSA
LOCATION... 14H1411
TEST DATE
15: 30: 41 11-17-1995

SAMPLE DEPTH (FT) 11
GROUNDWATER DEPTH (FT) 11

HYDROCONE TEST







ENSAFE MEMPHIS NSA
LOCATION... 14H1437

DATA NOT AVAILABLE

HYDROCONE TEST

VOLUME OF WATER (CC'S)

DATA NOT AVAILABLE

LOG (VOLUME OF WATER)

CONDUCTIVITY, (K) =

T_O =

T_F =

DATA NOT AVAILABLE

ELAPSED TIME (MIN)

ARGON GAS PRESSURE (FEET OF WATER)

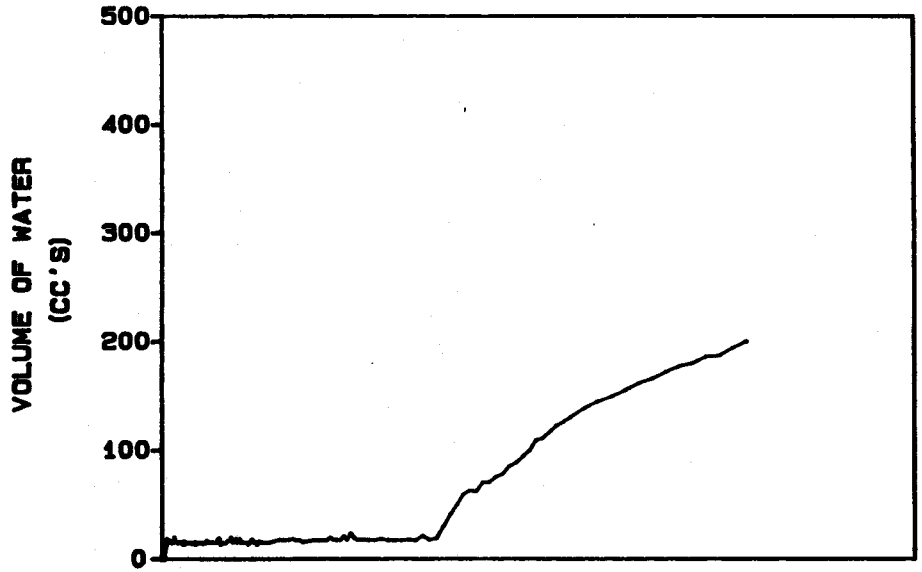
DATA NOT AVAILABLE

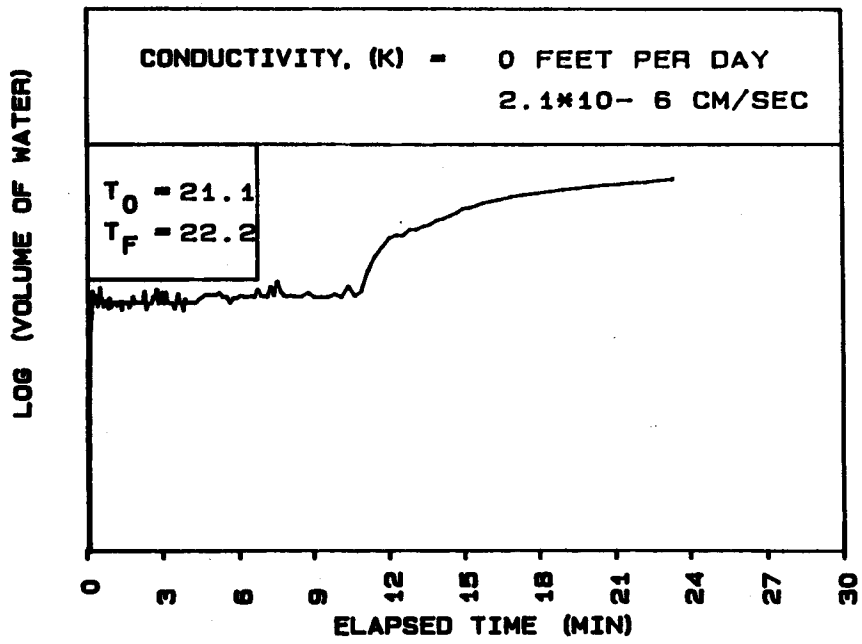
ELAPSED TIME (MIN)

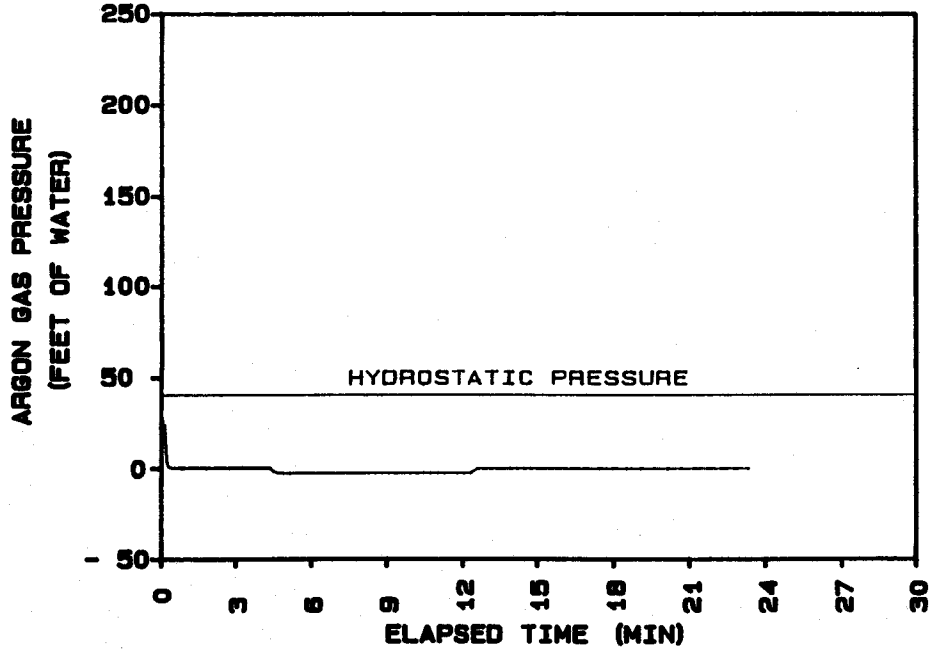
ENSAFE MEMPHIS NSA
LOCATION... 14H1513

DATA NOT AVAILABLE

HYDROCONE TEST







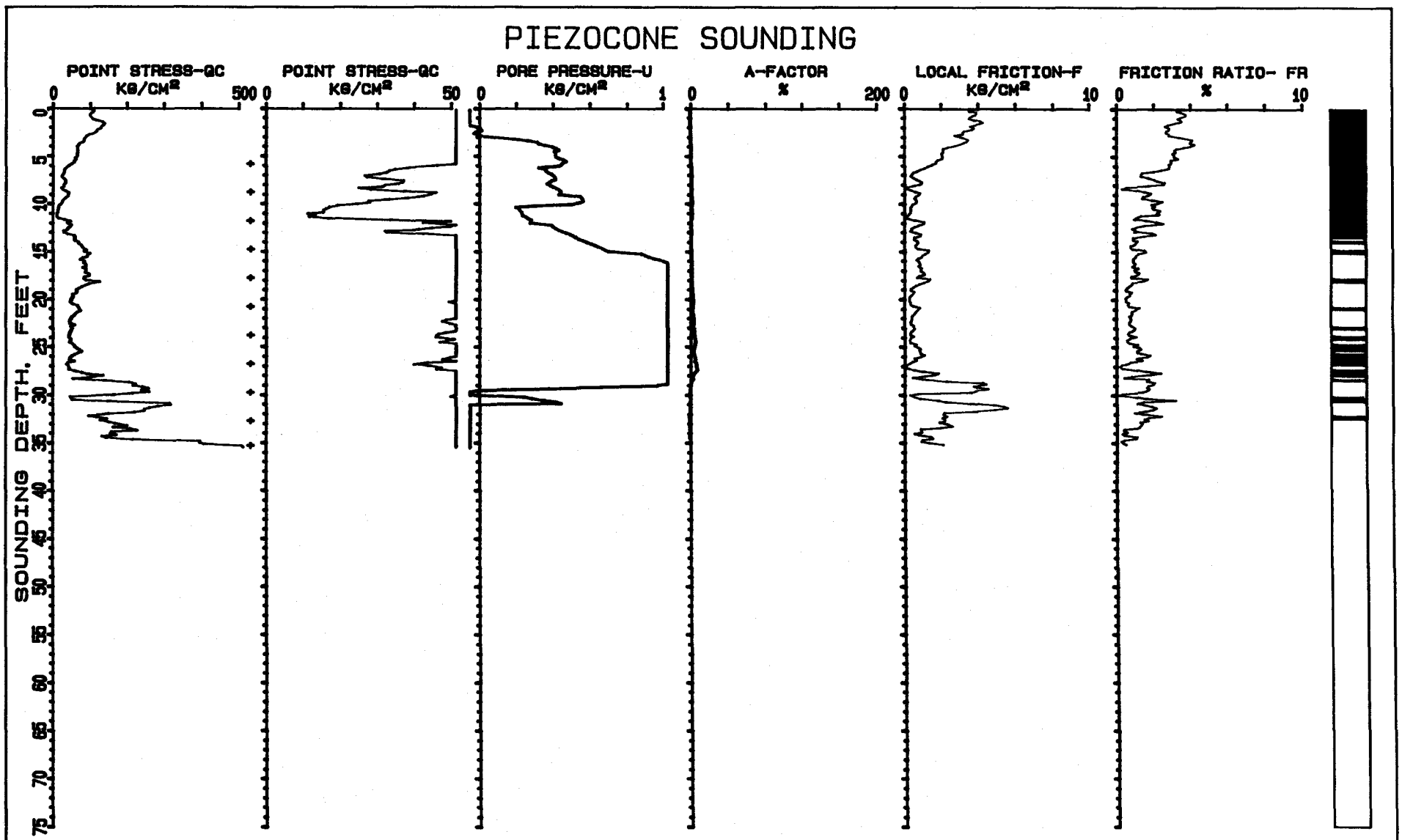
ENSAFE MEMPHIS NSA
LOCATION... 14H1543
TEST DATE
16: 50: 37 11-18-1995

SAMPLE DEPTH (FT) 45
GROUNDWATER DEPTH (FT) 5

SWMU 65

DPT SCREENING INVESTIGATION RESULTS

PIEZOCONE SOUNDING



+ PUSH INTERRUPTED TO ADD ROD
PORE PRESSURE DECAY DATA MAY BE AVAILABLE

FILE #..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
SOUNDING # 65-P01
TEST DATE 11-08-1995 11:28:58

IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE
FOR SOUTHEASTERN UNITED STATES SOILS

JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
FILE NAME..... 65-P01

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES #	N'	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	CLAYEY FINE SAND	104.2	3.7	41	41	.03	>90%	>48	229	--	--	--	--
2	CLAYEY FINE SAND	124.6	3.89	49	49	.061	>90%	>48	274	--	--	--	--
3	SILTY TO CLAYEY F.S.	114.3	3.24	38	38	.092	>90%	>48	251	--	--	--	--
4	CLAYEY FINE SAND	80.4	3.07	32	32	.123	70%-80%	>48	176	--	--	--	--
5	CLAYEY FINE SAND	66.8	2.14	26	26	.153	70%-80%	46-48	146	--	--	--	--
6	CLAYEY FINE SAND	61.2	1.77	24	24	.184	70%-80%	46-48	134	--	--	--	--
7	CLAYEY FINE SAND	38.6	.74	15	15	.215	50%-60%	42-44	84	--	--	--	--
8	CLAYEY FINE SAND	32.2	.67	12	12	.246	50%-60%	42-44	70	--	--	--	--
9	SILTY TO CLAYEY F.S.	33.7	.47	11	11	.276	50%-60%	40-42	74	--	--	--	--
10	SILTY TO CLAYEY F.S.	37.2	.62	12	12	.307	50%-60%	40-42	81	--	--	--	--
11	CLAYEY FINE SAND	19.5	.35	7	7	.338	<40%	38-40	42	--	--	--	--
12	CLAYEY FINE SAND	21.7	.49	8	8	.369	<40%	38-40	47	--	--	--	--
13	SILTY TO CLAYEY F.S.	44.6	.59	14	14	.399	50%-60%	40-42	98	--	--	--	--
14	SILTY TO CLAYEY F.S.	49.3	.71	16	16	.43	50%-60%	40-42	108	--	--	--	--
15	SILTY FINE SAND	76.5	.9	19	19	.461	60%-70%	42-44	168	--	--	--	--
16	SILTY FINE SAND	86.6	.87	21	21	.492	70%-80%	42-44	190	--	--	--	--
17	SILTY FINE SAND	84.2	.88	21	21	.523	60%-70%	42-44	185	--	--	--	--
18	SILTY FINE SAND	89.4	1.06	22	22	.553	60%-70%	42-44	196	--	--	--	--
19	SILTY FINE SAND	87.6	.6	21	21	.584	60%-70%	42-44	192	--	--	--	--
20	SILTY FINE SAND	59	.36	14	14	.615	50%-60%	40-42	129	--	--	--	--
21	SILTY FINE SAND	59.2	.53	14	14	.646	50%-60%	40-42	130	--	--	--	--
22	SILTY FINE SAND	65	.5	16	16	.676	50%-60%	40-42	143	--	--	--	--
23	SILTY FINE SAND	52.3	.43	13	13	.707	40%-50%	38-40	115	--	--	--	--
24	SILTY FINE SAND	49.2	.36	12	12	.738	40%-50%	38-40	108	--	--	--	--
25	SILTY TO CLAYEY F.S.	52.3	.52	17	17	.769	40%-50%	38-40	115	--	--	--	--
26	SILTY TO CLAYEY F.S.	65.4	.85	21	21	.799	50%-60%	40-42	143	--	--	--	--
27	SILTY FINE SAND	48.1	.3	12	12	.83	<40%	38-40	105	--	--	--	--
28	SILTY TO CLAYEY F.S.	60.9	1.04	20	20	.861	40%-50%	38-40	133	--	--	--	--
29	SILTY FINE SAND	147.2	2.65	36	36	.892	70%-80%	42-44	323	--	--	--	--
30	FINE SAND	229.5	2.52	45	45	.925	>90%	44-46	504	--	--	--	--

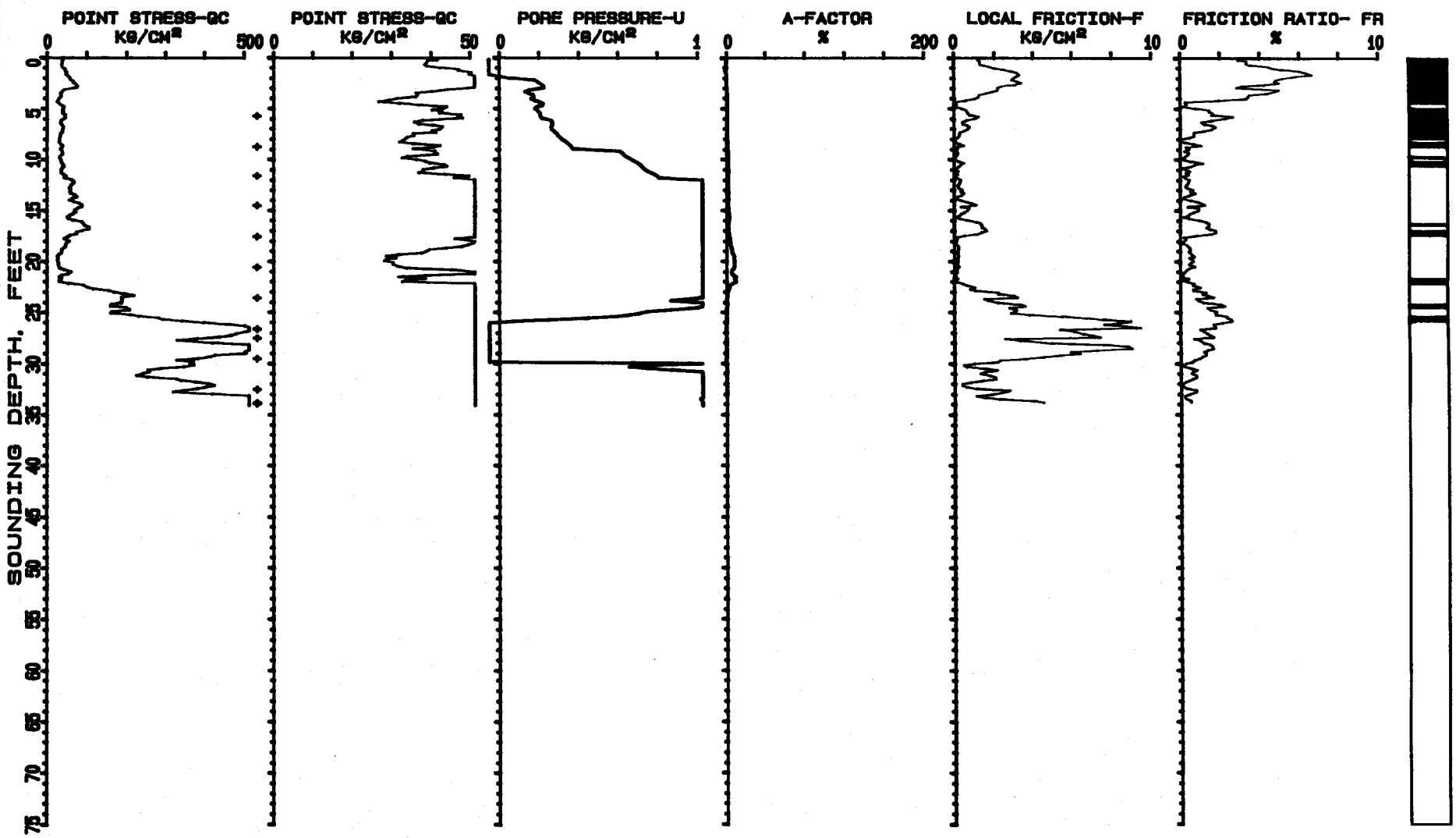
DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES	N'	VERTICAL STRESS	RELATIVE DENSITY	FRICTION ANGLE	YOUNGS MODULUS	UNDRAINED SHEAR ST	SENSITIVITY	COMP.	OCR
31	SILTY FINE SAND	159.3	2.76	39	39	.956	70%-80%	42-44	350	--	--	--	--
32	SILTY FINE SAND	248.2	3.77	62	62	.986	>90%	44-46	546	--	--	--	--
33	SILTY FINE SAND	137.3	2.22	34	34	1.017	70%-80%	42-44	302	--	--	--	--
34	FINE SAND	183.6	1.22	36	36	1.05	80%-90%	42-44	403	--	--	--	--

\# N'=POINT STRESS*(.2+.04*FRICTION RATIO)
* NORMALLY CONSOLIDATED SANDS
** FOR OVERCONSOLIDATED SANDS,SLIGHTLY REDUCE ABOVE FRICTION ANGLES
*** FOR OVERCONSOLIDATED SANDS, YOUNG'S MODULUS MAY BE AS MUCH AS 3 TO 6 TIMES HIGHER
**** NK OF 16 USED. FOR OVERCONSOLIDATED CLAYS, AN NK OF 17 IS SUGGESTED

THE ABOVE DATA WAS COMPUTED FOLLOWING 'BASIC' GUIDELINES BY P. K. ROBERTSON AND R. G. CAMPANELLA IN THE HANDBOOK 'GUIDELINES FOR USE AND INTERPERTATION OF THE ELECTRONIC CONE PENETRATION TEST'

ADDITIONAL LOCAL CORRELATIONS DEVELOPED BY IN-SITU TECHNOLOGY HAVE ALSO BEEN USED IN COMPUTING THE ABOVE DATA. IT IS THE POLICY OF IN-SITU TECHNOLOGY TO CONTINUALLY UPGRADE AND MODIFY C.P.T CORRELATIONS AS PUBLISHED RESEARCH AND LOCAL EXPERIENCE GROWS.

PIEZOCONE SOUNDING



◆ PUSH INTERRUPTED TO ADD ROD
PORE PRESSURE DECAY DATA MAY BE AVAILABLE

FILE #..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
SOUNDING # 65-P06
TEST DATE 11-08-1995 09:35:45

IN-SITU TECHNOLOGY SOIL BEHAVIOR TABLE
FOR SOUTHEASTERN UNITED STATES SOILS

JOB NAME ..... ENSAFE
MEMPHIS NSA
MILLINGTON TENNESSEE
FILE NAME..... 65-P06

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES #	N'	VERTICAL EFFECTIVE STRESS (KG/CM2)	RELATIVE DENSITY (%) *	FRICTION ANGLE (DEGREES) **	YOUNGS MODULUS (KG/CM2) ***	UNDRAINED SHEAR STRENGTH (KG/CM2) ****	SENSITIVITY	COMP.	OCR
1	SILTY CLAY TO CLAY	39.5	1.74	26	26	.027	--	--	--	2.46	2.2	UD	>6
2	CLAY	49.9	2.97	49	49	.052	--	--	--	3.11	1.6	UD	>6
3	SANDY CLAY	68.4	2.77	34	34	.079	--	--	--	4.26	2.4	0	>6
4	SANDY CLAY	44.9	1.55	22	22	.106	--	--	--	2.79	2.8	.01	>6
5	SILTY TO CLAYEY F.S.	35	.29	11	11	.137	60%-70%	44-46	77	--	--	--	--
6	SILTY TO CLAYEY F.S.	44.5	.8	14	14	.168	60%-70%	44-46	97	--	--	--	--
7	SILTY TO CLAYEY F.S.	40.6	.57	13	13	.199	60%-70%	44-46	89	--	--	--	--
8	SILTY TO CLAYEY F.S.	37.5	.2	12	12	.23	50%-60%	42-44	82	--	--	--	--
9	SILTY FINE SAND	36	.05	9	9	.26	50%-60%	42-44	79	--	--	--	--
10	SILTY FINE SAND	37.6	.04	9	9	.291	50%-60%	42-44	82	--	--	--	--
11	SILTY FINE SAND	39.1	.11	9	9	.322	50%-60%	40-42	86	--	--	--	--
12	SILTY FINE SAND	42	.03	10	10	.353	50%-60%	40-42	92	--	--	--	--
13	SILTY FINE SAND	60.9	.26	15	15	.383	60%-70%	42-44	133	--	--	--	--
14	SILTY FINE SAND	64.3	.3	16	16	.414	60%-70%	42-44	141	--	--	--	--
15	SILTY FINE SAND	76.1	.67	19	19	.445	70%-80%	42-44	167	--	--	--	--
16	SILTY FINE SAND	63	.44	15	15	.476	60%-70%	42-44	138	--	--	--	--
17	SILTY TO CLAYEY F.S.	92	1.39	30	30	.506	60%-70%	42-44	202	--	--	--	--
18	SILTY FINE SAND	66.4	.45	16	16	.537	50%-60%	40-42	146	--	--	--	--
19	SILTY FINE SAND	46.9	.15	11	11	.568	40%-50%	40-42	103	--	--	--	--
20	SILTY TO CLAYEY F.S.	32.1	.17	10	10	.599	<40%	36-38	70	--	--	--	--
21	SILTY TO CLAYEY F.S.	33.2	.15	11	11	.629	<40%	36-38	73	--	--	--	--
22	SILTY FINE SAND	43.7	.02	10	10	.66	40%-50%	38-40	96	--	--	--	--
23	SILTY FINE SAND	94.7	1.03	23	23	.691	60%-70%	42-44	208	--	--	--	--
24	FINE SAND	191.2	2.28	38	38	.724	80%-90%	44-46	420	--	--	--	--
25	SILTY FINE SAND	181.1	2.97	45	45	.755	80%-90%	44-46	398	--	--	--	--
26	SILTY TO CLAYEY F.S.	240.2	6.24	80	80	.786	>90%	44-46	528	--	--	--	--
27	FINE SAND	468.2	7.43	93	93	.819	>90%	>48	1030	--	--	--	--
28	FINE SAND	435.9	5.27	87	87	.852	>90%	46-48	958	--	--	--	--
29	FINE SAND	486.7	6.91	97	97	.885	>90%	>48	1070	--	--	--	--
30	DENSE OR CEMENTED S.	399.6	2.76	66	66	.922	>90%	46-48	879	--	--	--	--

65-P06 CONTINUED ENSAFE

DEPTH FEET	SOIL BEHAVIOR TYPE	PT (KG/CM2)	LF (KG/CM2)	N VALUES	N'	VERTICAL STRESS	RELATIVE DENSITY	FRICTION ANGLE	YOUNGS MODULUS	UNDRAINED SHEAR ST	SENSITIVITY	COMP.	OCR
31	DENSE OR CEMENTED S.	304.4	1.29	50	50	.959	>90%	44-46	669	--	--	--	--
32	DENSE OR CEMENTED S.	311.2	1.24	51	51	.995	>90%	44-46	684	--	--	--	--
33	DENSE OR CEMENTED S.	386.8	1.45	64	64	1.032	>90%	46-48	850	--	--	--	--

\# N'=POINT STRESS*(.2+.04*FRICTION RATIO)
* NORMALLY CONSOLIDATED SANDS
** FOR OVERCONSOLIDATED SANDS,SLIGHTLY REDUCE ABOVE FRICTION ANGLES
*** FOR OVERCONSOLIDATED SANDS, YOUNG'S MODULUS MAY BE AS MUCH AS 3 TO 6 TIMES HIGHER
**** NK OF 16 USED. FOR OVERCONSOLIDATED CLAYS, AN NK OF 17 IS SUGGESTED

THE ABOVE DATA WAS COMPUTED FOLLOWING 'BASIC' GUIDELINES BY P. K. ROBERTSON AND R. G. CAMPANELLA IN THE HANDBOOK 'GUIDELINES FOR USE AND INTERPERTATION OF THE ELECTRONIC CONE PENETRATION TEST'

ADDITIONAL LOCAL CORRELATIONS DEVELOPED BY IN-SITU TECHNOLOGY HAVE ALSO BEEN USED IN COMPUTING THE ABOVE DATA. IT IS THE POLICY OF IN-SITU TECHNOLOGY TO CONTINUALLY UPGRADE AND MODIFY C.P.T CORRELATIONS AS PUBLISHED RESEARCH AND LOCAL EXPERIENCE GROWS.

LEGEND

SWMU 14 — SWMU NO. AND LOCATION

260 — CONTOURS (4' INTERVAL)

600 0 600
SCALE FEET

SOURCE: U.S. NAVY

RFI REPORT
NSA MEMPHIS
MILLINGTON, TN.

FIGURE 1
LAND SURFACE ELEVATION MAP
SOUTHSIDE OF NSA MEMPHIS

Dr by: E/AH	Tr by: E/AH	
Ck by: A. CHOATE	App by: E/AH	Sheet 1
Date: 01/12/98	DWG Name: 106SEMSO	Of 1

GEOLOGICAL LOGGING SYSTEMS

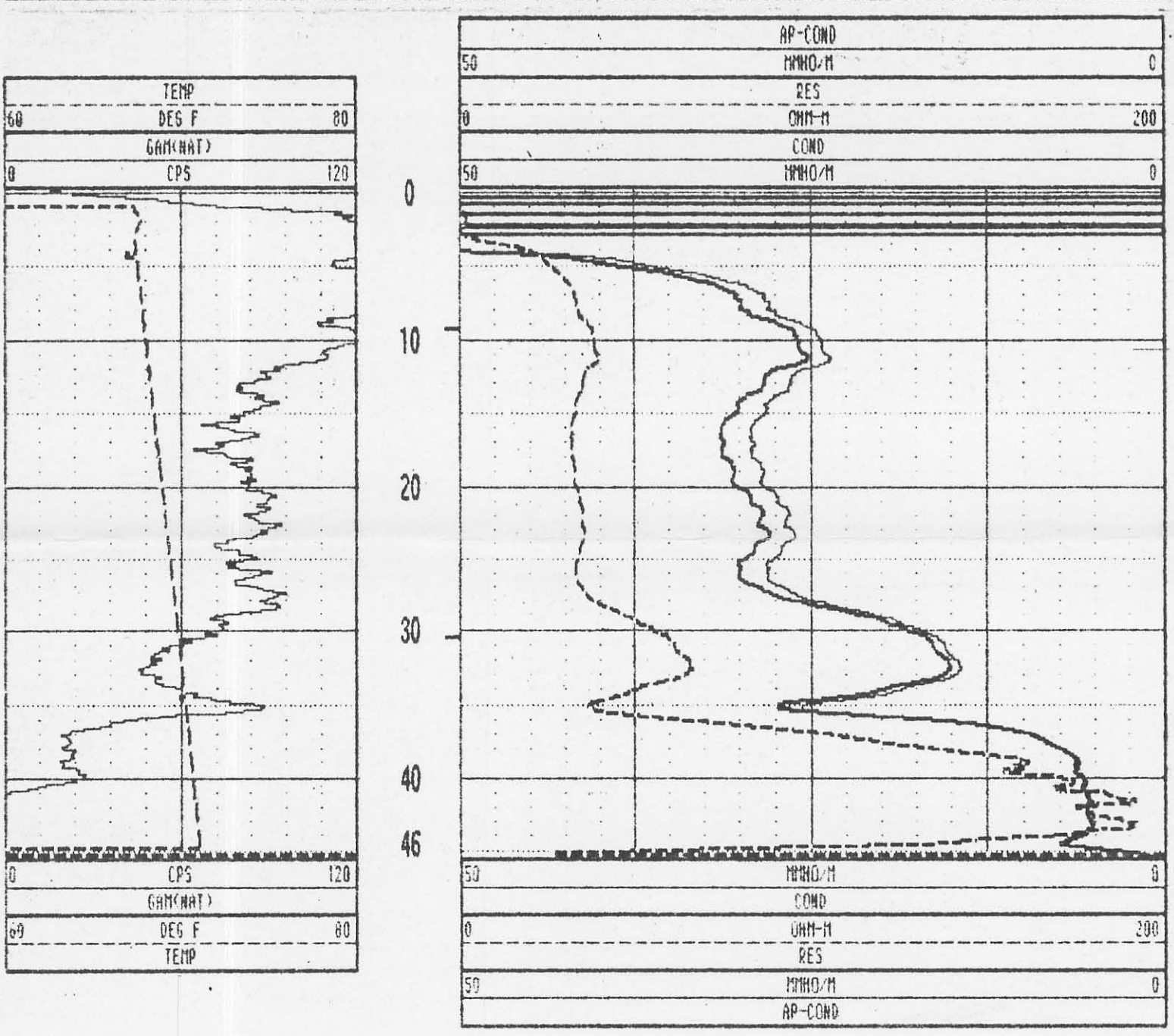
002G03DA

COMPANY	: ENSAFE,ALLEN & HOSHALL			OTHER SERVICES:	
WELL	: 002G03DA			9511	
LOCATION/FIELD	: NAS MEMPHIS			RUN ONE	
COUNTY	: SHELBY			OPEN	
STATE	: TENNESSEE				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 05/22/96	PERMANENT DATUM	: GL	ELEVATIONS	
DEPTH DRILLER	: 48	ELEV. PERM. DATUM:		KB	:
LOG BOTTOM	: 45.50	LOG MEASURED FROM:	GL	DF	: -
LOG TOP	: -3.40	DRL MEASURED FROM:	GL	GL	: 267.2
CASING DRILLER	: 48	LOGGING UNIT	: 05		
CASING TYPE	: PVC	FIELD OFFICE	: BLUEFIELD		
CASING THICKNESS	: .25	RECORDED BY	: J T GILBERT		
BIT SIZE	: 8	BOREHOLE FLUID	: WATER	FILE	: ORIGIN
MAGNETIC DECL.	: -	RM	:	TYPE	: 9511C
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:	LOG	: 6
FLUID DENSITY	: 1.2	MATRIX DELTA T	:	PLOT	: 9510C
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:	THRESH	: 9000

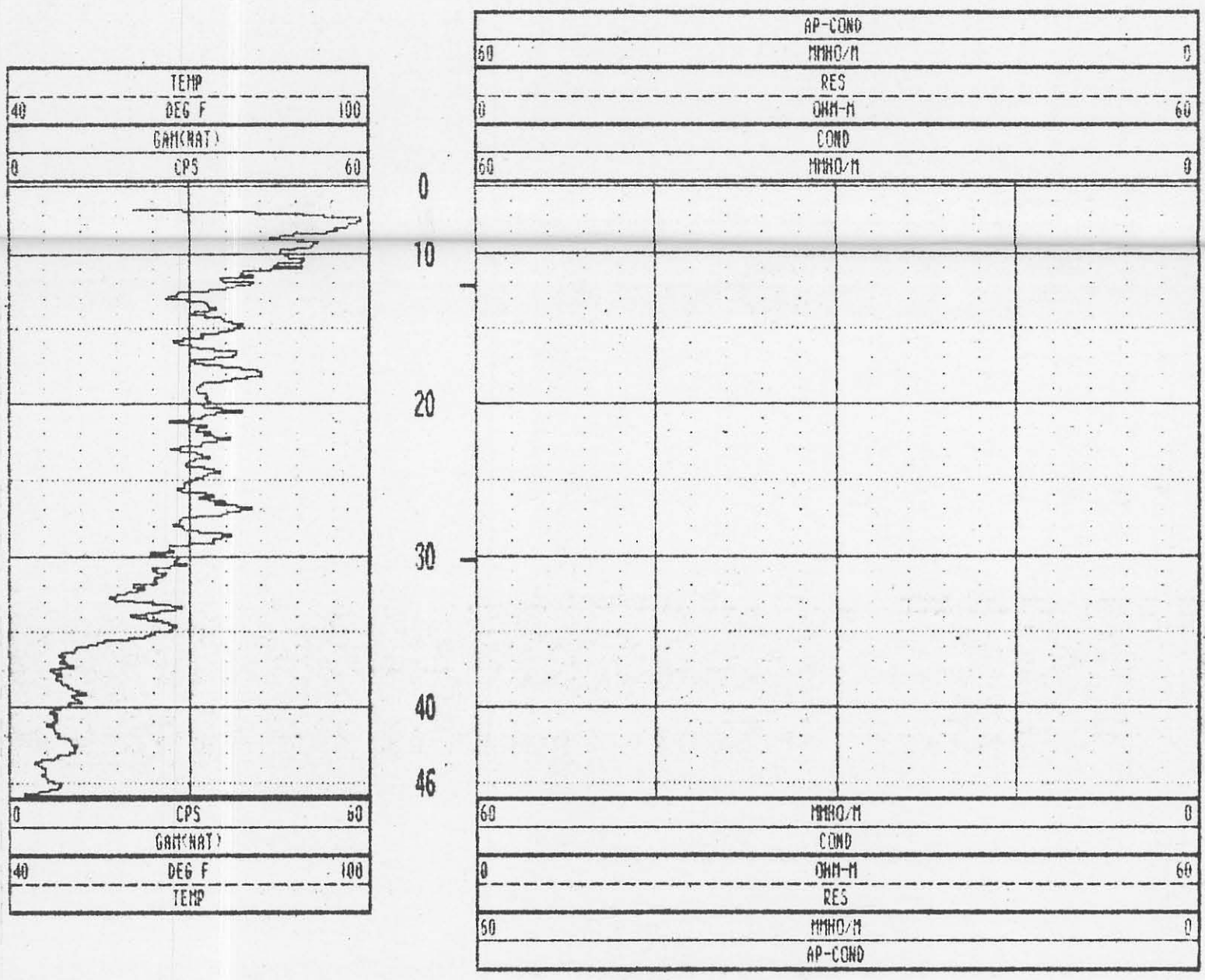
REMARKS :

ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



002G03DA 05/22/96 976



002G03DA 05/22/96 1025

Appendix C

Soil Boring/Monitoring Well Logs
Geophysical Logs
Geotechnical Analyses

SWMU 2

SOIL BORING/MONITORING WELL LOGS AND GEOTECHNICAL LABORATORY RESULTS

EnSafe/Allen & Hoshall

Boring 002S0029

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Geologist: *D. Ladd, W. Parks*
Started at *0750 on 2-6-96*	Surface Elevation: *266.60 feet msl*
Completed at *0915 on 2-6-96*	Drilling Method: *Rotasonic*
Total Depth: *55.0 feet*	Drilling Company: *Alliance Environmental, Inc.*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
					BG		OL	(0-35') Upper Alluvium (see descriptions below).	
					BG		OL	(0-3.5') Soil and roots.	
			1	56	BG		OL		263.1
					BG		ML	(3.5-16') Silt (see descriptions below).	
5					BG		ML	(3.5-6') Silt, moderate yellowish-brown mottled with light olive gray, with considerable iron staining.	
					BG		ML	(6-16') Silt, olive gray to light olive gray mottled with moderate yellowish-brown.	
					BG		ML		
10					BG		ML		
			2	70	BG		ML	Moist from 12' to 16'.	
					BG		ML	Contains iron-manganese nodules from 13' to 16'.	
15					BG		ML	Mottled with dark yellowish-orange near 16'.	
					BG				250.6
			3	100	BG			No description available, collected Shelby tube from 16' to 19' for geotechnical analysis.	
					BG				247.6
					BG		ML	(19-30') Silt (see descriptions below).	
20					BG		ML	(19-26') Silt, olive gray to greenish-gray, with a very few snail fragments, moist.	
					BG		ML	With very fine sand below 22'.	
			4	100	BG		ML	Contains roots below 23'.	
					BG		ML	Contains iron-manganese nodules from 24' to 26'.	
25					BG		ML		
					BG		ML	(26-30') Silt, sandy (very fine-grained), olive gray to greenish-gray becoming light olive gray near 30', contains snail shell fragments, moist.	
					BG		ML	Large piece of wood at 28'.	
					BG		ML	Percentage of sand increases near 30'.	
30							SM		238.6

EnSafe/Allen & Hoshall

Boring 002S0029

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Geologist: *D. Ladd, W. Parks*
Started at *0750 on 2-6-96*	Surface Elevation: *266.60 feet msl*
Completed at *0915 on 2-6-96*	Drilling Method: *Rotasonic*
Total Depth: *55.0 feet*	Drilling Company: *Alliance Environmental, Inc.*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
						266.6
	5	105	BG	SM	(30–35') Silty sand, fine to medium-grained, olive gray to light olive gray, contains a few snail shell fragments, moist.	
			BG		Contains silty seams and small pieces of gravel near 35'.	
35			BG			231.6
				SW	(35–50') Deeper Alluvium (see descriptions below). (35–37.5') Sand, fine to coarse-grained, with gravel up to 0.5" in longest dimension, olive gray, moist. Wet below 36'.	
			BG			229.1
	6	113		SC GW	(37.5–38.5') Sand and gravel. Sand is very clayey and medium to coarse-grained, gravel is up to 1.5" in longest dimension, color is light gray mottled with olive-gray; wet.	228.1
			BG	SC GW		
40					(38.5–40') Sand and gravel; sand is clayey, medium to coarse-grained, and moderate yellowish-brown; gravel is up to 2" in longest dimension and mostly dark gray.	226.6
	7	0			No description available, attempted to collect a Shelby tube sample from 40' to 43', no recovery.	
			BG			223.6
				GW SW	(43–46') Gravel up to 2" in longest dimension and sand, medium to coarse-grained, moderate yellowish-brown to dark yellowish-orange, wet.	
45			BG			
				SW	(46–47') Sand, fine to coarse-grained, light gray to pinkish-gray, with some pinkish-orange grains, becoming much coarser with gravel near 47'.	220.6
			BG			219.6
				SW GW	(47–50') Sand, medium to very coarse-grained, and gravel up to 4" in longest dimension, moderate yellowish-brown, wet.	
	8	77	BG			
50						216.6
			BG	SP	(50–54.5') Cockfield Formation: Sand, fine-grained, light gray to pinkish-gray, wet from 52' to 53'.	
			BG			
						212.1
55			BG	SC	(54.5–55') Clayey sand, fine-grained, moderate yellowish-brown to dark yellowish-orange.	211.6
					Terminated soil boring at 55'.	
60						

EnSafe/Allen & Hoshall

Boring 002S0030

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Geologist: *D. Ladd, W. Parks*
Started at *1015 on 2-1-96*	Surface Elevation: *265.60 feet msl*
Completed at *1150 on 2-1-96*	Drilling Method: *Rotasonic*
Total Depth: *50.0 feet*	Drilling Company: *Alliance Environmental, Inc.*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
					9		OL GW	(0-24') Upper Alluvium (see descriptions below).	
								(0-4') Soil, gravel, and asphalt.	
			1	40	6				
									261.6
5					6			(4-15') Silt, moderate yellowish-brown mottled with light olive gray and olive gray.	
					6			(4-10') Silt, moderate yellowish-brown mottled with light olive gray, with iron-manganese nodules.	
					6				
					6		ML		
10			2	70				(10-15') Clayey silt, moderate yellowish-brown mottled with olive gray, becoming moist near 15'.	
					6				
					6				
15					6				250.6
								No recovery from 15 to 16'.	
			3	100				No description available, collected Shelby tube sample from 16' to 19'	
					7				246.6
20					6		CL ML	(19-24') Clay and silt, olive gray to greenish-gray, wet.	
			4	67					
					6				
									241.6
							SW ML	(24-48') Deeper Alluvium (see descriptions below).	
25					6			(24-25') Sand, fine to medium-grained, and silt, olive gray to greenish-gray, with snail shell fragments, wet.	240.6
					7		ML SP	(25-26') Silt and sand, very fine-grained, olive-gray to greenish- gray, with snail shell fragments, moist.	
					6				
30									

EnSafe/Allen & Hoshall

Boring 002S0030

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Geologist: *D. Ladd, W. Parks*
Started at *1015 on 2-1-96*	Surface Elevation: *265.60 feet msl*
Completed at *1150 on 2-1-96*	Drilling Method: *Rotasonic*
Total Depth: *50.0 feet*	Drilling Company: *Alliance Environmental, Inc.*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
35			5	96	6		ML SP	(26-37.5') Same as above, with some areas smeared dark greenish-gray, becoming less moist near 36'.	
					6				
					6				
					6				
			6	100	6		SM	(37.5-39') Silty sand, fine to coarse-grained, olive gray with snail shell fragments, wet.	228.1
							SW GW	(39-40') Sand, medium to very coarse-grained, and gravel, olive gray, wet.	226.6
40			7	100			SW GW	No description available, collected Shelby tube sample from 40' to 43'	225.6
									222.6
45			8	107	6		SP GW	(43'-47.5') Very coarse-grained sand and gravel up to 2" in longest dimension, moderate yellowish-brown mottled with very light gray material, wet.	
					6				
					6		SP GW	(47.5-48.5') Gravel up to 3" in longest dimension, and sand, very coarse, very light gray, wet. maximum of 3", color changes to very light gray.	218.1 217.8
50							CL ML	(48-50') Cockfield Formation: Clay, sandy and silty, dusky yellowish-brown with sandy seams.	215.6
								Terminated soil boring at 50' and grouted to full depth.	
								Organic vapor readings may be attributed to moisture response of the instrument.	
55									
60									

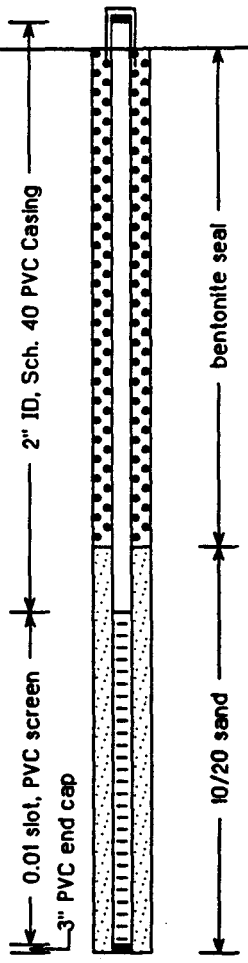
EnSafe/Allen & Hoshall

Monitoring Well 002G01UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *266.72 feet msl*
Started at *0800 on 2-13-96*	TOC Elevation: *269.30 feet msl*
Completed at *0900 on 2-13-96*	Depth to Groundwater: *11.52 feet* Measured: *4/9/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *257.78 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *27.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1					(0-27') Upper Alluvium (see descriptions below).	
								Clayey silt, moderate yellowish brown to light brown.	
5								Some organics and iron staining (5'-6').	
								Clayey silt, moderate yellowish brown, moist, abundant organic and iron specks from 6' to 10' becoming less frequent from 10' to 16'.	
10			2					speckles.	
							ML		
15			3					Clayey silt, olive green with dark yellowish orange mottling.	
								Silt, light olive gray to greeenish-gray, wet at 20', some minor sand 25' to 26', sulfur-like odor.	
20									
25								Same as above, shell and small snail fragments, organic debris	239.7
								Boring terminated at 27'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent monitoring well 002G01DA.	
30									
35									
40									

WELL DIAGRAM



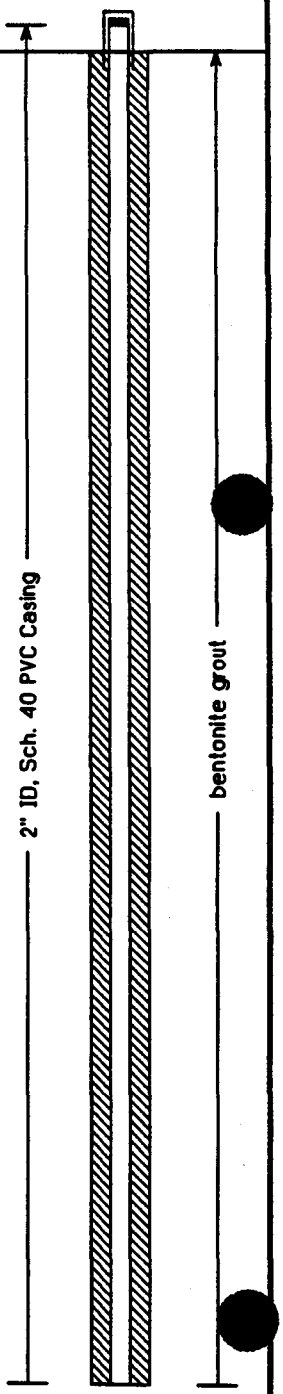
EnSafe/Allen & Hoshall

Monitoring Well 002G01DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *266.90 feet msl*
Started at *1400 on 2-12-96*	TOC Elevation: *269.55 feet msl*
Completed at *1645 on 2-12-96*	Depth to Groundwater: *6.49 feet* Measured: *4/10/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *263.06 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *66.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *48 to 58 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0								(0-39') Upper Alluvium (see descriptions below).	
			1	66	BG			Clayey silt, moderate yellowish-brown to light brown.	
5								Some organics and iron staining (5'-6').	
								Clayey silt, moderate yellowish brown, moist, abundant organic and iron specks from 6' to 10' becoming less frequent from 10' to 16'.	
10			2	90	BG				
15								Clayey silt, olive green with dark yellowish-orange mottling.	
								Silt, light olive gray to greenish-gray, wet at 20', some minor sand 25' to 26', sulfur-like odor.	
20			3	100	BG		ML		
25								Same as above, shell and small snail fragments, organic debris, wood at 28'.	
30			4	100	BG				
35									
40							SW GW	(39-59') Deeper Alluvium (see descriptions below).	227.9

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 002G01DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *266.90 feet msl*
Started at *1400 on 2-12-96*	TOC Elevation: *269.55 feet msl*
Completed at *1645 on 2-12-96*	Depth to Groundwater: *6.49 feet* Measured: *4/10/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *263.06 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *66.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *48 to 58 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
45			5	30	BG		SW GW	(39-48') Sand and gravel, light yellowish-brown. Contact is approximate; location unceratin due to poor return in the core barrel.	
									218.9
50			6	120	BG		SW	Sand, light yellowish-brown, gravel from 48' to 56'.	
55									210.9
							SW GW	Sand and gravel, light yellowish brown.	
								Gravel is up to 3" diameter.	207.9
60			7	100	BG		SC	Cockfield Formation: Silty fine-grained sand, tan to light brown at contact. Changes to medium-gray, silty and clayey fine-grained sand below, micaceous, mottled with light brown silt and fine sand.	
65									200.9
								Soil boring terminated at 66'.	
70									
75									
80									

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

0.01 slot, PVC screen

3" PVC end cap

bentonite seal

10/20 sand

bentonite seal

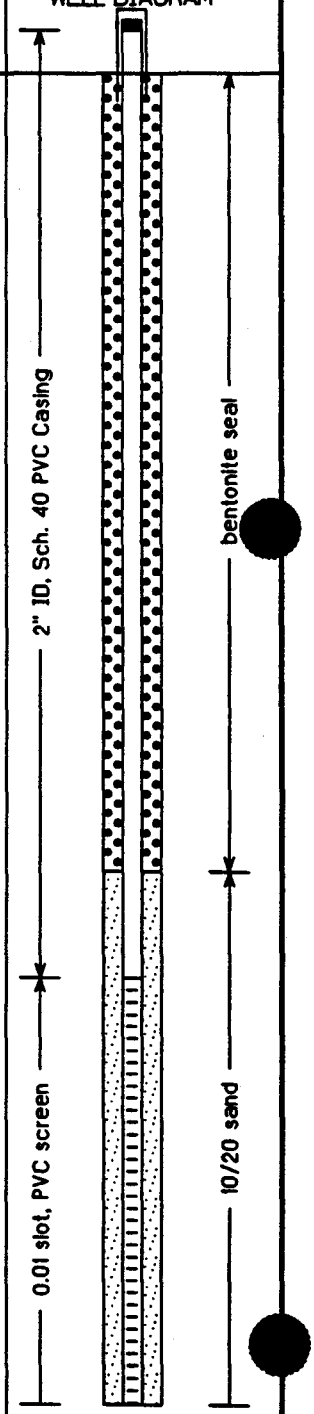
EnSafe/Allen & Hoshall

Monitoring Well 002G02UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.43 feet msl*
Started at *1150 on 2-12-96*	TOC Elevation: *269.57 feet msl*
Completed at *1230 on 2-12-96*	Depth to Groundwater: *10.64 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *258.93 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *27.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1				OL	(0-27') Upper Alluvium (see descriptions below).	266.4
								(0-1') Soil.	
								(1-15') Silt (see descriptions below).	
								(1-4') Silt, very clayey, moderate yellowish-brown.	
5								(4-6') Silt, moderate yellowish-brown, very dry from 4' to 5'.	
								(6-15') Silt, moderate yellowish-brown mottled with some light olive gray, with considerable iron staining and iron-manganese nodules, especially from 14' to 15'.	
			2				ML		
10									
								(14-15') Becoming moist.	
15			3						252.4
								(15-27') Silt, clayey, dark greenish-gray (see descriptions below).	
								(15-16') Silt, very clayey, dark greenish-gray, moist.	
								(16-26') Same as above with some snail shell fragments.	
20							ML		
								Slightly sandy from 23' to 26'.	
25									

WELL DIAGRAM



EnSafe/Allen & Hoshall	Monitoring Well 002G02UA
Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.43 feet msl*
Started at *1150 on 2-12-96*	TOC Elevation: *269.57 feet msl*
Completed at *1230 on 2-12-96*	Depth to Groundwater: *10.64 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *258.93 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *27.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
							ML	(26-27') Same as above, becoming mottled with olive gray material.	240.4	10/20 sand
								Soil boring terminated at 27'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent monitoring well 002G02DA.		
30										
35										
40										
45										
50										

EnSafe/Allen & Hoshall

Monitoring Well 002G02DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.09 feet msl*
Started at *0745 on 2-7-96*	TOC Elevation: *269.56 feet msl*
Completed at *0843 on 2-7-96*	Depth to Groundwater: *9.74 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *259.82 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *41 to 51 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0							OL	(0-38') Upper Alluvium (see descriptions below).	266.1
								(0-1') Soil.	
								(1-15') Silt (see descriptions below).	
			1	90	BG			(1-4') Silt, very clayey, moderate yellowish-brown.	
5								(4-6') Silt, moderate yellowish-brown, very dry from 4' to 5'.	
								(6-15') Silt, moderate yellowish-brown mottled with some light olive gray, with considerable iron staining and manganese nodules, especially from 14 to 15'.	
							ML		
10			2	46	BG				
								(14-15') Becoming moist.	
15								(15-27') Silt, clayey, dark greenish-gray (see descriptions below).	252.1
								(15-16') Silt, very clayey, dark greenish-gray, moist.	
								(16-26') Same as above, with some snail shell fragments.	
20							ML		
			3	89	BG				
								Slightly sandy from 23' to 26'.	
25									

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

grout

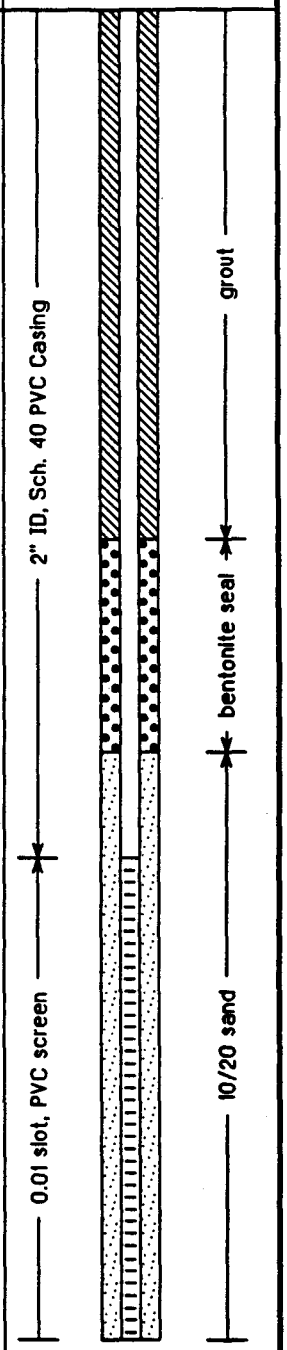
EnSafe/Allen & Hoshall

Monitoring Well 002G02DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.09 feet msl*
Started at *0745 on 2-7-96*	TOC Elevation: *269.56 feet msl*
Completed at *0843 on 2-7-96*	Depth to Groundwater: *9.74 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *259.82 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *41 to 51 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
							ML	(26-27') Same as above, becoming mottled with olive gray.	240.1
							ML	(27-30') Sandy silt, olive gray, moist.	237.1
30			4	100	BG		SM	(30-31') Silty sand; medium to coarse-grained, olive gray, wet, wood at 30'.	236.1
							ML	(31-32') Sandy silt; olive gray, moist.	235.1
							SM	(32-33') Silty sand; medium to coarse-grained with small diameter gravel, olive gray, wet, wood at 33'.	234.1
35							ML	(33-37.5') Silt (see descriptions below). (33-36') Clayey silt, olive gray with some snail shell fragments, moist. Some greenish-gray color material at 33.5'. (36-37.5') Same as above, becoming slightly sandy.	229.1
							SW GW	(38-53') Deeper Alluvium (see descriptions below). (38-40.5') Sand and gravel; sand is fine to coarse-grained, gravel is up to 0.5" in longest dimension, light olive gray to olive gray, with olive gray clay seams, wet. Wood at 38.5' and 40'.	226.6
40			5	100	BG		SM GW	(40.5-45') Silty sand and gravel; sand is coarse to very coarse- grained, gravel is up to 1.5" in longest dimension; mostly olive gray at 40.5' becoming moderate yellowish-brown mottled with light gray below, wet.	222.1
45							SW	Becoming lighter in color near 45'.	221.1
							SW GW	(45-46') Sand, medium to coarse-grained, dark yellowish-orange, with a few small pieces of gravel. (46-50') Gravel and sand; gravel is up to 3.5" in longest dimension; moderate yellowish-brown to dark yellowish-orange, wet.	217.1
50							SW GW		

WELL DIAGRAM



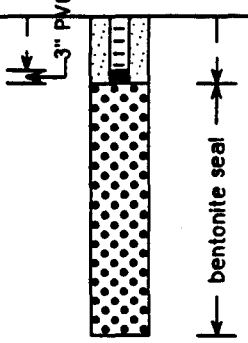
EnSafe/Allen & Hoshall

Monitoring Well 002G02DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.09 feet msl*
Started at *0745 on 2-7-96*	TOC Elevation: *269.56 feet msl*
Completed at *0843 on 2-7-96*	Depth to Groundwater: *9.74 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *259.82 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *41 to 51 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			6	95	BG		SW GW	(50-51') Sand, medium to very coarse-grained and gravel up to 2" in longest dimension. Moderate yellowish-brown mottled with light gray material, wet.	217.1
							CL ML		215.6
								(51.5-53') Silty and sandy clay with gravel up to 2.5" in longest dimension. Very light gray mottled with moderate yellowish-brown and dark yellowish-orange material. Wet.	214.1
55							SP SC	Cockfield Formation: Sand, fine-grained, very light gray mottled with moderate yellowish-brown and dark yellowish-orange material, slightly clayey, wet from 53' to 54'. With splotches of light brownish-gray material at 55', becoming very fine dark yellowish-orange sand below 55'.	211.1
								Terminated soil boring at 56'.	
60									
65									
70									
75									

WELL DIAGRAM



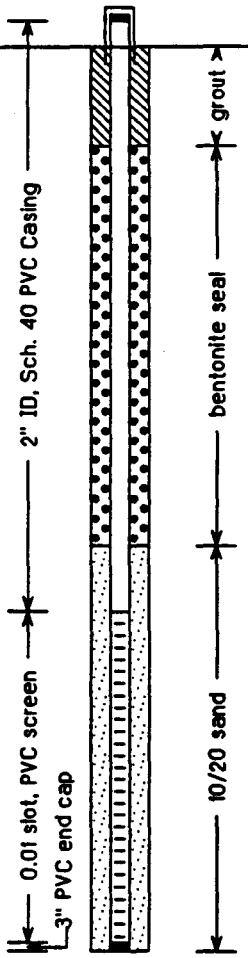
EnSafe/Allen & Hoshall

Monitoring Well 002G03UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.28 feet msl*
Started at *1400 on 2-6-96*	TOC Elevation: *269.73 feet msl*
Completed at *1500 on 2-6-96*	Depth to Groundwater: *13.09 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *256.64 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *27.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0	1	QL / GP	(0-27') Upper Alluvium (see descriptions below).	
			(0-2') Soil, gravel and asphalt.	265.3
5		ML	(2-6') Clayey silt; olive gray to light olive gray to greenish-gray. Contains some iron-manganese nodules.	261.3
	2	ML	(6-13.5') Silt, moderate yellowish-brown and mottled with light olive gray material.	
10			(11.5-13.5') Becoming moist with iron staining and iron-manganese nodules.	
				253.8
15	3		(13.5-27') Silt (see descriptions below).	
			(13.5-26') Silt, olive gray to greenish-gray. Moist.	
20		ML	Iron-manganese nodules below 20', becoming more moist with scattered shell fragments.	
			Becoming slightly sandy below 22'.	
25			Wood fragment at 25.5'.	
			(26-27') Sandy and clayey silt with iron-manganese nodules.	240.3
30			Terminated soil boring at 27'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent monitoring well 002G03DA.	
35				
40				

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 002G03DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.16 feet msl*
Started at *1015 on 2-6-96*	TOC Elevation: *269.62 feet msl*
Completed at *1150 on 2-6-96*	Depth to Groundwater: *10.91 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *258.71 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *60.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *38 to 48 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
							OL GP	(0-29') Upper Alluvium (see descriptions below). (0-2') Soil, gravel, and asphalt.	
									265.2
			1	42	1.5		ML	(2-6') Clayey silt; olive gray to light olive gray to greenish-gray. Contains some iron-manganese nodules.	
5									261.2
							ML	(6-13.5') Silt, moderate yellowish-brown mottled with light olive gray material.	
10			2	83	BG			(11.5-13.5') Becoming moist with iron staining and iron-manganese nodules.	
									253.7
							ML	(13.5-30') Silt (see descriptions below). (13.5-26') Silt, olive gray to greenish-gray. Moist.	
15									

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

grout

EnSafe/Allen & Hoshall

Monitoring Well 002G03DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.16 feet msl*
Started at *1015 on 2-6-96*	TOC Elevation: *269.62 feet msl*
Completed at *1150 on 2-6-96*	Depth to Groundwater: *10.91 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *258.71 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *60.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *38 to 48 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
20			3	65	BG		ML	Iron-manganese nodules below 20', becoming more moist with scattered shell fragments.		2" ID, Sch. 40 PVC Casing
								Becoming slightly sandy below 22'.		
25								Wood fragment at 25.5'.		
								(26-30') Sandy and clayey silt with iron-manganese nodules. Wood fragments from 28' to 29'.		
									238.2	
30							SW	(29-48') Deeper Alluvium (see descriptions below).		grout

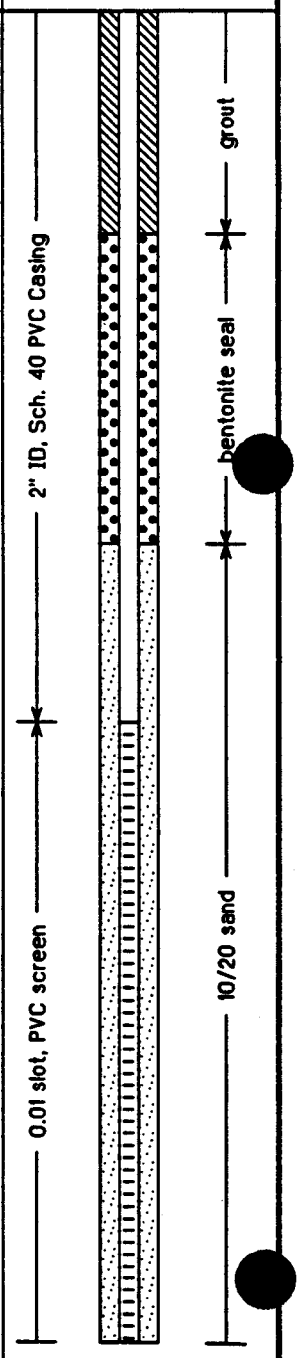
EnSafe/Allen & Hoshall

Monitoring Well 002G03DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.16 feet msl*
Started at *1015 on 2-6-96*	TOC Elevation: *269.62 feet msl*
Completed at *1150 on 2-6-96*	Depth to Groundwater: *10.91 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *258.71 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *60.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *38 to 48 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			4	66	BG		SW	(29-35') Sand, fine to medium-grained, olive gray in color. Coarsens downward. Moist. Contains few snail shell fragments.	
35									232.2
							SW	(35-38') Sand, medium to coarse (see descriptions below). (35-36') Sand, medium to coarse-grained, olive gray, wet. (36-38') Sand, medium to coarse, olive gray to light olive gray color. Coarser with gravel near 38'.	
			5	95	BG				229.2
							SW/SC	(38-39.5') Sand, slightly clayey with gravel, medium to very coarse- grained, moderate yellowish-brown, wet.	
									227.7
40							SW/SC	Clay and sand with gravel, light gray mottled with moderate yellowish- brown.	227.2
			6					Shelby tube sample collected from 40' to 43', no lithologic description available.	
									224.2
45							SW/GW	(43-45.5') Sand, medium to very coarse-grained, and gravel up to 1.5" in longest dimension. Moderate yellowish-brown color mottled with some light gray material. Less gravel near 45.5'. Wet.	

WELL DIAGRAM



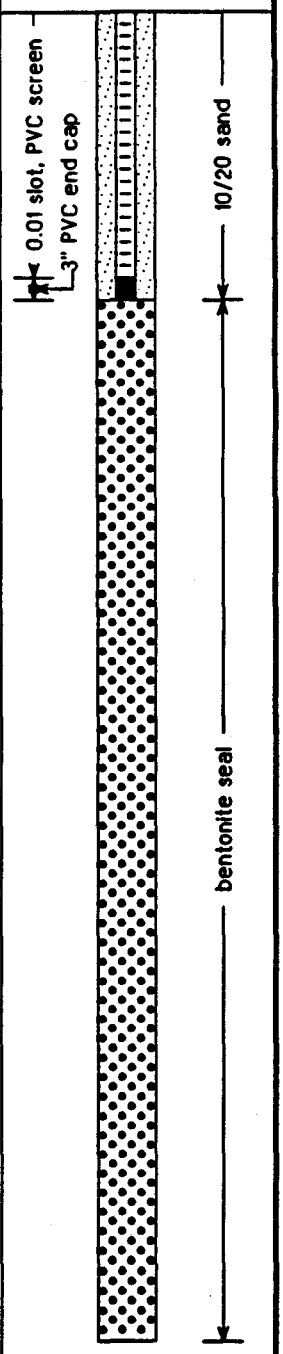
EnSafe/Allen & Hoshall

Monitoring Well 002G03DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.16 feet msl*
Started at *1015 on 2-6-96*	TOC Elevation: *269.62 feet msl*
Completed at *1150 on 2-6-96*	Depth to Groundwater: *10.91 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *258.71 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *60.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *38 to 48 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
							SW GW		221.7
			7	121	BG		SP	(45.5-46') Sand; fine to medium-grained, light gray with some pinkish-gray.	221.2
							SW GW		220.7
							SW GW	(46-46.5') Sand, medium to coarse-grained, and gravel; moderate yellowish-brown, wet.	
								(46.5-48') Sand, medium to very coarse-grained, and gravel; olive-gray color, wet. Bottom 3" is moderate yellowish-brown sand and gravel, with gravel piece up to 3" in longest dimension.	219.2
								(48-54') Cockfield Formation: Sand; fine-grained.	
50								(48-49.5') Light gray.	
								(49.5-50') Dusky yellow.	
							SP	(50-54') Light gray.	
									213.2
								(54-60') Clay (see descriptions below).	
55			8	110	BG		CL	(54-58') Silty and sandy clay; olive gray with sand seams, olive gray, dark yellowish-orange sand at top. Lignite seam near 58'.	
								(58-60') Clay; olive gray in color.	
								Terminated soil boring at 60'.	
60									207.2

WELL DIAGRAM



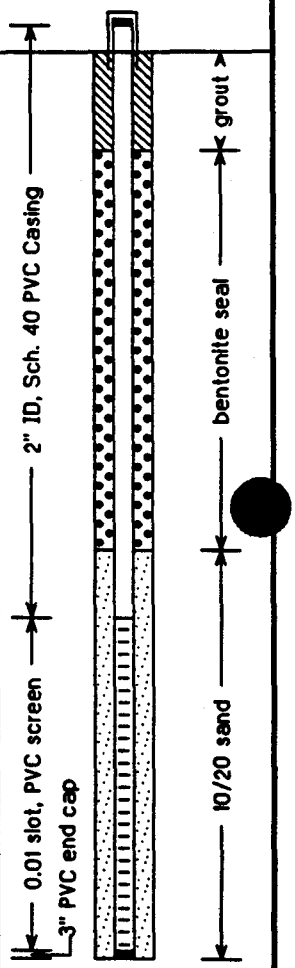
EnSafe/Allen & Hoshall

Monitoring Well 002G04UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *268.53 feet msl*
Started at *1455 on 2-5-96*	TOC Elevation: *268.76 feet msl*
Completed at *1515 on 2-5-96*	Depth to Groundwater: *8.91 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *259.85 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *27.25 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0	1	OL	(0-27') Upper Alluvium (see descriptions below).	
			(0-3.5') Soil and roots.	
				263
5			(3.5-16') Silt (see descriptions below).	
			(3.5-6') Silt, moderate yellowish-brown mottled with light olive gray, with considerable iron staining.	
	2	ML	(6-16') Silt, olive gray to light olive gray mottled with moderate yellowish-brown.	
10			Moist from 12' to 16'.	
			Contains iron-manganese nodules from 13' to 16'.	
15	3		Mottled with dark yellowish-orange near 16'.	
				250.5
			No description available, collected Shelby tube from 16' to 19' for geotechnical analysis.	
				247.5
20			(19-27') Silt (see descriptions below).	
			(19-26') Silt, olive gray to greenish-gray, with a very few snail shell fragments, moist.	
		ML	With very fine sand below 22'.	
			Contains roots below 23'.	
25			Contains iron-manganese nodules from 24' to 26'.	
				239.5
			(26-27') Silt, sandy (very fine-grained), olive gray to greenish-gray, contains snail shell fragments, moist.	
30			Terminated soil boring at 27'. Note: No samples were collected for lithologic description; these descriptions were transferred from the log of adjacent soil boring 002S0029DA.	
35				
40				

WELL DIAGRAM



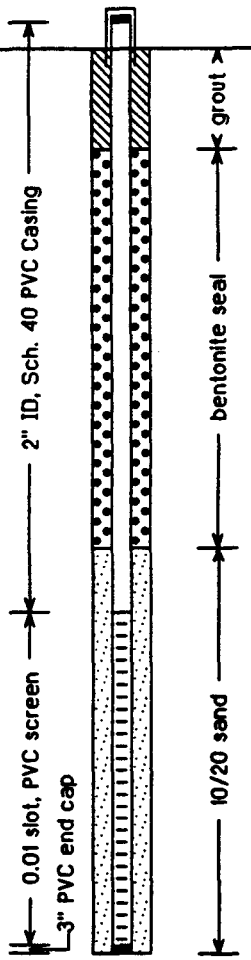
EnSafe/Allen & Hoshall

Monitoring Well 002G05UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.14 feet msl*
Started at *1315 on 2-5-96*	TOC Elevation: *269.39 feet msl*
Completed at *1400 on 2-5-96*	Depth to Groundwater: *11.45 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *257.94 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *27.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1					(0-27') Upper Alluvium (see descriptions below).	
								(0-15.5') Silt; moderate yellowish-brown mottled with some light olive gray material. Contains sattered iron-manganese nodules.	
5									
			2				ML		
10								Slightly moist near 11'.	
								Becoming mottled with some dark greenish-gray material near 14'.	
15			3						
								Increase in percentage of iron-manganese nodules near 15.5'.	251.6
								(15.5-26') Silt, dark greenish-gray, slightly moist.	
20							ML	Becoming light olive gray to greenish gray with depth.	
								Snail shell fragments near 20'.	
25									241.1
								No description available due to no sample recovery from 26' to 27'.	240.1
30								Terminated soil boring at 27'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent monitoring well 002G05DA.	
35									
40									

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 002G05DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.16 feet msl*
Started at *0850 on 2-5-96*	TOC Elevation: *269.33 feet msl*
Completed at *1030 on 2-5-96*	Depth to Groundwater: *12.99 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *256.34 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *55.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *40.5 to 50.5 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
5			1	88	BG		ML	(0-34') Upper Alluvium (see descriptions below). (0-15.5') Silt (see descriptions below). Moderate yellowish-brown and mottled with some light olive gray Contains scattered iron-manganese nodules.	
10			2	80	BG			Slightly moist near 11'.	
15					BG			Becoming mottled with some dark greenish-gray material near 14'.	

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

grout

EnSafe/Allen & Hoshall

Monitoring Well 002G05DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.16 feet msl*
Started at *0850 on 2-5-96*	TOC Elevation: *269.33 feet msl*
Completed at *1030 on 2-5-96*	Depth to Groundwater: *12.99 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *256.34 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *55.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *40.5 to 50.5 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
								Increase in percentage of iron-manganese nodules near 15.5'.	251.7
								(15.5-26') Silt (see descriptions below).	
								Dark greenish-gray, slightly moist.	
					BG			Becoming light olive gray to greenish-gray with depth.	
					BG				
20								Snail shell fragments near 20'.	
			3	75	BG		ML		
					BG				
25					BG				
							ML	No description available due to no sample recovery.	241.2
				0					
								(28-34') Silt and very-fine grained sand with rare snail shell fragments, moist.	239.2
					BG		ML SP		
30									

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

grout

EnSafe/Allen & Hoshall

Monitoring Well 002G05DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.16 feet msl*
Started at *0850 on 2-5-96*	TOC Elevation: *269.33 feet msl*
Completed at *1030 on 2-5-96*	Depth to Groundwater: *12.99 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *256.34 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *55.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *40.5 to 50.5 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			4	71	BG		ML SP		
					BG				233.2
							SM	(34-50') Deeper Alluvium (see descriptions below). (34-34.5') Sand, fine to coarse-grained, mixed with silt, olive gray to greenish-gray with snail shell fragments, moist.	232.7
35					BG		ML		232.2
							ML	(34.5-35') Silt; olive gray to greenish-gray. Dry.	
					BG		SM	(35-37') Clayey silt with some fine to medium-grained sand and a few pieces of dark-colored gravel, olive-gray, moist. Wood at 35.5'.	230.2
								(37-39') Silty sand, fine to very coarse-grained, with quartz and chert gravel, olive gray, wet.	
					BG		ML	(39-39.5') Silt; olive gray to light brownish-gray. Dry.	228.2
40			5	100			SW GW	(39.5-41') Sand, coarse to very coarse-grained, and gravel up to 2.5" in longest dimension, olive gray near 39.5', then very light gray mottled with moderate yellowish-brown, wet.	227.7
					BG				226.2
							SP GW	(41-43') Sand and gravel; sand is very coarse-grained, some gravel appears weathered; moderate yellowish-brown mottled with some light olive gray material, wet.	
					BG		SP GW	(43-43.5') Sand and gravel, dark yellowish-orange in color, wet.	224.2
							GW SW		223.7
							GW SW	(43.5-44') Gravel and sand, wet; gravel is gray and red in color and up to 1.5" in longest dimension, sand is light gray.	223.2
45					BG				

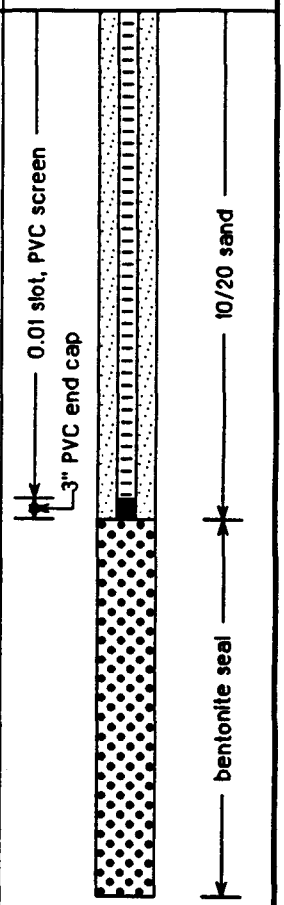
WELL DIAGRAM

- grout
- bentonite seal
- 10/20 sand
- 2" ID, Sch. 40 PVC Casing
- 0.01 slot, PVC screen

EnSafe/Allen & Hoshall	Monitoring Well 002G05DA
Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.16 feet msl*
Started at *0850 on 2-5-96*	TOC Elevation: *269.33 feet msl*
Completed at *1030 on 2-5-96*	Depth to Groundwater: *12.99 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *256.34 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *55.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *40.5 to 50.5 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
							GW SW	(44-46') Gravel and sand; gravel is up to 3" in longest dimension and dark gray, sand is moderate yellowish-brown to dark yellowish-orange, wet.	221.2
							GW SW		220.7
					BG			(46-46.5') Gravel and sand; gravel is up to .75" in longest dimension, sand is coarse-grained and moderate yellowish-brown to dark yellowish-orange, wet.	
							GW SW	(46.5-50') Gravel and sand; gravel is up to 3" in longest dimension, sand is very coarse-grained and moderate yellowish-brown to dark yellowish-orange, wet.	
					BG				
50			6	93	BG				217.2
					BG		SC	(50-52.5') Cockfield Formation: clayey sand; fine-grained, stained moderate yellowish-brown to dark yellowish-orange with some very light gray seams of material.	
					BG				214.7
					BG		SP	(52.5-55') Sand, fine-grained, very light gray color mottled with some dark yellowish-orange material.	
55								Soil boring terminated at 55'.	212.2
60									

WELL DIAGRAM



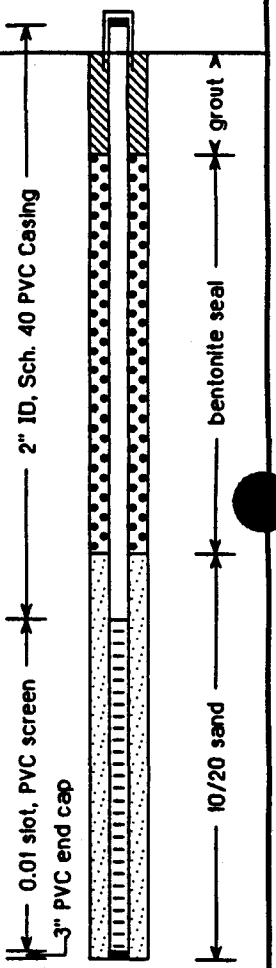
EnSafe/Allen & Hoshall

Monitoring Well 002G06UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.82 feet msl*
Started at *1350 on 2-2-96*	TOC Elevation: *269.61 feet msl*
Completed at *1515 on 2-2-96*	Depth to Groundwater: *16.74 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *252.87 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *27.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1				OL / GP	(0-27') Upper Alluvium (see descriptions below).	
								(0-.5) Soil, gravel, and asphalt.	
5								(.5-15') Silt, mostly moderate yellowish-brown to light olive gray.	
							ML	(.5-6') Silt; moderate yellowish-brown mottled with light olive gray material. Some iron staining and rare iron-manganese nodules.	
10			2					(6-14') Percentage of light olive gray-colored material decreases down to 14'.	
15			3					(14-15') Becoming mostly light olive gray to greenish-gray mottled with moderate yellowish-brown. Abundant iron staining and iron- manganese nodules just above 15'.	252.8
							ML	(15-19') Silt, olive gray to dark greenish-gray. Wet from 16-19'.	248.8
20							ML	(19-25') Silt, dark greenish-gray mottled with brownish-gray material. Some snail shell fragments present.	
25								Some iron/manganese nodules at 24'. Wood at 25'.	242.8
							ML	(25-27') Silt, olive gray to greenish-gray in color.	240.8
30								Rare snail shell fragments and wet below 26'.	
								Soil boring terminated at 27'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent monitoring well 002G06DA.	
35									
40									

WELL DIAGRAM



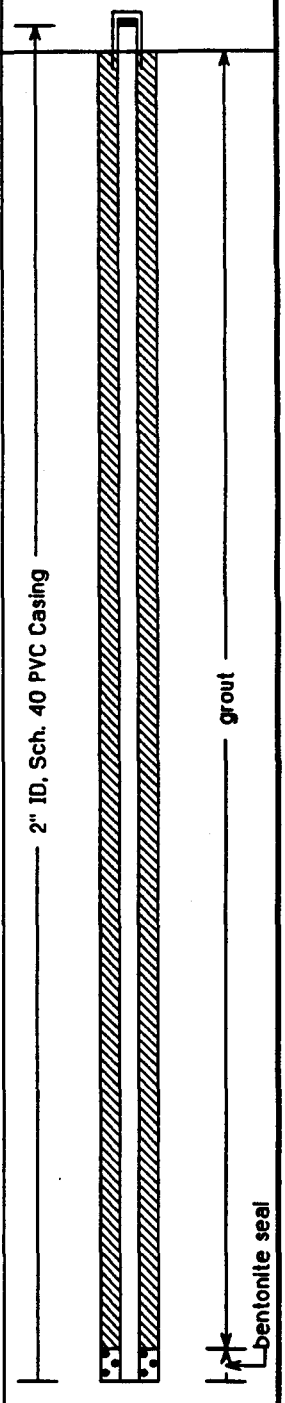
EnSafe/Allen & Hoshall

Monitoring Well 002G06DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.86 feet msl*
Started at *0925 on 2-2-96*	TOC Elevation: *269.69 feet msl*
Completed at *1030 on 2-2-96*	Depth to Groundwater: *16.52 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *253.17 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *55.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *44.5 to 54.5 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
							OL GP	(0-32') Upper Alluvium (see descriptions below).	
			1	75	8			(0-.5') Soil, gravel, and asphalt.	
5								(.5-15') Silt, mostly moderate yellowish-brown to light olive gray.	
							ML	(.5-6') Silt; moderate yellowish-brown mottled with light olive gray material. Some iron staining and rare iron-manganese nodules.	
10			2	53	5			(6-14') Percentage of light olive gray-colored material decreases down to 14'.	
15								(14-15') Becoming mostly light olive gray to greenish-gray mottled with moderate yellowish-brown. Abundant iron staining and iron- manganese nodules just above 15'.	252.9
							ML	(15-19') Silt, olive gray to dark greenish-gray. Wet from 18-19'.	248.9
20			3	50	5		ML	(19-25') Silt, dark greenish-gray mottled with brownish-gray material. Some snail shell fragments present.	
25								Some iron-manganese nodules at 24'. Wood at 25'.	242.9
							ML	(25-29') Silt, olive gray to greenish-gray in color. Rare snail shell fragments and wet from 26-29'.	238.9
30			4	78	4		SM ML	(29-32') Sand, very fine-grained, and silt; greenish-gray, rare snail shell fragments, wet. Becoming olive gray in color near 32'.	235.9
							SW SC	(32-54') Deeper Alluvium (see descriptions below).	
35								(32-36') Sand, fine to coarse-grained, with clay seams. Olive-gray in color with rare snail shell fragments, wet. Wood near 34'.	231.9
							SW	(36-39') Sand, fine to coarse-grained, olive gray, with scattered gravel and snail shell fragments, wet.	228.9
40							SW		

WELL DIAGRAM



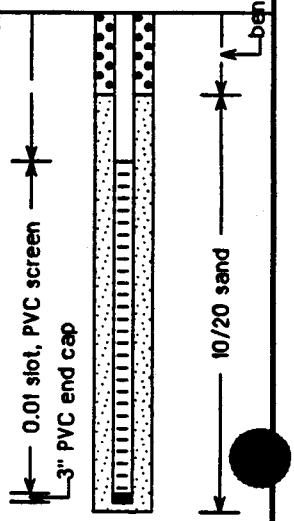
EnSafe/Allen & Hoshall

Monitoring Well 002G06DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.86 feet msl*
Started at *0925 on 2-2-96*	TOC Elevation: *269.69 feet msl*
Completed at *1030 on 2-2-96*	Depth to Groundwater: *16.52 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *253.17 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *55.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *44.5 to 54.5 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
45			5	90	4		SW	(39-44') Sand, fine to coarse, olive gray with gravel up to 1" in longest dimension. Rare snail shell fragments, wet. Clay seams (3" to 5" thick) at 40', 41', 42', and 43.5'.	223.9
							SW GW	(44-46.5') Sand, very coarse-grained, and gravel up to 2.5" in longest dimension. Moderate yellowish-brown mottled with light olive gray material, wet.	221.4
							ML		219.9
50			6	106	4		SP GW	(46.5-48') Sandy silt; light olive gray to light gray in color. A 2" thick sand and gravel seam occurs at 47'. Wet.	218.9
							SW GW	(48-51') Sand and gravel; sand is very coarse-grained and gravel is up to 3" in longest dimension. Moderate yellowish-brown mottled with light gray, wet. Clay seams near 51'.	213.9
55							CL SP	(51-54.5') Sand is now medium to coarse-grained and gravel is up to 2.5" in longest dimension. Moderate yellowish brown, wet.	212.9
60								(54-55') Cockfield Formation: Silty clay with very fine-grained sand. Dusky yellowish-brown to moderate yellowish-brown. Lignitic material at top.	
65								Terminated soil boring at 55'.	
70									
75									
80									

WELL DIAGRAM



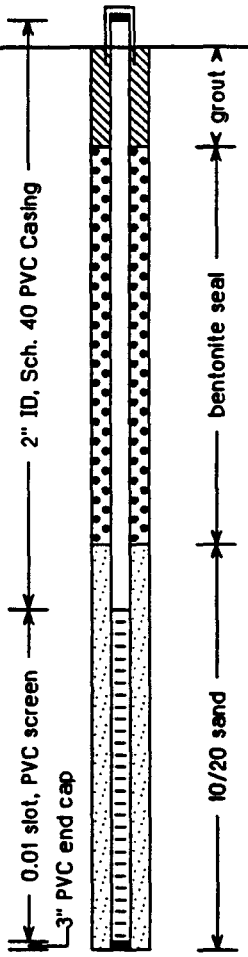
EnSafe/Allen & Hoshall

Monitoring Well 002G07UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *266.10 feet msl*
Started at *1405 on 2-1-96*	TOC Elevation: *268.21 feet msl*
Completed at *1530 on 2-1-96*	Depth to Groundwater: *15.56 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *252.65 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *27.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1				OL GP	(0-27') Upper Alluvium (see descriptions below). (0-4') Soil, gravel, and asphalt.	262.1
5							ML	(4-15') Silt, moderate yellowish-brown mottled with light olive gray and olive gray. (4-10') Silt, moderate yellowish-brown mottled with light olive gray, with iron-manganese nodules.	
10			2					(10-15') Clayey silt, moderate yellowish-brown mottled with olive gray, becoming moist near 15'.	
15			3					No recovery from 15' to 16'. No description available; collected a Shelby tube sample from 16' to 19'.	251.1
20							CL ML	(19-24') Clay and silt, olive gray to greenish-gray, wet.	247.1
25							SW ML ML SP	(24-27') Fluvial Deposits (see descriptions below). (24-25') Sand, fine to medium-grained, and silt, olive gray to greenish-gray, with snail shell fragments, wet.	242.1 241.1 239.1
30								(25-27') Silt and sand, very fine-grained, olive-gray to greenish- gray, with snail shell fragments, moist. Terminated soil boring at 27'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent soil boring 002S0030DA.	
35									
40									

WELL DIAGRAM



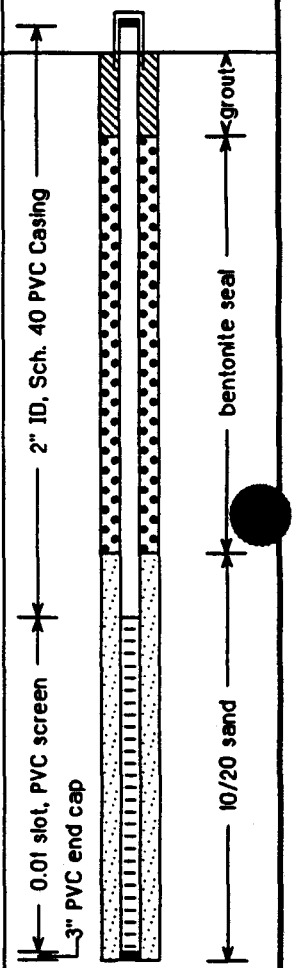
EnSafe/Allen & Hoshall

Monitoring Well 002G08UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.05 feet msl*
Started at *0800 on 2-1-96*	TOC Elevation: *269.37 feet msl*
Completed at *1010 on 2-1-96*	Depth to Groundwater: *17.34 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *252.03 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *27 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0							OL / GP	(0-27') Upper Alluvium (see descriptions below).	266
								(0-.5') Concrete.	
			1				CL / ML	(.5-1') Soil and gravel.	263
5								(1-4') Silt and clay.	
								(1-2') Clayey silt; light olive gray to greenish-gray and mottled with moderate yellowish-brown material.	
			2					(2-4') Silty clay; dark greenish-gray.	
10							ML	(4-18') Silt, clayey (see descriptions below).	
								(4-5') Clayey silt, light olive gray mottled with moderate yellowish- brown material.	
15			3					(5-15') Moderate yellowish-brown mottled with olive gray material, contains iron-manganese nodules.	
								Becoming moist; more clay-rich with less olive gray-colored material from 14-18'.	249
20							ML / SP	(18-27') Silt and very fine-grained sand. Olive gray to greenish-gray in color. Contains snail shell fragments. Top of Fluvial Deposits estimated at 22'.	
								Sand, jelly-like, lighter in color, wet at 27'.	
25								Wood fragments scattered throughout from 24' to 27'.	
								Terminated soil boring at 27'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent monitoring well 002G08DA.	240
30									
35									
40									

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 002G08DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.10 feet msl*
Started at *0930 on 1-31-96*	TOC Elevation: *269.33 feet msl*
Completed at *1425 on 1-31-96*	Depth to Groundwater: *17.54 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *251.79 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *51.5 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *35 to 45 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			BG	OL/GP	(0–22') Upper Alluvium (see descriptions below).	266.1
	1	100	BG	CL/ML	(0–.5') Concrete.	
5			BG		(.5–1') Soil and gravel.	263.1
			BG		(1–4') Silt and clay.	
			BG		(1–2') Clayey silt, light olive gray to greenish-gray and mottled with moderate yellowish-brown material.	
			BG		(2–4') Silty clay; dark greenish-gray.	
10	2	53	BG	ML	(4–18') Silt, clayey (see descriptions below).	
			BG		(4–5') Clayey silt, light olive gray mottled with moderate yellowish- brown material.	
15			BG		(5–15') Moderate yellowish-brown mottled with olive gray material. Contains iron-manganese nodules from 5' to 18'.	
			BG		Becoming moist; more clay-rich with less olive gray-colored material from 14–18'.	249.1
20	3	90	BG		(18–29') Silt and very fine-grained sand. Olive gray to greenish-gray in color. Contains snail shell fragments. Top of Deeper Alluvium deposits estimated at 22'.	
			BG	ML/SP	Sand, jelly-like, lighter in color, wet at 22'.	
25			BG		Wood fragments scattered throughout from 24' to 41'.	
	4	96	BG			
			BG			238.1
30			BG	SW/ML	(29–33') Silt and sand; sand is fine to coarse-grained.	
	4	96	BG		Olive gray to greenish-gray with snail shell fragments, wood scattered throughout, wet.	234.1
35			BG	SW/ML	(33–39') Sand, fine to very coarse-grained, and silt, olive gray to greenish-gray, with snail shell fragments, wood scattered throughout, wet.	
			BG			
			BG			228.1
40	5	100		SW/ML		

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

grout

bentonite seal

10/20 sand

EnSafe/Allen & Hoshall

Monitoring Well 002G08DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.10 feet msl*
Started at *0930 on 1-31-96*	TOC Elevation: *269.33 feet msl*
Completed at *1425 on 1-31-96*	Depth to Groundwater: *17.54 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *251.79 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *51.5 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *35 to 45 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
45					BG		SW ML	(39-41') Sand, fine to coarse-grained, and silt, olive gray to greenish-gray, with snail shell fragments, with wood scattered throughout, wet.	226.1	3" PVC end cap
					BG		SM		225.1	
							SP GW	(41-42') Sand, fine to coarse-grained, and silt with gravel up to 2.5" in longest dimension. Olive gray to greenish-gray, wet.	224.1	
					BG		SP GW		222.1	
					BG			(42-43') Very coarse-grained sand and gravel up to 2"in longest dimension. Moderate yellowish-brown, wet.		
					BG		CL			
50			6	75	BG			(43-45') Gravel up to 2" in longest dimension, and sand, very coarse, very light gray mottled with moderate yellowish-brown, wet.	215.6	bentonite seal
								(45-51.5') Cockfield Formation: Clay, dusky to dark yellowish-brown with light olive gray fine-grained sand laminations.		10/20 sand
55								Becoming very sandy near base of soil boring; sand is fine to medium-grained and light olive gray in color.		
								Terminated soil boring at 51.5'.		
60										
65										
70										
75										
80										

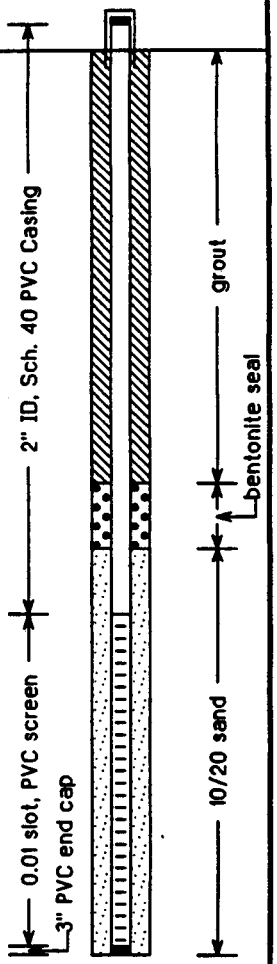
EnSafe/Allen & Hoshall

Monitoring Well 002G09UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *265.68 feet msl*
Started at *1320 on 1-30-96*	TOC Elevation: *268.09 feet msl*
Completed at *1500 on 1-30-96*	Depth to Groundwater: *16.19 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *251.90 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *27 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1				OL GW	(0-26') Upper Alluvium (see descriptions below). (0-3.5') Soil and gravel (fill).	
									262.2
5							ML	(3.5-8') Clayey silt; moderate yellowish-brown mottled with light olive gray material containing iron-manganese nodules.	
									257.7
			2					(8-19') Silt, very clayey, moderate yellowish-brown to dark yellowish- brown mottled with medium gray material. Abundant iron-manganese nodules from 9' to 11'. Moist with some iron-manganese nodules from 13' to 15'.	
10							ML		
15			3					Less iron-manganese nodules, becoming more dark yellowish-orange from 15-19'.	
									246.7
20							ML	(19-23') Silt, clayey, olive gray to greenish-gray, becoming just olive gray from 22' to 23', containing snail shell fragments.	
									242.7
25							SM	(23-27') Silty sand; fine to medium-grained, olive gray in color, with snail shell fragments, moist to wet. Top of Deeper Alluvium deposits estimated at 26'.	
								Wet below 25'.	238.7
30								Terminated soil boring at 27'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent monitoring well 002G09DA.	
35									
40									

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 002G09DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *265.51 feet msl*
Started at *0830 on 1-30-96*	TOC Elevation: *267.96 feet msl*
Completed at *0945 on 1-30-96*	Depth to Groundwater: *17.15 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *250.81 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *55.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *36 to 46 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1	75	8		OL/GW	(0-26') Upper Alluvium (see descriptions below). (0-3.5') Soil and gravel (fill).	
					6				262
5					5		ML	(3.5-8') Clayey silt; moderate yellowish-brown mottled with light olive gray material containing iron-manganese nodules.	
					6				257.5
			2	98	5		ML	(8-19') Silt, very clayey, moderate yellowish-brown to dark yellowish- brown mottled with medium gray material. Abundant iron-manganese nodules from 9' to 11'.	
10					6				
					6			Moist with some iron-manganese nodules from 13' to 15'.	
15					4			Less iron-manganese nodules, becoming more dark yellowish-orange from 15-19'.	
					5				
					2				246.5
20			3	90	5		ML	(19-23') Silt, clayey (see descriptions below). (19-22') Silt, clayey, olive gray to greenish-gray, containing snail shell fragments. (22-23') Same as above, but olive gray in color.	
					6				242.5
25					6		SM/SW	(23-27.5') Sand, fine to medium, silty, olive gray in color, with snail shell fragments, moist to wet, wet below 25'. Top of Deeper Alluvium deposits estimated at 26'.	
			4	100	5			(27.5-28') Sand, fine to very coarse-grained, olive gray, with snail shell fragments, wet.	237.5
					5		ML	(28-31') Silt; olive gray in color with snail shell fragments. Wet. Vegetation near 29'.	
30									

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

grout

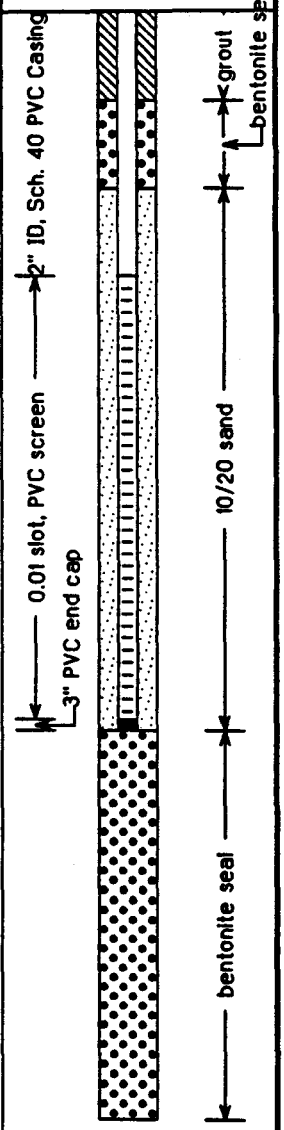
EnSafe/Allen & Hoshall

Monitoring Well 002G09DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *265.51 feet msl*
Started at *0830 on 1-30-96*	TOC Elevation: *267.96 feet msl*
Completed at *0945 on 1-30-96*	Depth to Groundwater: *17.15 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *250.81 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *55.0 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *36 to 46 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			3	ML		234.5
	4	100	8	SM	(31-34') Silty sand, very fine-grained becoming progressively coarser near 34', olive gray to light olive gray near 34', with snail shell fragments, wet.	231.5
35			6	SW	(34-34.5') Coarse to very coarse-grained sand with gravel. Light olive gray to greenish-gray, containing snail shell fragments, wet.	231
			6	SW		230.5
			6	SM	(34.5-35') Sand, very fine to medium-grained, light olive gray to greenish-gray, wet.	
			7	SP GW	(35-38') Silty sand, very fine to very coarse-grained, with quartz and chert gravel up to 1" in longest dimension, olive gray, wet.	227.5
40	5	390	5		(38-43') Sand and gravel; sand is fine to very coarse-grained, gravel is up to 1"in longest dimension; moderate yellowish-brown mottled with light gray material, wet.	
			6	SP	(43-44') Coarse-grained sand, moderate yellowish-brown mottled with medium light gray material, wet.	222.5
			6	SW GW		221.5
45					(44-46') Sand and gravel, gravel and sand (see descriptions below).	219.5
			5		(44-45') Sand and gravel; sand is very coarse-grained and gravel is up to 1.5" in longest dimension; moderate yellowish-brown mottled with medium light gray material, wet.	
50	6	102	5	CL	(45-46') Gravel up to 1.5" in longest dimension, and sand, dark yellowish-brown to moderate yellowish-brown; becoming clayey near 46'.	
			6		(46-55') Cockfield Formation: Clay, dusky yellowish-brown to dark yellowish-brown.	
			5		With light olive gray sandy seams below 52'.	
55			5		With some lignite seams below 53'.	210.5
60					Terminated soil boring at 55'.	

WELL DIAGRAM



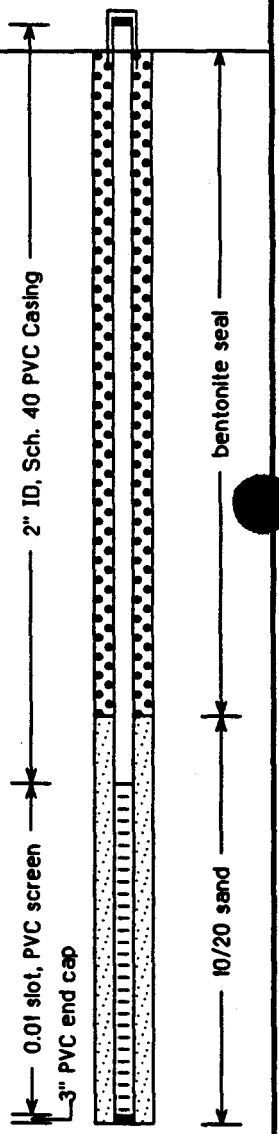
EnSafe/Allen & Hoshall

Monitoring Well 002G10UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 - Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *270.36 feet msl*
Started at *1400 on 2-13-96*	TOC Elevation: *270.19 feet msl*
Completed at *1445 on 2-13-96*	Depth to Groundwater: *8.79 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" core barrel inside 6" casing*	Groundwater Elevation: *261.40 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *32.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *22 to 32 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1					(0-32') Upper Alluvium (see descriptions below). Silt and clay (fill material) from 0' to 6', moderate brown to moderate gray color.	
5									264.4
10							ML CL	Moderate gray to light yellowish-brown, slightly moist.	
15			2					Mottling with dark yellowish-orange material with some organic material from 13' to 16'.	254.4
20			3					Silt, moderate brown to light gray with dark orangish-yellow mottling from 16' to 25'. Organic material present. Moist. Becomes wet at 20'.	
25							ML	Color change at 25' to light greenish-gray and olive gray. Shell fragments present. Wet. Silt with minor clay and sand. Moderate greenish-gray with common snail shells. Wet.	
30									238.4
35								Terminated soil boring at 32'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent monitoring well 002G10DA.	
40									

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 002G10DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *270.36 feet msl*
Started at *1220 on 2-12-96*	TOC Elevation: *270.17 feet msl*
Completed at *1400 on 2-12-96*	Depth to Groundwater: *9.36 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *260.81 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *40 to 50 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0					4			(0-36') Upper Alluvium (see descriptions below).	
			1	67	4			Silt and clay (fill material) from 0' to 6', moderate brown to moderate gray in color.	
5					2				
					3			Moderate gray to light yellowish-brown, slightly moist.	264.4
					3				
10			2	35	3		ML CL		
					3			Mottling with dark yellowish-orange material with some organic material from 13' to 16'.	
15					3				
					4			Silt, moderate brown to light gray with dark orangish-yellow mottling from 16' to 25'. Organic material present. Moist.	254.4
					3				
20			3	90	3			Wet at 20'.	
					3				
					3			Color change at 25' to light greenish-gray to olive gray. Shell fragments present. Wet.	
25					3		ML		
					2			Silt with minor clay and sand. Moderate greenish-gray with common snail shells. Wet.	
			4	100	2				
30					2				
			4	100	2				
					2				
35					3				
					2				234.4
					2		SW SM	(36-50') Deeper Alluvium (see descriptions below).	
40					2				

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

grout

bentonite seal

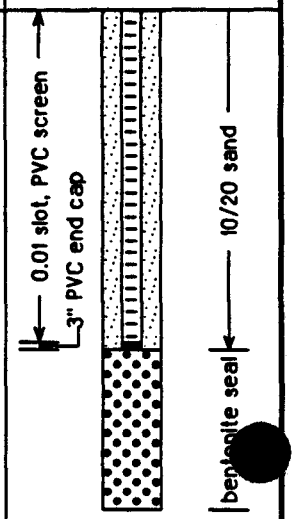
EnSafe/Allen & Hoshall

Monitoring Well 002G10DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *270.36 feet msl*
Started at *1220 on 2-12-96*	TOC Elevation: *270.17 feet msl*
Completed at *1400 on 2-12-96*	Depth to Groundwater: *9.36 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *260.81 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *40 to 50 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
45			5	85	2		SW SM	(36-45') Sand with gravel. Silt seams from 38-42', with thicknesses ranging from 6 to 12 inches. Sand is brownish-gray to light yellowish-brown.	
					2				
					2		GC GM	Gravel in a silt and clay matrix with minor sand. Very hard, dry to moist.	225.4
					3		SW GW	Sand and gravel, light yellowish-brown to light yellowish gray.	224.4
50					2			Color change to dark orangish-yellow.	220.4
			6	120	2		CL ML	Cockfield Formation: Dark brownish-gray clay with interbeds of silt and fine sand. Fine to medium-grained sand lense at 55'.	
					2				
55					2				
									214.4
								Terminated soil boring at 56'. Note: PID response likely due to moisture in samples.	
60									
65									
70									
75									
80									

WELL DIAGRAM



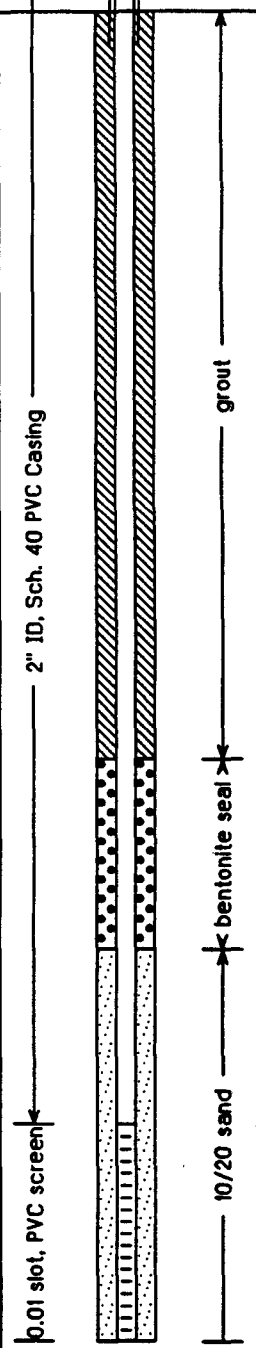
EnSafe/Allen & Hoshall

Monitoring Well 002G11UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 - Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *265.12 feet msl*
Started at *1500 on 1-17-96*	TOC Elevation: *266.91 feet msl*
Completed at *1300 on 1-18-96*	Depth to Groundwater: *3.92 feet* Measured: *4/8/96*
Drilling Method: *4 1/4" ID Hollow-Stem Auger with 5' Flights*	Groundwater Elevation: *262.99 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *26.75 feet*
Geologist: *J. Carmichael, W. Parks, D. Ladd*	Well Screen: *16.75 to 26.75 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1					(0-27') Upper Alluvium (see descriptions below).	264.1
								(0-1') Fill and skeet fragments.	
								(1-24') Silt, clayey (see descriptions below).	
								(1-2') Clayey silt; yellowish-brown to brownish-gray in color.	
								(2-6') Silt, clayey, dark yellowish-brown with dark yellowish-orange staining. Trace of organic material.	
5								Finely laminated and contains small iron-manganese nodules from 4-6'.	
								(6-8') Silt, decreasing clay content and increasing iron-manganese nodule content. Yellowish-brown to light olive gray color, moist.	
			2					(8-18') Silt, slightly clayey, yellowish-gray to light olive gray color, moist.	
10							ML	Increase in dark yellowish-orange staining, moisture content, and iron-manganese content from 10-14'.	
								Stained dark yellowish-orange in color from 14-16'. Very moist from 14-15'.	
15			3					Less staining from 16-18'. Very moist from 16-17' (water came up the borehole when auger was advanced).	
								(18-19') Silt, slightly clayey, medium gray in color. Moist.	
20								(19-20') Silt, slightly clayey, yellowish-gray to light olive gray, moist.	

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 002G11UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 - Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *265.12 feet msl*
Started at *1500 on 1-17-96*	TOC Elevation: *266.91 feet msl*
Completed at *1300 on 1-18-96*	Depth to Groundwater: *3.92 feet* Measured: *4/8/96*
Drilling Method: *4 1/4" ID Hollow-Stem Auger with 5' Flights*	Groundwater Elevation: *262.99 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *26.75 feet*
Geologist: *J. Carmichael, W. Parks, D. Ladd*	Well Screen: *16.75 to 26.75 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
25							ML	(20-22') Silt, slightly clayey, medium light gray to light gray, stained moderate brown. Moist. (22-24') Clayey silt, pale yellowish-brown to pale brown in color. Moist.	241.1	0.01 slot, PVC screen 3" PVC end cap 10/20 sand
							ML	(24-27') Silt (see descriptions below). (24-26') Silt; medium gray to brownish-gray with patches of dark yellowish-orange material. Moist. (26-27') Silt, light olive gray to medium gray, slightly moist.	238.1	
30								Soil boring terminated at 27'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent monitoring well 002G11DA.		
35										
40										

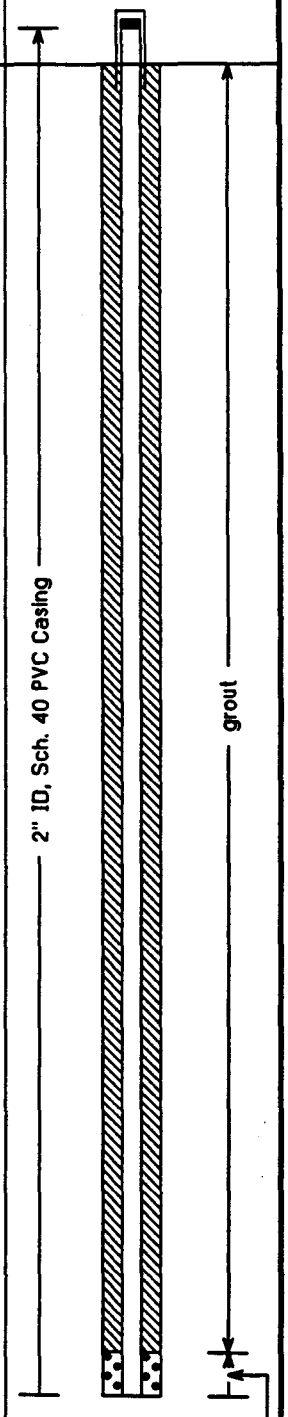
EnSafe/Allen & Hoshall

Monitoring Well 002G11DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *265.17 feet msl*
Started at *1010 on 1-16-96*	TOC Elevation: *266.77 feet msl*
Completed at *0915 on 1-17-96*	Depth to Groundwater: *4.17 feet* Measured: *4/8/96*
Drilling Method: *4 1/4" ID Hollow-Stem Auger, 5' Flights*	Groundwater Elevation: *262.60 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *46.0 feet*
Geologist: *J. Carmichael, W. Parks, D. Ladd*	Well Screen: *32.2 to 42.2 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
	1	42	BG		(0-33') Upper Alluvium (see descriptions below).	264.2
					(0-1') Fill and skeet fragments.	
	2	71	BG		(1-24') Silt, clayey (see descriptions below).	
					(1-2') Clayey silt, yellowish-brown to brownish-gray in color.	
5	3	73	BG		(2-6') Silt, clayey, dark yellowish-brown with dark yellowish-orange staining. Trace of organic material.	
	4	83	BG		Finely laminated and contains small iron-manganese nodules from 4-6'.	
	5	96	BG		(6-8') Silt, decreasing clay content and increasing iron-manganese nodule content. Yellowish-brown to light olive gray, moist.	
10	6	100	BG		(8-18') Silt, slightly clayey yellowish-gray to light olive gray color, moist.	
	7	100	BG	ML	Increase in dark yellowish-orange staining, moisture content, and iron-manganese content from 10-14'.	
15	8	100	BG		Stained dark yellowish-orange in color from 14-16'. Very moist from 14-15'.	
	9	100	BG		Less staining from 16-18'. Very moist from 16' to 17' (water came up the borehole when auger was advanced).	
	10	92	BG		(18-19') Silt, slightly clayey, medium gray in color. Moist.	
20	11	83	BG		(19-20') Silt, slightly clayey, yellowish-gray to light olive gray, moist.	
	12	100	BG		(20-22') Silt, slightly clayey, medium light gray to light gray, stained moderate brown, moist.	
	13	100	BG		(22-24') Silt, clayey, pale yellowish-brown to pale brown color, moist.	241.2
25				ML	(24-28') Silt (see descriptions below).	
	14	100	BG		(24-26') Silt; medium gray to brownish-gray with patches of dark yellowish-orange material. Moist.	
	15	100	BG	ML	(26-28') Silt; light olive gray to medium gray. Slightly moist.	237.2
30					(28-33') Silt, sandy (see descriptions below).	

WELL DIAGRAM



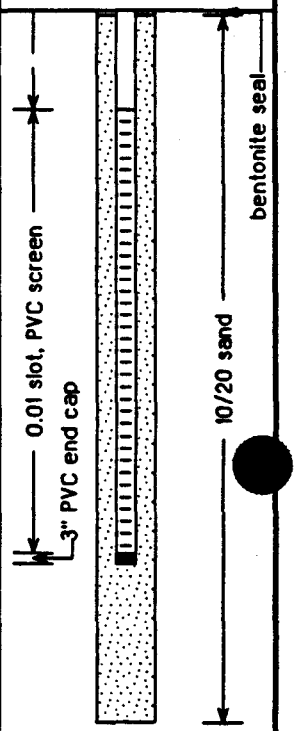
EnSafe/Allen & Hoshall

Monitoring Well 002G11DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 - Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *265.17 feet msl*
Started at *1010 on 1-16-96*	TOC Elevation: *266.77 feet msl*
Completed at *0915 on 1-17-96*	Depth to Groundwater: *4.17 feet* Measured: *4/8/96*
Drilling Method: *4 1/4" ID Hollow-Stem Auger, 5' Flights*	Groundwater Elevation: *262.60 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *46.0 feet*
Geologist: *J. Carmichael, W. Parks, D. Ladd*	Well Screen: *32.2 to 42.2 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			16	100	BG		ML	(28-30') Sandy silt; light olive gray to medium gray in color, slightly moist.	
			17	100	BG			(30-32') Silt, sandy, light olive gray, slightly moist, contains pockets of small red carbonaceous material.	232.2
35			18	71	BG			(32-33') Silt, sandy, medium light gray to medium gray, moist.	
			19	92	BG		SW GW	(33-43') Deeper Alluvium (see descriptions below).	
			20	58	BG			(33-34') Sand, fine to coarse-grained, light olive gray color, wet.	
40			21	88	BG			(34-36.25') Sand, fine to coarse-grained, with clay, silt, and gravel up to .5" in longest dimension. Light brownish-gray to pale red, moist. Coantains silt and clay from 34-35'.	
			22	92	BG			(36.25-38') Clayey sand with gravel up to 1" in longest dimension, olive gray to medium gray, moist.	222.2
45			23	83	BG		CL	(38-40') Sand and gravel, light olive gray to pale brown. Gravel content increases with depth.	
								(40-42') Sand and gravel, olive gray to brownish-gray stained dark yellowish-orange, wet.	219.2
								(42-43') Sand and gravel, light olive gray, wet.	
50								(43-46') Cockfield Formation: Clay, brownish-gray to dusky brown, finely micaceous, with fine-grained sand laminae from 44' to 46'.	
								Terminated soil boring at 46'.	
55									
60									

WELL DIAGRAM



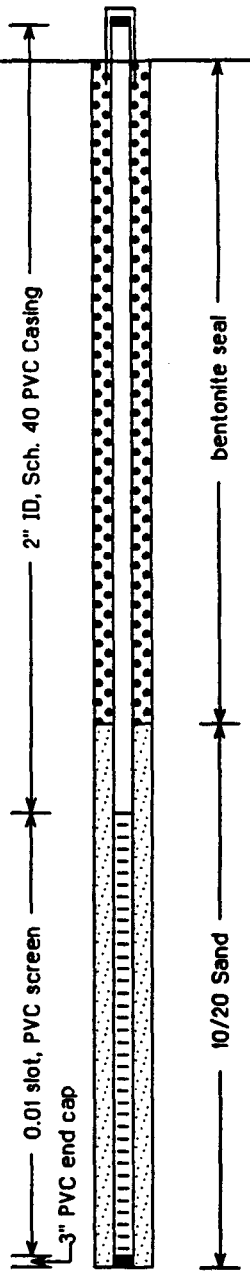
EnSafe/Allen & Hoshall

Monitoring Well 002G12UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *266.64 feet msl*
Started at *1030 on 1-23-96*	TOC Elevation: *268.63 feet msl*
Completed at *1200 on 1-29-96*	Depth to Groundwater: *12.87 feet* Measured: *4/8/96*
Drilling Method: *4 1/4" ID Hollow-Stem Auger with 5' Flights*	Groundwater Elevation: *255.76 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *28.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			1	58	4			(0-28') Upper Alluvium (see descriptions below). Silt and clay; light brown to dark yellowish-brown color from 0'-2'.	
			2	75	6			Light brown to yellowish-brown color. Many small iron-manganese nodules. Staining with orange rust-colored material. Dry.	
5			3	50	5			Grayish-brown to light brown color, stained dark orange to rust- colored. Iron-manganese nodules common. Dry.	
			4	75	4			Slightly moist.	
			5	100	3			Fewer iron-manganese nodules, very slightly moist.	
10			6	92	3			Increase in percentage of iron-manganese nodules; increase in moisture content from 11.5' to 12'.	
			7	92	3		ML CL	Yellowish-brown to light olive gray color. Decreased staining and percentage of iron-manganese nodules. Moist.	
15			8	96	3			Medium yellowish-brown to light olive gray, moist.	
			9	92	3			Silt and clay, moist. Increased staining.	
								Light olive gray.	
			10	100	4			Color change to medium gray at 18.5'. Some staining with black material (iron/manganese or organics).	
20			11	100	4				
			12	100	3				
								Decreased moisture content.	
25			13	100	4				
								Clay and silt; greenish-gray, dry.	
			14	100	4				
								Terminated soil boring at 28'. Note: PID response likely due to moisture content of soil.	238.6
30									

WELL DIAGRAM



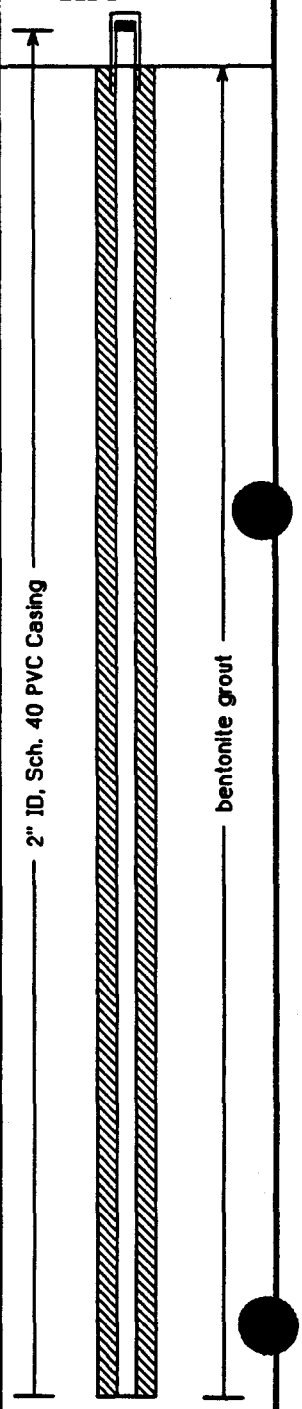
EnSafe/Allen & Hoshall

Monitoring Well 002G12DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *266.56 feet msl*
Started at *1300 on 1-29-96*	TOC Elevation: *268.63 feet msl*
Completed at *1400 on 1-30-96*	Depth to Groundwater: *6.02 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic*	Groundwater Elevation: *262.61 feet msl*
Drilling Company: *Alliance Drilling*	Total Depth: *50.0 feet*
Geologist: *J. Kingsbury, R. Thomas*	Well Screen: *38.5 to 48.5 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0							ML/CL	(0-35') Upper Alluvium (see descriptions below).	
								Silt and clay; light brown to dark yellowish-brown color from 0'-2'.	
								Light brown to yellowish-brown color. Many small iron-manganese nodules. Staining with orange rust-colored material. Dry.	
5								Grayish-brown to light brown color, stained dark orange to rust- colored. Iron-manganese nodules common. Dry.	
								Dry to slightly moist.	
10								Fewer iron-manganese nodules, very slightly moist.	
								Increase in percentage of iron-manganese nodules; increase in moisture content from 11.5' to 12.0'.	
								Yellowish-brown to light olive gray color. Decreased staining and percentage of iron-manganese nodules. Moist.	
15								Medium yellowish-brown to light olive gray, moist.	
								Silt and clay, moist. Increased staining.	
								Light olive gray.	
								Color change to medium gray at 18.5'. Some staining with black material (iron/manganese or organics).	
20									
								Decreased moisture content.	
25								Clay and silt; greenish-gray, dry.	
									238.6
			1	75	BG		ML	Clayey silt, light olive gray to medium gray color. Some orangish- brown staining. Mostly dry.	
30									

WELL DIAGRAM



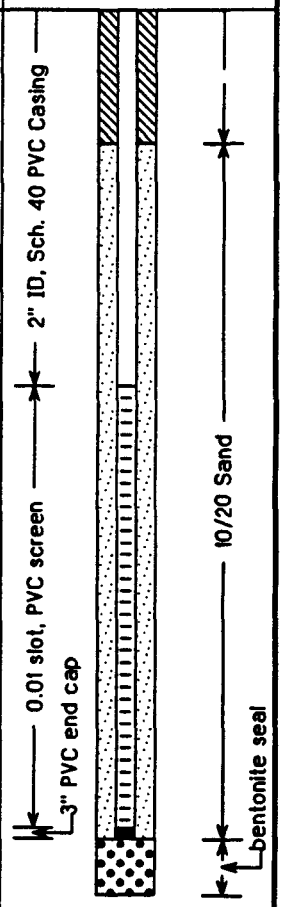
EnSafe/Allen & Hoshall

Monitoring Well 002G12DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *266.56 feet msl*
Started at *1300 on 1-29-96*	TOC Elevation: *268.63 feet msl*
Completed at *1400 on 1-30-96*	Depth to Groundwater: *6.02 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic*	Groundwater Elevation: *262.61 feet msl*
Drilling Company: *Alliance Drilling*	Total Depth: *50.0 feet*
Geologist: *J. Kingsbury, R. Thomas*	Well Screen: *38.5 to 48.5 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
	2	75	BG	ML	Contains streaks of fine to medium-grained sand approximately 1 to 2 inches thick, light olive-gray to medium gray.	
	3	83	BG			
				SC SM	Silt, sand, and clay, light olive gray.	232.6
35	4	100	BG	SW	(35-51') Deeper Alluvium (see descriptions below).	231.6
					(35-36') Sand; fine to coarse-grained, yellowish-gray to yellowish- brown color.	230.6
					Start five-foot split-spoon intervals.	
40	5	67	BG	SW GW	Sand and gravel; gravel up to 1" in diameter. Yellowish-gray to yellowish-brown in color.	226.6
						224.6
45	6	83	BG	SW GW	Sand and gravel, yellowish-brown to yellowish-gray.	221.6
						219.6
50	7	75	BG	SW	Sand with rare gravel, light olive gray, matrix resembles reworked Cockfield Formation from 50' to 51'. Cockfield Formation contact is at 51'.	216.6
				SC SM	Sand, fine to medium-grained, finely lignitic and micaceous, is present from 51' to 51.5'.	215.6
					Sand with silt and clay.	
55					Terminated soil boring at 51.5'. Note: Sample lithology and PID readings from 0' to 28' obtained during the advancement of 002G12UA. Lithology and PID readings from 28' to 51.5' obtained during the advancement of 002G12DA.	
60						

WELL DIAGRAM



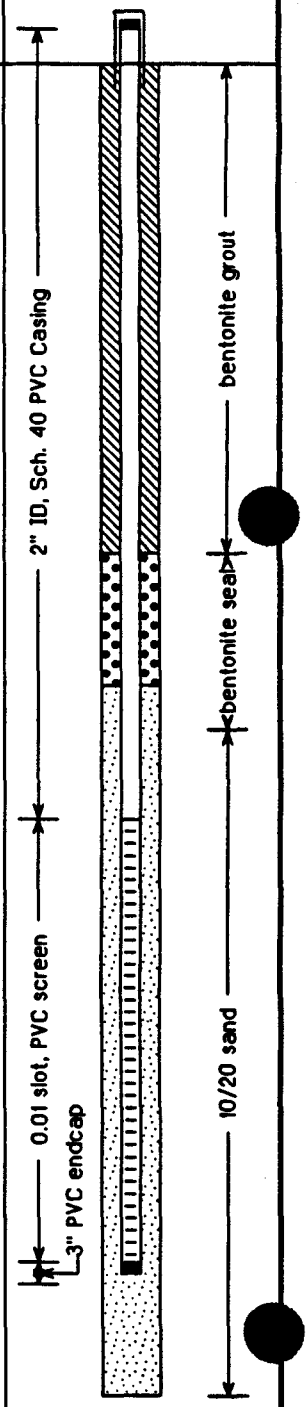
EnSafe/Allen & Hoshall

Monitoring Well 002G13UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.13 feet msl*
Started at *1400 on 1-22-96*	TOC Elevation: *268.96 feet msl*
Completed at *0845 on 1-23-96*	Depth to Groundwater: *3.30 feet* Measured: *4/8/96*
Drilling Method: *4 1/4" ID Hollow-Stem Auger With 5" Flights*	Groundwater Elevation: *265.66 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *30.0 feet*
Geologist: *D. Ladd, J. Kingsbury, A. Choate*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
	OL	(0-30') Upper Alluvium (see descriptions below).	
	CL	Clay and silt, dark yellowish-brown, moist, with organic material and roots.	265.1
	ML	Silty clay/clayey silt, greenish-gray and moderate yellowish-brown, slightly moist, soft to slightly firm, with some dark iron staining.	263.1
5	ML	Clayey silt, greenish-gray and moderate yellowish-brown, with iron/ manganese inclusions and organic material, slightly moist.	
		Iron-manganese nodules increasing in percentage and size (up to .5" in diameter).	
		Some staining with a dark yellowish-orange material.	
10		Increase in clay percentage.	
		Clayey silt, light olive gray color stained light brown to dark yellowish-orange. Moisture content increasing as iron/manganese nodules decrease in percentage.	
15		Very moist at 14' becoming less moist near 16', rare iron/manganese nodules.	
		Clayey silt, medium gray to light olive gray stained light brown to dark yellowish-orange, very moist.	
			248.1
20	CL	Silty clay, medium light to medium gray, wet.	
		Dark greenish-gray to grayish-olive green color, wet.	
		Very moist.	
25		Light olive gray to grayish-olive green color. Very moist and soft.	
			239.1
	ML	Clayey silt, slightly moist, soft.	
30			237.1

WELL DIAGRAM



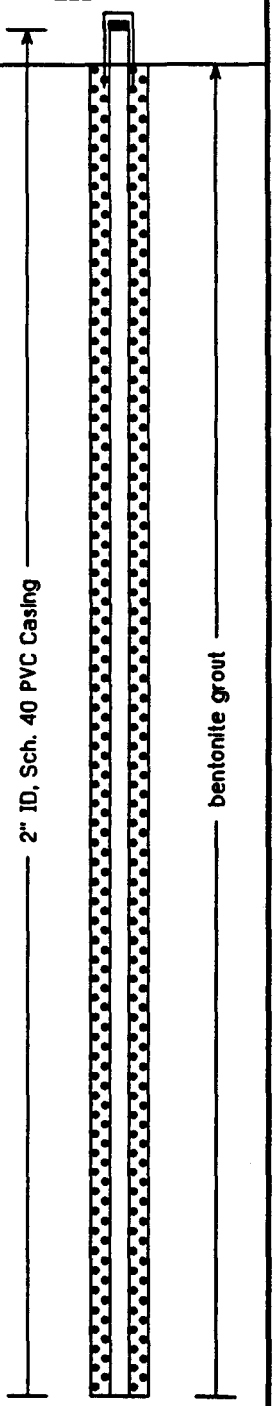
EnSafe/Allen & Hoshall

Monitoring Well 002G13MA

Project: *NAS Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.23 feet msl*
Started at *1300 on 1-21-96*	TOC Elevation: *269.20 feet msl*
Completed at *1145 on 1-22-96*	Depth to Groundwater: *5.38 feet* Measured: *4/8/96*
Drilling Method: *4 1/4" ID Hollow-Stem Auger With 5' Flights*	Groundwater Elevation: *263.82 feet msl*
Drilling Company: *Alliance Drilling*	Total Depth: *46.0 feet*
Geologist: *D. Ladd, J. Kingsbury, A. Choate*	Well Screen: *36 to 46 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1		BG		OL	(0-34') Upper Alluvium (see descriptions below).	
							ML CL	Clay and silt, dark yellowish-brown, moist, with organic material and roots.	265.2
								Silty clay/clayey silt, greenish-gray and moderate yellowish-brown, slightly moist, soft to slightly firm, with some dark iron staining.	263.2
5								Clayey silt, greenish-gray and moderate yellowish-brown, with iron/manganese inclusions and organic material, slightly moist.	
								Iron-manganese nodules increasing in percentage and size (up to .5" in diameter).	
			2		BG			Some staining with a dark yellowish-orange material.	
10							ML	Increase in clay percentage.	
								Clayey silt, light olive gray color stained light brown to dark yellowish-orange. Moisture content increases and the percentage of iron/manganese nodules decreases.	
15			3		BG			Very moist at 14' becoming less moist near 16', rare iron/manganese nodules.	
								Clayey silt, medium gray to light olive gray stained light brown to dark yellowish-orange, very moist.	
									248.2
20								Silty clay, medium light to medium gray, wet.	
								Dark greenish-gray to grayish-olive green color, wet.	
								Very moist.	
							CL		
25								Light olive gray to grayish-olive green color. Very moist and soft.	
									239.2
30							ML	Clayey silt, light olive gray to grayish-olive green color, slightly moist, soft.	

WELL DIAGRAM



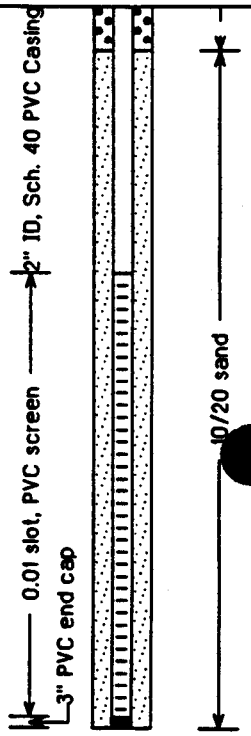
EnSafe/Allen & Hoshall

Monitoring Well 002G13MA

Project: *NAS Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.23 feet msl*
Started at *1300 on 1-21-96*	TOC Elevation: *269.20 feet msl*
Completed at *1145 on 1-22-96*	Depth to Groundwater: *5.38 feet* Measured: *4/8/96*
Drilling Method: *4 1/4" ID Hollow-Stem Auger With 5' Flights*	Groundwater Elevation: *263.82 feet msl*
Drilling Company: *Alliance Drilling*	Total Depth: *46.0 feet*
Geologist: *D. Ladd, J. Kingsbury, A. Choate*	Well Screen: *36 to 46 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
35							ML	Sandy silt with rare coarse subangular sand grains. Wet. Olive gray color, wet, soft. Sandy silt with fine to coarse-grained sand between 34' and 35' fining downward to fine-grained sand between 35' and 36', soft. Top of Deeper Alluvium deposits estimated at 34'.	231
							SW GW	Sand and gravel, gravel up to 1" in diameter, light olive gray.	229.7
40							SW SM	Silty sand, light olive gray	
								Silty sand with some gravel, light olive gray to light gray. No sample collected from 40' to 46' due to heaving sand.	227.2
45								Terminated soil boring at 46'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log for monitoring well 002G13DA.	221.2
50									
55									
60									

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 002G13DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 - Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.05 feet msl*
Started at *1110 on 1-19-96*	TOC Elevation: *269.12 feet msl*
Completed at *1130 on 1-20-96*	Depth to Groundwater: *5.36 feet* Measured: *4/8/96*
Drilling Method: *4 1/4" ID Hollow-Stem Auger, 5' Flights*	Groundwater Elevation: *263.76 feet msl*
Drilling Company: *Alliance Drilling*	Total Depth: *67.0 feet*
Geologist: *D. Ladd, J. Kingsbury, A. Choate*	Well Screen: *55 to 65 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			1	46	BG		OL	(0-34') Upper Alluvium (see descriptions below).	
								Clay and silt, dark yellowish-brown, moist, with organic material and roots.	265
			2	83	BG		CL ML	Silty clay/clayey silt, greenish-gray and moderate yellowish-brown, slightly moist, soft to slightly firm, with some dark iron staining.	263
5			3	88	3			Clayey silt, greenish-gray and moderate yellowish-brown, with iron/ manganese inclusions and organic material, slightly moist.	
			4	79	2.5			Iron-manganese nodules increasing in percentage and size (up to .5" in diameter).	
			5	100	2			Some staining with a dark yellowish-orange material.	
10			6	108	BG		ML	Increase in clay percentage.	
			7	108	BG			Clayey silt, light olive gray color stained light brown to dark yellowish-orange. Moisture content increasing as iron/manganese nodules decrease in percentage.	
15			8	108	BG			Very moist at 14' becoming less moist near 16', rare iron/manganese nodules.	
			9	108	BG			Clayey silt, medium gray to light olive gray stained light brown to dark yellowish-orange, very moist.	
			10	100	BG				248
20			11	92	BG			Silty clay, medium light to medium gray, wet. Dark greenish-gray to grayish-olive green color, wet.	
			12	100	BG		CL	Very moist.	
25			13	96	BG			Light olive gray to grayish-olive green color. Very moist and soft.	
			14	96	BG				
									239
			15	96	BG		ML	Clayey silt, light olive gray to grayish-olive green color, slightly moist, soft.	
30									

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

bentonite grout

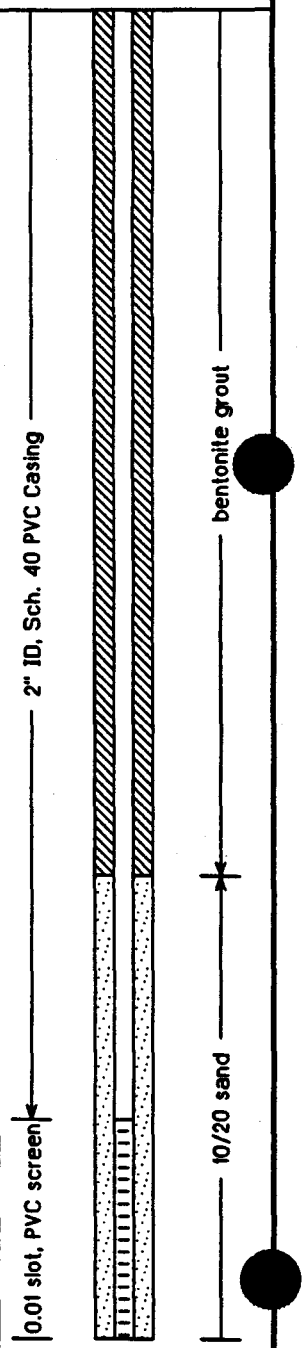
EnSafe/Allen & Hoshall

Monitoring Well 002G13DA

Project: NSA Memphis	Location: Millington, TN SWMU#2 - Southside Landfill
Project No.: 106-08420	Surface Elevation: 267.05 feet msl
Started at 1110 on 1-19-96	TOC Elevation: 269.12 feet msl
Completed at 1130 on 1-20-96	Depth to Groundwater: 5.36 feet Measured: 4/8/96
Drilling Method: 4 1/4" ID Hollow-Stem Auger, 5' Flights	Groundwater Elevation: 263.76 feet msl
Drilling Company: Alliance Drilling	Total Depth: 67.0 feet
Geologist: D. Ladd, J. Kingsbury, A. Choate	Well Screen: 55 to 65 feet

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
	16	33	BG		Sandy silt with rare coarse subangular sand grains. Wet.	
	17	83	BG	ML	Olive gray color, wet, soft.	
35	18	79	BG		Sandy silt with fine to coarse sand between 34' and 35' fining downward to fine-grained sand between 35' and 36', soft. Top of Deeper Alluvium deposits estimated at 34'.	
	19	100	BG	SW GW	Sand and gravel, gravel up to 1" in longest dimension, light olive gray.	230.9
					Silty sand, light olive gray.	229.5
	20	100	BG	SW	Silty sand with some gravel, light olive gray to light gray.	
40					No sample collected from 40' to 46' due to heaving sand.	227
45	21	96	BG	SW GW	Sand and gravel, light olive gray. Wet. Considerable iron-staining at 47.5'.	221
					No sample collected from 48' to 51'.	219
50	22	100	BG	SW GW	Sand and gravel, dark yellowish-orange changing to yellowish-gray color near 53'.	216
					No sample collected from 53' to 56'.	214
55	23	100	BG	SW GW	Sand and gravel, yellowish-gray to pale yellowish-brown. Gravel up to 1" in longest dimension. Locally stained dark yellowish-orange, wet.	211
					No sample collected from 58' to 61'.	209
60						

WELL DIAGRAM



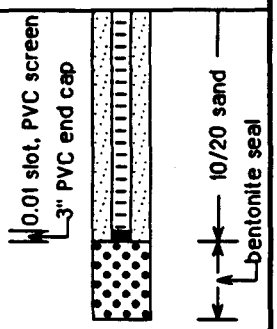
EnSafe/Allen & Hoshall

Monitoring Well 002G13DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *267.05 feet msl*
Started at *1110 on 1-19-96*	TOC Elevation: *269.12 feet msl*
Completed at *1130 on 1-20-96*	Depth to Groundwater: *5.36 feet* Measured: *4/8/96*
Drilling Method: *4 1/4" ID Hollow-Stem Auger, 5' Flights*	Groundwater Elevation: *263.76 feet msl*
Drilling Company: *Alliance Drilling*	Total Depth: *67.0 feet*
Geologist: *D. Ladd, J. Kingsbury, A. Choate*	Well Screen: *55 to 65 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			24	141	BG		SW GW	Sand and gravel, moderate yellowish-brown to dark yellowish-brown color.	206
								Color change to dusky yellow brown. Wet.	204.6
								No sample collected from 62.5' to 65'.	
65			25	100	BG		SW GW SP	Fine to coarse-grained sand and gravel, olive-gray to light olive gray. Fining downward and turning dark yellowish-orange to light brown in color near 65.5'.	202.1 201.1 200.1
								Cockfield Formation: Sand, fine-grained, dark yellowish-orange to light brown, wet. Terminated soil boring at 67'.	
70									
75									
80									
85									
90									

WELL DIAGRAM



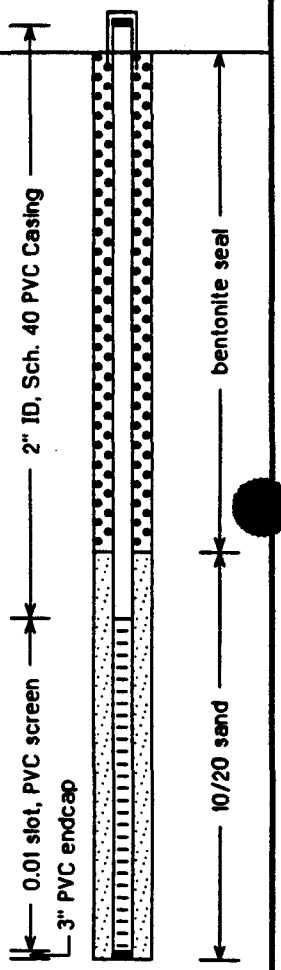
EnSafe/Allen & Hoshall

Monitoring Well 002G14UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *269.17 feet msl*
Started at *1455 on 2-14-96*	TOC Elevation: *271.23 feet msl*
Completed at *1530 on 2-14-96*	Depth to Groundwater: *5.50 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *265.73 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *27.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *17 to 27 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1					(0-27') Upper Alluvium (see descriptions below). Clayey silt, dark yellowish-brown to brownish-gray.	
5								Some organic material between 5' and 6'.	
10			2				ML	Silt, light yellowish-brown to yellowish-gray mottled with dark orangish-yellow material. Organic material (specks) common from 10' to 16', very moist.	
15			3					Common iron staining from 16' to 20'.	
20									249.2
							ML/CL	Silt and clay, olive gray to greenish-gray, wet.	
25								Slightly moist between 25' and 27'.	
									242.2
30								Terminated soil boring at 27'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent monitoring well 002G14DA.	
35									
40									

WELL DIAGRAM



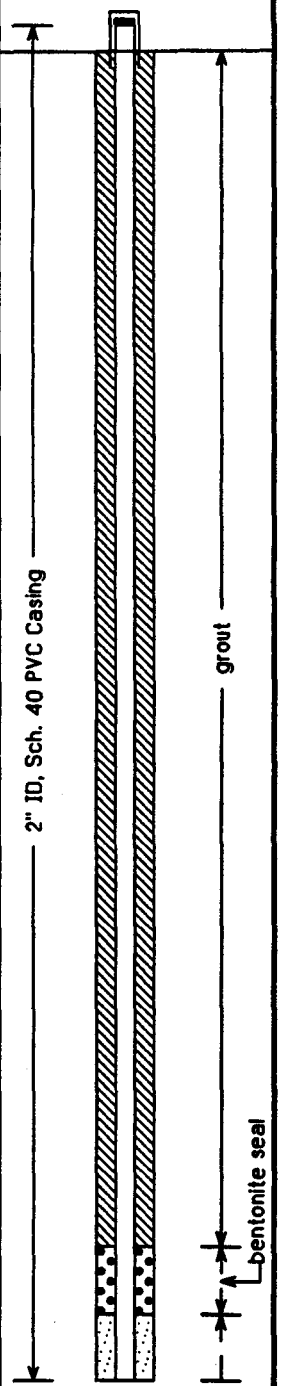
EnSafe/Allen & Hoshall

Monitoring Well 002G14DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *269.00 feet msl*
Started at *1213 on 2-14-96*	TOC Elevation: *271.00 feet msl*
Completed at *1400 on 2-14-96*	Depth to Groundwater: *6.90 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *264.10 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *76.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *40 to 50 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0								(0-32') Uper Alluvium (see descriptions below).	
			1	83	3			Clayey silt, dark yellowish-brown to brownish-gray	
5								Some organic material between 5' and 6'.	
10			2	80	BG		ML	Silt, light yellowish-brown to yellowish-gray mottled with dark orangish-yellow material. Organic material (specks) common from 10' to 16'. Very moist.	
15								Common iron staining from 16' to 20'.	
20			3	90	BG			Silt and clay, olive-gray to greenish-gray, wet.	249
25							ML/CL	Slightly moist between 25' and 29'.	
30			4	90	BG			Light olive gray color; mottled with brown to reddish-brown material.	
									237
							ML/SM	(32-66') Deeper Alluvium (see descriptions below).	
35								Light olive gray silt to fine sand. No mottling. Wet.	233
							SM	More sand from 36' to 39'.	
40							SP		230

WELL DIAGRAM



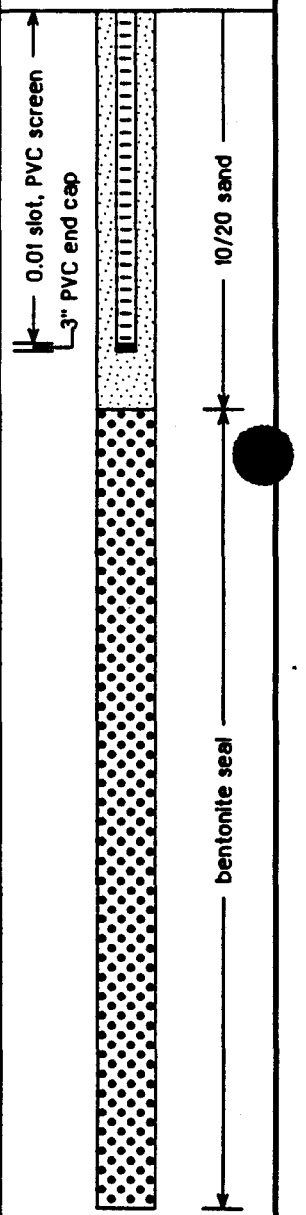
EnSafe/Allen & Hoshall

Monitoring Well 002G14DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU#2 – Southside Landfill*
Project No.: *106-08420*	Surface Elevation: *269.00 feet msl*
Started at *1213 on 2-14-96*	TOC Elevation: *271.00 feet msl*
Completed at *1400 on 2-14-96*	Depth to Groundwater: *6.90 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" core barrel inside 6" casing*	Groundwater Elevation: *264.10 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *76.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *40 to 50 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
	5	90	BG	SP	Coarse-grained sand with rare gravel. Dusky yellow color from 40' to 41' changing to olive gray in color from 42' to 43'.	226
45				SP/GW	Sand and gravel, reddish-brown to dark orangish-yellow.	223
				SP	Coarse-grained sand with some gravel. Dark orangish-yellow to reddish-brown becoming dusky yellow around 49' to 50'.	219
50	6	110	BG	SP	Sand, fine-grained, yellowish-gray to very light yellowish-brown, finely micaceous, wet.	
55						
60	7	90	BG			
65					Some ironstone and reddish-brown sand.	203
					Cockfield Formation: clay and silt, dark gray.	
70	8	100	BG	CL/ML		
75						193
					Terminated soil boring at 76'.	
80						

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 002G09DA

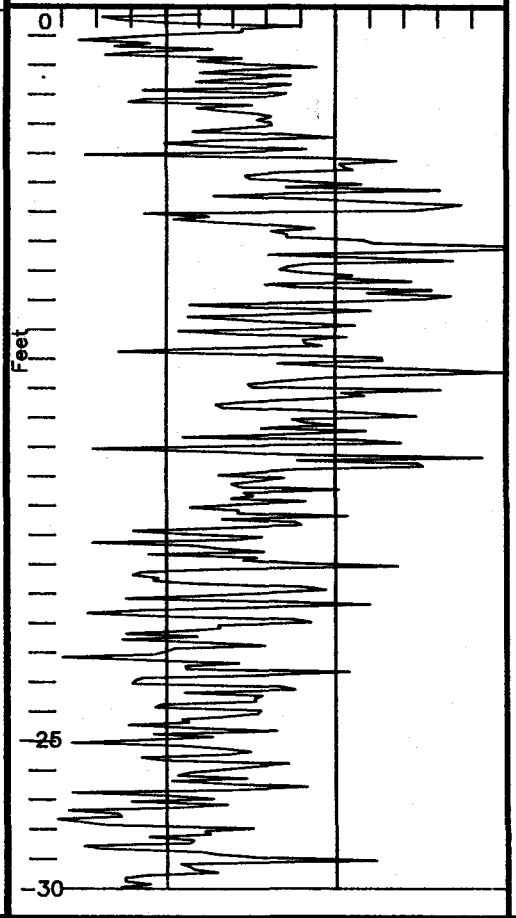
Project: NSA Memphis	Location: Millington, TN. SWMU #2–Southside Landfill
Project No.: 106–08420	Surface Elevation: 265.51 feet msl
Started at 0830 on 1–30–96	TOC Elevation: 267.96 feet msl
Completed at 0945 on 1–30–96	Depth to Groundwater: 17.15 feet Measured: 4/8/96
Drilling Method: Rotasonic–4" core barrel inside 6" casing	Groundwater Elevation: 250.81 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 55.0 feet
Geologist: D. Ladd, W. Parks	Well Screen: 36 to 46 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0					8			(0–26') Upper Alluvium (see descriptions below).	
			1	75	6		GP GW	(0–3.5') Soil and gravel (fill).	
								(3.5–6') Clayey silt; moderate yellowish–brown mottled with light olive gray material containing iron–manganese nodules.	262
5					5		ML		
					6				257.5
					5			(8–19') Silt, very clayey, moderate yellowish–brown to dark yellowish– brown mottled with medium gray material.	
10			2	98	6			Abundant iron–manganese nodules from 9' to 11'.	
					6		ML	Moist with some iron–manganese nodules from 13' to 15'.	
15					4			Less iron–manganese nodules, becoming more dark yellowish–orange from 15–19'.	
					5				
					2				246.5
20			3	90	5		ML	(19–23') Silt, clayey (see descriptions below). (19–22') Silt, clayey, olive gray to greenish–gray, containing snail shell fragments. (22–23') Same as above, but olive gray in color.	
					6				242.5
					6		SM SW	(23–27.5') Sand, fine to medium, silty, olive gray in color, with snail shell fragments, moist to wet, wet below 25'. Top of Deeper Alluvium deposits estimated at 26'.	
25					5				
			4	100				(27.5–28') Sand, fine to very coarse–grained, olive gray, with snail shell fragments, wet.	237.5
30					5		ML	(28–31') Silt; olive gray in color with snail shell fragments. Wet. Vegetation near 29'.	

WELL DIAGRAM: 2" ID, Sch. 40 PVC Casing

GAMMA RAY LOG

COUNTS PER SECOND



CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/23/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 2
SOUTHSIDE LANDFILL

DWG DATE: 12/10/96

DWG NAME: 94GL29

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

EnSafe/Allen & Hoshall

Monitoring Well 002G09DA

Project: NSA Memphis	Location: Millington, TN. SWMU#2 – Southside Landfill
Project No.: 106-08420	Surface Elevation: 265.51 feet msl
Started at 0830 on 1-30-96	TOC Elevation: 267.96 feet msl
Completed at 0945 on 1-30-96	Depth to Groundwater: 17.15 feet Measured: 4/8/96
Drilling Method: Rotasonic-4" core barrel inside 6" casing	Groundwater Elevation: 250.81 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 55.0 feet
Geologist: D. Ladd, W. Parks	Well Screen: 36 to 46 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
					3		ML		234.5
			4	100	8		SM	(31–34') Silty sand, very fine–grained becoming progressively coarser near 34', olive gray to light olive gray near 34', with small shell fragments, wet.	
							SW		231.5
35					6		SW	(34–34.5') Coarse to very coarse–grained sand with gravel. Light olive gray to greenish–gray, containing small shell fragments, wet.	231 / 230.5
					6		SM	(34.5–35') Sand, very fine to medium–grained, light olive gray to greenish–gray, wet.	
					7		SP GW	(35–38') Silty sand, very fine to very coarse–grained, with quartz and chert gravel up to 1" in longest dimension, olive gray, wet.	227.5
40			5	390	5			(38–43') Sand and gravel; sand is fine to very coarse–grained, gravel is up to 1"in longest dimension; moderate yellowish–brown mottled with light gray material, wet.	
					6		SP	(43–44') Coarse–grained sand, moderate yellowish–brown mottled with medium light gray material, wet.	222.5 / 221.5
45					6		SW GW	(44–46') Sand and gravel, gravel and sand (see descriptions below).	219.5
					5			(44–45') Sand and gravel; sand is very coarse–grained and gravel is up to 1.5" in longest dimension; moderate yellowish–brown mottled with medium light gray material, wet.	
					5			(45–46') Gravel up to 1.5" in longest dimension, and sand, dark yellowish–brown to moderate yellowish–brown; becoming clayey near 46'.	
50			6	102	6		CL	(46–55') Cockfield Formation: Clay, dusky yellowish–brown to dark yellowish–brown.	
					5			With light olive gray sandy seams below 52'.	
					5			With some lignite seams below 53'.	210.5
55								Terminated soil boring at 55'.	
60									

WELL DIAGRAM: 2" ID, Sch. 40 PVC Casing; 0.01 slot, PVC screen; 3" PVC end cap

GAMMA RAY LOG

COUNTS PER SECOND

0 20 40 60

-30 -40 Feet

CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/23/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 2
SOUTHSIDE LANDFILL

DWG DATE: 12/10/96 DWG NAME: 94G129A

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

EnSafe/Allen & Hoshall

Monitoring Well 002G11DA

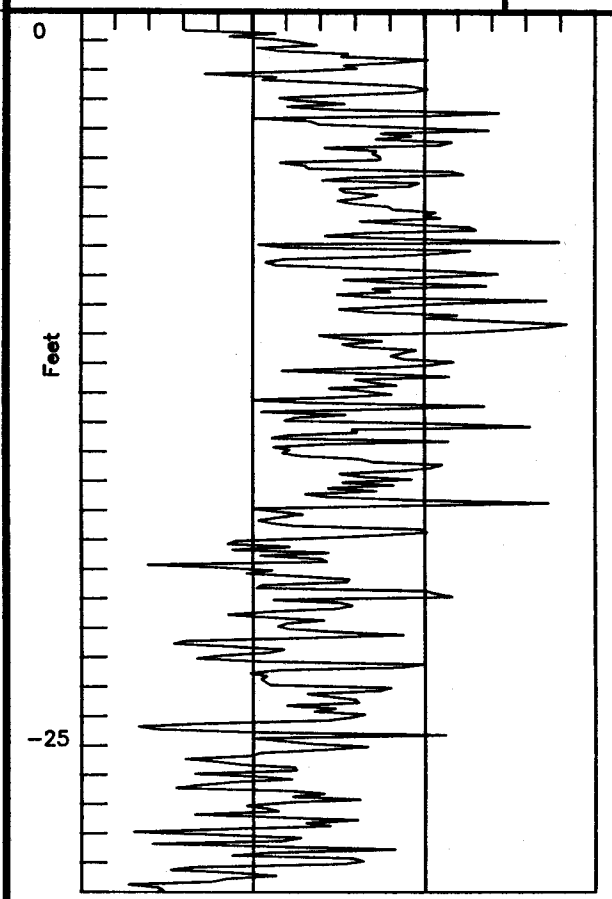
Project: NSA Memphis	Location: Millington,TN.SWMU#2--Southside Landfill
Project No.: 106-08420	Surface Elevation: 265.17 feet msl
Started at 1010 on 1-16-96	TOC Elevation: 266.77 feet msl
Completed at 0915 on 1-17-96	Depth to Groundwater 4.17 feet Measured: 4/8/96
Drilling Method: 4 1/4" ID Hollow-Stem Auger, 5' Flights	Groundwater Elevation: 262.60 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 46.0 feet
Geologist: J. Carmichael, W. Parks, D. Ladd	Well Screen: 32.2 to 42.2 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			1	42	BG			(0-33') Upper Alluvium (see descriptions below).	
								(0-1') Fill and skeet fragments.	264.2
			2	71	BG			(1-24') Silt, clayey (see descriptions below).	
								(1-2') Clayey silt, yellowish-brown to brownish-gray in color.	
5			3	73	BG			(2-6') Silt, clayey, dark yellowish-brown with dark yellowish-orange staining. Trace of organic material.	
			4	83	BG			Finely laminated and contains small iron-manganese nodules from 4-6'.	
			5	96	BG			(6-8') Silt, decreasing clay content and increasing iron-manganese nodule content. Yellowish-brown to light olive gray, moist.	
10			6	100	BG			(8-18') Silt, slightly clayey yellowish-gray to light olive gray color, moist.	
			7	100	BG		ML	Increase in dark yellowish-orange staining, moisture content, and iron-manganese content from 10-14'.	
15			8	100	BG			Stained dark yellowish-orange in color from 14-16'. Very moist from 14-15'.	
			9	100	BG			Less staining from 16-18'. Very moist from 16' to 17' (water came up the borehole when auger was advanced).	
			10	92	BG			(18-19') Silt, slightly clayey, medium gray in color. Moist.	
20			11	83	BG			(19-20') Silt, slightly clayey, yellowish-gray to light olive gray, moist.	
			12	100	BG			(20-22') Silt, slightly clayey, medium light gray to light gray, stained moderate brown, moist.	
								(22-24') Silt, clayey, pale yellowish-brown to pale brown color, moist.	241.2
25			13	100	BG			(24-28') Silt (see descriptions below).	
			14	100	BG		ML	(24-26') Silt; medium gray to brownish-gray with patches of dark yellowish-orange material. Moist.	
									237.2
			15	100	BG		ML	(26-28') Silt; light olive gray to medium gray. Slightly moist.	
30								(28-33') Silt, sandy (see descriptions below).	

WELL DIAGRAM: 2" ID, Sch. 40 PVC Casing

GAMMA RAY LOG

COUNTS PER SECOND



CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/23/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 2
SOUTHSIDE LANDFILL

DWG DATE: 12/10/96 | DWG NAME: 94G0211

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

EnSafe/Allen & Hoshall

Monitoring Well 002G11DA

Project: NSA Memphis	Location: Millington, TN. SWMU#2-Southside Landfill
Project No.: 106-08420	Surface Elevation: 265.17 feet msl
Started at 1010 on 1-16-96	TOC Elevation: 266.77 feet msl
Completed at 0915 on 1-17-96	Depth to Groundwater 1.17 feet Measured: 1/8/96
Drilling Method: 4 1/4" ID Hollow-Stem Auger, 5' Flights	Groundwater Elevation: 262.60 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 46.0 feet
Geologist: J. Carmichael, W. Parks, D. Ladd	Well Screen: 32.2 to 42.2 feet

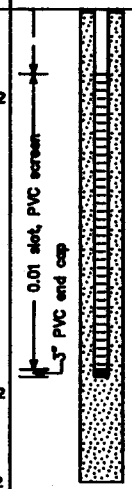
GAMMA RAY LOG
COUNTS PER SECOND

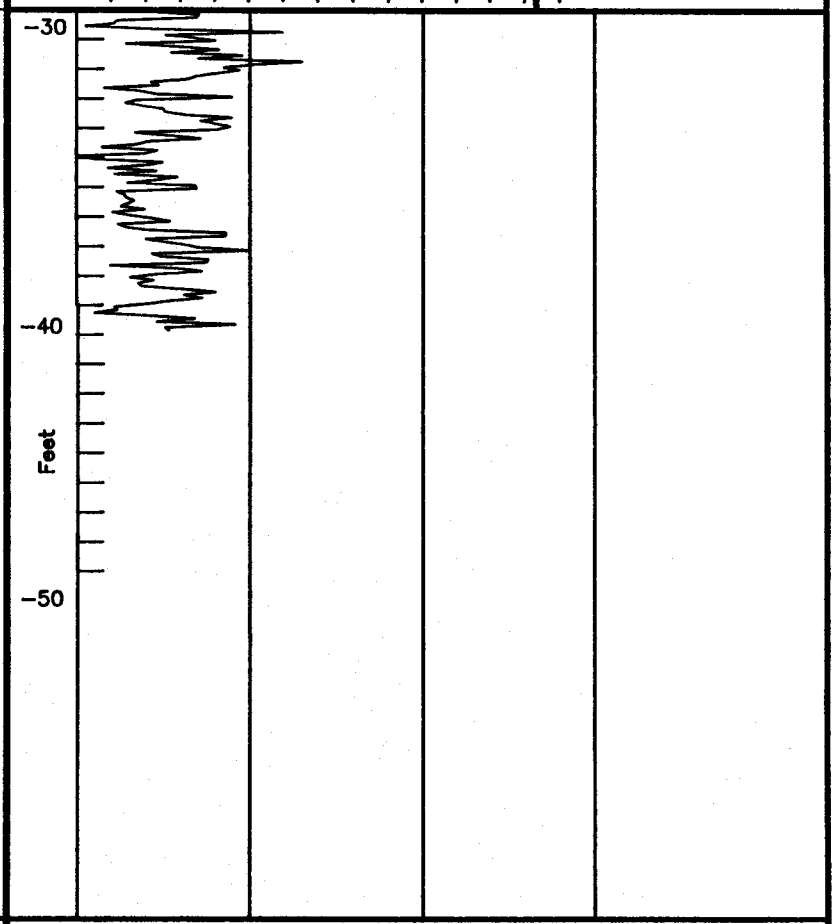
CASING TYPE: 2" PVC
TOP OF LOG = GROUND SURFACE
DATE LOGGED: 05/23/96

NOTES

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			16	100	BG		ML	(28–30') Sandy silt; light olive gray to medium gray in color, slightly moist.	
			17	100	BG			(30–32') Silt, sandy, light olive gray, slightly moist, contains pockets of small red carbonaceous material.	232.2
35			18	71	BG			(32–33') Silt, sandy, medium light gray to medium gray, moist.	
			19	92	BG			(33–43') Deeper Alluvium (see descriptions below).	
							SW GW	(33–34') Sand, fine to coarse–grained, light olive gray color, wet.	
40			20	58	BG			(34–36.25') Sand, fine to coarse–grained, with clay, silt, and gravel up to .5" in longest dimension. Light brownish–gray to pale red, moist. Coantains silt and clay from 34–35'.	
			21	88	BG				
			22	92	BG			(36.25–38') Clayey sand with gravel up to 1" in longest dimension, olive gray to medium gray, moist.	222.2
45			23	83	BG		CL	(38–40') Sand and gravel, light olive gray to pale brown. Gravel content increases with depth.	
								(40–42') Sand and gravel, olive gray to brownish–gray stained dark yellowish–orange, wet.	219.2
								(42–43') Sand and gravel, light olive gray, wet.	
50								(43–46') Cookfield Formation: Clay, brownish–gray to dusky brown, finely micaceous, with fine–grained sand laminae from 44' to 46'.	
								Terminated soil boring at 46'.	
55									
60									

WELL DIAGRAM





RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 2
SOUTHSIDE LANDFILL

DWG DATE: 12/10/96
DWG NAME: 96G0211A

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

EnSafe/Allen & Hoshall

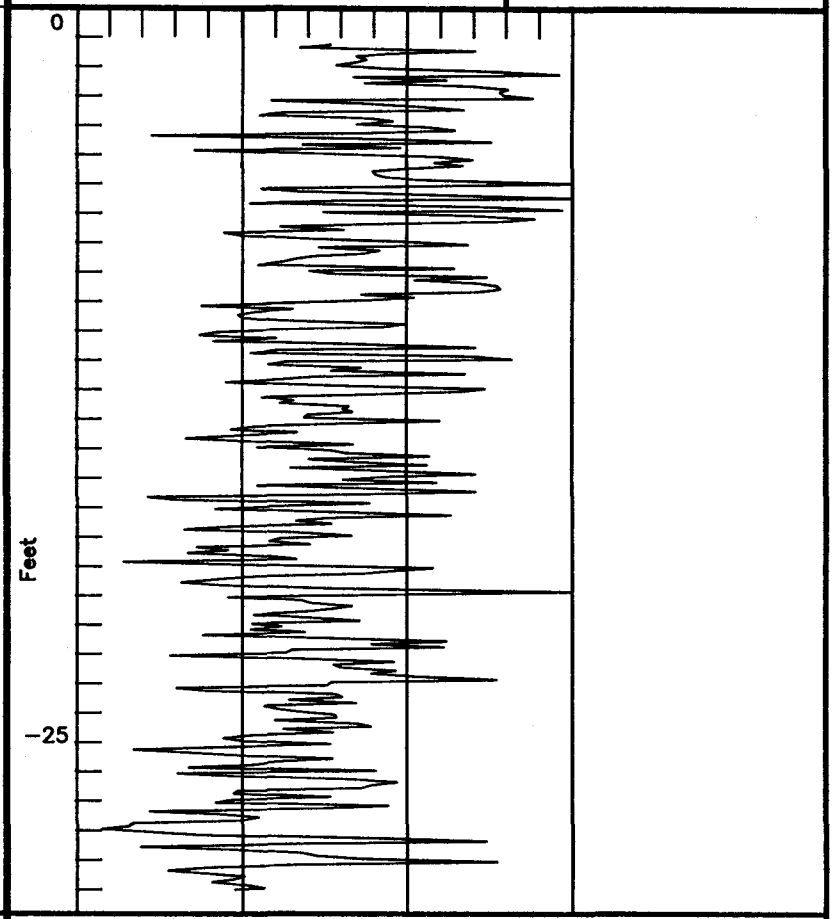
Monitoring Well 002G13DA

Project: NSA Memphis	Location: Millington,TN.SWMU#2–Southside Landfill
Project No.: 106–08420	Surface Elevation: 267.05 feet msl
Started at 1110 on 1–19–96	TOC Elevation: 269.12 feet msl
Completed at 1130 on 1–20–96	Depth to Groundwater:5.36 feet Measured: 4/8/96
Drilling Method: 4 1/4" ID Hollow–Stem Auger, 5' Flights	Groundwater Elevation:263.76 feet msl
Drilling Company: Alliance Drilling	Total Depth: 67.0 feet
Geologist: D. Ladd, J. Kingsbury, A. Choate	Well Screen: 55 to 65 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1	46	BG		OL	(0–34') Upper Alluvium (see descriptions below).	
			2	83	BG		CL ML	Clay and silt, dark yellowish–brown, moist, with organic material and roots.	265
								Silty clay/clayey silt, greenish–gray and moderate yellowish–brown, slightly moist, soft to slightly firm, with some dark iron staining.	263
5			3	88	3			Clayey silt, greenish–gray and moderate yellowish–brown, with iron/ manganese inclusions and organic material, slightly moist.	
			4	79	2.5			Iron–manganese nodules increasing in percentage and size (up to .5" in diameter).	
			5	100	2			Some staining with a dark yellowish–orange material.	
10			6	108	BG		ML	Increase in clay percentage.	
			7	108	BG			Clayey silt, light olive gray color stained light brown to dark yellowish–orange. Moisture content increasing as iron/manganese nodules decrease in percentage.	
15			8	108	BG			Very moist at 14' becoming less moist near 16', rare iron/manganese nodules.	
			9	108	BG			Clayey silt, medium gray to light olive gray stained light brown to dark yellowish–orange, very moist.	
			10	100	BG				248
20			11	92	BG			Silty clay, medium light to medium gray, wet. Dark greenish–gray to grayish–olive green color, wet.	
			12	100	BG		CL	Very moist.	
25			13	96	BG			Light olive gray to grayish–olive green color. Very moist and soft.	
			14	98	BG				
			15	96	BG		ML	Clayey silt, light olive gray to grayish–olive green color, slightly moist, soft.	239
30									

WELL DIAGRAM: 2" ID, Sch. 40 PVC Casing

GAMMA RAY LOG
COUNTS PER SECOND



CASING TYPE: 2" PVC
TOP OF LOG = GROUND SURFACE
DATE LOGGED: 05/23/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 2
SOUTHSIDE LANDFILL

DWG DATE: 12/10/96
DWG NAME: 94GL213

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

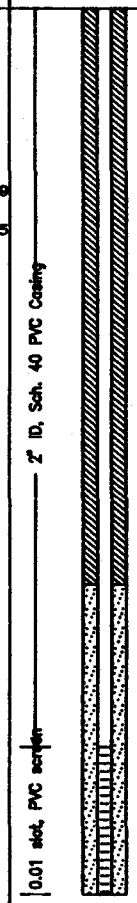
EnSafe/Allen & Hoshall

Monitoring Well 002G13DA

Project: NSA Memphis	Location: Millington,TN.SWMU#2–Southside Landfill
Project No.: 106–08420	Surface Elevation: 267.05 feet msl
Started at 1110 on 1–19–96	TOC Elevation: 269.12 feet msl
Completed at 1130 on 1–20–96	Depth to Groundwater:5.36 feet Measured: 4/8/96
Drilling Method: 4 1/4" ID Hollow–Stem Auger, 5' Flights	Groundwater Elevation: 263.76 feet msl
Drilling Company: Alliance Drilling	Total Depth: 67.0 feet
Geologist: D. Ladd, J. Kingsbury, A. Choate	Well Screen: 55 to 65 feet

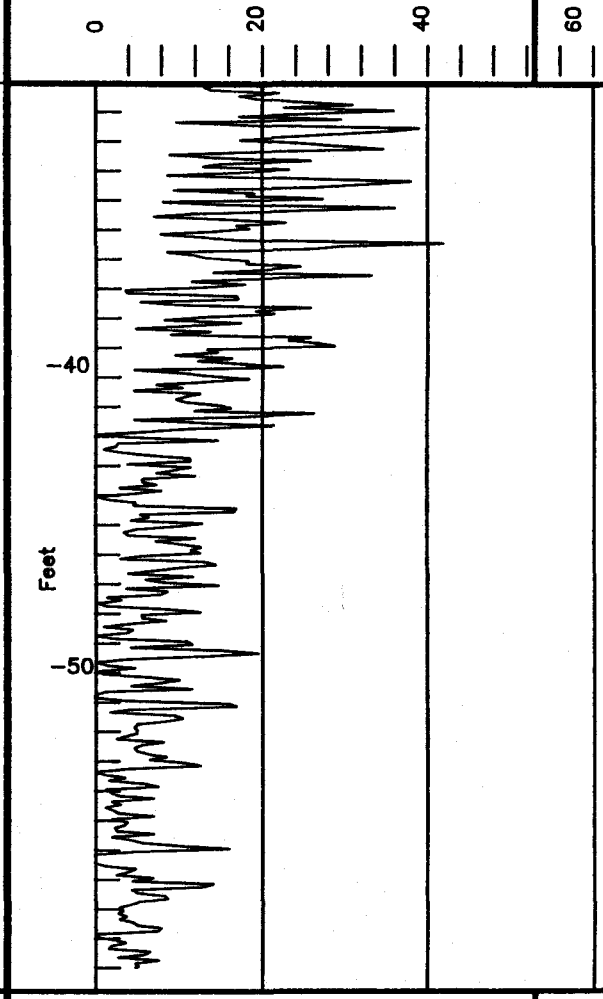
DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft–msl)
			16	33	BG			Sandy silt with rare coarse subangular sand grains. Wet.	
								Olive gray color, wet, soft.	
			17	83	BG		ML	Sandy silt with fine to coarse sand between 34' and 35' fining downward to fine–grained sand between 35' and 36', soft. Top of Deeper Alluvium deposits estimated at 34'.	
35			18	79	BG				
									230.9
			19	100	BG		SW GW	Sand and gravel, gravel up to 1" in longest dimension, light olive gray.	229.5
								Silty sand, light olive gray.	
			20	100	BG		SW	Silty sand with some gravel, light olive gray to light gray.	227
40								No sample collected from 40' to 46' due to heaving sand.	
45									221
			21	98	BG		SW GW	Sand and gravel, light olive gray. Wet. Considerable iron–staining at 47.5'.	219
								No sample collected from 48' to 51'.	
50									216
			22	100	BG		SW GW	Sand and gravel, dark yellowish–orange changing to yellowish–gray color near 53'.	214
								No sample collected from 53' to 56'.	
55									211
			23	100	BG		SW GW	Sand and gravel, yellowish–gray to pale yellowish–brown. Gravel up to 1" in longest dimension. Locally stained dark yellowish–orange, wet.	209
60								No sample collected from 58' to 61'.	

WELL DIAGRAM



GAMMA RAY LOG

COUNTS PER SECOND



CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/23/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 2
SOUTHSIDE LANDFILL

DWG DATE: 10/31/96

DWG NAME: 94GL213A

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

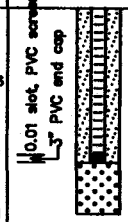
EnSafe/Allen & Hoshall

Monitoring Well 002G13DA

Project: NSA Memphis	Location: Millington, TN. SWMU#2-Southside Landfill
Project No.: 106-08420	Surface Elevation: 267.05 feet msl
Started at 1110 on 1-19-96	TOC Elevation: 269.12 feet msl
Completed at 1130 on 1-20-96	Depth to Groundwater: 5.36 feet Measured: 1/8/96
Drilling Method: 4 1/4" ID Hollow-Stem Auger, 5' Flights	Groundwater Elevation: 263.76 feet msl
Drilling Company: Alliance Drilling	Total Depth: 67.0 feet
Geologist: D. Ladd, J. Kingsbury, A. Choate	Well Screen: 55 to 65 feet

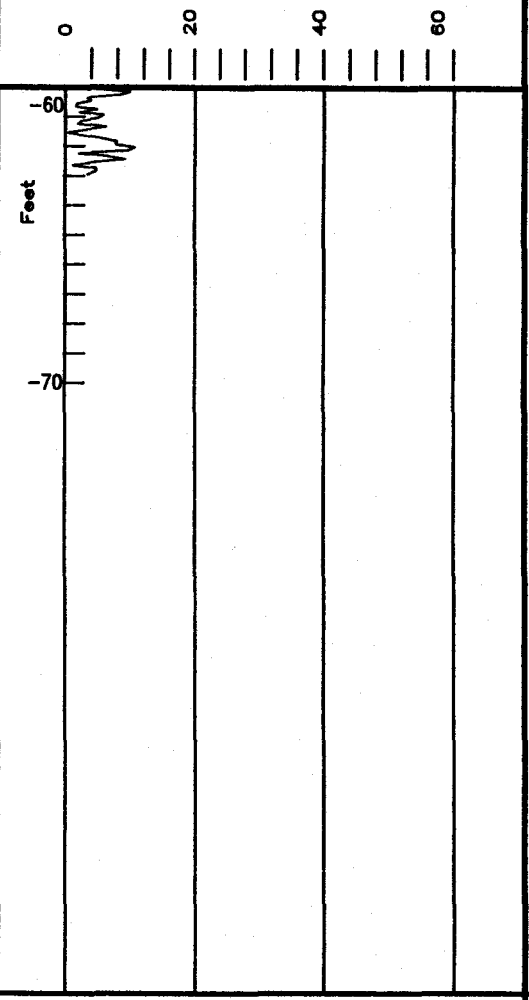
DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			24	141	BG		SW GW	Sand and gravel, moderate yellowish-brown to dark yellowish-brown color.	206
								Color change to dusky yellow brown. Wet.	204.6
								No sample collected from 62.5' to 65'.	
65			25	100	BG		SW GW SP	Fine to coarse-grained sand and gravel, olive-gray to light olive gray. Fining downward and turning dark yellowish-orange to light brown in color near 65.5'.	202.1 201.1
								Cockfield Formation: Sand, fine-grained, dark yellowish-orange to light brown, wet. Terminated soil boring at 67'.	200.1
70									
75									
80									
85									
90									

WELL DIAGRAM



GAMMA RAY LOG

COUNTS PER SECOND



CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/23/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 2
SOUTHSIDE LANDFILL

DWG DATE: 10/31/96

DWG NAME: 94GL213B

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

GEOLOGICAL LOGGING SYSTEMS

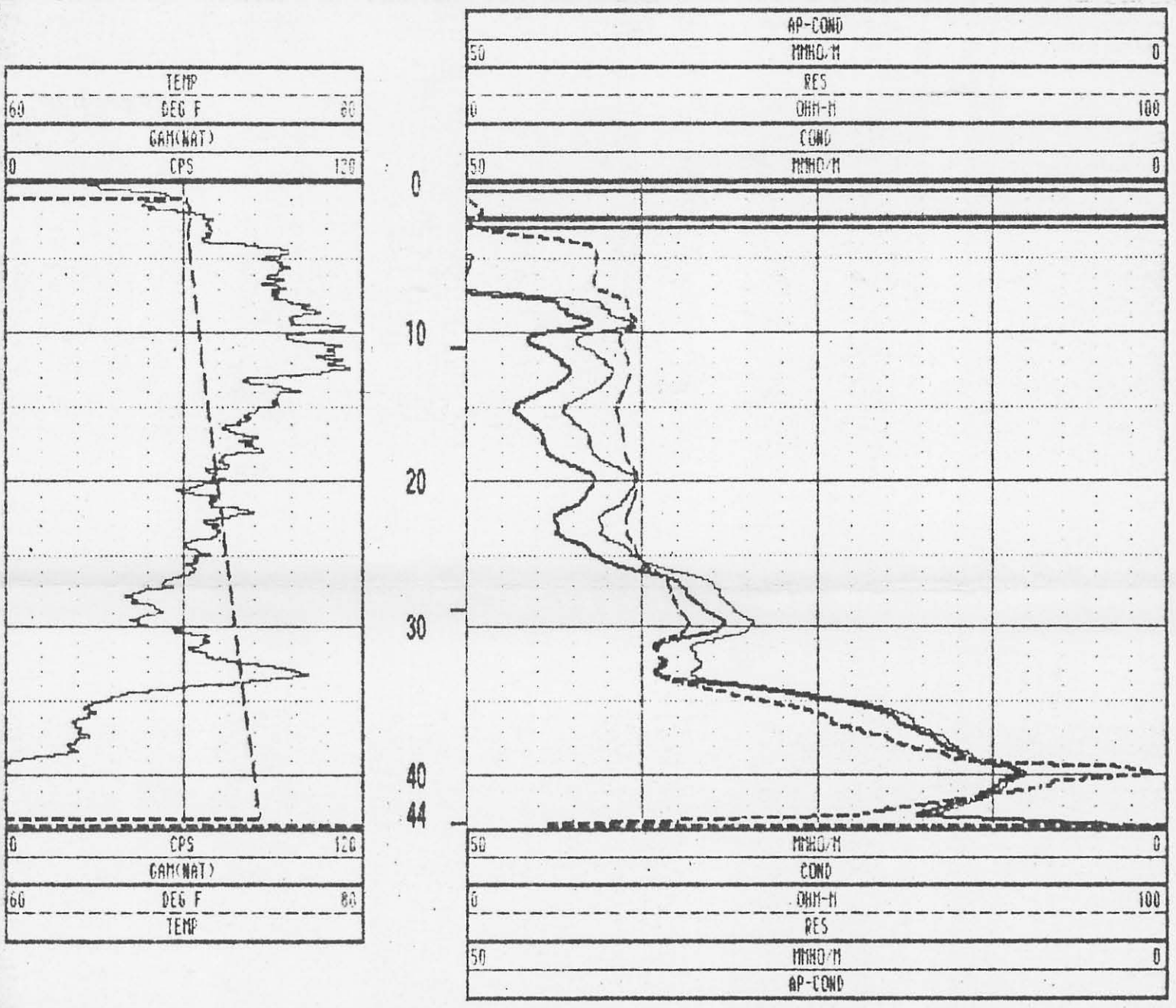
002G09DA

COMPANY	: ENSAFE,ALLEN & HOSHALL			OTHER SERVICES:	
WELL	: 002G09DA			9511	
LOCATION/FIELD	: NAS MEMPHIS			RUN ONE	
COUNTY	: SHELBY			OPEN	
STATE	: TENNESSEE				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 05/22/96	PERMANENT DATUM	: GL	ELEVATIONS	
DEPTH DRILLER	: 46	ELEV. PERM. DATUM	:	KB	:
LOG BOTTOM	: 43.60	LOG MEASURED FROM	: GL	DF	: -
LOG TOP	: -3.30	DRL MEASURED FROM	: GL	GL	: 265.5
CASING DRILLER	: 46	LOGGING UNIT	: 05		
CASING TYPE	: PVC	FIELD OFFICE	: BLUEFIELD		
CASING THICKNESS	: .25	RECORDED BY	: J T GILBERT		
BIT SIZE	: 8	BOREHOLE FLUID	: WATER	FILE	: ORIGIN
MAGNETIC DECL.	: -	RM	:	TYPE	: 9511C
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:	LOG	: 4
FLUID DENSITY	: 1.2	MATRIX DELTA T	:	PLOT	: 9510C
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:	THRESH	: 9000

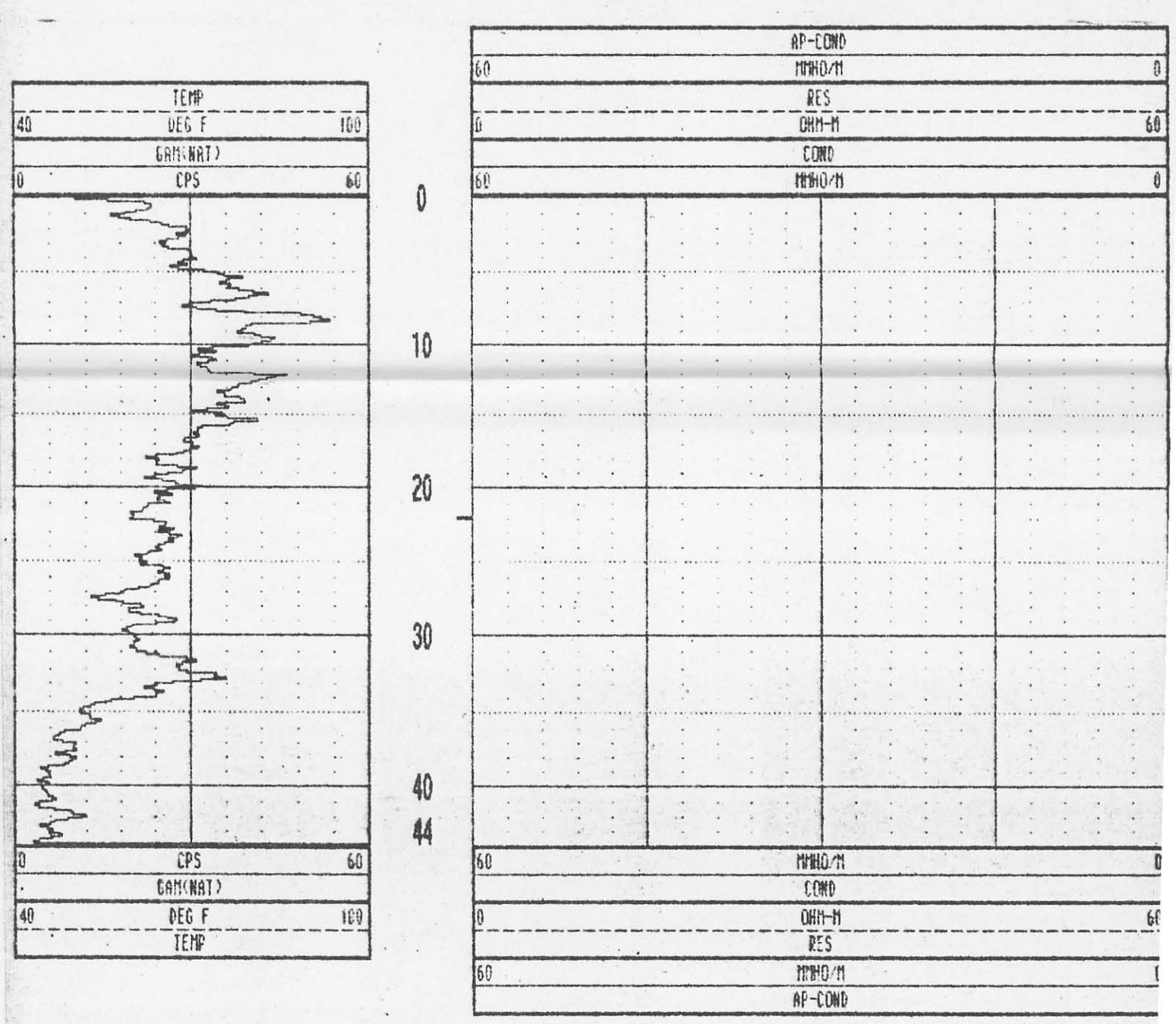
REMARKS :

ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



002G09DA 05/22/96 936



002G09DA 05/22/96 1025

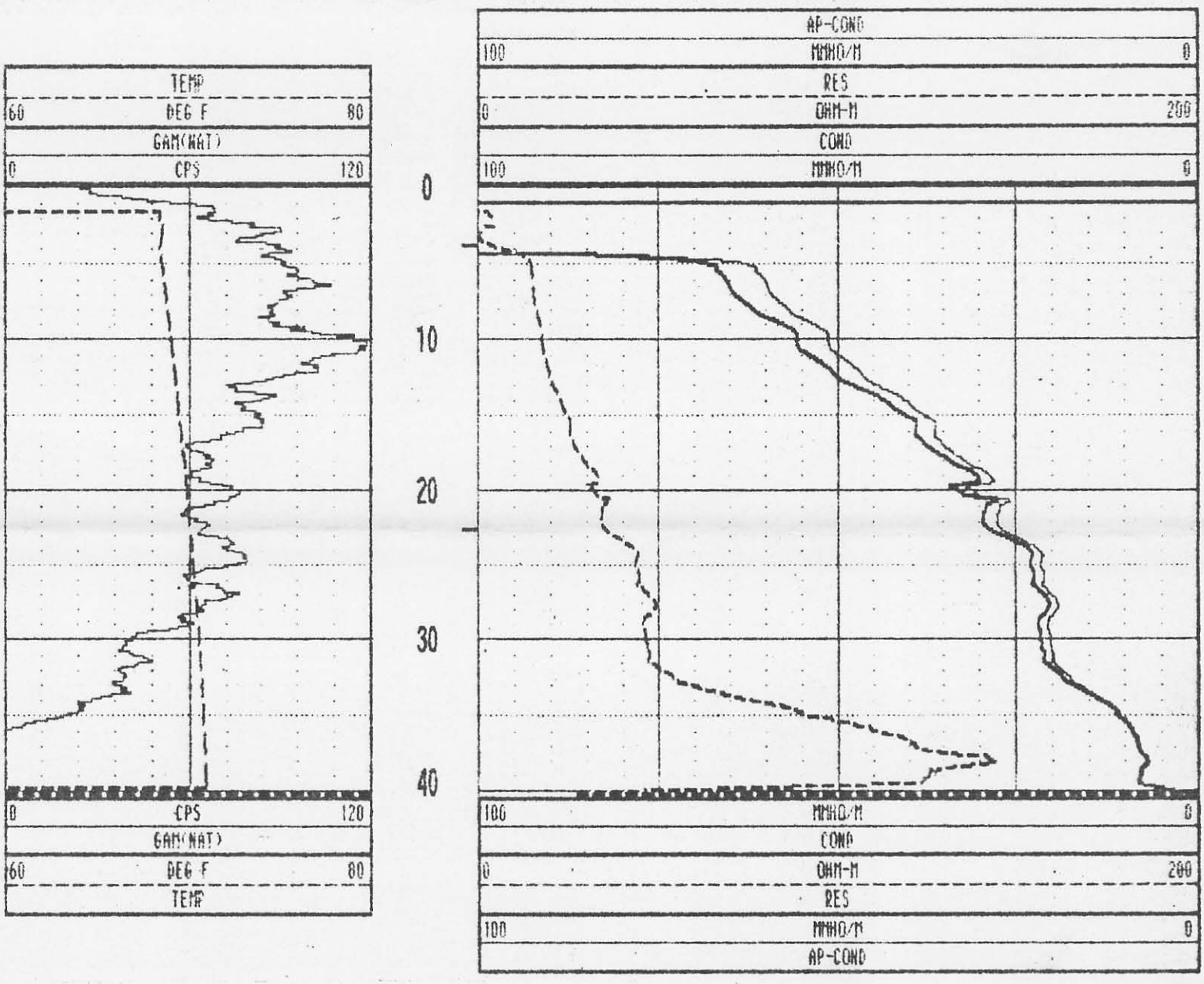
GEOLOGICAL LOGGING SYSTEMS

002G11DA

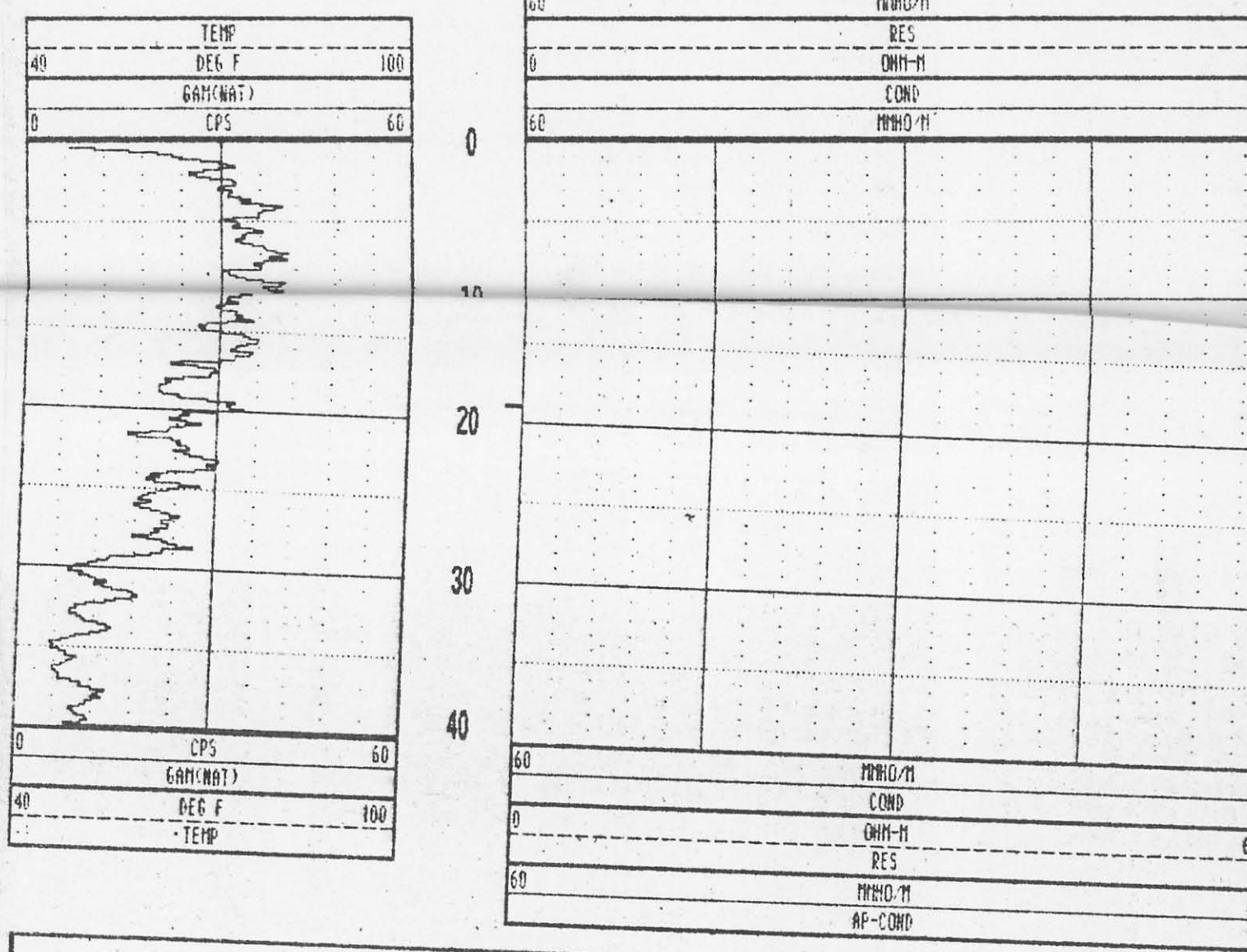
COMPANY	: ENSAFE,ALLEN & HOSHALL			OTHER SERVICES:	
WELL	: 002G11DA			9511	
LOCATION/FIELD	: NAS MEMPHIS			RUN ONE	
COUNTY	: SHELBY			OPEN	
STATE	: TENNESSEE				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 05/22/96	PERMANENT DATUM	: GL	ELEVATIONS	
DEPTH DRILLER	: 42.2	ELEV. PERM. DATUM:		KB	:
LOG BOTTOM	: 40.40	LOG MEASURED FROM:	GL	DF	: -
LOG TOP	: -2.80	DRL MEASURED FROM:	GL	GL	: 265.2
CASING DRILLER	: 42	LOGGING UNIT	: 05		
CASING TYPE	: PVC	FIELD OFFICE	: BLUEFIELD		
CASING THICKNESS	: .25	RECORDED BY	: J T GILBERT		
BIT SIZE	: 8	BOREHOLE FLUID	: WATER	FILE	: ORIGIN
MAGNETIC DECL.	: -	RM	:	TYPE	: 9511C
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:	LOG	: 0
FLUID DENSITY	: 1.2	MATRIX DELTA T	:	PLOT	: 9510C
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:	THRESH	: 9000
REMARKS	:				

ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



002G11DA 05/22/96 976



002G11DA 05/22/96 1025

GEOLOGICAL LOGGING SYSTEMS

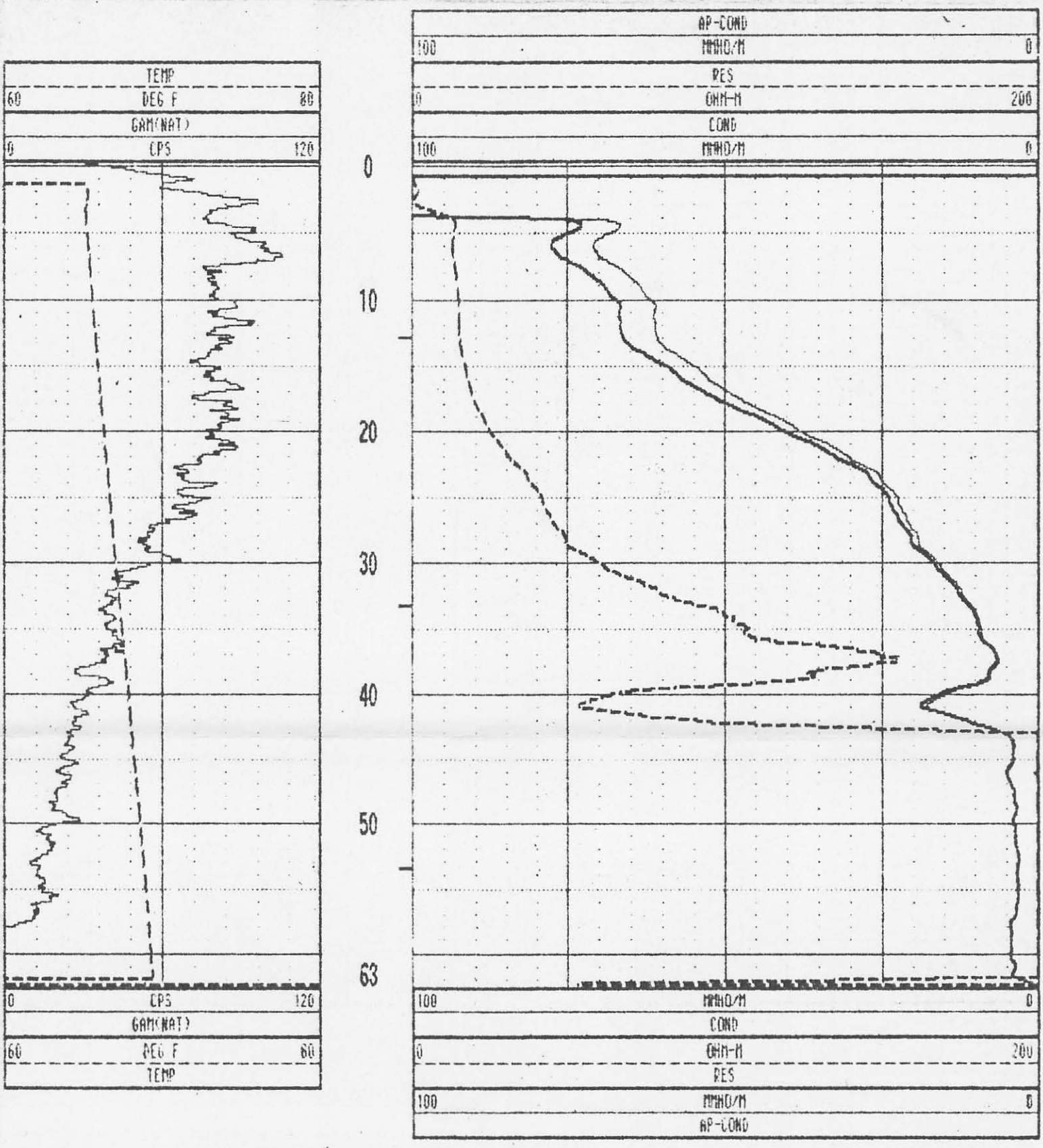
002G13DA

COMPANY	: ENSAFE,ALLEN & HOSHALL			OTHER SERVICES:	
WELL	: 002G13DA			9511	
LOCATION/FIELD	: NAS MEMPHIS			RUN ONE	
COUNTY	: SHELBY			OPEN	
STATE	: TENNESSEE				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 05/22/96	PERMANENT DATUM	: GL	ELEVATIONS	
DEPTH DRILLER	: 65	ELEV. PERM. DATUM:		KB	:
LOG BOTTOM	: 62.60	LOG MEASURED FROM:	GL	DF	: -
LOG TOP	: -2.90	DRL MEASURED FROM:	GL	GL	: 267.0
CASING DRILLER	: 65	LOGGING UNIT	: 05		
CASING TYPE	: PVC	FIELD OFFICE	: BLUEFIELD		
CASING THICKNESS	: .25	RECORDED BY	: J T GILBERT		
BIT SIZE	: 8	BOREHOLE FLUID	: WATER	FILE	: ORIGIN
MAGNETIC DECL.	: -	RM	:	TYPE	: 9511C
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:	LOG	: 8
FLUID DENSITY	: 1.2	MATRIX DELTA T	:	PLOT	: 9510C
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:	THRESH	: 9000

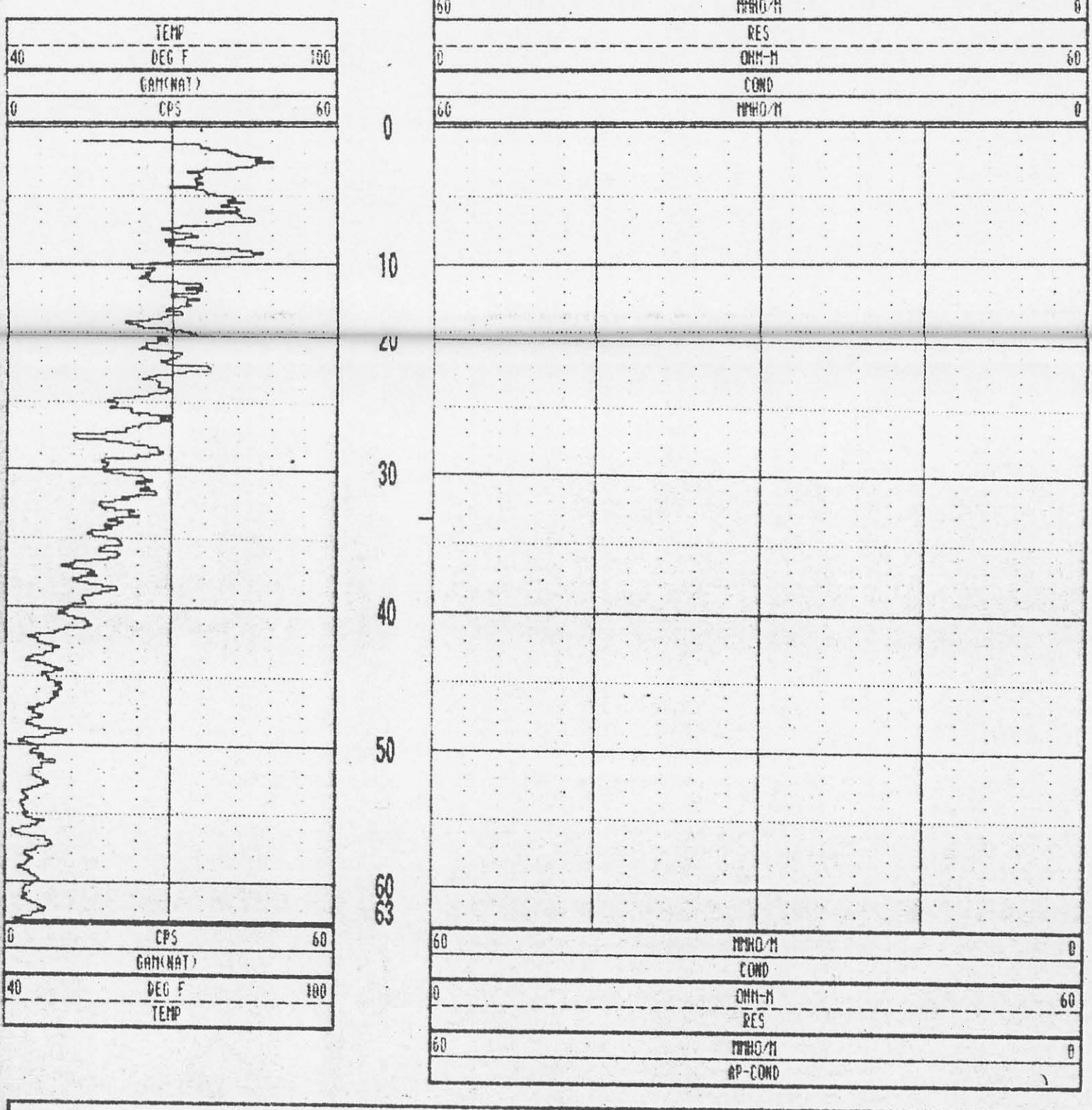
REMARKS :

ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



002G13DA 05/22/96 976



002G13DA 05/22/96 1025

TRI STATE
TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 02/28/96 **Project No.:** E-3-157

Client's Project No.: 0106090000

Sample I.D.: 002S002919

Soil Description: Light Gray Clayey Silt

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	123.9	121.3
Dry Density (Lbs/ft^3)	95.7	96.0
Moisture (% Dry Wt)	29.5	26.4
Porosity (n)	.41	.40
Degree of Saturation (%)	1.0	1.0
Specific Gravity (ASTM D-854)	2.58	---

Permeability

Temperature Correction, $R_t = 1.024$

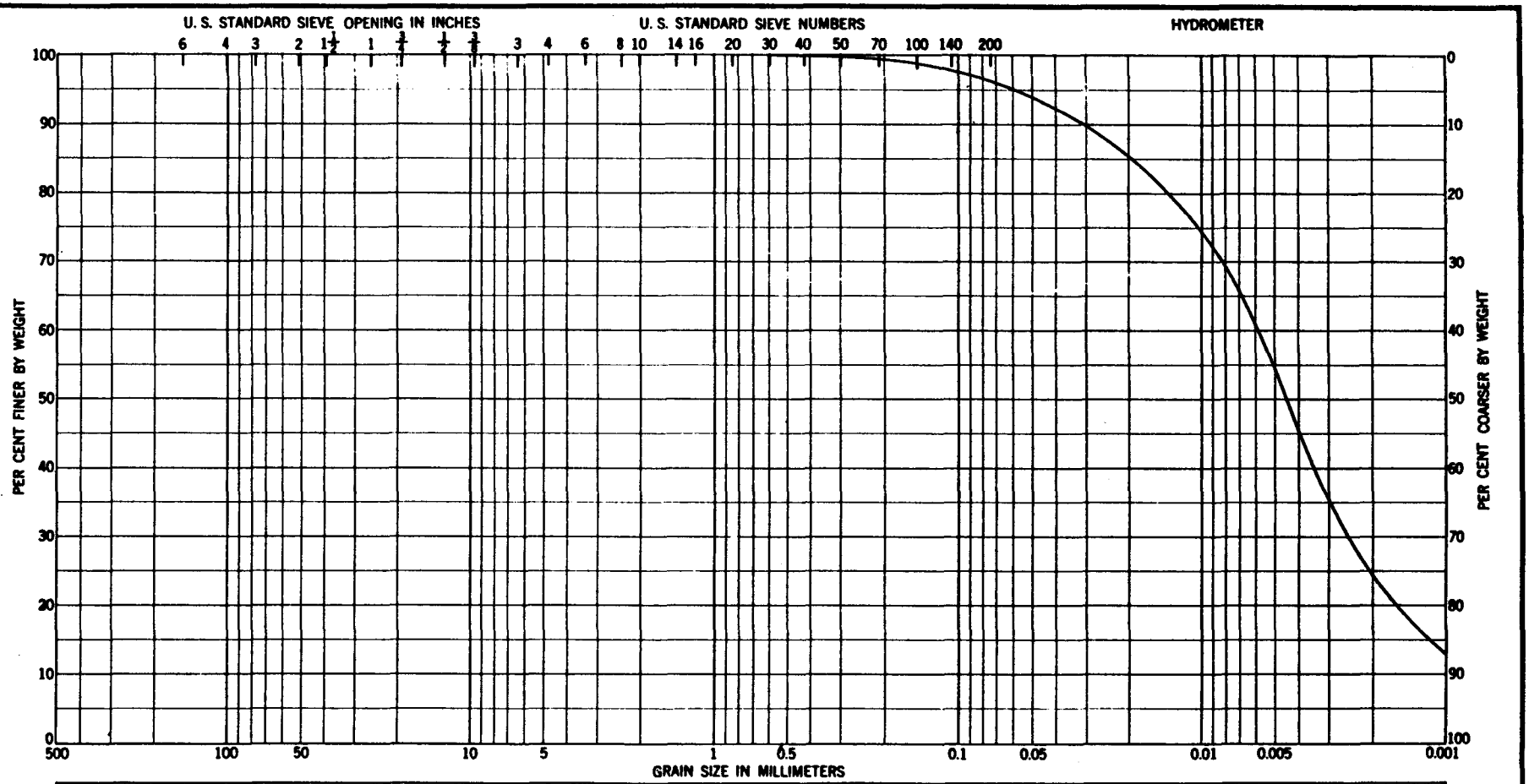
$K_1 = 6.6 \times 10^{-7}$ cm/sec
$K_2 = 6.3 \times 10^{-7}$ cm/sec
$K_3 = 6.9 \times 10^{-7}$ cm/sec
$K_4 = 6.4 \times 10^{-7}$ cm/sec

Coefficient of Permeability, $K_{20} = 6.8 \times 10^{-7}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-010 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 Fax 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
002 S0029 19			30			

GRADATION CURVES

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 02/28/96

TRI STATE
TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 02/26/96 Project No.: E-3-157

Client's Project No.: 0106090000

Sample I.D.: 002S003019

Soil Description: Light Gray Clayey Silt

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	119.1	119.4
Dry Density (Lbs/ft^3)	95.4	88.2
Moisture (% Dry Wt)	24.8	35.3
Porosity (n)	.42	.46
Degree of Saturation (%)	.91	1.0
Specific Gravity (ASTM D-854)	2.62	---

Permeability

Temperature Correction, R_t = 1.009

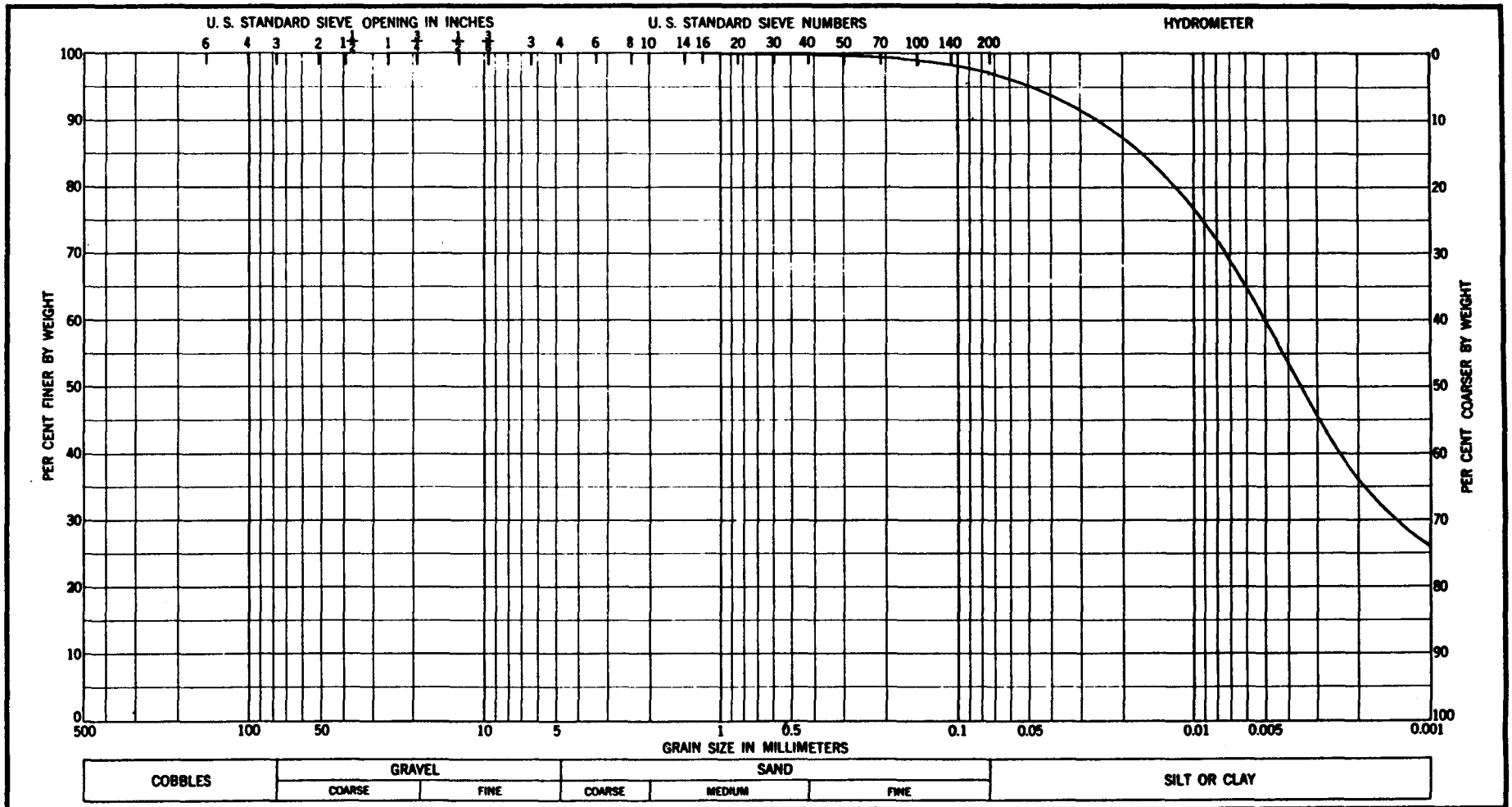
$K_1 = 3.3 \times 10^{-6}$ cm/sec
$K_2 = 1.1 \times 10^{-6}$ cm/sec
$K_3 = 2.3 \times 10^{-6}$ cm/sec
$K_4 = 2.4 \times 10^{-6}$ cm/sec

Coefficient of Permeability, $K_{20} = 2.3 \times 10^{-6}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-007 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 Fax 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
002S003019			25			

GRADATION CURVES

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 02/26/96

TRI STATE
TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 02/26/96 Project No.: E-3-157

Client's Project No.: 0106090000

Sample I.D.: 002S003043

Soil Description: Coarse Sand with gravel & some clay

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	123.5	126.6
Dry Density (Lbs/ft^3)	112.1	110.4
Moisture (% Dry Wt)	10.2	14.7
Porosity (n)	.33	.34
Degree of Saturation (%)	.55	.96
Specific Gravity (ASTM D-854)	2.69	---

Permeability

Temperature Correction, $R_t = 1.056$

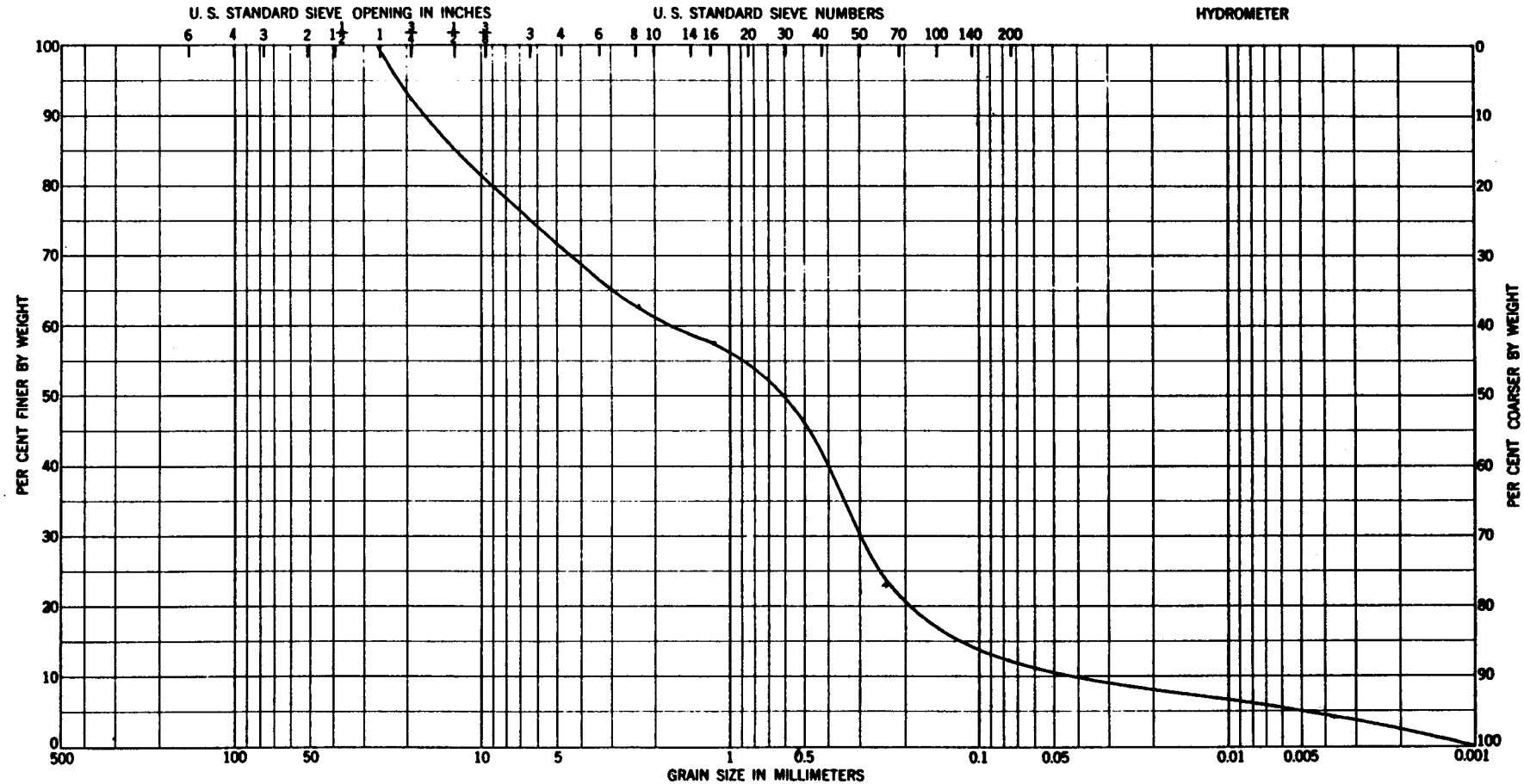
$K_1 = 1.4 \times 10^{-4}$ cm/sec
$K_2 = 3.4 \times 10^{-4}$ cm/sec
$K_3 = 4.2 \times 10^{-4}$ cm/sec
$K_4 = 3.8 \times 10^{-4}$ cm/sec

Coefficient of Permeability, $K_{20} = 3.4 \times 10^{-4}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-008 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 FAX 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
002S003048			10			

GRADATION CURVES

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 02/26/96

TRI STATE
TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 02/27/96 **Project No.:** E-3-157

Client's Project No.: 0106090000

Sample I.D.: 002S03DA43

Soil Description: Clean Sand with some small gravel

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	127.6	130.4
Dry Density (Lbs/ft^3)	115.3	115.9
Moisture (% Dry Wt)	10.7	12.5
Porosity (n)	.29	.30
Degree of Saturation (%)	.79	1.0
Specific Gravity (ASTM D-854)	2.68	---

Permeability

Temperature Correction, $R_t = 1.031$

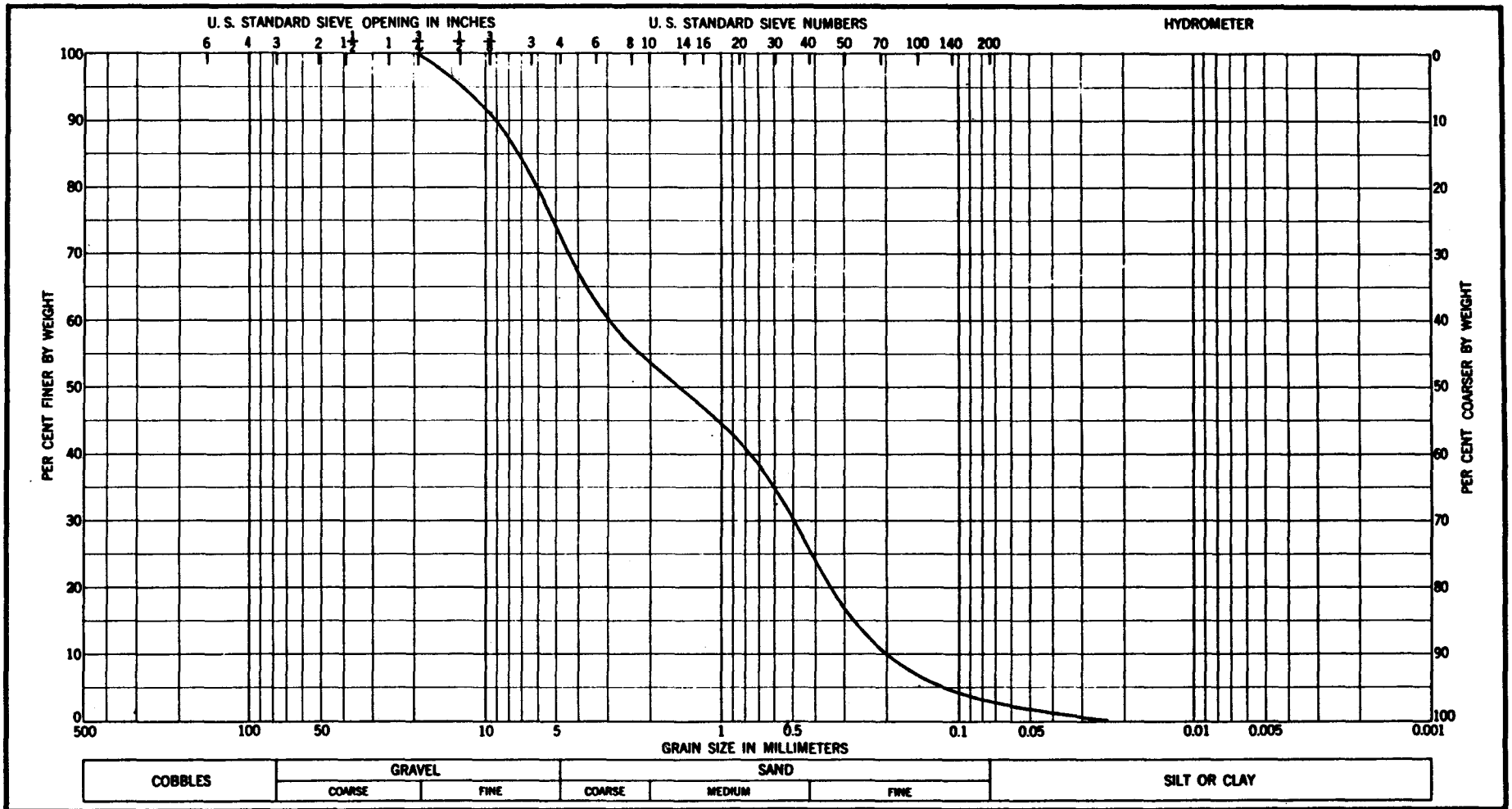
$K_1 = 8.6 \times 10^{-4}$ cm/sec
$K_2 = 8.4 \times 10^{-4}$ cm/sec
$K_3 = 8.7 \times 10^{-4}$ cm/sec
$K_4 = 8.2 \times 10^{-4}$ cm/sec

Coefficient of Permeability, $K_{20} = 8.6 \times 10^{-4}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-009 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 FAX 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
002S03DA43			11			

GRADATION CURVES

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 02/27/97

SWMU 9

SOIL BORING/MONITORING WELL LOGS AND GEOTECHNICAL LABORATORY RESULTS

EnSafe/Allen & Hoshall

Monitoring Well 009G01DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #9 (Sewage Lagoons)*
Project No.: *0106-2211*	Surface Elevation: *269.69 feet msl*
Started at *1230 on 2-15-96*	TOC Elevation: *271.62 feet msl*
Completed at *1500 on 2-15-96*	Depth to Groundwater: *19.87 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *251.75 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *66 feet*
Geologist: *J.A. Kingsbury*	Well Screen: *46 to 56 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			BG	ML CL	(0-39') Upper Alluvium (see descriptions below).	
	1	50	BG		(0-6') Silt and clay, brown to dark yellowish-brown in color with some organic material.	
5			BG			263.7
			BG		(6-39') Silt (see descriptions below).	
			BG		(6-16) Medium brown in color, with some iron, organic material and dark orangish-yellow staining, moist.	
10	2	40	BG			
			BG			
			BG			
15			BG		Shelby Tube sample collected from 16-18' for geotechnical analysis. (18-24') Mottled yellowish-brown and yellowish-gray in color with dark orangish-yellow to reddish-brown iron staining.	
			BG			
20	3	70	BG			
			BG	ML		
			BG		(24-26') Light olive gray to greenish-gray in color. Wet.	
25			BG		(26-29') Greenish-gray in color.	
			BG			
			BG		(29-39') Sandy silt with common snail shells. Greenish-gray to olive gray in color between 29' and 34'.	
30	4	90	BG			
			BG			
			BG		Brownish-gray in color between 34' and 39'. Some snail shells present.	
35			BG			
			BG			
			BG	SP		230.7
40					(39-56') Deeper Alluvium (see descriptions below).	

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

grout

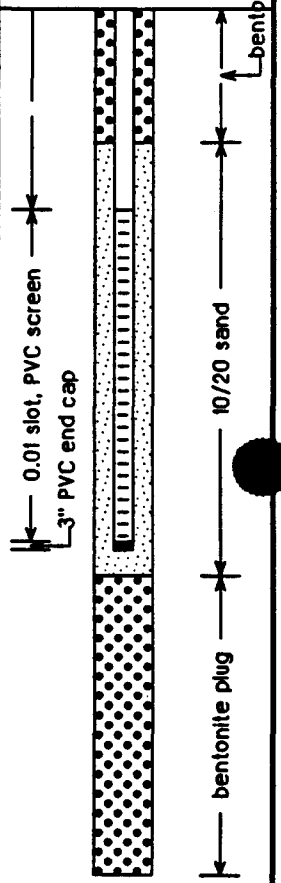
EnSafe/Allen & Hoshall

Monitoring Well 009G01DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #9 (Sewage Lagoons)*
Project No.: *0106-22111*	Surface Elevation: *269.69 feet msl*
Started at *1230 on 2-15-96*	TOC Elevation: *271.62 feet msl*
Completed at *1500 on 2-15-96*	Depth to Groundwater: *19.87 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *251.75 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *66 feet*
Geologist: *J.A. Kingsbury*	Well Screen: *46 to 56 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			5	90	BG		SP	(39-42') Coarse-grained sand, light olive gray in color.	227.7
					BG		GW	(42-42.5') Gravel lense.	227.2
							SP		226.7
					BG		ML	(42.5-43') Coarse-grained sand.	
45					BG		SW	(43-45') Silt, very light gray to moderate gray in color.	224.7
					BG			(45-48') Sand with some gravel, yellowish-gray in color.	221.7
					BG				
50			6	70	BG		SW GW	(48-56') Sand and gravel. Gravel is up to 3" in longest dimension. Dusky yellow to yellowish-gray in color.	
					BG				
55					BG				
					BG			Cockfield Formation: Fine-grained sand, light olive gray, finely lignitic and micaceous.	213.7
					BG				
60			7	90	BG		SP		
					BG				
65					BG				203.7
								Terminated soil boring at 66'.	
70									
75									
80									

WELL DIAGRAM



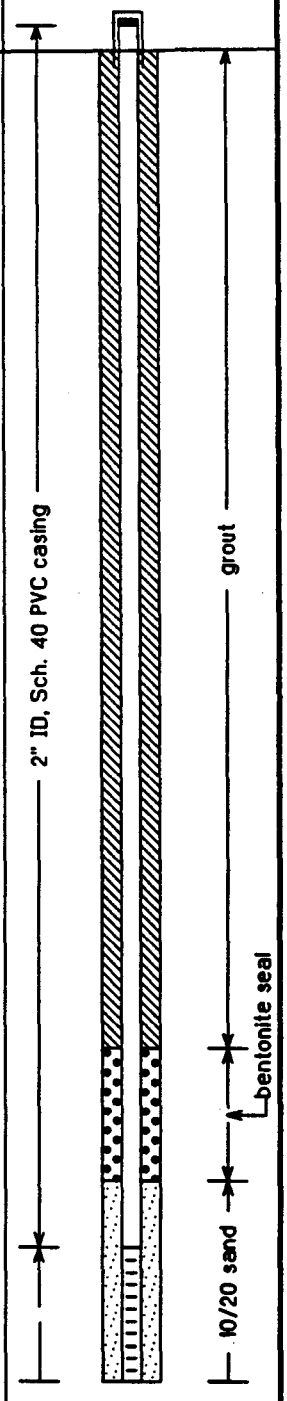
EnSafe/Allen & Hoshall

Monitoring Well 009G02DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #9 (Sewage Lagoons)*
Project No.: *0106-22111*	Surface Elevation: *268.85 feet msl*
Started at *0930 on 2-16-96*	TOC Elevation: *270.80 feet msl*
Completed at *1100 on 2-16-96*	Depth to Groundwater: *11.65 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *259.15 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56 feet*
Geologist: *J.A. Kingsbury*	Well Screen: *36 to 46 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0					BG			(0-40') Upper Alluvium (see descriptions below).	
			1	83	BG			(0-4') Fill material. Silt, moderate brown in color with some iron-staining. Wood fragments that appear to be burnt.	
5					BG			(4-40') Silt (see descriptions below).	
					BG			(4-6') Light olive gray to light brown in color. Dry.	
					BG			Clayey silt. Moderate yellowish-brown to light gray in color, mottled with some dark orangish-yellow-colored material. Moist. Organic material present from 6' to 18'.	
10			2	80	BG				
					BG				
15					BG			Increased iron staining from 15' to 16'.	
					BG				
					BG			Silt, greenish-gray to olive gray in color from 18' to 28'. Wet, with snail shells throughout.	
20			3	70	BG		ML		
					BG				
25					BG				
					BG				
					BG			Color change to brownish-gray. Thin sand lenses, occasionally as thick as 6", are present from 28' to 40'.	
30			4	90	BG				
					BG				
35					BG			Shelby Tube collected from 36-38'.	
					BG				
40					BG		SP		228.9

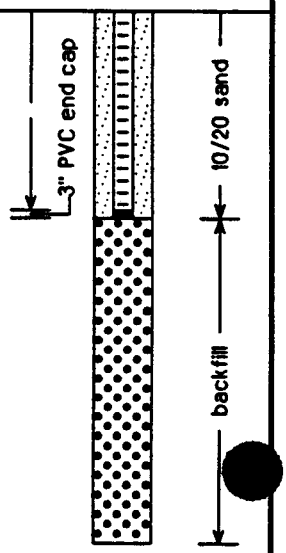
WELL DIAGRAM



EnSafe/Allen & Hoshall	Monitoring Well 009G02DA
Project: *NSA Memphis*	Location: *Millington, TN. SWMU #9 (Sewage Lagoons)*
Project No.: *0106-22111*	Surface Elevation: *268.85 feet msl*
Started at *0930 on 2-16-96*	TOC Elevation: *270.80 feet msl*
Completed at *1100 on 2-16-96*	Depth to Groundwater: *11.65 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *259.15 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56 feet*
Geologist: *J.A. Kingsbury*	Well Screen: *36 to 46 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			5	100	BG		SP	(40-46.5') Deeper Alluvium (see descriptions below).	228.9
45					BG			(40-46') Coarse-grained sand, yellowish-gray to dusky yellow. Some gravel (< 1" in longest dimension) is present from 45' to 46.5.	
					BG				222.9
					BG		SM	(46-46.5') Silt and sand, olive-gray in color.	222.4
					BG		CL	Cockfield Formation: Clay, dark brown in color, hard. Fine-grained sand streaks are present from 46.5' to 56'.	
50			6	110	BG				
					BG		SC	The percentage of sand incresases to greater than 50 percent from 52' to 56'.	216.9
55					BG				
								Soil boring terminated at 56'.	212.9
60									
65									
70									
75									
80									

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 009G03DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #9 (Sewage Lagoons)*
Project No.: *0106-08420*	Surface Elevation: *267.18 feet msl*
Started at *1300 on 1-31-96*	TOC Elevation: *269.05 feet msl*
Completed at *1200 on 2-1-96*	Depth to Groundwater: *15.79 feet* Measured: *4/8/96*
Drilling Method: *Hollow-Stem Auger/3" diameter split spoon*	Groundwater Elevation: *253.26 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *62 feet*
Geologist: *J.A. Kingsbury*	Well Screen: *45 to 55 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
	1	75	BG	ML	(0-34') Upper Alluvium (see descriptions below).	
	2	92	BG		(0-2') Clayey silt. Light brown to light yellowish-brown and brownish- orange in color.	
5	3	67	BG		(2-4') Silt, light brown in color. Some debris with burnt wood are also present. Appears to be fill.	263.2
	4	83	BG	ML CL	(4-6') Silt and clay, light gray to moderate gray color with black plant debris. Organic odor.	
	5	96	BG		From 6' to 10', silt and clay is light gray to greenish-gray in color with moderate brown specks of material. Slightly moist from 6' to 8', and moist from 8' to 10'.	
10	6	79	BG			257.2
	7	71	BG	ML	(10-14') Silt, greenish-gray to light gray/brown color. Moist.	
	8	92	BG			253.2
15	9	71	BG		(14-34') Silt and clay, greenish-gray in color. Moist. Prevalent iron staining from 16' to 20'.	
	10	100	BG		Abundant organic debris from 18' to 19'.	
20	11	71	BG		Greenish-gray to olive gray in color from 20' to 22'.	
	12	83	BG		Light olive gray to light greenish-gray from 22' to 34'. Moist. Some organic specks of material present.	
25	13	67	BG	ML CL		
	14	83	BG			
	15	100	BG			
30	16	92	BG			
	17	100	BG		With minor amount of sand near 34'.	
35	18	83	BG	SW	Contact with Deeper Alluvium deposits estimated at 34'.	233.2

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

bentonite grout

EnSafe/Allen & Hoshall

Monitoring Well 009G03DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #9 (Sewage Lagoons)*
Project No.: *0106-08420*	Surface Elevation: *267.18 feet msl*
Started at *1300 on 1-31-96*	TOC Elevation: *269.05 feet msl*
Completed at *1200 on 2-1-96*	Depth to Groundwater: *15.79 feet* Measured: *4/8/96*
Drilling Method: *Hollow-Stem Auger/3" diameter split spoon*	Groundwater Elevation: *253.26 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *62 feet*
Geologist: *J.A. Kingsbury*	Well Screen: *45 to 55 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
				SW	(34-37') Sand, fine to coarse-grained, medium olive gray in color. Some silt lenses present.	
	19	100	BG			230.2
				ML	(37-38') Silt, light olive gray.	229.2
	20	100	BG	SW	(38-39.5') Sand.	227.7
40				ML	(39.5-40') Silt.	227.2
	21	100	BG	SW	(40-42') Sand, fine to coarse-grained, light olive gray in color at 40' changing to yellowish brown/gray near 42'.	
	22	100	BG			225.2
				SW GW		224.2
	23	92	BG	SP	(42-43') Sand and gravel, light olive gray to yellowish-gray.	
45					(43-45') Coarse-grained sand, yellowish-gray.	222.2
	24	100	BG	SC GC	(45-49') Sand and gravel in a clay matrix. Yellow gravel, light gray clay.	
	25	100	BG		Sand and gravel with some clay, light olive gray to yellowish-gray in color.	218.2
50	26	100	BG	SW GW	(49-53') Sand and gravel. Yellowish-brown to reddish-brown.	
	27	100	BG			214.2
	28	0	BG		No sample recovery from 53' to 60'.	
55						
60				SP	Cockfield Formation: very fine-grained sand, light gray in color, finely lignitic.	207.2
	29	100	BG	ML CL	Silt and clay, light brown to light gray.	206.2
						205.2
					Terminated soil boring at 62'.	
65						
70						

WELL DIAGRAM

- 2" ID, Sch. 40 PVC Casing
- 0.01 slot, PVC screen
- 3" PVC end cap
- bentonite grout
- 10/20 sand

EnSafe/Allen & Hoshall

Monitoring Well 009G04DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #9 (Sewage Lagoons)*
Project No.: *0106-08420*	Surface Elevation: *268.15 feet msl*
Started at *0745 on 2-15-96*	TOC Elevation: *270.09 feet msl*
Completed at *1000 on 2-15-96*	Depth to Groundwater: *19.89 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *250.20 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *76 feet*
Geologist: *J.A. Kingsbury*	Well Screen: *62 to 72 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
5	1	50	BG	ML	(0-41') Upper Alluvium (see descriptions below). (0-6') Clayey silt, brown in color. Appears to be fill material used during levee construction.	
			BG			262.1
10	2	85	BG	CL	Slightly silty clay, brownish-gray in color. Very stiff. Increasing silt fraction. Mottling with olive gray-colored silt. Dark greenish-yellow staining is present with iron/organic specks.	
15			BG			252.1
20	3	100	BG	ML	(16-42') Silt (see descriptions below). (16-22') Yellowish-brown to yellowish-gray in color with dark orangish-yellow staining. Moist to wet.	
25			BG		(22-26') Color change to predominantly gray. Wet.	
30	4	120	BG		(26-34') Olive gray to greenish-gray in color, with common snail shells. Wet.	
35			BG		Increasing clay fraction from 34' to 36'. Brownish-gray in color. (36-38') Brownish-gray in color, dry.	
40			BG		(38-42') Contains some scattered gravel and a few sand lenses. Contact with Deeper Alluvium deposits (41-72') estimated at 41'.	

WELL DIAGRAM

2" ID, Sch. 40 PVC casing

grout

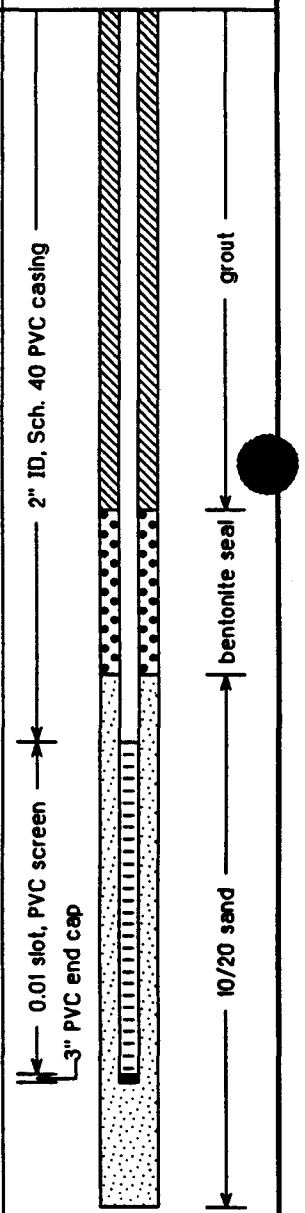
EnSafe/Allen & Hoshall

Monitoring Well 009G04DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #9 (Sewage Lagoons)*
Project No.: *0106-08420*	Surface Elevation: *268.15 feet msl*
Started at *0745 on 2-15-96*	TOC Elevation: *270.09 feet msl*
Completed at *1000 on 2-15-96*	Depth to Groundwater: *19.89 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *250.20 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *76 feet*
Geologist: *J.A. Kingsbury*	Well Screen: *62 to 72 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			5	60	BG		ML		226.1
45					BG		SW GW	(42-55') Sand and gravel; gravel is up to 2" in longest dimension. Yellowish-gray to light olive gray in color.	
					BG			Minor clay fraction in sand and gravel from 46' to 52'. Yellowish- gray to very light gray in color.	
50					BG				
			6	90	BG			Sand and gravel, yellowish-gray to light yellowish-brown from 52' to 56'.	
					BG				
55					BG		SM GC		213.1
					BG			Sand and gravel with intersitial silt and clay. Dark orangish-yellow to reddish-brown from 55' to 56'.	212.1
					BG			Sand and gravel with minor clay, gravel is up to 3" in longest dimension, dark yellowish-brown to reddish-brown from 56' to 72'.	
60			7	90	BG				
					BG		SW GW		
65					BG				
					BG				
70					BG				
			8	80	BG				196.1
					BG		SP	Cockfield Formation: Fine to medium-grained sand, very light gray to very light olive gray, micaceous and finely lignitic.	
75					BG				192.1
								Soil boring terminated at 76'.	
80									

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 009G04DA

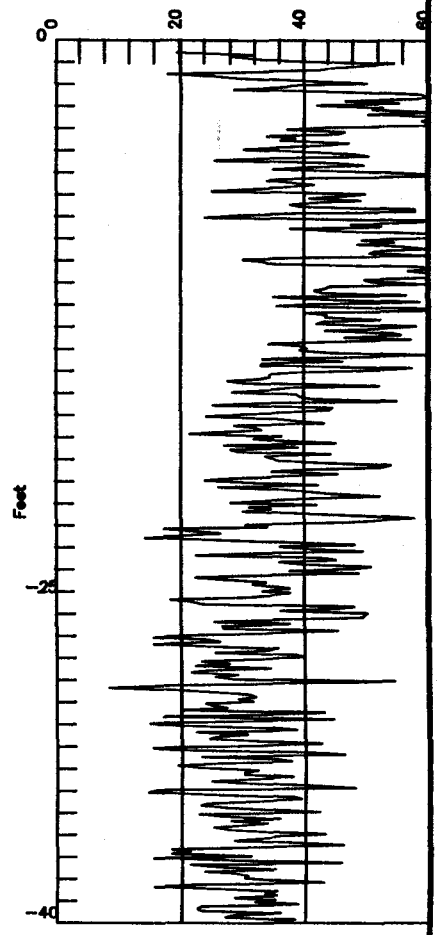
Project: NSA Memphis	Location: Millington, TN. SWMU #9 (Sewage Lagoons)
Project No.: 0106-08420	Surface Elevation: 268.15 feet msl
Started at 0745 on 2-15-96	TOC Elevation: 270.09 feet msl
Completed at 1000 on 2-15-96	Depth to Groundwater: 19.89 feet Measured: 4/8/96
Drilling Method: Rotosonic-4" inner core barrel/6" OD casing	Groundwater Elevation: 250.20 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 76 feet
Geologist: J.A. Kingsbury	Well Screen: 62 to 72 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
0					BG		ML	(0-41') Upper Alluvium (see descriptions below). (0-6') Clayey silt, brown in color. Appears to be fill material used during levee construction.		
5			1	50	BG				262.1	
					BG			Slightly silty clay, brownish-gray in color. Very stiff.		
10			2	85	BG		CL	Increasing silt fraction. Mottling with olive gray-colored silt. Dark greenish-yellow staining is present with iron/organic specks.		
15					BG				252.1	
					BG			(16-42') Silt (see descriptions below). (16-22') Yellowish-brown to yellowish-gray in color with dark orangish-yellow staining. Moist to wet.		
20			3	100	BG					
					BG			(22-26') Color change to predominantly gray. Wet.		
25					BG			(26-34') Olive gray to greenish-gray in color, with common small shells. Wet.		
					BG		ML			
30			4	120	BG					
					BG			Increasing clay fraction from 34' to 36'. Brownish-gray in color.		
35					BG			(36-38') Brownish-gray in color, dry.		
					BG			(38-42') Contains some scattered gravel and a few sand lenses. Contact with Deeper Alluvium deposits (41-72') estimated at 41'.		
40					BG					

2" ID, Sch. 40 PVC casing

GAMMA RAY LOG

COUNTS PER SECOND



CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/22/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 9
SEWAGE LAGOONS

DWG DATE: 12/10/96

DWG NAME: 94GL904

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

EnSafe/Allen & Hoshall

Monitoring Well 009G04DA

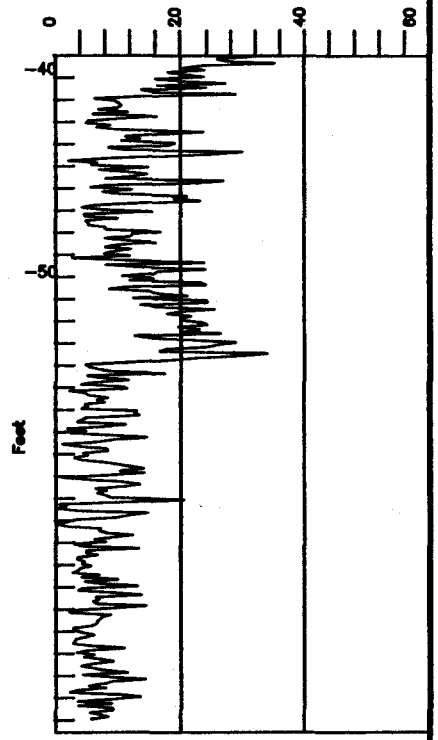
Project: NSA Memphis	Location: Millington, TN. SWMU #9 (Sewage Lagoons)
Project No.: 0106-08420	Surface Elevation: 268.15 feet msl
Started at 0745 on 2-15-96	TOC Elevation: 270.09 feet msl
Completed at 1000 on 2-15-96	Depth to Groundwater: 19.89 feet Measured: 4/8/96
Drilling Method: Rotasonic-4" inner core barrel/6" OD casing	Groundwater Elevation: 250.20 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 76 feet
Geologist: J.A. Kingsbury	Well Screen: 62 to 72 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
45			5	60	BG		ML		
					BG			(42-55') Sand and gravel; gravel is up to 2" in longest dimension. Yellowish-gray to light olive gray in color.	226.1
					BG				
					BG			Minor clay fraction in sand and gravel from 46' to 52'. Yellowish- gray to very light gray in color.	
50					BG		SW GW		
			6	90	BG			Sand and gravel, yellowish-gray to light yellowish-brown from 52' to 56'.	
					BG				
55					BG				213.1
					BG		SM GC	Sand and gravel with interstitial silt and clay. Dark orangish-yellow to reddish-brown from 55' to 56'.	212.1
					BG			Sand and gravel with minor clay, gravel is up to 3" in longest dimension, dark yellowish-brown to reddish-brown from 56' to 72'.	
60			7	90	BG				
					BG		SW GW		
65					BG				
					BG				
70					BG				
			8	80	BG				196.1
					BG		SP	Cookfield Formation: Fine to medium-grained sand, very light gray to very light olive gray, micaceous and finely lignitic.	
75					BG				192.1
								Soil boring terminated at 76'.	
80									

WELL DIAGRAM: 2" ID, Sch. 40 PVC casing; 0.01 slot, PVC screen; 3" PVC end cap

GAMMA RAY LOG

COUNTS PER SECOND



CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/22/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 9
SEWAGE LAGOONS

DWG DATE: 12/10/96

DWG NAME: 94GL904A

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

GEOLOGICAL LOGGING SYSTEMS

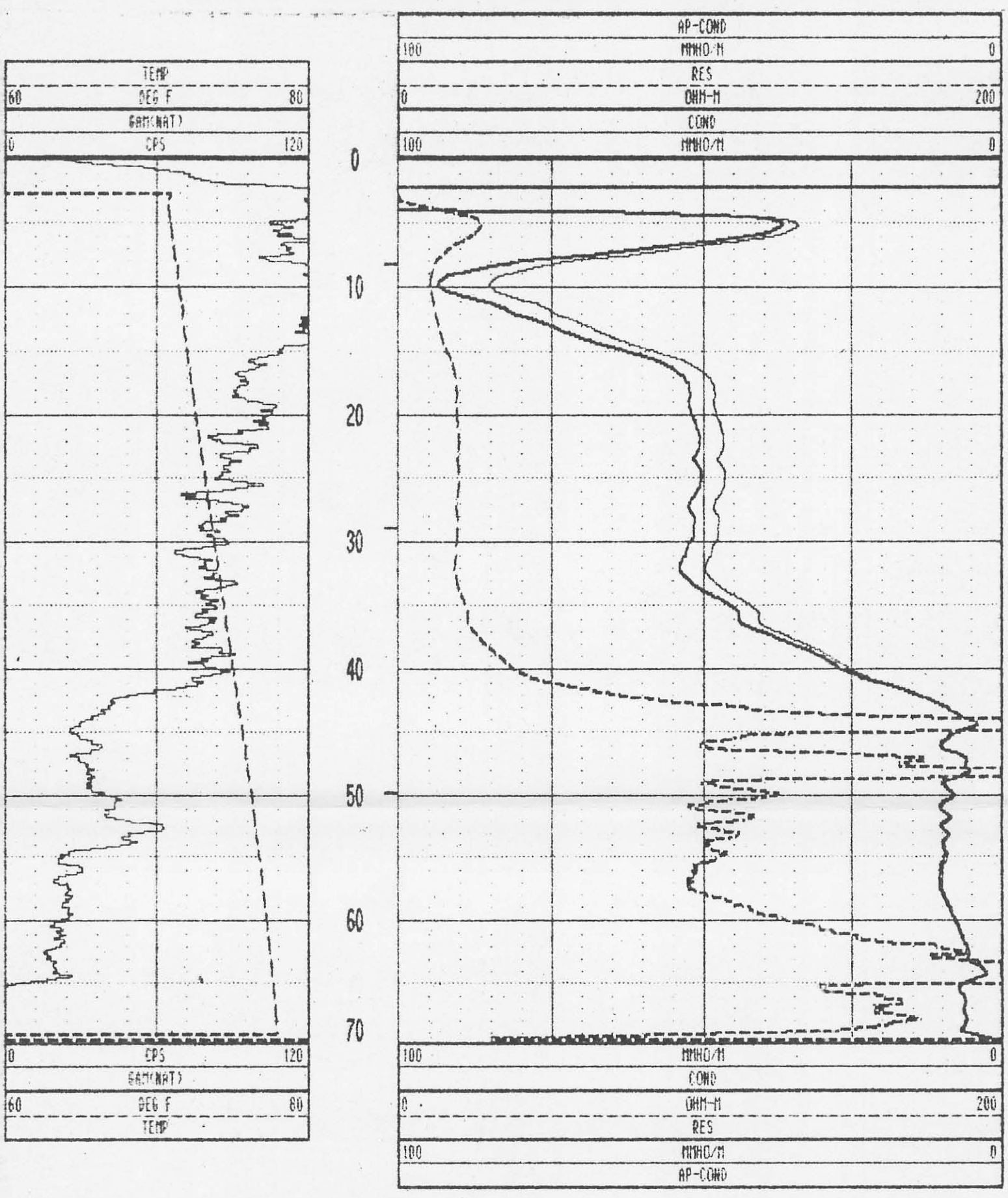
009G04DA

COMPANY	: ENSAFE,ALLEN & HOSHALL			OTHER SERVICES:	
WELL	: 009G04DA			9511	
LOCATION/FIELD	: NAS MEMPHIS			RUN ONE	
COUNTY	: SHELBY			OPEN	
STATE	: TENNESSEE				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 05/23/96	PERMANENT DATUM	: GL	ELEVATIONS	
DEPTH DRILLER	: 72	ELEV. PERM. DATUM	:	KB	:
LOG BOTTOM	: 69.70	LOG MEASURED FROM	: GL	DF	: -
LOG TOP	: -1.60	DRL MEASURED FROM	: GL	GL	: 268.1
CASING DRILLER	: 72	LOGGING UNIT	: 05		
CASING TYPE	: PVC	FIELD OFFICE	: BLUEFIELD		
CASING THICKNESS	: .25	RECORDED BY	: J T GILBERT		
BIT SIZE	: 8	BOREHOLE FLUID	: WATER	FILE	: ORIGIN
MAGNETIC DECL.	: -	RM	:	TYPE	: 9511C
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:	LOG	: 0
FLUID DENSITY	: 1.2	MATRIX DELTA T	:	PLOT	: 9510C
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:	THRESH	: 9000

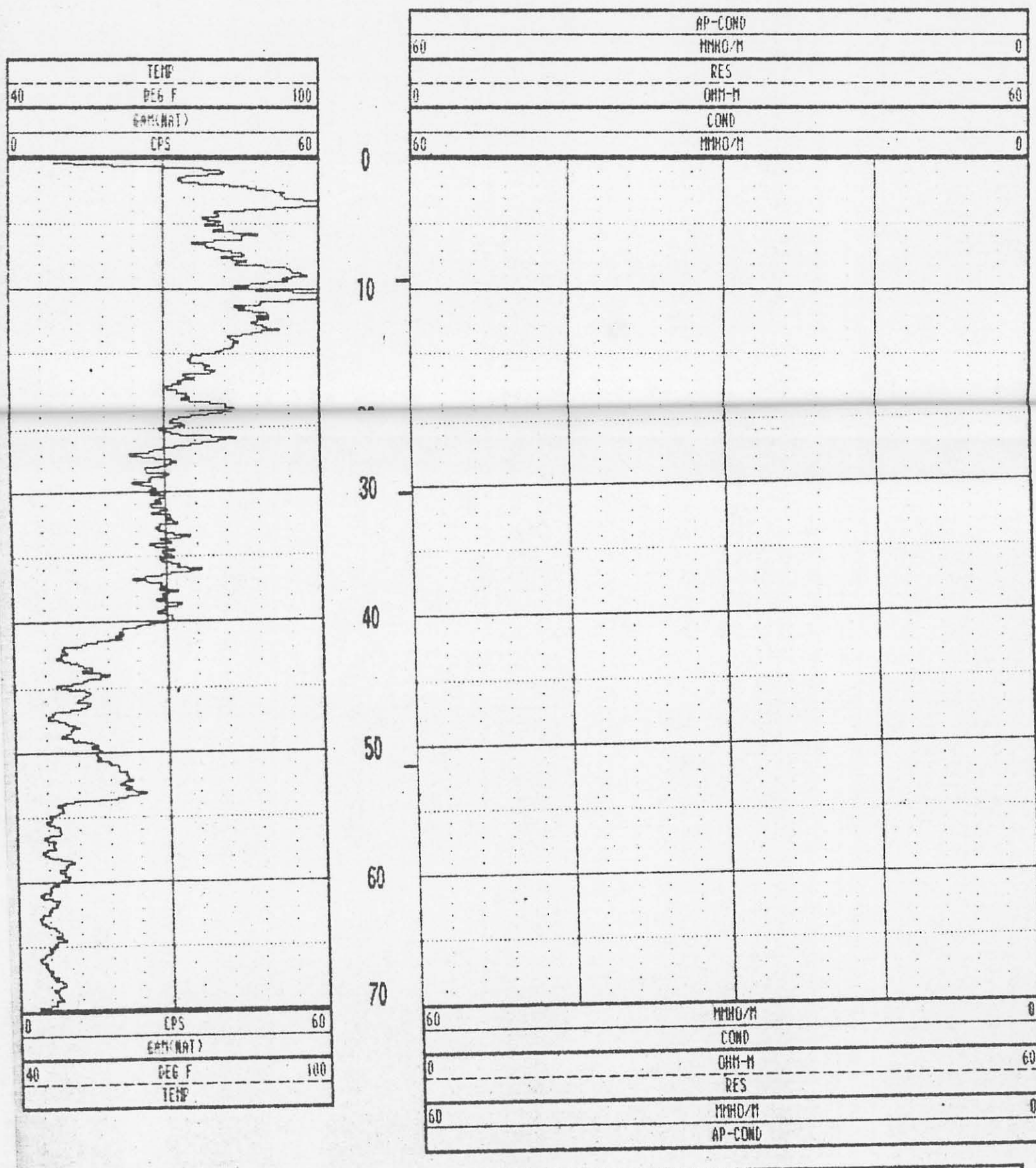
REMARKS :

ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



009G04DA 05/23/96 976



009G04DA 05/23/96 1025

TRI STATE
TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 02/29/96 **Project No.:** E-3-157

Client's Project No.: 0106090000

Sample I.D.: 009S01DA18

Soil Description: Tan & Light Gray Silty Clay

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	122.1	120.5
Dry Density (Lbs/ft^3)	91.3	91.0
Moisture (% Dry Wt)	33.8	32.4
Porosity (n)	.43	.44
Degree of Saturation (%)	1.0	1.0
Specific Gravity (ASTM D-854)	2.59	---

Permeability

Temperature Correction, $R_t = 1.043$

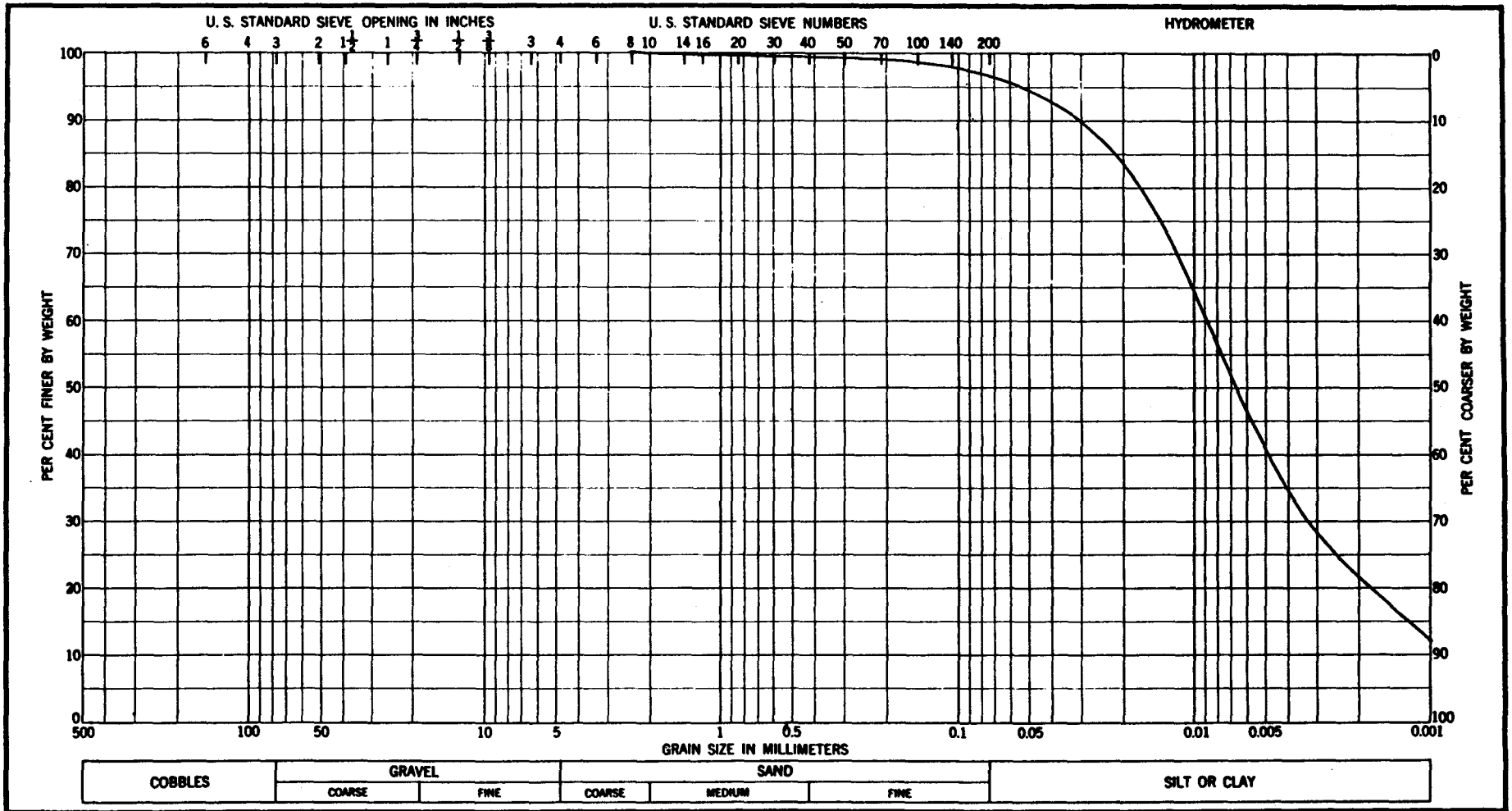
$K_1 = 9.0 \times 10^{-7}$ cm/sec
$K_2 = 8.5 \times 10^{-7}$ cm/sec
$K_3 = 9.4 \times 10^{-7}$ cm/sec
$K_4 = 9.9 \times 10^{-7}$ cm/sec

Coefficient of Permeability, $K_{20} = 9.6 \times 10^{-7}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-011 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 FAX 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
009S01DA18	16'-18'		34			

GRADATION CURVES

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 02/29/96

SWMU 14

SOIL BORING/MONITORING WELL LOGS AND GEOTECHNICAL LABORATORY RESULTS

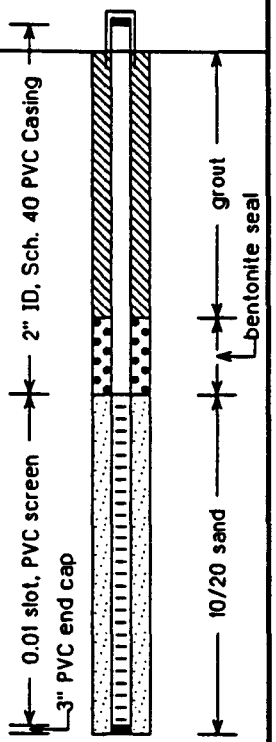
EnSafe/Allen & Hoshall

Monitoring Well 014G01LS

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *267.37 feet msl*
Started at *1030 on 1-29-96*	TOC Elevation: *269.17 feet msl*
Completed at *1245 on 1-29-96*	Depth to Groundwater: *6.79 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *262.38 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.59 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *10.34 to 20.34 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			1				GP GW	(0-1') Soil and gravel.	266.4
							ML	(1-3.5') Silt and clay (see descriptions below).	
								(1-2') Clayey silt. Dark yellowish-brown to dusky yellowish-brown in in color.	263.9
5			2				CL	(2-3.5') Silty clay. Dark yellowish-brown to dusky yellowish-brown in in color.	
								(3.5-7') Clay, silty, pale yellowish-brown, mottled with light olive gray-colored material.	260.4
			3					Collected Shelby Tube from 7' to 10'. No sample for description.	257.4
10								(10-16') Clay and silt (see descriptions below).	
							CL	(10-15.5') Clay, silty, moderate yellowish-brown in color, mottled with light olive gray-colored silt. Iron-staining and iron-manganese nodules present near 15'.	
15								(15.5-16') Clayey silt, moderate yellowish-brown in color mottled with light olive gray to greenish-gray. Iron-manganese nodules and iron staining present.	251.4
							ML	(16-20.5') Clayey silt, greenish-gray mottled with moderate yellowish-brown material near 16'. Iron staining increases with depth.	246.8
20								Soil boring terminated at approximately 20.5'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent monitoring well 014G01LF.	
25									
30									
35									
40									

WELL DIAGRAM



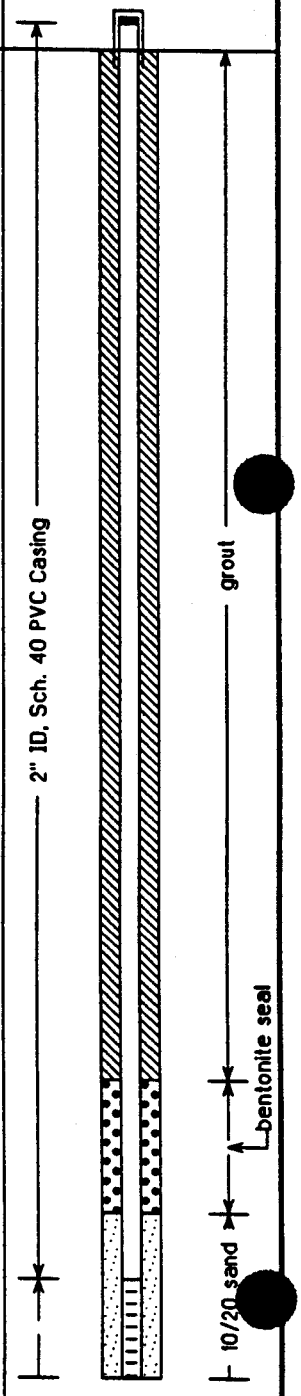
EnSafe/Allen & Hoshall

Monitoring Well 014G01LF

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *267.24 feet msl*
Started at *1320 on 1-29-96*	TOC Elevation: *269.11 feet msl*
Completed at *1530 on 1-29-96*	Depth to Groundwater: *7.46 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *261.65 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *51 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *37 to 47 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			BG	QL GW	(0-1') Soil and gravel.	266.2
			BG	ML	(1-3.5') Silt and clay (see descriptions below).	
	1	100	BG		(1-2') Clayey silt. Dark yellowish-brown to dusky yellowish-brown in color.	263.7
5			5	CL	(2-3.5') Silty clay. Dark yellowish-brown to dusky yellowish-brown in color.	
			4			260.2
	2	83	3		(3.5-7') Clay, silty, pale yellowish-brown, mottled with light olive gray-colored material.	
10			BG		No description available; collected a Shelby tube sample from 7' to 10' for geotechnical analysis.	257.2
			BG		(10-16') Clay and silt (see descriptions below).	
	3	155	BG	CL	(10-15.5') Clay, silty, moderate yellowish-brown in color, mottled with light olive gray-colored silt. Iron-staining and iron-manganese nodules present near 15'.	
15			4			
			BG			251.2
			BG		(15.5-16') Clayey silt, moderate yellowish-brown in color mottled with light olive gray to greenish-gray. Iron-manganese nodules and iron staining present.	
			BG			
20	4	97	BG	ML	(16-26) Clayey silt, greenish-gray mottled with moderate yellowish-brown material near 16'. Iron staining increases with depth.	
			BG			
			BG			
25			BG		Iron-manganese nodules present near 26'.	
			BG			240.2
			BG		(27-32') Silt, clayey, moderate yellowish-brown in color, mottled with light olive gray to very light gray-colored material, with some hard siliceous clayey material, contains a large siliceous clay concretion at 27'.	
30	5	135	BG	ML		
			BG			235.2
			BG	ML	(32-35') Clayey silt, moderate yellowish-brown mottled slightly with light olive gray to very light gray-colored material.	
35			BG			232.2
			BG	ML SC	(35-47') Fluvial Deposits (see descriptions below).	
	6	113	BG		(35-40') Silt, clay, and sand, with some scattered gravel, dusky yellow color mottled with light olive gray to very light gray material, moist.	
40						227.2

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 014G01LF

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *267.24 feet msl*
Started at *1320 on 1-29-96*	TOC Elevation: *269.11 feet msl*
Completed at *1530 on 1-29-96*	Depth to Groundwater: *7.46 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *261.65 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *51 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *37 to 47 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
			7	93				No description available; collected a Shelby tube sample from 40' to 43' for geotechnical analysis.	227.2	
45			8	125	BG BG		SM/GW SW/GW	(43-43.5') Silt, sand, and gravel (up to 1" in longest dimension), very light gray, wet. (43.5-47') Sand and gravel. Sand is fine to very coarse-grained, and gravel (up to 1.5" in longest dimension) from 44' to 45'. Moderate yellowish-brown to light gray, wet. Longest dimension of gravel increases to up to 3.5" at 47'.	224.2 223.7	0.01 slot, PVC screen 3" PVC end cap 10/20 sand collapsed
			9	142	BG BG BG		SP/CL		220.2	
50					BG			(47-51') Cockfield Formation: Very fine-grained sand, silt, and clay. Dusky yellowish-brown mottled with light olive gray near 47'.	216.2	
55								Soil boring terminated at 51'.		
60										
65										
70										
75										
80										

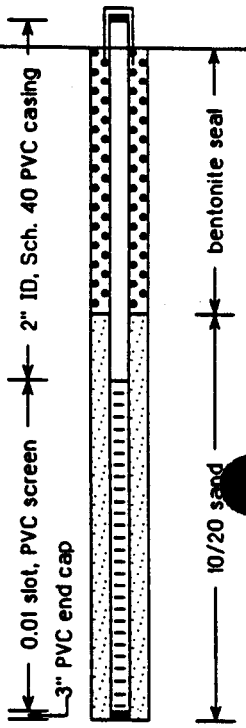
EnSafe/Allen & Hoshall

Monitoring Well 014G02LS

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.44 feet msl*
Started at *0850 on 2-14-96*	TOC Elevation: *270.12 feet msl*
Completed at *0915 on 2-14-96*	Depth to Groundwater: *7.61 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *262.51 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *A. Choate, C. Ivey*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0							ML GC	(0-3') Gravel, silt, clay, and bricks from 0' to 3' (fill).	
									265.4
5			1	100	BG		CL	(3-6') Clay, brownish-gray in color	
									262.4
10							ML CL	Silt and clay, light olive gray to dark yellowish-brown in color from 6' to 9'. Silt and clay, yellowish-gray to yellowish-brown in color from 9' to 20'. Moist, with iron-staining and specks of organic material.	
15			2	120	BG				
20								Soil boring terminated at 20'. Note: This is a replacement well. The original well was installed a few feet away on 1/23/96 but was subsequently abandoned due to faulty construction. Analytical samples indicated on this boring log were collected from the soil boring associated with the original well.	248.4
25									
30									
35									
40									

WELL DIAGRAM



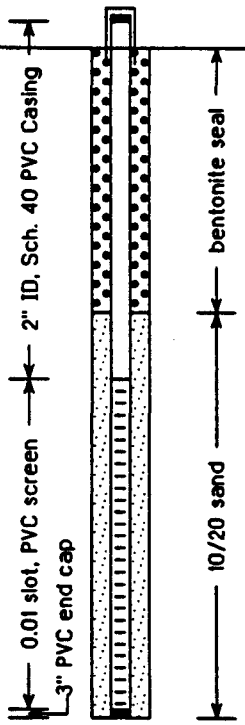
EnSafe/Allen & Hoshall

Monitoring Well 014G03LS

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.64 feet msl*
Started at *0745 on 2-14-96*	TOC Elevation: *271.09 feet msl*
Completed at *0815 on 2-14-96*	Depth to Groundwater: *8.39 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *262.70 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *J.A. Kingsbury*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			BG			
			5	CL/ML	(0-8') Clay with some silt, dark brown to brownish-gray in color.	
5	1	70	5			
			6			
			6			260.6
10			6		(8-20') Silt, light yellowish-brown to yellowish-gray in color with dark orangish-yellow mottling and specks of organic material. Moist.	
			5	ML		
15	2	90	5		Small concretion present at 15'.	
			5			
			5			248.6
20					Soil boring terminated at 20'.	
25						
30						
35						
40						

WELL DIAGRAM



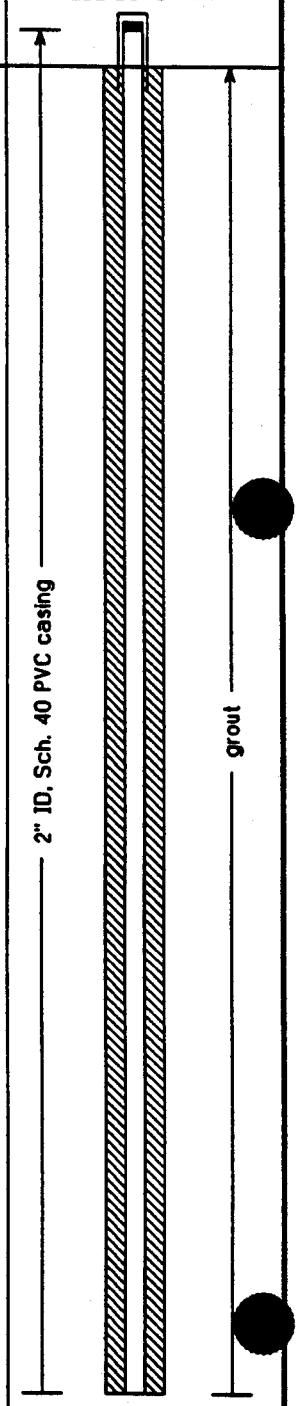
EnSafe/Allen & Hoshall

Monitoring Well 014G04LF

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.82 feet msl*
Started at *1330 on 1-23-96*	TOC Elevation: *270.88 feet msl*
Completed at *1530 on 1-23-96*	Depth to Groundwater: *8.79 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *262.09 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *55 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *39 to 49 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
	1	46	BG	OL GW	(0-2.5') Soil, gravel, brick, grass and roots (fill material).	
			BG	CL	(2.5-5') Silty clay. Dark yellowish-brown in color.	266.3
5			BG		(5-20.5') Clayey silt. Moderate yellowish-brown to light olive gray in color. Mottled with light olive gray and olive gray-colored material. Iron-manganese nodules near 5'.	263.8
			BG		Moist near 7.5'.	
			BG			
10	2	107	BG		(10-12') Very moist.	
			8		Iron-manganese nodules near 11'.	
			8	ML		
15			6			
			6			
			6			
20	3	121	6			248.3
			6	ML	(20.5-23') Clayey silt is light olive gray in color with considerable dark yellowish-orange to moderate yellowish-brown colored iron staining. Some iron/manganese nodules are present	245.8
			6.5		(23-30') Silty clay, greenish-gray in color with some dark yellowish- orange to moderate yellowish-brown iron-staining near 23'. Iron-staining and mottled light olive brown in color near 30'.	
25			6.5			
			6.5	CL		
			5		Fluvial Deposits (30-50') contact estimated at 30'.	
30				SP		238.8

WELL DIAGRAM



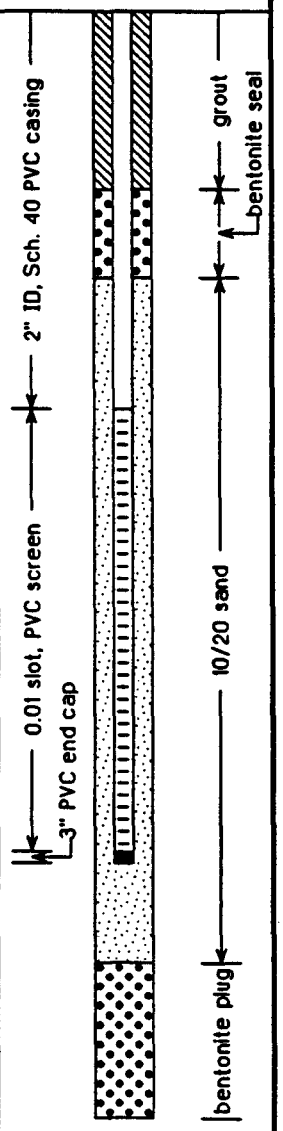
EnSafe/Allen & Hoshall

Monitoring Well 014G04LF

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.82 feet msl*
Started at *1330 on 1-23-96*	TOC Elevation: *270.88 feet msl*
Completed at *1530 on 1-23-96*	Depth to Groundwater: *8.79 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *262.09 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *55 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *39 to 49 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
						238.8
	4	127	5	SP	(30-32') Sand, very fine-grained, moderate yellowish-brown in color mottled light gray-colored material.	236.8
			5	SM SC	(32-35') Sand (very fine to coarse-grained), silt, and clay. Moderate yellowish-brown in color mottled with light gray material. Moist near 34'. Becomes mostly very fine-grained sand and silt near 35'.	
35			5			233.8
				ML CL	(35-37') Silt and clay, greenish-gray in color mottled with moderate yellowish-brown material.	231.8
			4.5	SM SC	(37-38') Sand, silt, and clay. Olive gray to light brownish-gray in color.	230.8
			5.5	SC GM	(38-39') Silty and clayey sand and gravel. Light olive gray to moderate yellowish-brown in color. Wet.	229.8
40	5	113	5	GW GC	(39-42.5') Gravel, sand, and clay. Light olive gray in color, mottled with moderate yellowish-brown and dark yellowish-orange-colored material. Very cohesive and moist.	226.3
			5	SW GW	(42.5-46.5') Sand (medium to coarse-grained) and gravel (up to 1" in longest dimension. Light gray in color mottled with moderate yellowish-brown material. Wet.	
45			5			
	6	95	4			
			5	GW	(46.5-48') Sand is medium to very coarse-grained. Moderate yellowish-brown to dark yellowish-orange, wet.	220.8
			5	SP SM	(48-49.5') Gravel (up to 4" in longest dimension) with sand. Moderate yellowish-brown in color. Wet.	218.8
50	7	183	4.5		(50-55') Cockfield Formation (see description below).	
			5		Very fine-grained silty sand, moderate yellowish-brown to dusky yellowish brown with light olive gray laminations.	213.8
55					Soil boring terminated at 55'.	
60						

WELL DIAGRAM



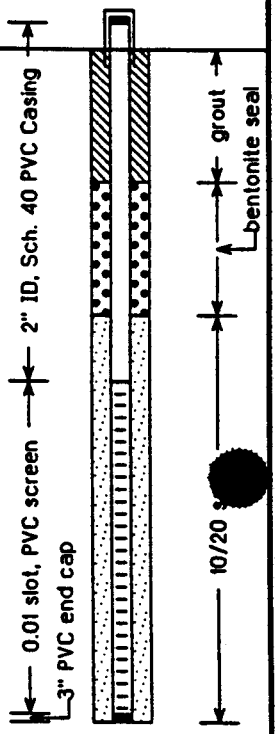
EnSafe/Allen & Hoshall

Monitoring Well 014G05LS

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.24 feet msl*
Started at *1445 on 1-21-96*	TOC Elevation: *270.12 feet msl*
Completed at *1605 on 1-21-96*	Depth to Groundwater: *9.84 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *260.28 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *A. Choate, C. Ivey*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
							OL	(0-1.5') Soil and grass.	268.7
			1	108	BG			(1.5-20') Silt and clay (see descriptions below).	
5								(1.5-6') Silt and clay, dark yellowish-brown in color, becoming dark yellowish-brown to pale yellowish-brown in color near 6'. Dry.	
10			2	118	BG		ML CL	Clayey silt, dark yellowish-brown to dark yellowish-orange in color mottled with medium light gray-colored material. Slightly moist. Contains iron-manganese nodules.	
15								Wet from 15' to 16'. The percentage of iron-manganese nodules increases near 16'.	
20			3	142	BG			(16-20') Very clayey silt, light olive gray in color mottled with dark yellowish-brown to dark yellowish-orange material. The percentage of mottled material decreases with depth. Very moist. Contains iron-manganese nodules.	248.2
								Terminated soil boring at 20'.	
25									
30									
35									
40									

WELL DIAGRAM



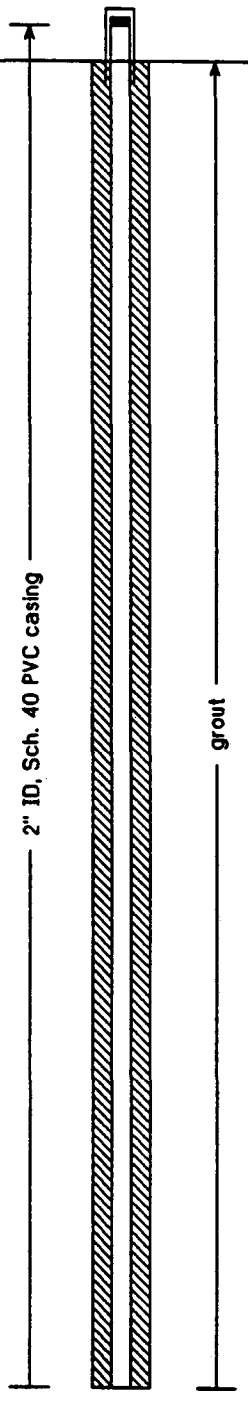
EnSafe/Allen & Hoshall

Monitoring Well 014G06LF

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.62 feet msl*
Started at *1450 on 1-20-96*	TOC Elevation: *270.57 feet msl*
Completed at *0850 on 1-21-96*	Depth to Groundwater: *10.32 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *260.25 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56 feet*
Geologist: *A. Choate, C. Ivey*	Well Screen: *39 to 49 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			BG	OL	(0-2') Soil, roots, and brick fragments. Soil is dark yellowish-brown to moderate yellowish-brown.	268.6
	1	72	BG	ML CL	(2-17') Clayey silt and silty clay (see descriptions below). (2-6.5') Very clayey silt. Moderate yellowish-brown to dark yellowish- brown in color. Color becomes lighter near 6.5'. (6.5-17') Silty clay. Moderate yellowish-brown in color mottled with yellowish-gray-colored material. Contains iron-manganese nodules. Slightly moist, becoming more moist, oxidized, and stained dark yellowish-orange near 11'.	
5			BG			
			BG			
10	2	89	BG			
			BG			
15			BG			
			BG			251.6
			BG	ML	(17-37') Silt, clayey (see descriptions below). (17-26') Clayey silt. Light olive gray to greenish-gray in color. Slightly moist. Becoming stiff near 26'.	
20	3	95	BG			
			BG			
25			BG		(26-32') Clayey silt, moderate yellowish-brown in color mottled with light olive-gray material. The percentage of light olive gray material progressively decreases from 26' to 32'. Iron concretions are present near 26'. Slightly moist at 26' becoming more moist near 32'.	
			BG			
30			BG			

WELL DIAGRAM



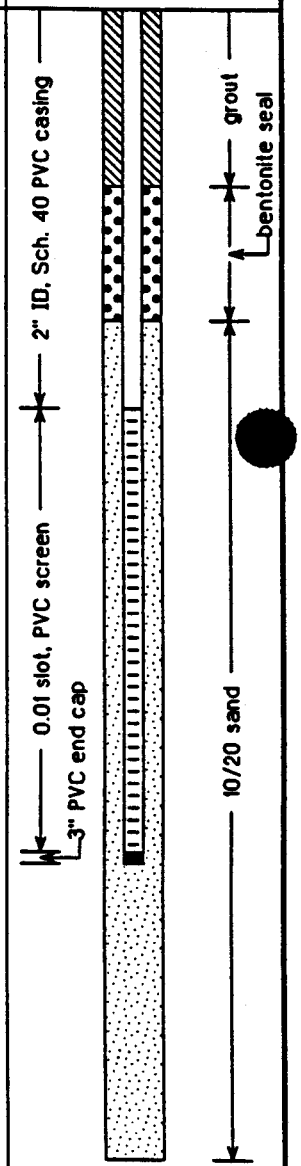
EnSafe/Allen & Hoshall

Monitoring Well 014G06LF

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.62 feet msl*
Started at *1450 on 1-20-96*	TOC Elevation: *270.57 feet msl*
Completed at *0850 on 1-21-96*	Depth to Groundwater: *10.32 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *260.25 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56 feet*
Geologist: *A. Choate, C. Ivey*	Well Screen: *39 to 49 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
35			4	113	BG		ML	(32-36') Silt, clayey, moderate yellowish-brown in color and slightly moist.	
					BG				
					BG				
					BG			(36-37') Clayey silt, moderate yellowish-brown in color mottled with light olive gray material, slightly moist.	231.6
40					BG			(37-49') Fluvial Deposits (see descriptions below). (37-49') Sand and gravel (see descriptions below).	
			5	97	BG			(37-38') Fine-grained sand and silt with gravel (up to 2" in longest dimension). Moderate yellowish-brown.	
					BG		SM GW	(38-42') Sand, fine, and gravel (up to 2" in longest dimension), silty, moderate brown mottled with pale yellowish-brown material.	
45					BG			(42-45') Sand (fine to coarse-grained) and gravel (up to 2" in longest dimension). Moderate brown to dark yellowish-orange in color. Wet.	
					BG			(45-49') Sand, medium to coarse, and gravel (up to 2" in longest dimension), moderate yellowish-brown to dark yellowish-orange. Wet.	
					BG			(49-56') Cockfield Formation (see description below).	219.6
50			6	114	BG			Silty, very fine-grained sand with silty clay laminations. Sand is dusky yellowish brown in color; clay laminations are light gray in color.	
					BG		SM CL		
					BG				
55					BG			Becoming waxy near 56'.	
									212.6
60								Soil boring terminated at 56'.	

WELL DIAGRAM



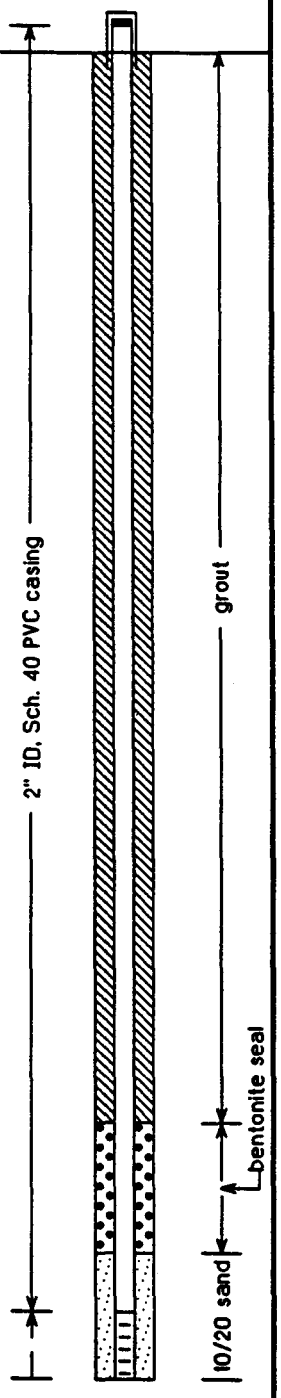
EnSafe/Allen & Hoshall

Monitoring Well 014G07LF

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.88 feet msl*
Started at *1000 on 1-22-96*	TOC Elevation: *270.63 feet msl*
Completed at *1145 on 1-22-96*	Depth to Groundwater: *9.30 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *261.33 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *50 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *38 to 48 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0	1	50	BG	OL	(0-5') Soil, concrete, and rubble (fill). Note: Concrete was encountered at 2' below ground surface.	
5			BG			263.9
			BG	CL ML	(5-22') Clay and silt (see descriptions below). (5-12') Silty clay. Dark yellowish-brown in color mottled with moderate yellowish-brown to dark yellowish-orange-colored material. Mottling increases in content progressively near 12'. Hard from 4' to 7'.	
10	2		BG		Silt content increases near 11'.	
			BG		(12-16') Silty clay, olive gray to light olive gray in color mottled with moderate yellowish-brown to dark yellowish-orange-colored material. Contains iron-manganese nodules, increasing in percentage around 16'.	
15			BG			
			BG		(16-22') Clayey silt. Moderate yellowish-brown in color mottled with light olive gray-colored material. Contains scattered iron- manganese nodules.	
20	3	139	BG		Dark yellowish-orange staining near 21'.	246.9
			BG	ML	(22-32.5') Silt (see descriptions below). (22-25') Silt, medium dark gray to medium gray, mottled with some moderate yellowish-brown material near 22' where a few scattered iron-manganese nodules are located.	
25			BG			
			BG		(25-31.5') Silt, olive gray to greenish-gray in color, mottled with moderate yellowish-brown near 32.5'. Contains iron staining and iron-manganese nodules mostly near 29'.	
30	4	118	BG		(31.5-32.5') Silt, moderate yellowish-brown mottled with light gray.	236.4
			BG	ML	(32.5-36') Clayey silt, moderate yellowish-brown in color. Mottled with light gray material near 34'.	
35			BG			232.9
			BG	SM GW	(36-48') Fluvial Deposits (see descriptions below). (36-43.5') Sand, silty, with gravel (see descriptions below).	
40			BG		(36-37.5') Silty sand (very fine-grained) with gravel. Moderate yellowish-brown in color.	

WELL DIAGRAM



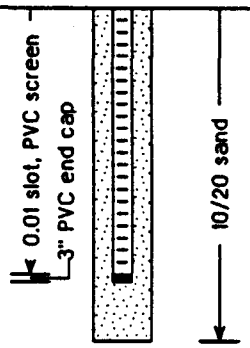
EnSafe/Allen & Hoshall

Monitoring Well 014G07LF

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.88 feet msl*
Started at *1000 on 1-22-96*	TOC Elevation: *270.63 feet msl*
Completed at *1145 on 1-22-96*	Depth to Groundwater: *9.30 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *261.33 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *50 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *38 to 48 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
45	5	107	BG	SM/GW	Very silty sand (fine to coarse-grained) and gravel (up to 2" in longest dimension) subangular to rounded. Moderate yellowish-brown in color mottled with light olive gray and some dark yellowish- orange-colored material. From 37.5' to 41.5', sample is very difficult to split.	225.4
			BG			
			BG	SW/GW	(43.5-48') Sand and gravel, gravel and sand (see descriptions below).	
			BG			
50	6	120	BG	SM	(43.5-46') Sand (medium to coarse-grained) and gravel (up to 2" in longest dimension). Dark yellowish-orange to moderate yellowish- brown in color. Wet.	220.9
					(46-48') Gravel and sand, dark yellowish-orange to moderate yellowish- brown. Wet.	218.9
55					(48-50') Cockfield Formation (see description below).	
60					Very fine-grained silty sand. Mottled with gray to light gray-colored very fine-grained sand, which decreases with depth. Becomes clayey near 50'.	
65					Soil boring terminated at 50'.	
70						
75						
80						

WELL DIAGRAM



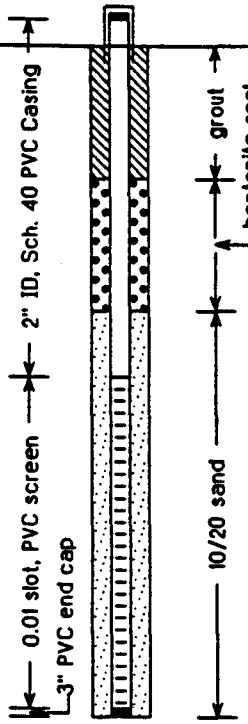
EnSafe/Allen & Hoshall

Monitoring Well 014G08LS

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.52 feet msl*
Started at *1500 on 1-22-96*	TOC Elevation: *268.14 feet msl*
Completed at *1530 on 1-22-96*	Depth to Groundwater: *6.48 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *261.66 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0			1	40	1		OL	(0-5') Fill material: Soil, with bits of concrete and grass and roots.	
5					BG				263.5
					BG			(5-17') Clay and silt (see descriptions below).	
					BG			(5-7') Silty clay. Moderate yellowish-brown to dark yellowish-orange in color and mottled with light olive gray-colored material. Slightly moist.	
10			2	82	BG		CL ML	(7-16') Clayey silt. Moderate yellowish-brown to dark yellowish- orange in color mottled with light olive gray and some dark yellowish- orange material. Slightly moist.	
					BG				
15					BG			Moisture content increases near 16'. Sparse iron-manganese nodules are present near 16'.	252.5
			3	75	BG		ML	(16-17') Clayey silt moderate yellowish-brown to dark yellowish-orange in color and mottled with olive gray to light olive gray-colored material. Considerable iron staining. Contains iron-manganese nodules. Moist.	
20					BG				248.5
								(17-20') Silt, clayey, olive gray to light olive gray in color slightly mottled with dark yellowish-orange-colored material. Contains iron-manganese nodules, moist.	
25								Terminated soil boring at 20'.	
30									
35									
40									

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well 014G04LF

Project: NSA Memphis	Location: Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)
Project No.: 0106-08420	Surface Elevation: 268.82 feet msl
Started at 1330 on 1-23-96	TOC Elevation: 270.88 feet msl
Completed at 1530 on 1-23-96	Depth to Groundwater: 8.79 feet Measured: 4/8/96
Drilling Method: Rotasonic-4" inner core barrel/6" OD casing	Groundwater Elevation: 262.09 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 55 feet
Geologist: D. Ladd, W. Parks	Well Screen: 39 to 49 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
					BG		GW	(0-2.5') Soil, gravel, brick, grass and roots (fill material).	
			1	46	BG		CL	(2.5-5') Silty clay. Dark yellowish-brown in color.	266.3
5					BG		ML	(5-20.5') Clayey silt. Moderate yellowish-brown to light olive gray in color. Mottled with light olive gray and olive gray-colored material. Iron-manganese nodules near 5'.	263.8
					BG			Moist near 7.5'.	
					BG				
10			2	107	BG			(10-12') Very moist.	
					8			Iron-manganese nodules near 11'.	
					8				
15					6				
					6				
					6				
20			3	121	6		ML	(20.5-23') Clayey silt is light olive gray in color with considerable dark yellowish-orange to moderate yellowish-brown colored iron staining. Some iron/manganese nodules are present	248.3
					6.5				245.8
25					6.5		CL	(23-30') Silty clay, greenish-gray in color with some dark yellowish- orange to moderate yellowish-brown iron-staining near 23'. Iron-staining and mottled light olive brown in color near 30'.	
					6.5				
					5			Fluvial Deposits (30-50') contact estimated at 30'.	
30							SP		238.8

WELL DIAGRAM: 2" ID, Sch. 40 PVC casing

GAMMA RAY LOG

COUNTS PER SECOND

0 20 40 60

0 Feet -25

CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/22/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 14
BUILDING S-140 AND
SEVENTH AVENUE DRAINAGE DITCH

DWG DATE: 12/10/96 DWG NAME: 9[illegible]144

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

EnSafe/Allen & Hoshall

Monitoring Well 014G04LF

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #14 (S-140/7th Ave. Ditch)*
Project No.: *0106-08420*	Surface Elevation: *268.82 feet msl*
Started at *1330 on 1-23-96*	TOC Elevation: *270.88 feet msl*
Completed at *1530 on 1-23-96*	Depth to Groundwater *8.79 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic-4" inner core barrel/8" OD casing*	Groundwater Elevation: *262.09 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *55 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *39 to 49 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			4	127	5		SP	(30–32') Sand, very fine-grained, moderate yellowish-brown in color mottled light gray-colored material.	238.8
					5		SM SC	(32–35') Sand (very fine to coarse-grained), silt, and clay. Moderate yellowish-brown in color mottled with light gray material. Moist near 34'. Becomes mostly very fine-grained sand and silt near 35'.	236.8
35					5		ML CL	(35–37') Silt and clay, greenish-gray in color mottled with moderate yellowish-brown material.	233.8
					4.5		SM SC	(37–38') Sand, silt, and clay. Olive gray to light brownish-gray in color.	231.8
					5.5		SC GM	(38–39') Silty and clayey sand and gravel. Light olive gray to moderate yellowish-brown in color. Wet.	230.8
40			5	113	5		GW GC	(39–42.5') Gravel, sand, and clay. Light olive gray in color, mottled with moderate yellowish-brown and dark yellowish-orange-colored material. Very cohesive and moist.	229.8
					5				226.3
45					5		SW GW	(42.5–46.5') Sand (medium to coarse-grained) and gravel (up to 1" in longest dimension. Light gray in color mottled with moderate yellowish-brown material. Wet.	
			6	95	4				
					5		GW	(46.5–48') Sand is medium to very coarse-grained. Moderate yellowish-brown to dark yellowish-orange, wet.	220.8
50					5			(48–49.5') Gravel (up to 4" in longest dimension) with sand. Moderate yellowish-brown in color. Wet.	218.8
			7	163	4.5		SP SM	(50–55') Cockfield Formation (see description below).	
55					5			Very fine-grained silty sand, moderate yellowish-brown to dusky yellowish brown with light olive gray laminations.	213.8
60								Soil boring terminated at 55'.	

WELL DIAGRAM

0.01 slot, PVC screen — 2" ID, Sch. 40 PVC casing

3" PVC end cap

GAMMA RAY LOG

COUNTS PER SECOND

0 20 40 60

-30 -40 -50

Feet

CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/22/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 14
BUILDING S-140 AND
SEVENTH AVENUE DRAINAGE DITCH

DWG DATE: 12/10/96

DWG NAME: 94GL144A

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

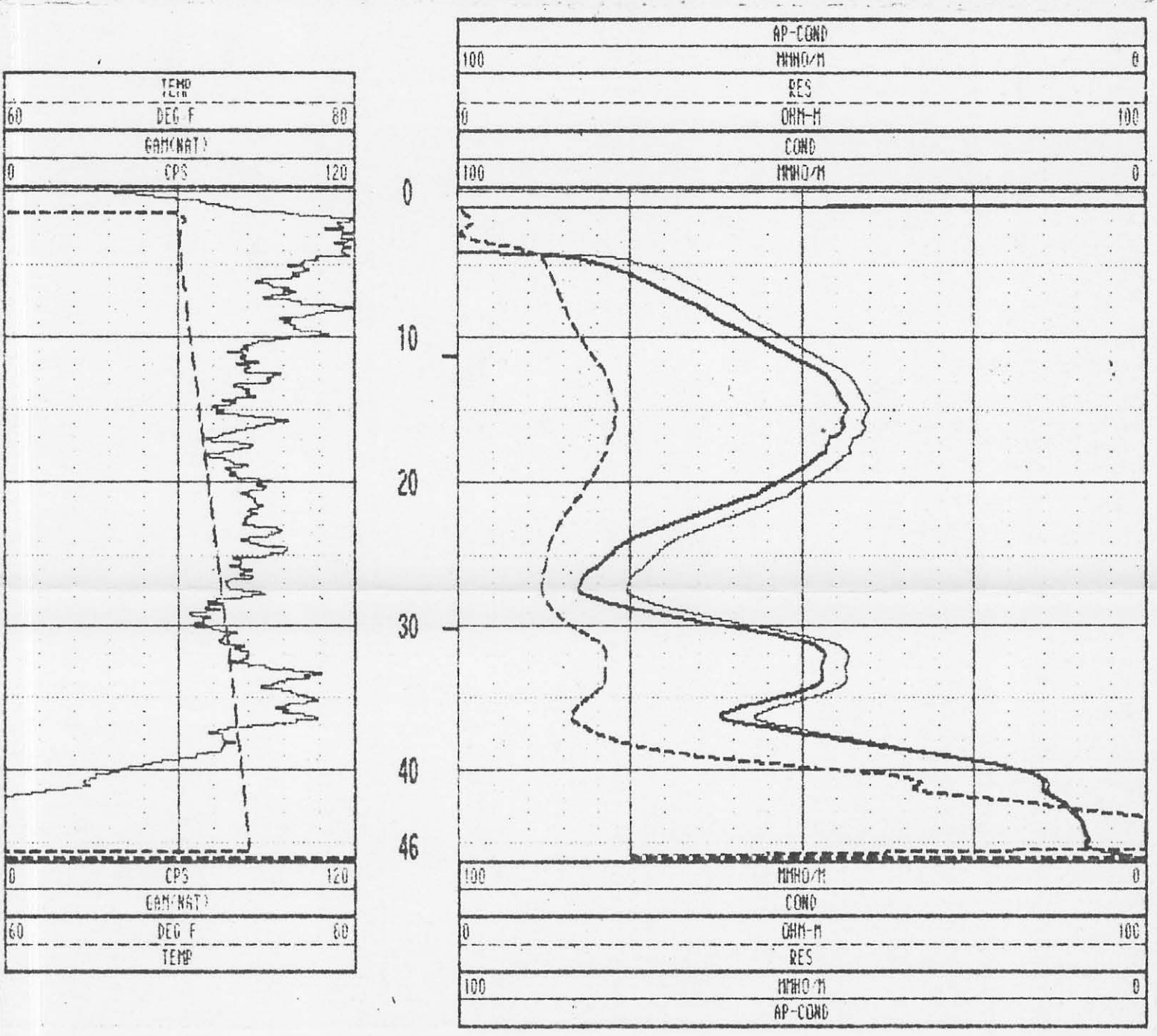
GEOLOGICAL LOGGING SYSTEMS

014G04LF

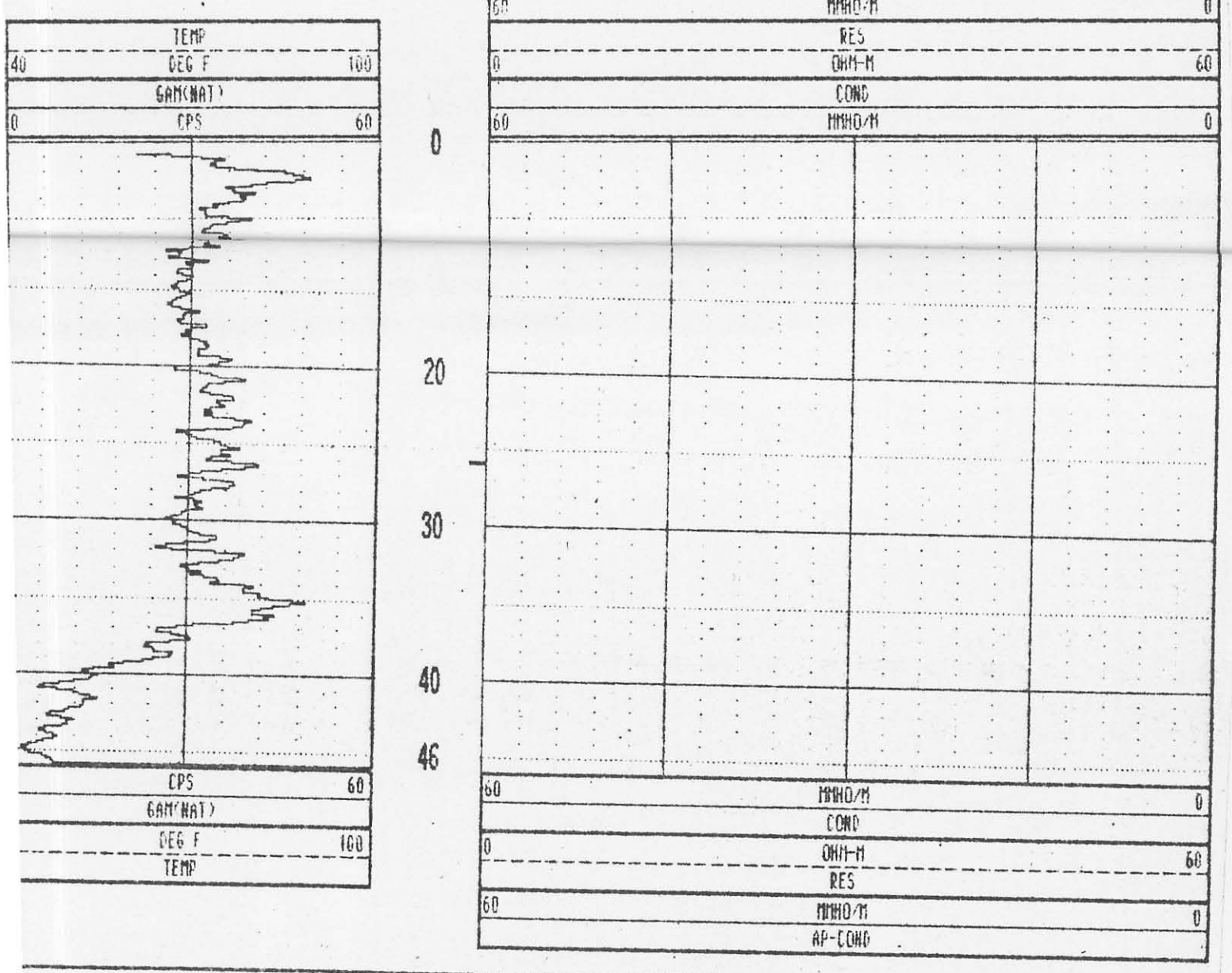
COMPANY	: ENSAFE,ALLEN & HOSHALL			OTHER SERVICES:	
WELL	: 014G04LF			9511	
LOCATION/FIELD	: NAS MEMPHIS			RUN ONE	
COUNTY	: SHELBY			OPEN	
STATE	: TENNESSEE				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 05/22/96	PERMANENT DATUM	: GL	ELEVATIONS	
DEPTH DRILLER	: 51.5	ELEV. PERM. DATUM:		KB	:
LOG BOTTOM	: 46.30	LOG MEASURED FROM:	GL	DF	: -
LOG TOP	: -2.80	DRL MEASURED FROM:	GL	GL	: 268.8
CASING DRILLER	: 51.5	LOGGING UNIT	: 05		
CASING TYPE	: PVC	FIELD OFFICE	: BLUEFIELD		
CASING THICKNESS	: .25	RECORDED BY	: J T GILBERT		
BIT SIZE	: 8	BOREHOLE FLUID	: WATER	FILE	: ORIGIN
MAGNETIC DECL.	: -	RM	:	TYPE	: 9511C
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:	LOG	: 4
FLUID DENSITY	: 1.2	MATRIX DELTA T	:	PLOT	: 9510C
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:	THRESH	: 9000
REMARKS	:				

ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



014G04LF 05/22/96 976



014G04LF 05/22/96 1025

TRI STATE
TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 02/22/96 **Project No.:** E-3-157

Client's Project No.: 0106090000

Sample I.D.: 014S01LF10

Soil Description: Light Gray Clayey Silt

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	120.0	117.8
Dry Density (Lbs/ft^3)	90.8	92.6
Moisture (% Dry Wt)	32.1	27.2
Porosity (n)	.44	.43
Degree of Saturation (%)	1.00	.95
Specific Gravity (ASTM D-854)	2.59	---

Permeability

Temperature Correction, $R_t = 1.000$

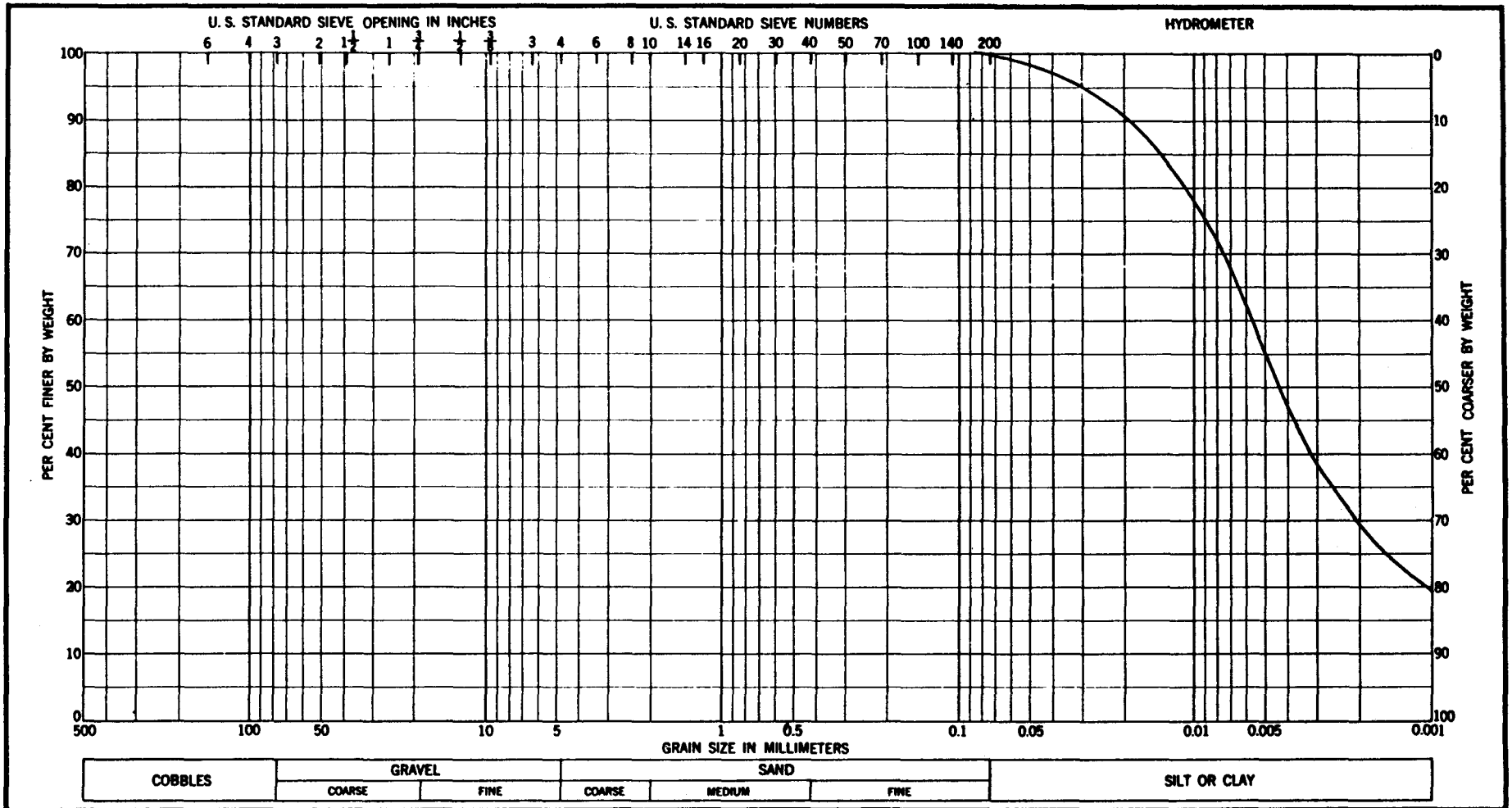
$K_1 = 4.4 \times 10^{-7}$ cm/sec
$K_2 = 3.9 \times 10^{-7}$ cm/sec
$K_3 = 4.0 \times 10^{-7}$ cm/sec
$K_4 = 4.3 \times 10^{-7}$ cm/sec

Coefficient of Permeability, $K_{20} = 4.2 \times 10^{-7}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-005 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 Fax 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
014S011LF10	7-10'		32	--	--	--

GRADATION CURVES

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 02/23/96

TRI-STATE
TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 02/22/96 Project No.: E-3-157

Client's Project No.: 0106090000

Sample I.D.: 014S01LF43

Soil Description: Light Gray & Tan Silty Clay with Sand and small gravel

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	127.0	133.4
Dry Density (Lbs/ft^3)	105.2	113.5
Moisture (% Dry Wt)	20.7	17.5
Porosity (n)	.32	.26
Degree of Saturation (%)	1.0	1.20
Specific Gravity (ASTM D-854)	2.47	---

Permeability

Temperature Correction, $R_t = 1.010$

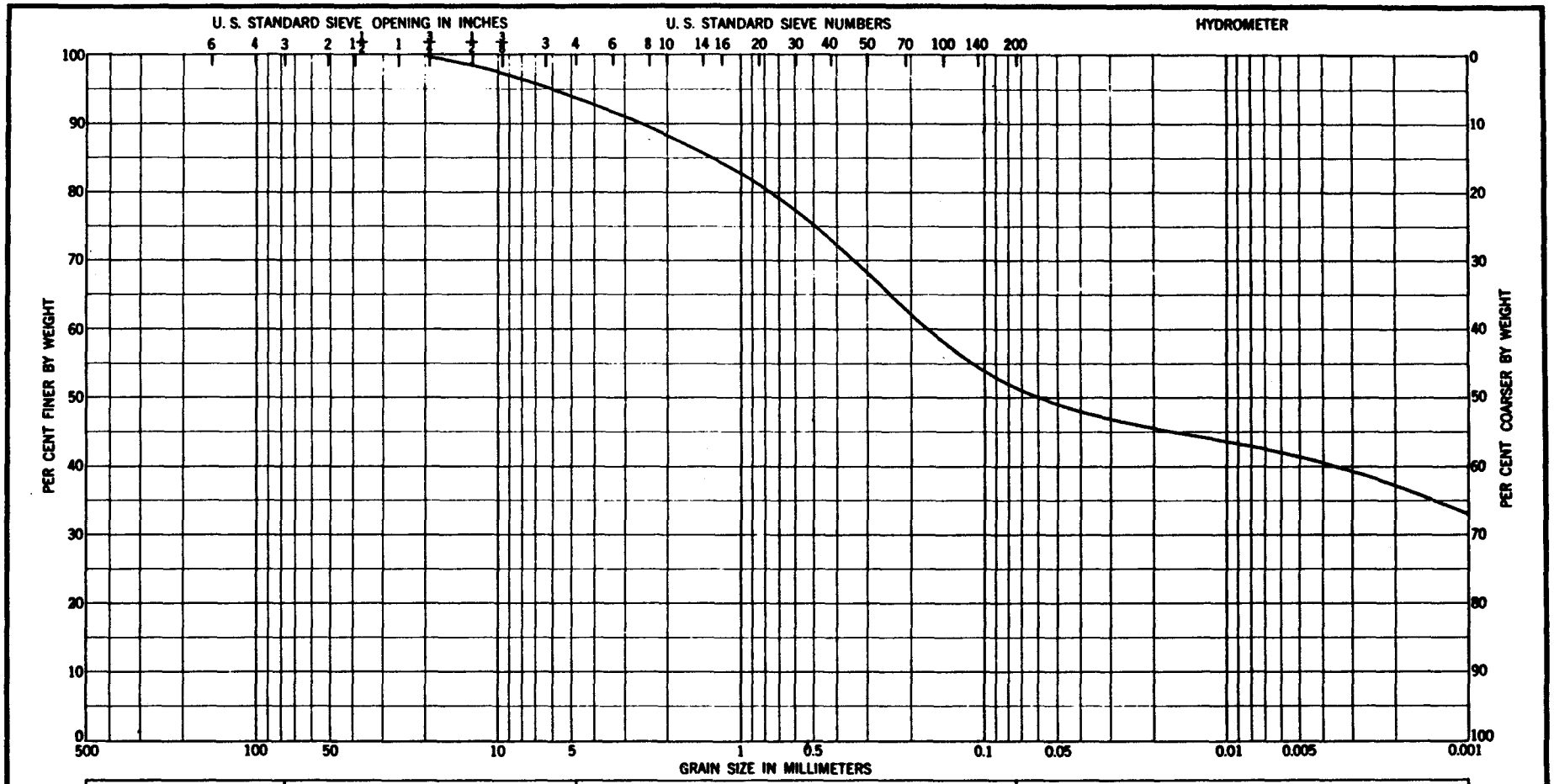
$K_1 = 3.7 \times 10^{-7}$ cm/sec
$K_2 = 4.0 \times 10^{-7}$ cm/sec
$K_3 = 4.2 \times 10^{-7}$ cm/sec
$K_4 = 4.1 \times 10^{-7}$ cm/sec

Coefficient of Permeability, $K_{20} = 4.0 \times 10^{-7}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-006 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 Fax 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
014S01LF43	40-43'		21	--	--	--

GRADATION CURVES

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 02/23/96

SWMU 59

SOIL BORING/MONITORING WELL LOGS AND GEOTECHNICAL LABORATORY RESULTS

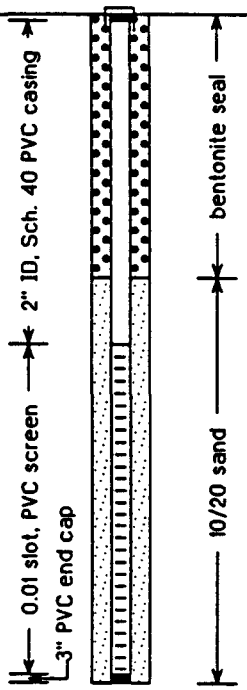
EnSafe/Allen & Hoshall

Monitoring Well 059G01LS

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #59 (Old Pesticide Shop)*
Project No.: *0106-08420*	Surface Elevation: *263.40 feet msl*
Started at *1000 on 3-4-96*	TOC Elevation: *263.24 feet msl*
Completed at *1046 on 3-4-96*	Depth to Groundwater: *7.55 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *255.69 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
	1	100		GW	(0-1') Asphalt and gravel fill.	262.4
	2	100		GW	(1-2') Soil and gravel fill.	261.4
	3	100	1.6	ML	(2-7') Clayey silt, olive gray in color, moist, with a trace of organic material.	
5	4	83	1.8	CL	(7-11') Silty clay, olive gray in color. Contains organic material. Iron-staining from 9' to 11'.	256.4
10			2.4			252.4
			2.0	CL	(11-20') Clay, olive gray to light olive gray in color with dark yellowish-orange iron-staining. Contains abundant iron-manganese nodules.	
15	5	120	1.6			
			1.6		Less dark yellowish-orange iron-staining from 16' to 17'.	
			1.8			
20			2.0			243.4
					Terminated soil boring at 20'.	
25						
30						
35						
40						

WELL DIAGRAM



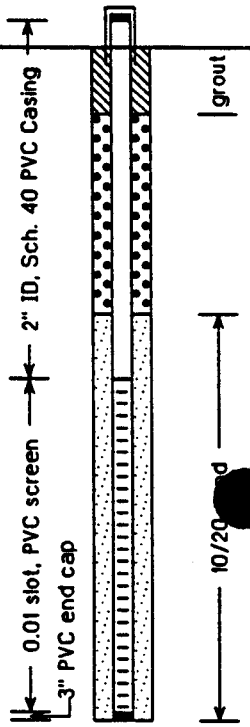
EnSafe/Allen & Hoshall

Monitoring Well 059G02LS

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #59 (Old Pesticide Shop)*
Project No.: *0106-08420*	Surface Elevation: *263.16 feet msl*
Started at *0822 on 3-2-96*	TOC Elevation: *265.18 feet msl*
Completed at *0900 on 3-2-96*	Depth to Groundwater: *10.14 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *255.04 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *D. Ladd, C. Ivey*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			OL	(0-2') Soil, moderate yellowish-brown in color with roots.	261.2
			ML	(2-4.5') Silt, moderate yellowish-brown mottled with olive gray material, predominantly near 4.5'.	258.7
5	1	65	ML	(4.5-9') Clayey silt, olive gray in color. Contains iron-manganese nodules. Mottled with moderate yellowish-brown colored material near 9'.	
				Moist from 5' to 6'.	254.2
10				Dry and crumbly from 7' to 8'.	
				(9-18.5') Silt and silty caly (see descriptions below).	
			ML CL	(9-10') Silt. Moderate yellowish-brown in color mottled with olive gray-colored material. Very common iron-manganese nodules.	
15	2	75		(10-18') Silty clay. Olive gray in color and mottled with moderate yellowish-brown-colored material, mostly moderate yellowish-brown near 10' and again at 18'. Very common iron-manganese nodules.	244.7
20			CL	(18-18.5') Silt. Moderate yellowish-brown in color mottled with olive gray-colored material. Dry. Contains common iron-manganese nodules.	243.2
				(18.5-20') Clay, olive gray in color, moist.	
25				Terminated soil boring at 20'. Note: Due to the potential for significant contamination in this soil boring, no samples were field screened for organic vapors so that the well could be completed in minimal time.	
30					
35					
40					

WELL DIAGRAM



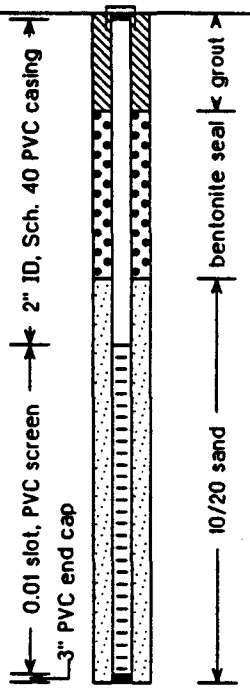
EnSafe/Allen & Hoshall

Monitoring Well 059G03LS

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #59 (Old Pesticide Shop)*
Project No.: *0106-08420*	Surface Elevation: *263.54 feet msl*
Started at *1237 on 3-4-96*	TOC Elevation: *263.35 feet msl*
Completed at *1330 on 3-4-96*	Depth to Groundwater: *9.50 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic – 4" inner core barrel/6" OD casing*	Groundwater Elevation: *253.85 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *10 to 10 feet*

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
	1	OL / GW	(0-1') Asphalt, soil, and gravel fill.	262.5
5	2	ML	(1-12') Silt. Moderate yellowish-brown in color mottled with light olive gray material. Organic material and less light olive gray material from 2' to 12'. Moist from 7' to 10'.	
10	3		Very moist from 10' to 12'.	251.5
15			No description available; collected a Shelby tube sample from 12' to 15'.	248.5
		ML	(15-16') Silt, moderate yellowish-brown in color mottled with light olive gray material.	247.5
		ML	(16-20') Silt, light olive gray in color, mottled with a light moderate yellowish-brown material.	
20			Terminated soil boring at 20'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log for adjacent monitoring well 059G03UF.	243.5
25				
30				
35				
40				

WELL DIAGRAM



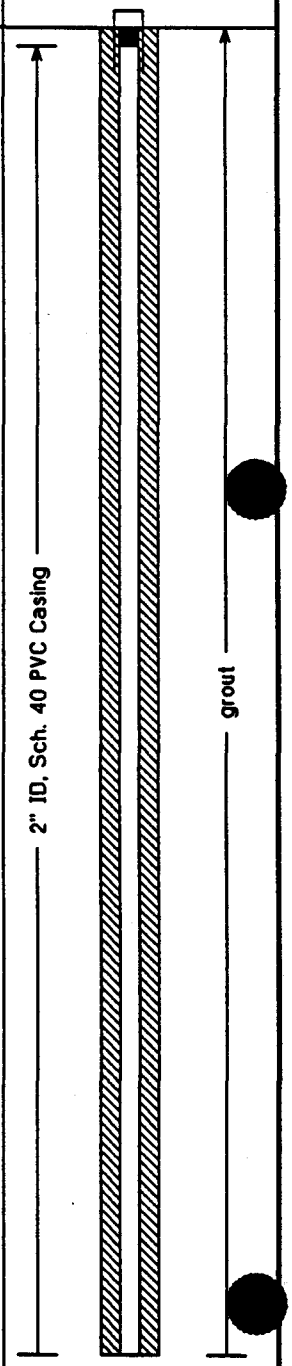
EnSafe/Allen & Hoshall

Monitoring Well 059G03UF

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #59 (Old Pesticide Shop)*
Project No.: *0106-08420*	Surface Elevation: *263.51 feet msl*
Started at *1337 on 3-4-96*	TOC Elevation: *263.32 feet msl*
Completed at *1457 on 3-4-96*	Depth to Groundwater: *14.63 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - "4 inner core barrel/6" OD casing*	Groundwater Elevation: *248.69 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *44 to 54 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			1	100	.8		OL GW	(0-1') Asphalt, soil, and gravel fill.	
			2	100				(1-12') Silt, moderate yellowish-brown in color mottled with light olive gray-colored material. Contains organic and less light olive gray material from 2' to 12'.	262.5
					1.0				
5					1.0				
			3	95	2.2		ML	Moist from 7' to 10'.	
					1.0				
10								Very moist from 10' to 12'.	
					1.2				251.5
			4	83				No description available; collected Shelby tube sample from 12' to 15'.	
15					.6		ML		248.5

WELL DIAGRAM



EnSafe/Allen & Hoshall	Monitoring Well 059G03UF
Project: *NSA Memphis*	Location: *Millington, TN. SWMU #59 (Old Pesticide Shop)*
Project No.: *0106-08420*	Surface Elevation: *263.51 feet msl*
Started at *1337 on 3-4-96*	TOC Elevation: *263.32 feet msl*
Completed at *1457 on 3-4-96*	Depth to Groundwater: *14.63 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - "4 inner core barrel/6" OD casing*	Groundwater Elevation: *248.69 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *44 to 54 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
							ML	(15-16') Silt, moderate yellowish-brown in color mottled with light olive gray-colored material.	248.5	
					1.4			(16-22') Silt, light olive gray in color, mottled with a light moderate yellowish-brown-colored material from 16' to around 20'.	247.5	
20			5	82	1.8		ML			
					2.0					
					1.4			(22-26') Silt, moderate yellowish-brown to dusky yellow in color. Contains iron-staining and iron-manganese nodules.	241.5	
25					0.8		ML			
					1.2			(26-31') Silt, moderate yellowish-brown to dark yellowish-orange in color mottled with dark yellowish-brown-colored material.	237.5	
					1.4		ML			
30										

2" ID, Sch. 40 PVC Casing

grout

EnSafe/Allen & Hoshall	Monitoring Well 059G03UF
Project: *NSA Memphis*	Location: *Millington, TN. SWMU #59 (Old Pesticide Shop)*
Project No.: *0106-08420*	Surface Elevation: *263.51 feet msl*
Started at *1337 on 3-4-96*	TOC Elevation: *263.32 feet msl*
Completed at *1457 on 3-4-96*	Depth to Groundwater: *14.63 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - "4 inner core barrel/6" OD casing*	Groundwater Elevation: *248.69 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *44 to 54 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
	6	100	1.4	ML		
					(31-35') Silt, moderate yellowish-brown in color mottled with very fine, very light gray colored sand. Dark yellowish-orange staining and iron-manganese nodules are present near 35'.	232.5
			1.4	ML		
35			1.4	SW	(35-36.5') Sand, very fine-grained, very light gray in color mottled with dark yellowish-orange material. Wet.	228.5
				SW GW	Contains some coarse dark yellowish-orange sand from 36' to 36.5'.	227
	7	100	2.4	CL	(36.5-37') Sand (medium to very coarse-grained) and gravel. Moderate yellowish-brown to dark yellowish-orange in color.	226.5
			2.6	SM	(37-39') Sandy clay, moderate yellowish-brown to dark yellowish- orange in color mottled with very light gray-colored material. Becomes mostly pale yellowish-brown in color near 39'.	224.5
40					Top of Fluvial Deposits estimated at 39'.	223.5
	8	100			(39-40') Silty sand, medium to coarse-grained, with scattered gravel. Moderate yellowish-brown to dark yellowish-orange. Wet.	
					No description available; collected a Shelby tube sample from 40' to 43'.	
			1.4	SW GW	(43-44.5') Sand, fine to very coarse-grained, moderate yellowish-brown to dark yellowish-orange, and gravel, up to .75" in longest dimension, angular to rounded, composed of quartz and chert, wet.	220.5
	9	125	1.2	SW GW		219
45						

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

grout

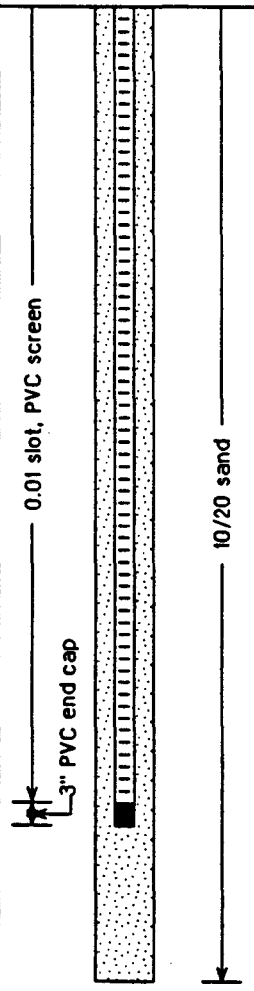
bentonite seal

10/20 sand

EnSafe/Allen & Hoshall	Monitoring Well 059G03UF
Project: *NSA Memphis*	Location: *Millington, TN. SWMU #59 (Old Pesticide Shop)*
Project No.: *0106-08420*	Surface Elevation: *263.51 feet msl*
Started at *1337 on 3-4-96*	TOC Elevation: *263.32 feet msl*
Completed at *1457 on 3-4-96*	Depth to Groundwater: *14.63 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - "4 inner core barrel/6" OD casing*	Groundwater Elevation: *248.69 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *56 feet*
Geologist: *D. Ladd, W. Parks*	Well Screen: *44 to 54 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
					1.2		SW GW	(44.5-47.5') Sand, coarse to very coarse-grained, moderate yellowish- brown to dark yellowish-orange, and gravel, up to 2.5" in longest dimension, composed mostly of angular chert, wet.	218
							SW GW	(47.5-48') Sand, fine to coarse-grained, very light gray and mottled with dark yellowish-orange, and gravel, up to 1.5" in longest dimension, composed mostly of angular to rounded quartz and chert, wet.	215.5
					1.0		SW		214.5
50							SW GW	(48-49') Sand, fine to medium-grained, with rare quartz gravel. Yellowish-gray in color mottled with dark yellowish-orange material, slightly micaceous, wet.	
			10	130	1.6			(49-51.5') Sand (fine to coarse-grained) and gravel (mostly quartz and chert); dark yellowish-orange in color mottled with yellowish-gray material; micaceous; wet.	212
							SW GW	(51.5-53.5') Sand, fine to very coarse-grained, and gravel (quartz and chert) is up to .75" in longest dimension; yellowish-gray and wet.	
					1.6				210
55					0.8		SW	(53.5-56') Sand, fine to medium-grained, with rare gravel. Yellowish- gray color, micacous, wet.	
								Terminated soil boring at 56'.	207.5
60									

WELL DIAGRAM



EnSafe/Allen & Hoshall

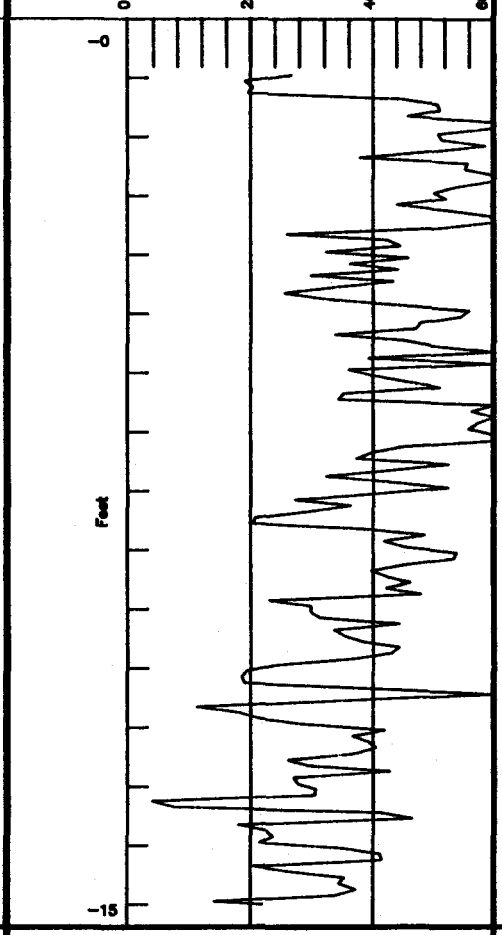
Monitoring Well 059G03UF

Project: NSA Memphis	Location: Millington,TN.SWMU #59 (Old Pesticide Shop)
Project No.: 0106-08420	Surface Elevation: 263.51 feet msl
Started at 1337 on 3-4-96	TOC Elevation: 263.32 feet msl
Completed at 1457 on 3-4-96	Depth to Groundwater:14.63 feet Measured: 4/8/96
Drilling Method: Rotasonic-4" inner core barrel/6" OD casing	Groundwater Elevation:248.69 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 56 feet
Geologist: D. Ladd, W. Parks	Well Screen: 44 to 54 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			1	100	.8		GP GW	(0-1') Asphalt, soil, and gravel fill.	
			2	100	1.0		ML	(1-12') Silt, moderate yellowish-brown in color mottled with light olive gray-colored material. Contains organic and less light olive gray material from 2' to 12'.	262.5
5					1.0				
			3	95	2.2			Moist from 7' to 10'.	
					1.0				
10					1.2			Very moist from 10' to 12'.	
			4	83				No description available; collected Shelby tube sample from 12' to 15'.	251.5
15					.6		ML		248.5

WELL DIAGRAM: 2" ID, Sch. 40 PVC Casing

GAMMA RAY LOG
COUNTS PER SECOND



CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/22/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 59
OLD PESTICIDE SHOP

DWG DATE: 12/10/96 | DWG NAME: 94GL593

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

EnSafe/Allen & Hoshall

Monitoring Well 059G03UF

Project: NSA Memphis	Location: Millington, TN. SWMU #59 (Old Pesticide Shop)
Project No.: 0106-08420	Surface Elevation: 263.51 feet msl
Started at 1337 on 3-4-96	TOC Elevation: 263.32 feet msl
Completed at 1457 on 3-4-96	Depth to Groundwater: 14.63 feet Measured: 4/8/96
Drilling Method: Rotasonic-4" inner core barrel/6" OD casing	Groundwater Elevation: 248.69 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 56 feet
Geologist: D. Ladd, W. Parks	Well Screen: 44 to 54 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
							ML	(15-16') Silt, moderate yellowish-brown in color mottled with light olive gray-colored material.	248.5
					1.4			(16-22') Silt, light olive gray in color, mottled with a light moderate yellowish-brown-colored material from 18' to around 20'.	247.5
20			5	82	1.6		ML		
					2.0				
					1.4			(22-26') Silt, moderate yellowish-brown to dusky yellow in color. Contains iron-staining and iron-manganese nodules.	241.5
25					0.8		ML		
					1.2			(26-31') Silt, moderate yellowish-brown to dark yellowish-orange in color mottled with dark yellowish-brown-colored material.	237.5
30					1.4		ML		

WELL DIAGRAM: 2" ID, Sch. 40 PVC Casing

GAMMA RAY LOG

COUNTS PER SECOND

0 20 40 80

-15 Feet -30

CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/22/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 59
OLD PESTICIDE SHOP

DWG DATE: 12/10/96

DWG NAME: 94GL593A

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

EnSafe/Allen & Hoshall

Monitoring Well 059G03UF

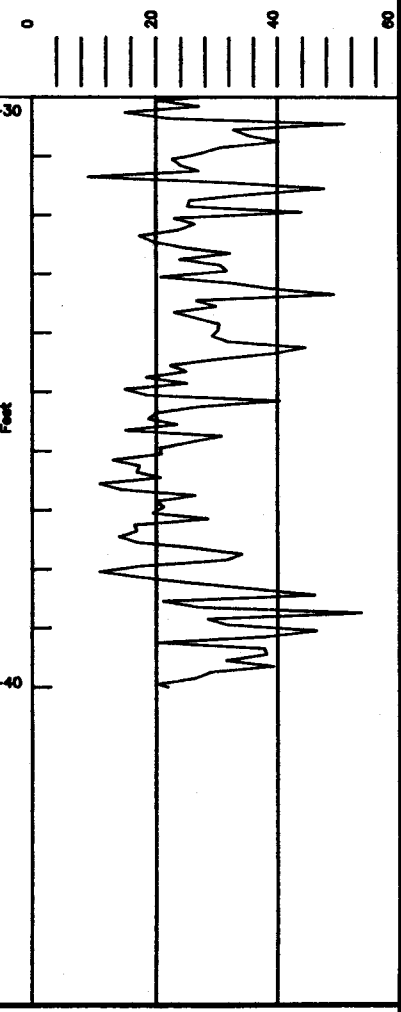
Project: NSA Memphis	Location: Millington,TN.SWMU #59(Old Pesticide Shop)
Project No.: 0106-08420	Surface Elevation: 263.51 feet msl
Started at 1337 on 3-4-96	TOC Elevation: 263.32 feet msl
Completed at 1457 on 3-4-96	Depth to Groundwater:14.63 feet Measured: 4/8/96
Drilling Method: Rotasonic-4" inner core barrel/6" OD casing	Groundwater Elevation: 248.69 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 56 feet
Geologist: D. Ladd, W. Parks	Well Screen: 44 to 54 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
							ML		
			6	100	1.4			(31-35') Silt, moderate yellowish-brown in color mottled with very fine, very light gray colored sand. Dark yellowish-orange staining and iron-manganese nodules are present near 35'.	232.5
					1.4		ML		
35					1.4		SW	(35-36.5') Sand, very fine-grained, very light gray in color mottled with dark yellowish-orange material. Wet.	228.5
							SW GW	Contains some coarse dark yellowish-orange sand from 36' to 36.5'.	227
					2.4			(36.5-37') Sand (medium to very coarse-grained) and gravel. Moderate yellowish-brown to dark yellowish-orange in color.	226.5
			7	100			CL	(37-39') Sandy clay, moderate yellowish-brown to dark yellowish- orange in color mottled with very light gray-colored material. Becomes mostly pale yellowish-brown in color near 39'.	
					2.6		SM	Top of Fluvial Deposits estimated at 39'.	224.5
40								(39-40') Silty sand, medium to coarse-grained, with scattered gravel. Moderate yellowish-brown to dark yellowish-orange. Wet.	223.5
			8	100				No description available; collected a Shelby tube sample from 40' to 43'.	
					1.4		SW GW	(43-44.5') Sand, fine to very coarse-grained, moderate yellowish-brown to dark yellowish-orange, and gravel, up to .75" in longest dimension, angular to rounded, composed of quartz and chert, wet.	220.5
			9	125			SW GW		219
45					1.2				

WELL DIAGRAM: 2" ID, Sch. 40 PVC Casing

GAMMA RAY LOG

COUNTS PER SECOND



CASING TYPE: 2" PVC

TOP OF LOG = GROUND SURFACE

DATE LOGGED: 05/23/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 59
OLD PESTICIDE SHOP

DWG DATE: 12/10/96

DWG NAME: 94G593B

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

EnSafe/Allen & Hoshall

Monitoring Well 059G03UF

Project: NSA Memphis	Location: Millington,TN.SWMU #59(Old Pesticide Shop)
Project No.: 0106-08420	Surface Elevation: 263.51 feet msl
Started at 1337 on 3-4-96	TOC Elevation: 263.32 feet msl
Completed at 1457 on 3-4-96	Depth to Groundwater:14.63 feet Measured: 4/8/96
Drilling Method: Rotasonic-4" inner core barrel/6" OD casing	Groundwater Elevation: 248.69 feet msl
Drilling Company: Alliance Environmental, Inc.	Total Depth: 56 feet
Geologist: D. Ladd, W. Parks	Well Screen: 44 to 54 feet

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
50			10	130	1.2		SW GW	(44.5–47.5') Sand, coarse to very coarse-grained, moderate yellowish- brown to dark yellowish-orange, and gravel, up to 2.5" in longest dimension, composed mostly of angular chert, wet.	216	0.01 slot, PVC screen
							SW GW	(47.5–48') Sand, fine to coarse-grained, very light gray and mottled with dark yellowish-orange, and gravel, up to 1.5" in longest dimension, composed mostly of angular to rounded quartz and chert, wet.	215.5	
					1.0		SW		214.5	
							SW GW	(48–49') Sand, fine to medium-grained, with rare quartz gravel. Yellowish-gray in color mottled with dark yellowish-orange material, slightly micaceous, wet.		
					1.6			(49–51.5') Sand (fine to coarse-grained) and gravel (mostly quartz and chert); dark yellowish-orange in color mottled with yellowish-gray material; micaceous; wet.	212	
					1.6		SW GW	(51.5–53.5') Sand, fine to very coarse-grained, and gravel (quartz and chert) is up to .75" in longest dimension; yellowish-gray and wet.		
55									210	3" PVC end cap
					0.8		SW	(53.5–56') Sand, fine to medium-grained, with rare gravel. Yellowish- gray color, micaceous, wet.		
								Terminated soil boring at 56'.	207.5	
60										

GAMMA RAY LOG
COUNTS PER SECOND

CASING TYPE: 2" PVC
TOP OF LOG = GROUND SURFACE
DATE LOGGED: 05/23/96

NOTES

RCRA FACILITY INVESTIGATION
NSA MEMPHIS
MILLINGTON, TENNESSEE

SWMU 59
OLD PESTICIDE SHOP

DWG DATE: 12/10/96
DWG NAME: 94GL593C

LOGGED BY:
GEOLOGICAL LOGGING SYSTEMS

TRI STATE
TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 03/22/96 **Project No.:** E-3-157

Client's Project No.: 0106090000

Sample I.D.: 0059S03UF15

Soil Description: Brown & Gray Clayey Silt

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	139.4	139.9
Dry Density (Lbs/ft^3)	107.6	107.7
Moisture (% Dry Wt)	29.5	29.9
Porosity (n)	.36	.34
Degree of Saturation (%)	.99	1.0
Specific Gravity (ASTM D-854)	2.66	---

Permeability

Temperature Correction, $R_t = 1.008$

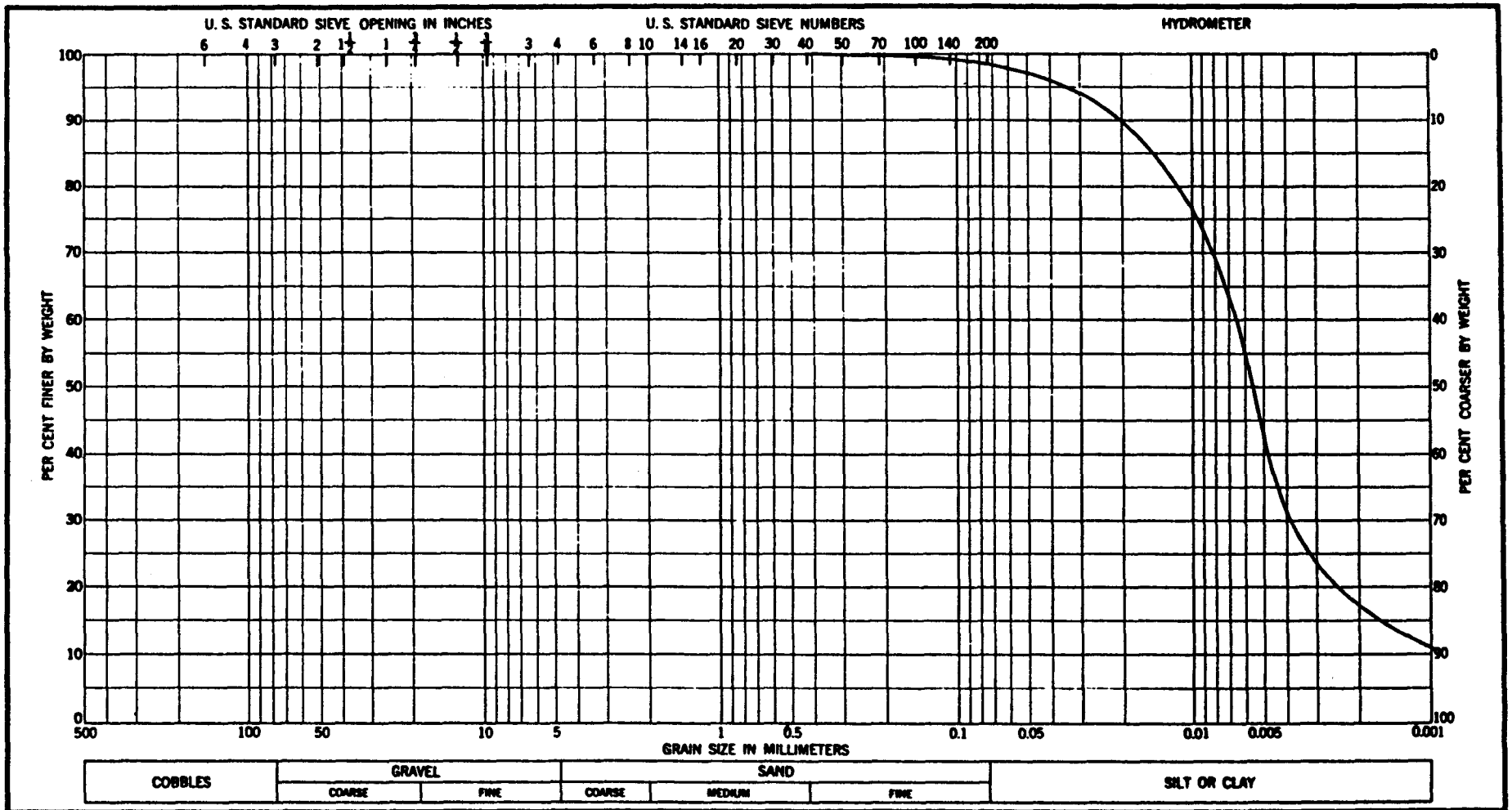
$K_1 = 6.0 \times 10^{-7}$ cm/sec
$K_2 = 4.1 \times 10^{-7}$ cm/sec
$K_3 = 7.2 \times 10^{-7}$ cm/sec
$K_4 = 5.5 \times 10^{-7}$ cm/sec

Coefficient of Permeability, $K_{20} = 5.7 \times 10^{-7}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-017 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 Fax 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
059S03uF15			30	--	--	--

GRADATION CURVES

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 03/22/96

TRI-STATE TESTING SERVICES, INC.

GEOLOGICAL LOGGING SYSTEMS

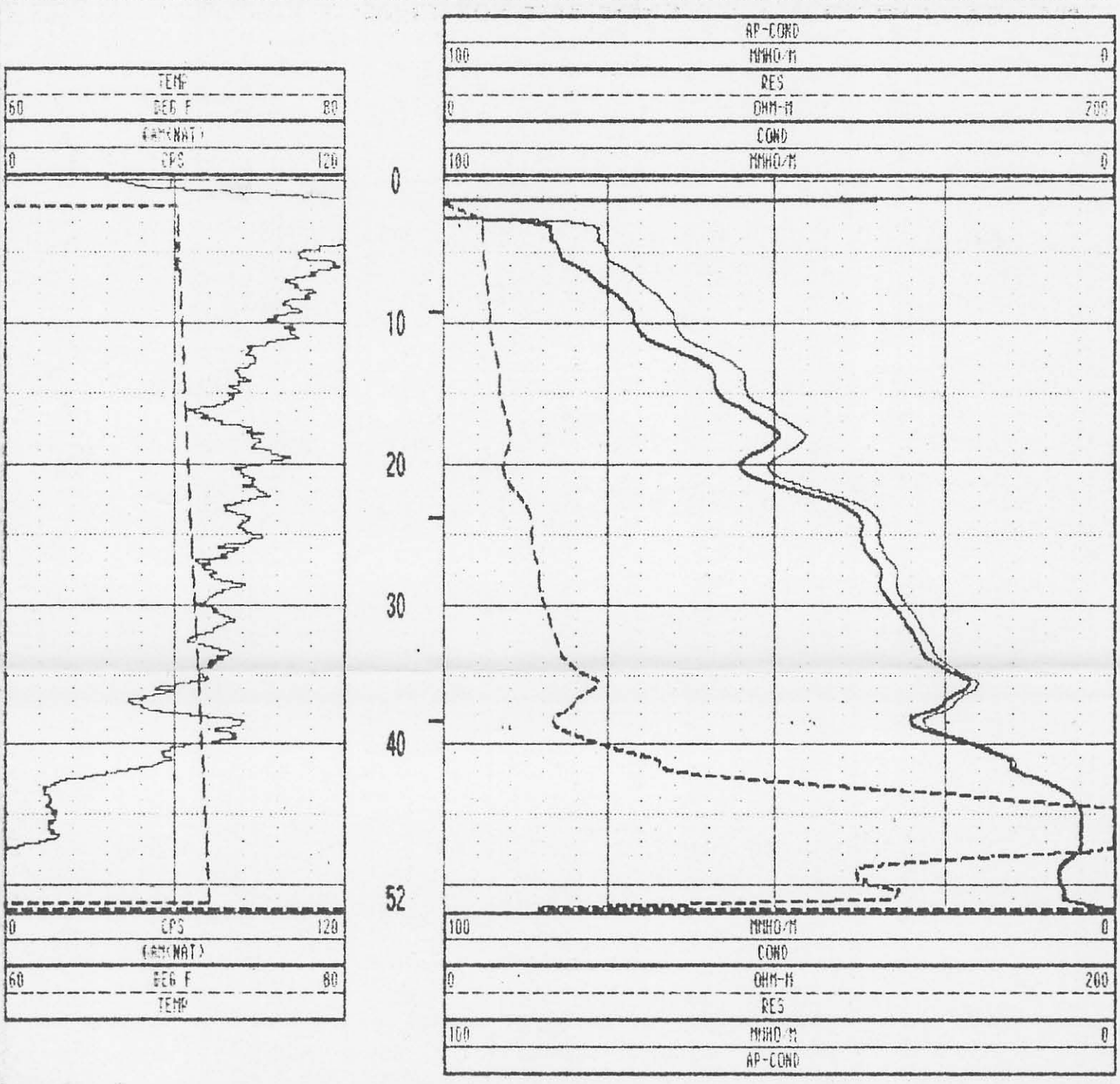
059G03UF

COMPANY	: ENSAFE,ALLEN & HOSHALL			OTHER SERVICES:	
WELL	: 059G03UF			9511	
LOCATION/FIELD	: NAS MEMPHIS			RUN ONE	
COUNTY	: SHELBY			OPEN	
STATE	: TENNESSEE				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 05/22/96	PERMANENT DATUM	: GL	ELEVATIONS	
DEPTH DRILLER	: 50	ELEV. PERM. DATUM:		KB	:
LOG BOTTOM	: 52.00	LOG MEASURED FROM:	GL	DF	: -
LOG TOP	: -2.50	DRL MEASURED FROM:	GL	GL	: 263.5
CASING DRILLER	: 50	LOGGING UNIT	: 05		
CASING TYPE	: PVC	FIELD OFFICE	: BLUEFIELD		
CASING THICKNESS	: .25	RECORDED BY	: J T GILBERT		
BIT SIZE	: 8	BOREHOLE FLUID	: WATER	FILE	: ORIGIN
MAGNETIC DECL.	: -	RM	:	TYPE	: 9511C
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:	LOG	: 8
FLUID DENSITY	: 1.2	MATRIX DELTA T	:	PLOT	: 9510C
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:	THRESH	: 9000

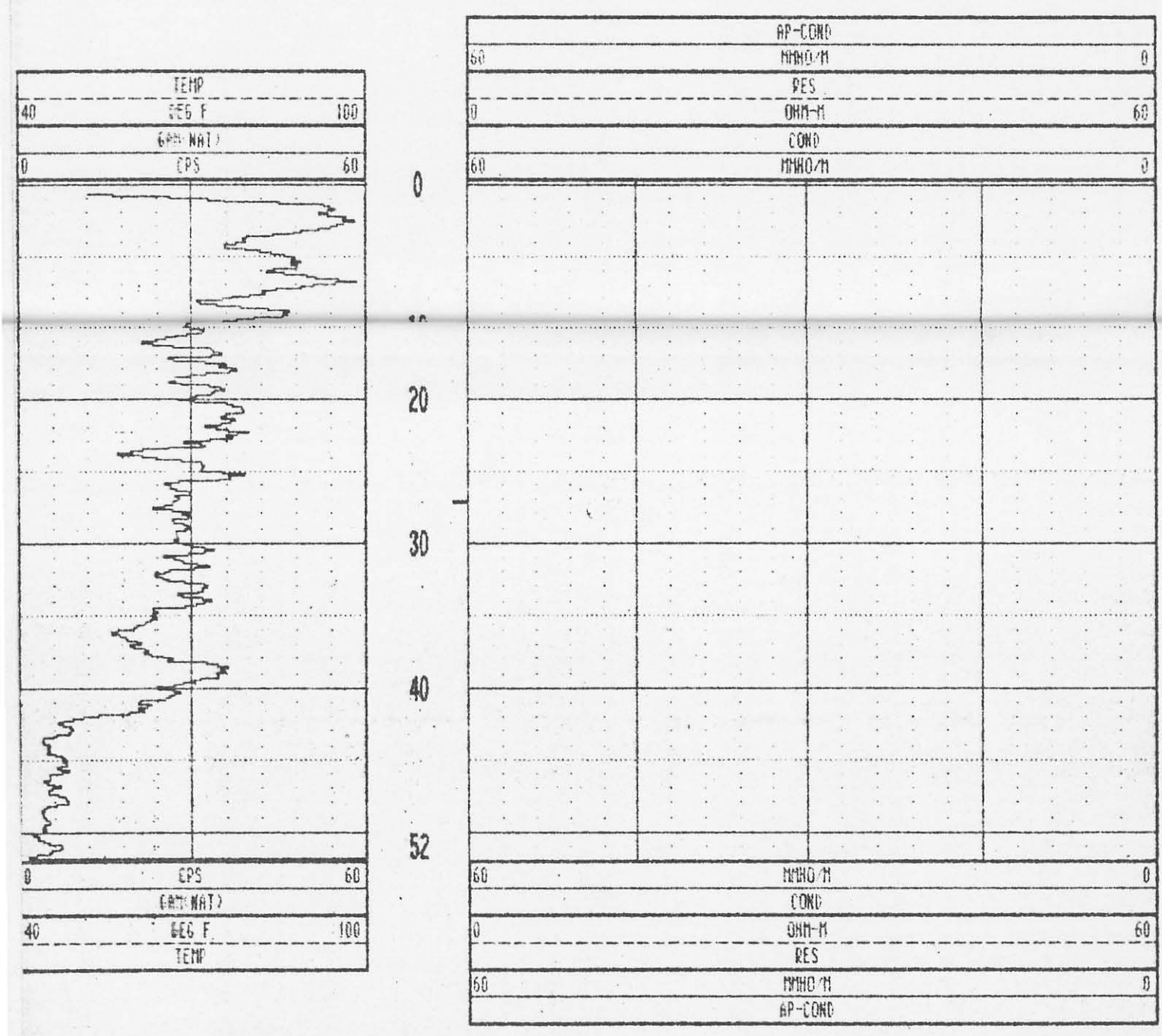
REMARKS :

ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



059G03UF 05/22/96 976



059G03UF 05/22/96 1025

TRI STATE
TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 03/22/96 **Project No.:** E-3-157

Client's Project No.: 0106090000

Sample I.D.: 059S03UF43

Soil Description: Brown Sandy Gravel

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	136.7	148.7
Dry Density (Lbs/ft^3)	115.7	130.0
Moisture (% Dry Wt)	18.2	14.4
Porosity (n)	.30	.22
Degree of Saturation (%)	.97	1.0
Specific Gravity (ASTM D-854)	2.65	---

Permeability

Temperature Correction, $R_t = 1.043$

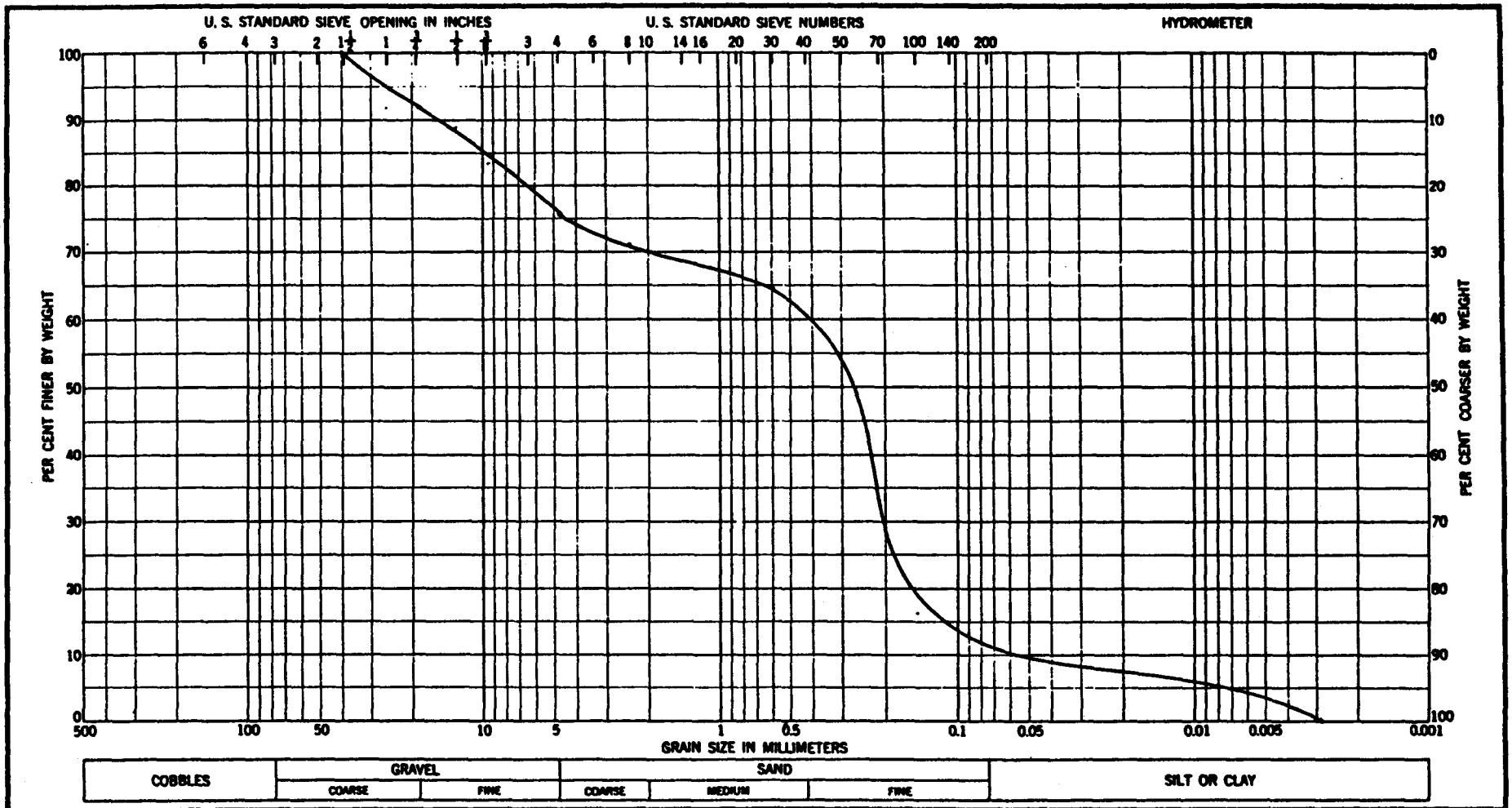
$K_1 = 1.4 \times 10^{-4}$ cm/sec
$K_2 = 2.7 \times 10^{-4}$ cm/sec
$K_3 = 4.3 \times 10^{-4}$ cm/sec
$K_4 = 1.5 \times 10^{-4}$ cm/sec

Coefficient of Permeability, $K_{20} = 2.6 \times 10^{-4}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-018 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 FAX 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
059S03UF43	40-43'		18	--	--	--

GRADATION CURVES

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 03/22/96

NAVY CLEAN
ENSAFE/ALLEN & HOSHALL
(901) 383-9115

CHAIN OF CUSTODY RECORD

PAGE 1 OF 1

CLIENT EnSafe
ADDRESS 5724 Summer Trees Dr.
PROJECT NAME/NUMBER 0106 09000
MEDIA STATUS: (A, B, OR C) _____

PROJECT MANAGER A. Choate
TELEPHONE NO. 9013727962
FAX. NO. 3722454
SAMPLERS: (SIGNATURE) Alison Choate

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION TEMP.	PRESERVATION CHEMICAL	NO. OF CONTAINERS	ANALYSIS REQUIRED: Hydraulic Conductivity	Porosity	Bulk Density	Particle Size	Percent Moisture	Specific Grav	REMARKS
0595MW0315	3/4/96	1400	soil	3" dia. Shelby Tube	-	-	1	X	X	X	X	X	X	
0595MW0343	3/4/96	1422	soil	3" dia. Shelby T.	-	-	1	X	X	X	X	X	X	

RELINQUISHED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
SIGNATURE Alison Choate	3/4/96	1700	SIGNATURE			SIGNATURE			SIGNATURE		
PRINTED Alison Choate			PRINTED			PRINTED			PRINTED		
COMPANY EnSafe			COMPANY			COMPANY			COMPANY		
REASON Analysis			REASON			REASON			REASON		

METHOD OF SHIPMENT: direct
SHIPMENT NO. transport.
SPECIAL INSTRUCTION: _____

COMMENTS: _____

AFTER ANALYSIS, SAMPLES ARE TO BE:
- ☐ DISPOSED OF (ADDITIONAL FEE)
- ☐ STORED (90 DAYS MAX)
- ☐ STORED OVER 90 DAYS (ADDITIONAL FEE)
- ☐ RETURNED TO CUSTOMER

SWMU 65

SOIL BORING/MONITORING WELL LOGS AND GEOTECHNICAL LABORATORY RESULTS

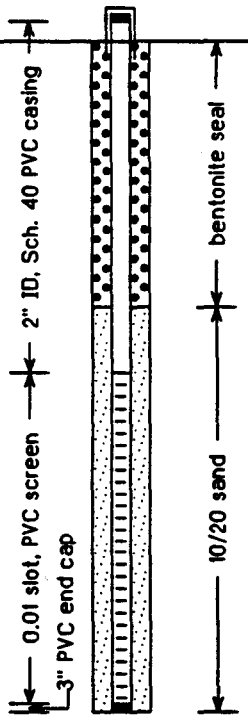
EnSafe/Allen & Hoshall

Monitoring Well 065G05UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #65 (Training Mock-Up Site)*
Project No.: *0106-08420*	Surface Elevation: *264.10 feet msl*
Started at *1230 on 2-17-96*	TOC Elevation: *266.04 feet msl*
Completed at *1320 on 2-17-96*	Depth to Groundwater: *3.99 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *262.05 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *J. Kingsbury*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0					BG		CL	(0-20') Upper Alluvium (see descriptions below). Clay, brownish-gray in color, hard and dry.	
5			1	100	BG				259.1
					BG		ML	Silt. From 5' to 8', is very light brown in color and moist. From 8' to 18', silt is yellowish-brown to yellowish-gray in color, with specks of organic material and some orangish-colored staining.	
10					BG				
					BG				
15			2	70	BG				
					BG				
20					BG			At 18', color changes to greenish-gray/olive gray. Very moist to wet with some snail shells present.	244.1
								Terminated soil boring at 20'.	
25									
30									
35									
40									

WELL DIAGRAM



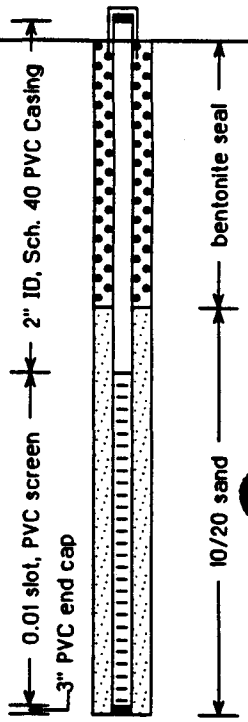
EnSafe/Allen & Hoshall

Monitoring Well 065G06UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #65 (Training Mock-Up Site)*
Project No.: *0106-08420*	Surface Elevation: *264.25 feet msl*
Started at *0930 on 2-17-96*	TOC Elevation: *266.28 feet msl*
Completed at *1045 on 2-17-96*	Depth to Groundwater: *4.90 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *261.38 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *J. Kingsbury*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0	1	ML	(0-20') Upper Alluvium (see descriptions below).	
			Silt. Light brown to yellowish-brown in color.	262.2
5		CL	Clay. Brownish-gray to light brown in color. Hard.	
				258.2
	2	ML	Silt. Yellowish-gray to yellowish-brown in color. Rare organics with iron-stained haloes around them from 6' to 12'.	
10				
	3		From 12' to 14', increase in orange-colored iron staining and mottling. Silt is yellowish-brown to with some gray, and moist.	250.2
15			No description available; collected Shelby tube sample from 14' to 16' in 65MW06DA.	248.2
		ML	Silt, yellowish-brown with some gray, with orange-colored iron staining and mottling, moist to wet.	
20				244.2
			Terminated soil boring at 20'. Note: No samples were collected for lithologic description. These descriptions were transferred from the log of adjacent monitoring well 65MW06DA.	
25				
30				
35				
40				

WELL DIAGRAM



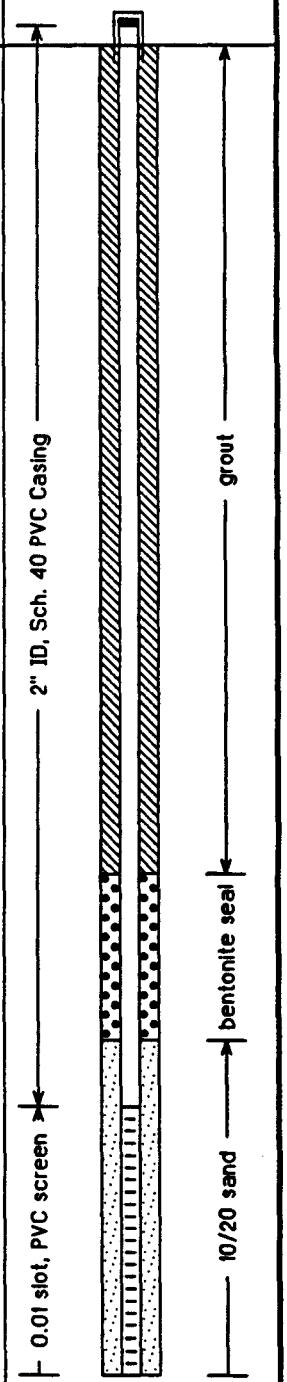
EnSafe/Allen & Hoshall

Monitoring Well 065G06DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #65 (Training Mock-Up Site)*
Project No.: *0106-08420*	Surface Elevation: *264.18 feet msl*
Started at *0815 on 2-17-96*	TOC Elevation: *266.12 feet msl*
Completed at *0930 on 2-17-96*	Depth to Groundwater: *9.62 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *256.50 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *46 feet*
Geologist: *J. Kingsbury*	Well Screen: *32 to 42 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0					BG		ML	(0-29') Upper Alluvium (see descriptions below).	
			1	25	BG			Silt. Light brown to yellowish-brown in color.	262.2
5					BG		CL	Clay. Brownish-gray to light brown in color. Hard.	
									258.2
					BG			Silt. Yellowish-gray to yellowish-brown in color. Rare organics with iron-stained haloes around them from 6' to 12'.	
10			2	120	BG		ML		
					BG			From 12' to 14', increase in orange-colored iron staining and mottling. Silt is yellowish-brown to with some gray, and moist.	250.2
15			3	100				No description available; collected Shelby tube sample from 14' to 16'.	248.2
					BG			Silt, yellowish-brown with some gray, with orange-colored iron staining and mottling, moist to wet.	
20			4	90	BG			From 20' to 34', clayey silt, olive gray to brownish-gray, with some snail shells, moist.	
					BG		ML		
25					BG			With lenses of sand from 28' to 34'.	
					BG			Top of Deeper Alluvium deposits estimated at 29'.	
30			5	83	BG				
					BG				230.2
35					BG		SW	Sand, dusky yellow to olive gray, with gravel up to 1" in longest dimension. Percentage of gravel increases with depth to 38'.	
					BG				228.2
			6	100				No description available; collected Shelby tube sample from 38' to 40'.	
40							SW/GW		224.2

WELL DIAGRAM



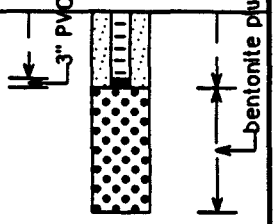
EnSafe/Allen & Hoshall

Monitoring Well 065G06DA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #65 (Training Mock-Up Site)*
Project No.: *0106-08420*	Surface Elevation: *264.18 feet msl*
Started at *0815 on 2-17-96*	TOC Elevation: *266.12 feet msl*
Completed at *0930 on 2-17-96*	Depth to Groundwater: *9.62 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *256.50 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *46 feet*
Geologist: *J. Kingsbury*	Well Screen: *32 to 42 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
					BG		SW GW	Sand and gravel.	264.2
			7	125	BG		CL	Cockfield Formation: Brown stiff clay with fine-grained sand interbeds.	222.2
45					BG				218.2
								Terminated soil boring at 46'.	
50									
55									
60									
65									
70									
75									
80									

WELL DIAGRAM



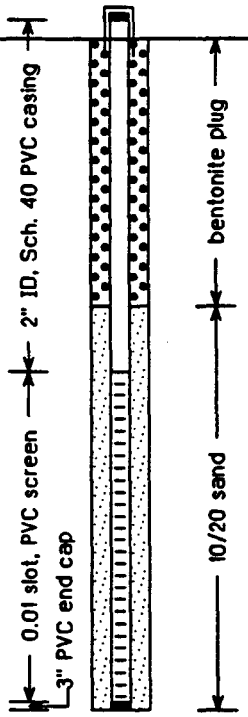
EnSafe/Allen & Hoshall

Monitoring Well 065G07UA

Project: *NSA Memphis*	Location: *Millington, TN. SWMU #65 (Training Mock-Up Site)*
Project No.: *0106-08420*	Surface Elevation: *262.85 feet msl*
Started at *1100 on 2-17-96*	TOC Elevation: *264.86 feet msl*
Completed at *on 2-17-96*	Depth to Groundwater: *4.13 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic - 4" inner core barrel/6" OD casing*	Groundwater Elevation: *260.73 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *20.25 feet*
Geologist: *J. Kingsbury*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0					BG		ML	(0-20') Upper Alluvium (see descriptions below).	
					BG			Fill material is present from 0' to 2'. Silt with some gravel, brown in color.	260.9
5			1	100	BG		CL	Clay, brown in color, hard and dry.	
					BG				
					BG				253.9
10					BG			Silt, yellowish-gray to yellowish-brown in color, moist.	
					BG			Some mottling with dark yellowish-orange stained material from 10' to 20'.	
15			2	70	BG		ML		
					BG				
					BG			Silt exhibits a color change near 20' to olive gray/greenish-gray.	
20									242.9
								Terminated soil boring at 20'.	
25									
30									
35									
40									

WELL DIAGRAM



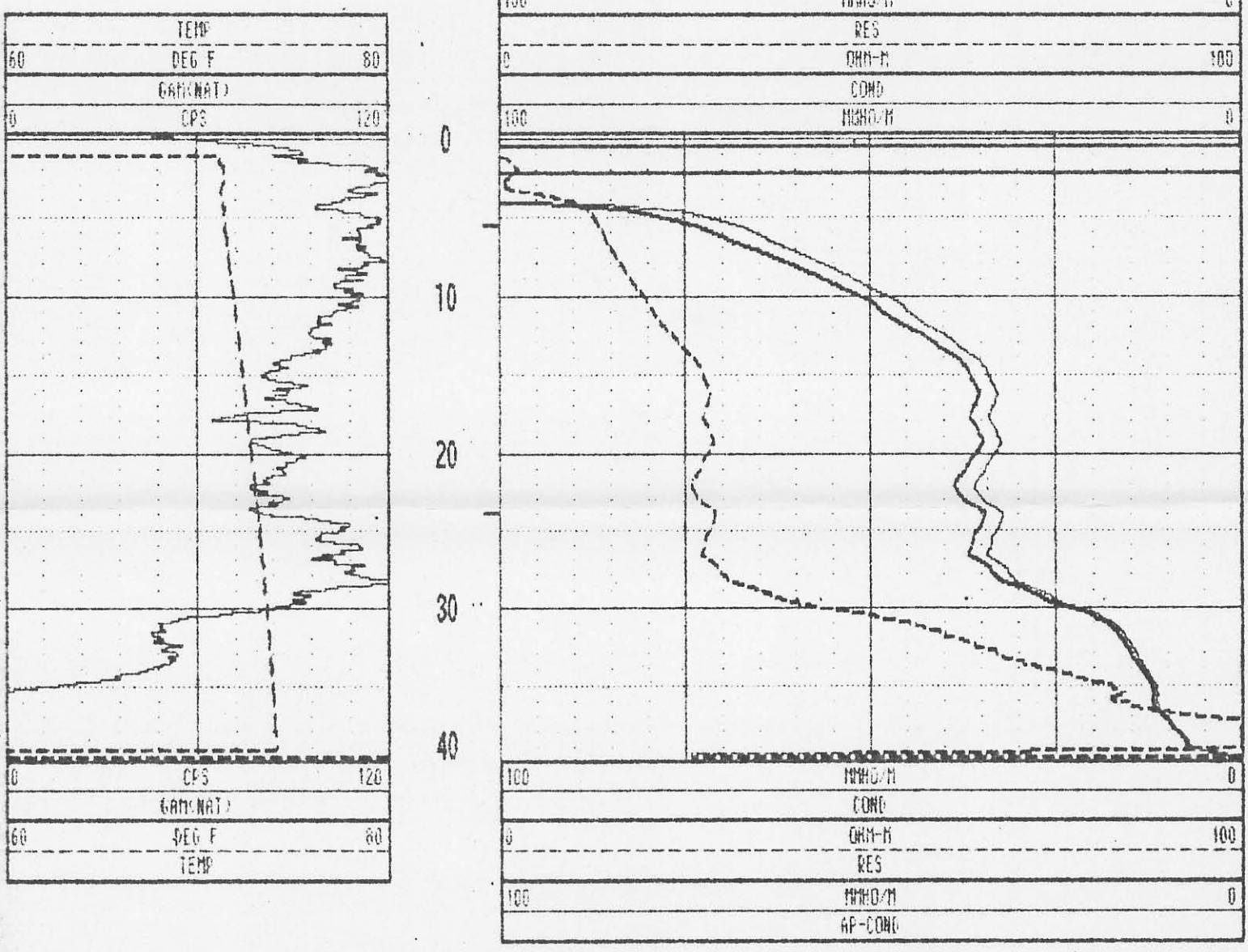
GEOLOGICAL LOGGING SYSTEMS

065G06DA

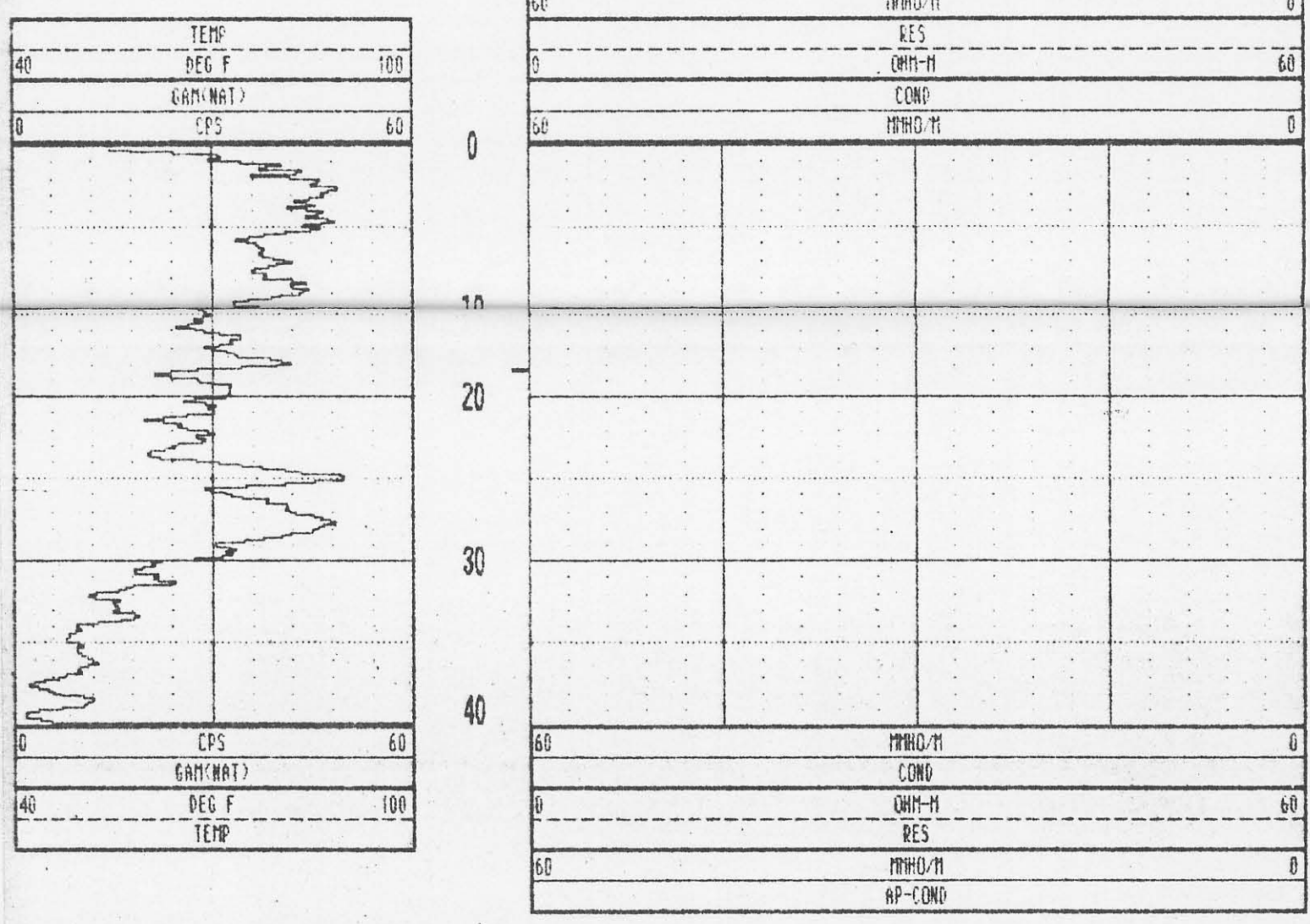
COMPANY	: ENSAFE,ALLEN & HOSHALL			OTHER SERVICES:	
WELL	: 065G06DA			9511	
LOCATION/FIELD	: NAS MEMPHIS			RUN TWO	
COUNTY	: SHELBY			OPEN	
STATE	: TENNESSEE				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 05/23/96	PERMANENT DATUM	: GL	ELEVATIONS	
DEPTH DRILLER	: 42	ELEV. PERM. DATUM:		KB	:
LOG BOTTOM	: 39.80	LOG MEASURED FROM:	GL	DF	: -
LOG TOP	: -3.20	DRL MEASURED FROM:	GL	GL	: 264.2
CASING DRILLER	: 42	LOGGING UNIT	: 05		
CASING TYPE	: PVC	FIELD OFFICE	: BLUEFIELD		
CASING THICKNESS	: .25	RECORDED BY	: J T GILBERT		
BIT SIZE	: 8	BOREHOLE FLUID	: WATER	FILE	: ORIGIN
MAGNETIC DECL.	: -	RM	:	TYPE	: 9511C
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:	LOG	: 2
FLUID DENSITY	: 1.2	MATRIX DELTA T	:	PLOT	: 9510C
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:	THRESH	: 9000
REMARKS	:				

ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



065G06DA 05/23/96 976



065G06DA 05/23/96 1025

TRI STATE
TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 03/01/96 **Project No.:** E-3-157

Client's Project No.: 010609000

Sample I.D.: 065S06DA16

Soil Description: Gray & Brown Clayey Silt

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	124.8	125.6
Dry Density (Lbs/ft^3)	96.5	97.6
Moisture (% Dry Wt)	29.3	28.7
Porosity (n)	.43	.42
Degree of Saturation (%)	1.0	1.0
Specific Gravity (ASTM D-854)	2.70	---

Permeability

Temperature Correction, $R_t = 1.041$

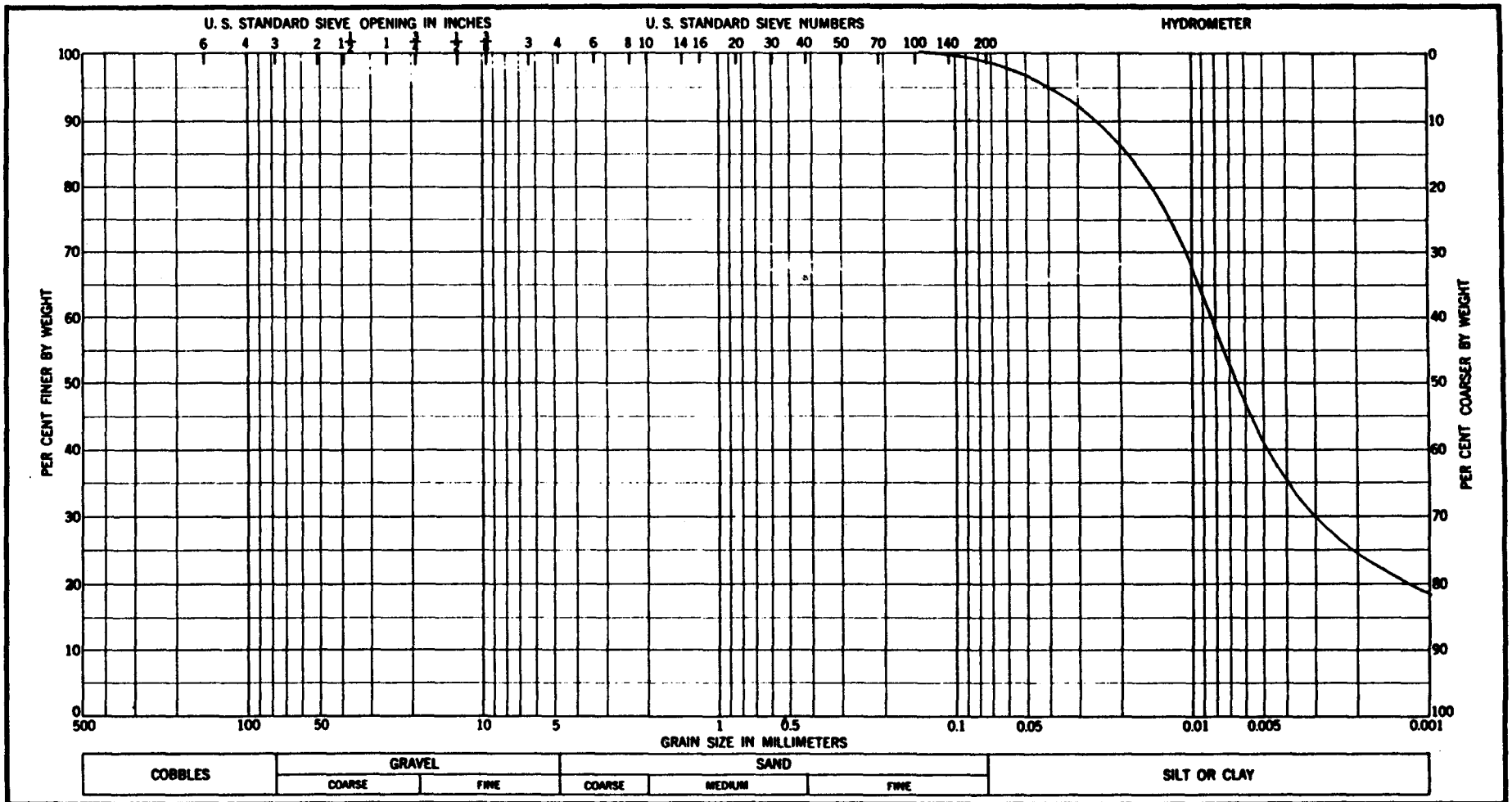
$K_1 = 4.6 \times 10^{-6}$ cm/sec
$K_2 = 4.0 \times 10^{-6}$ cm/sec
$K_3 = 5.1 \times 10^{-6}$ cm/sec
$K_4 = 4.7 \times 10^{-6}$ cm/sec

Coefficient of Permeability, $K_{20} = 4.8 \times 10^{-6}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-012 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 FAX 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
065S06DA16			29			

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 03/01/96

GRADATION CURVES

TESTING SERVICES, INC.

Measurement of Hydraulic Conductivity

Client: EnSafe/Allen & Hoshall

Date of Report: 03/01/96 **Project No.:** E-3-157

Client's Project No.: 0106090000

Sample I.D.: 065S06DA40

Soil Description: Gray gravelly Sand with trace of silt

Test Media: City of Memphis Water

	Pre-Test	Post Test
Wet Density (Lbs/ft^3)	136.9	137.4
Dry Density (Lbs/ft^3)	127.8	120.6
Moisture (% Dry Wt)	7.1	13.9
Porosity (n)	.20	.24
Degree of Saturation (%)	.71	1.0
Specific Gravity (ASTM D-854)	2.57	---

Permeability

Temperature Correction, $R_t = 1.000$

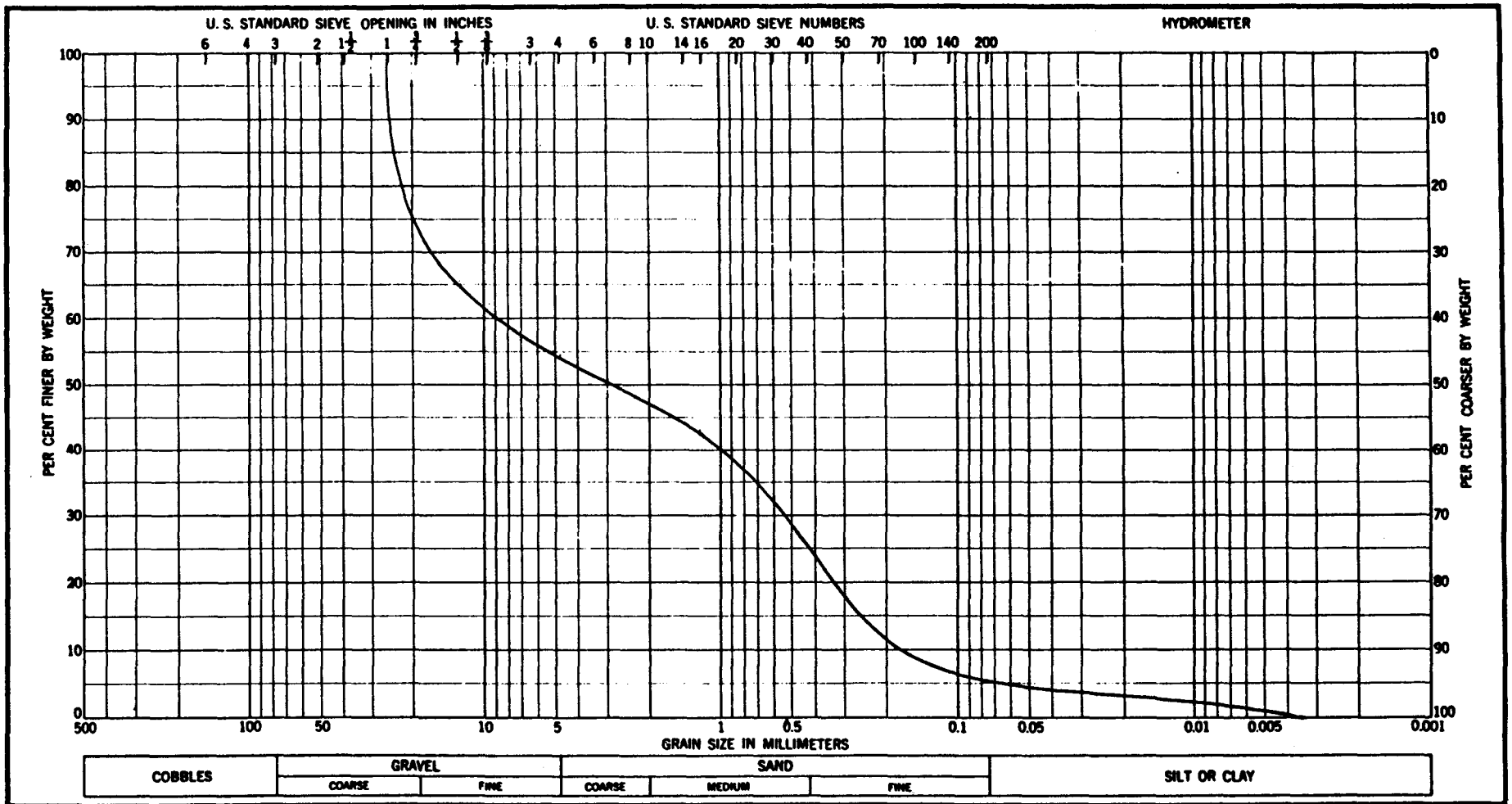
$K_1 = 1.9 \times 10^{-4}$ cm/sec
$K_2 = 2.0 \times 10^{-4}$ cm/sec
$K_3 = 1.1 \times 10^{-4}$ cm/sec
$K_4 = 1.8 \times 10^{-4}$ cm/sec

Coefficient of Permeability, $K_{20} = 1.8 \times 10^{-4}$ cm/sec

Tested in accordance with ASTM D-5084-90.

Lab No. P-96-013 Reviewed By: David D. McCray

6756 Buckles Cove Memphis, TN 38133 901-385-1199 FAX 901-386-6614



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
065S06DA40			7			

GRADATION CURVES

Project EnSafe/A&H # 010609000

Area

Boring No.

Date 03/01/96

BACKGROUND WELLS

SOIL BORING/MONITORING WELL LOGS

★ Change BG log IDs

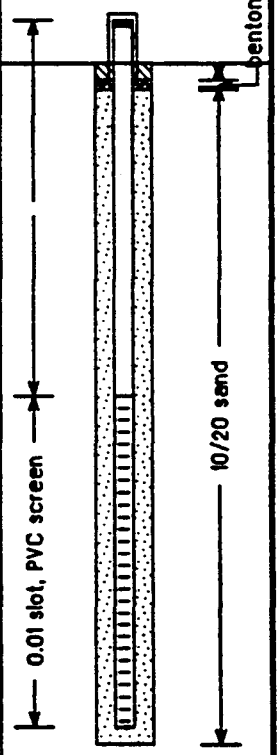
Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-02-S~~ OBGG-02LS

Project: *NAS Memphis*	Location: *Millington, TN. Background Site #2*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *0745 on 1-12-95*	TOC Elevation: *feet msl*
Completed at *0845 on 1-12-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *20.0 feet*
Geologist: *Jack Carmichael and William Parks*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0								Fill and roots.	
5			1	75	BG			Silt, clayey, yellow brown to gray brown, moist, soft.	
10			2	50	BG		ML	Silt, clayey, yellow gray to olive gray, stained yellow orange, laminated with orange to brown thin striations.	
15			3	87.5	BG				
20			4	75	BG			Log information taken form the boring for the lower fluvial well BG-2.	
25									
30									
35									
40									

WELL DIAGRAM



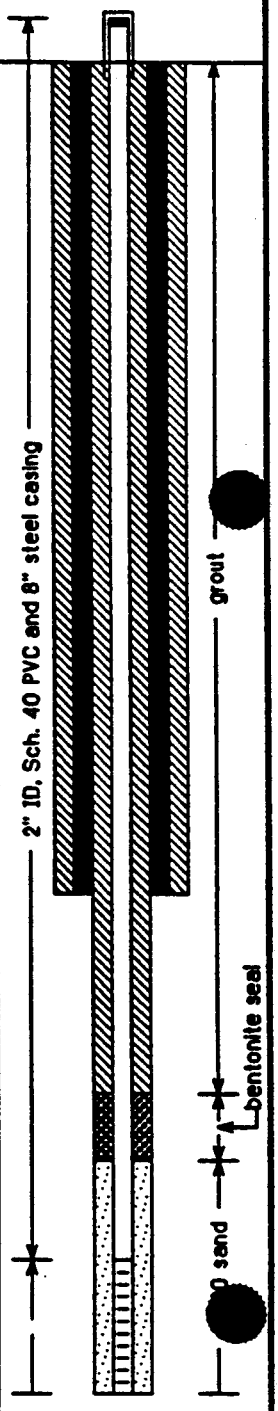
Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-02-UF~~ OBGG02UF

Project: *NAS Memphis*	Location: *Millington, TN. Background Site #2*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *0745 on 1-17-95*	TOC Elevation: *feet msl*
Completed at *0845 on 1-17-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *46.0 feet*
Geologist: *Jack Carmichael and William Parks*	Well Screen: *36 to 46 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0								Fill and roots.	
5			1	75	BG			Silt, clayey, yellow brown to gray brown, moist, soft.	
10			2	50	BG			Silt, clayey, yellow gray to olive gray, stained yellow orange, laminated with orange to brown thin striations.	
15			3	87.5	BG		ML		
20			4	75	BG				
25			5	100	BG			Silt, clayey, light olive gray to yellow gray with iron staining, trace gravel. Silt, clayey, light olive gray, less iron staining.	
30								Sand, silty, trace clay, some gravel, yellow brown to gray brown. Sand, medium to coarse with gravel, orange brown to yellow.	
35			6	108	BG		GP	Sand, fine, with trace gravel, grayish pink to grayish orange, some yellow orange mottling.	
40									

WELL DIAGRAM



Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-02-UF~~ OBG02UF

Project: *NAS Memphis*	Location: *Millington, TN. Background Site #2*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *0745 on 1-17-95*	TOC Elevation: *feet msl*
Completed at *0845 on 1-17-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *46.0 feet*
Geologist: *Jack Carmichael and William Parks*	Well Screen: *36 to 46 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
45							GP	Same as above but dark yellowish orange.		10/20 sand
			7	90	BG			Log information taken form the boring for the lower fluvial well BG-2.		
50										
55										
60										
65										
70										
75										
80										

Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-04-S~~ OBGG04LS

Project: *NAS Memphis*	Location: *Memphis, TN*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *1000 on 1-11-95*	TOC Elevation: *feet msl*
Completed at *1115 on 1-11-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *20.0 feet*
Geologist: *Jack Carmichael*	Well Screen: *10 to 20 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
0								Fill and debris.		
5			1	100	BG			Silty clay, pale olive with reddish brown mottling, stiff.		
10							ML	Clayey silt, yellow gray to yellow brown, mottled with reddish brown.		
15			2	100	BG			Clayey silt, yellow gray to yellow brown mottled yellowish orange, laminated, low plasticity.		
20			3	100	BG			Log information taken from the boring for the lower fluvial well bg-4.		
25										
30										
35										
40										

WELL DIAGRAM: 0.01 slot, PVC screen; 10/20 sand; grout; bentonite seal

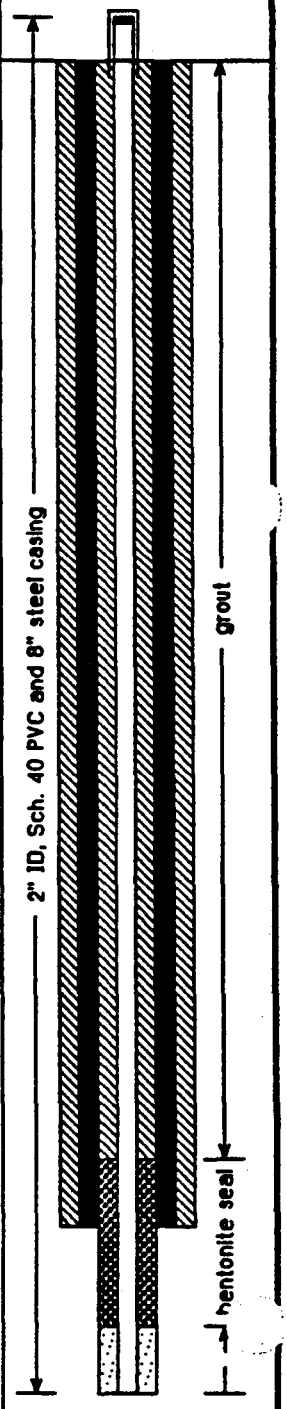
Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-04-UF~~ OBGG04UF

Project: *NAS Memphis*	Location: *Millington, TN. Background Site #4*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *1000 on 1-16-95*	TOC Elevation: *feet msl*
Completed at *1115 on 1-16-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *50.0 feet*
Geologist: *Jack Carmichael*	Well Screen: *40 to 50 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0								Fill and debris.	
5			1	100	BG			Silty clay, pale olive with reddish brown mottling, stiff.	
10								Clayey silt, yellow gray to yellow brown, mottled with reddish brown.	
			2	100	BG			Clayey silt, yellow gray to yellow brown mottled yellowish orange, laminated, low plasticity.	
15									
20			3	100	BG		ML	Silt, medium gray, massive, low plasticity, traces of iron inclusions.	
25								Silt, clayey, medium gray stained yellowish orange, plastic.	
			4	100	BG				
30								Silt, clayey, yellow gray to olive gray.	
35			5	100	BG				
40							GP	Sand, silty, with gravel, yellowish gray to yellowish brown, mottled yellow orange, moist to wet	

WELL DIAGRAM



Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-04-UF~~ OBGG04UF

Project: *NAS Memphis*	Location: *Millington, TN. Background Site #4*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *1000 on 1-16-95*	TOC Elevation: *feet msl*
Completed at *1115 on 1-16-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *50.0 feet*
Geologist: *Jack Carmichael*	Well Screen: *40 to 50 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
45			6	108	BG		GP	Gravel, sandy, fine to very coarse sand, traces of silt, wet, yellow gray.		0.01 slot, PVC screen
			7	100	BG					
50								Log information taken from the boring for the lower fluvial well bg-4.		10/20 sand
55			8	90	BG					
60										
65										
70										
75										
80										

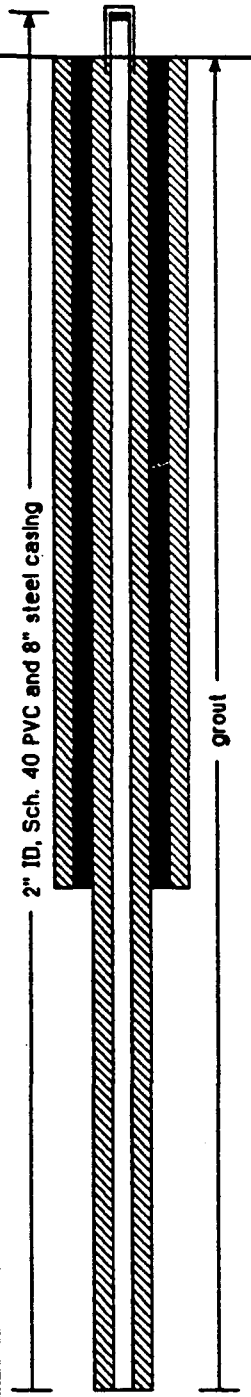
Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-02-LF~~ OBGG02LF

Project: *NAS Memphis*	Location: *Millington, TN. Background Site #2*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *0745 on 1-17-95*	TOC Elevation: *feet msl*
Completed at *0845 on 1-17-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *87.0 feet*
Geologist: *Jack Carmichael and William Parks*	Well Screen: *67 to 77 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0								Fill and roots.	
5			1	75	BG			Silt, clayey, yellow brown to gray brown, moist, soft.	
10			2	50	BG			Silt, clayey, yellow gray to olive gray, stained yellow orange, laminated with orange to brown thin striations.	
15			3	87.5	BG		ML		
20			4	75	BG				
25			5	100	BG			Silt, clayey, light olive gray to yellow gray with iron staining, trace gravel. Silt, clayey, light olive gray, less iron staining.	
30								Sand, silty, trace clay, some gravel, yellow brown to gray brown. Sand, medium to coarse with gravel, orange brown to yellow.	
35			6	108	BG		GP	Sand, fine, with trace gravel, grayish pink to grayish orange, some yellow orange mottling.	
40									

WELL DIAGRAM



Environmental & Safety Designs, Inc.

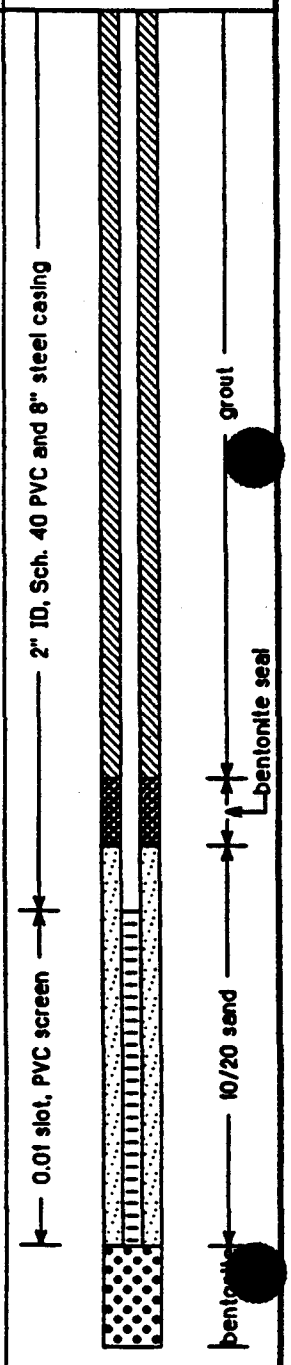
Monitoring Well BG-02-LF

OBGG02LF

Project: *NAS Memphis*	Location: *Millington, TN. Background Site #2*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *0745 on 1-17-95*	TOC Elevation: *feet msl*
Completed at *0845 on 1-17-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *87.0 feet*
Geologist: *Jack Carmichael and William Parks*	Well Screen: *67 to 77 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
45			7	90	BG			Same as above but dark yellowish orange. Sand, gravelly, silty, dark yellowish orange, wet.	
50									
55			8	100	BG		GP	Sand, very fine to fine, silty, traces of clay, yellowish gray to grayish orange.	
60									
65			9	105	BG				
70									
75			10	120	BG		SC	Sand, fine, clayey and silty, moderate gray to brownish gray, laminated, soft to stiff.	
80									

WELL DIAGRAM



Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-02-LF~~ OBGG02LF

Project: *NAS Memphis*	Location: *Millington, TN. Background Site #2*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *0745 on 1-17-95*	TOC Elevation: *feet msl*
Completed at *0845 on 1-17-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *87.0 feet*
Geologist: *Jack Carmichael and William Parks*	Well Screen: *67 to 77 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
85			11	100	BG		SC	End of boring at 87'.		bentonite
90										
95										
100										
105										
110										
115										
120										

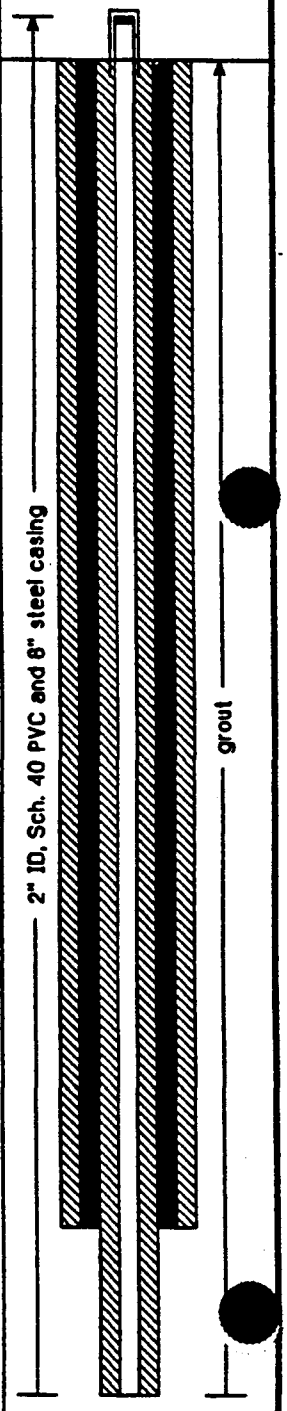
Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-04-LF~~ OBGG04LF

Project: *NAS Memphis*	Location: *Millington, TN · Background Site #4*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *1000 on 1-11-95*	TOC Elevation: *feet msl*
Completed at *1115 on 1-11-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *76.0 feet*
Geologist: *Jack Carmichael*	Well Screen: *60 to 70 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0								Fill and debris.	
5			1	100	BG			Silty clay, pale olive with reddish brown mottling, stiff.	
10								Clayey silt, yellow gray to yellow brown, mottled with reddish brown.	
			2	100	BG			Clayey silt, yellow gray to yellow brown mottled yellowish orange, laminated, low plasticity.	
15									
20			3	100	BG		ML	Silt, medium gray, massive, low plasticity, traces of iron inclusions.	
25								Silt, clayey, medium gray stained yellowish orange, plastic.	
			4	100	BG				
30								Silt, clayey, yellow gray to olive gray.	
35			5	100	BG				
40							GP	Sand, silty, with gravel, yellowish gray to yellowish brown, mottled yellow orange, moist to wet	

WELL DIAGRAM



ENSAFE (SM)

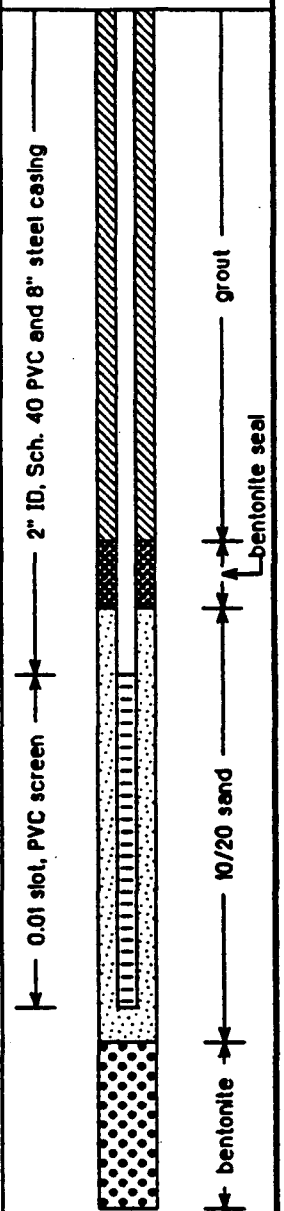
Environmental & Safety Designs, Inc.

Monitoring Well ~~BG-04-LF~~ OBGG04LF

Project: *NAS Memphis*	Location: *Millington, TN. Background Site #4*
Project No.: *N0094*	Surface Elevation: *feet msl*
Started at *1000 on 1-11-95*	TOC Elevation: *feet msl*
Completed at *1115 on 1-11-95*	Depth to Groundwater: *feet* Measured:
Drilling Method: *Rotasonic*	Groundwater Elevation: *feet msl*
Drilling Company: *North Star Drilling*	Total Depth: *76.0 feet*
Geologist: *Jack Carmichael*	Well Screen: *60 to 70 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
			6	108	BG			Gravel, sandy, fine to very coarse sand, traces of silt, wet, yellow gray.	
45			7	100	BG				
50									
55			8	90	BG		GP	Same as above with color changing to dark yellowish orange to moderate yellowish brown.	
60									
65			9	85	BG				
70								Sand with clay, sand is yellow gray stained yellowish orange, clay light brownish gray, moist to wet.	
							SC	Sand, very fine, clay, medium dark gray, olive black laminations.	
75			10	100	BG			End of boring at 76'	
80									

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well OBGG11UA

Project: *NSA Memphis*	Location: *Millington, TN. Background Location #11*
Project No.: *0106-08420*	Surface Elevation: *261.81 feet msl*
Started at *0800 on 3-18-96*	TOC Elevation: *263.84 feet msl*
Completed at *1300 on 3-18-96*	Depth to Groundwater: *16.42 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic*	Groundwater Elevation: *247.42 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *76.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *38 to 48 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
				GP GM	Gravel and silt (fill)	
						259.8
	1	100	BG		Brown silt with some dark yellowish-orange staining and organic flecks	
5					Silt, yellowish brown mottled with yellowish gray, moist	
10	2	90	BG		Silt, olive gray to greenish-gray, wet	
15				ML	Silt, brownish-gray to greenish-gray, wet	
					Large wood fragment	
20					With sand streaks between 22' and 26', wet	
25	3	105	BG			
30						

WELL DIAGRAM

2" ID, Sch. 40 PVC Casing

grout

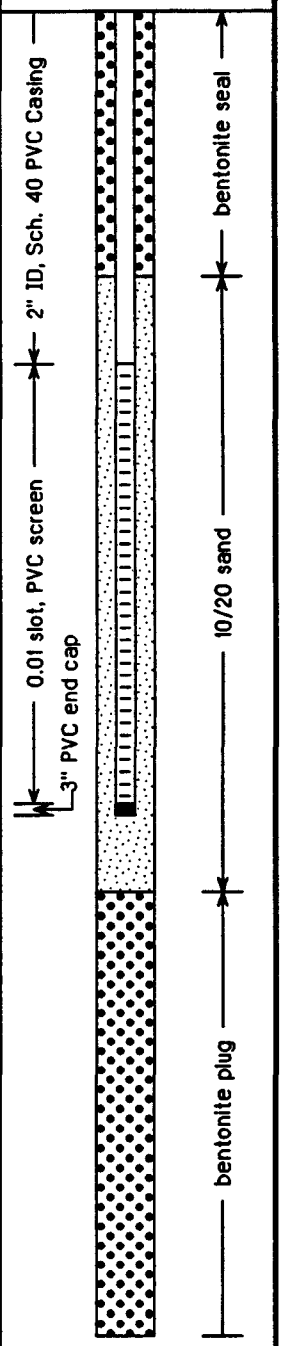
EnSafe/Allen & Hoshall

Monitoring Well OBGG11UA

Project: *NSA Memphis*	Location: *Millington, TN. Background Location #11*
Project No.: *0106-08420*	Surface Elevation: *261.81 feet msl*
Started at *0800 on 3-18-96*	TOC Elevation: *263.84 feet msl*
Completed at *1300 on 3-18-96*	Depth to Groundwater: *16.42 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic*	Groundwater Elevation: *247.42 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *76.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *38 to 48 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
35							ML	With sand streaks between 30' and 36', wet Silt and sand, olive-gray	
									224.8
40							SW GW	Sand and gravel, reddish-brown to orangish-yellow	
									217.8
45			4	100	BG		SW	Sand, coarse-grained, with some gravel, grayish-yellow to dusky yellow	
									209.8
50							GW GC	Gravel with some sand and clay in the matrix, grayish-yellow to 54' turning to reddish-brown at 56'.	
									205.8
55							SW GW	Sand and gravel, reddish-brown to yellowish-orange	
									202.8
60							GW	Gravel lense between 59' and 61'	

WELL DIAGRAM



EnSafe/Allen & Hoshall	Monitoring Well OBGG11UA
Project: *NSA Memphis*	Location: *Millington, TN. Background Location #11*
Project No.: *0106-08420*	Surface Elevation: *261.81 feet msl*
Started at *0800 on 3-18-96*	TOC Elevation: *263.84 feet msl*
Completed at *1300 on 3-18-96*	Depth to Groundwater: *16.42 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic*	Groundwater Elevation: *247.42 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *76.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *38 to 48 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
			5	100	BG		GW			
								Predominantly sand with several layers of iron-cemented gravel 1" to 2" thick, maximum diameter of gravel is 2"	200.8	
65							SW GW			
									192.8	
70			6	120	BG		SP CL	Cockfield Formation: sand, fine-grained and olive-gray, with some seams of brown clay and organic material		
75									185.8	
								Soil boring terminated at 76'.		
80										
85										
90										

bentonite plug

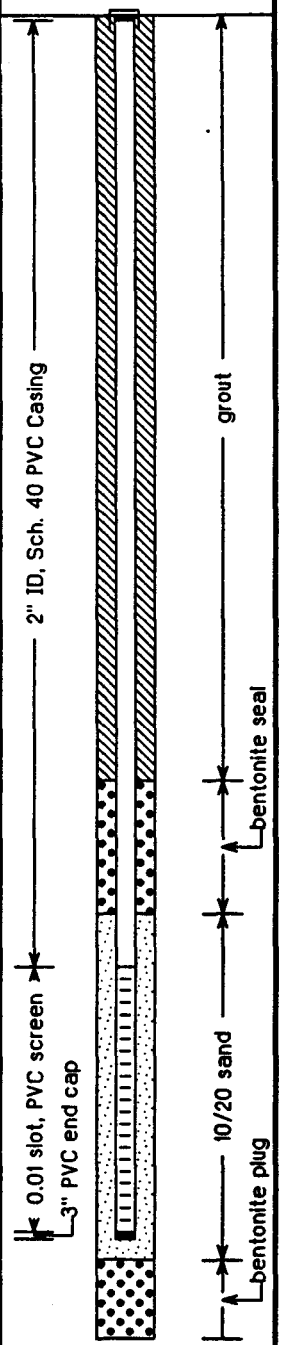
EnSafe/Allen & Hoshall

Monitoring Well OBGG12UF

Project: *NSA Memphis*	Location: *Millington, TN. Background Location #12*
Project No.: *0106-08420*	Surface Elevation: *268.90 feet msl*
Started at *1415 on 2-18-96*	TOC Elevation: *268.71 feet msl*
Completed at *1530 on 2-18-96*	Depth to Groundwater: *9.09 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic*	Groundwater Elevation: *259.62 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *66.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *36 to 46 feet*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
0				SP SC	Asphalt, sand, and clay (fill)	
	1	100	BG			265.9
5				CL ML	Clay and silt, gray	
						262.9
					Silt, yellowish-brown to yellowish-gray with organic specks and iron staining, moist	
10	2	90	BG	ML		
15						252.9
				CL	Clay with some silt, brownish-gray, stiff	
20						248.9
					Silt, light olive gray with some reddish-brown staining and mottling	
25	3	75	BG	ML		
30						238.9
				SP	Fine sand, tan to yellowish-brown	
						234.9
35				SW	Sand, medium to coarse-grained, reddish-brown to light brown	232.9
					Sand and gravel, reddish-brown, majority of gravel from 40' to 47', with gravel up to 2" diameter	
40				SW GW		
45	4	100	BG			221.9
				SC SM	Cockfield Formation: sand, silt, and clay, light olive gray to light yellowish-brown, micaceous, finely lignitic, with streaks of clay throughout	
50						

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well OBGG12UF

Project: *NSA Memphis*	Location: *Millington, TN. Background Location #12*
Project No.: *0106-08420*	Surface Elevation: *268.90 feet msl*
Started at *1415 on 2-18-96*	TOC Elevation: *268.71 feet msl*
Completed at *1530 on 2-18-96*	Depth to Groundwater: *9.09 feet* Measured: *4/8/96*
Drilling Method: *Rotasonic*	Groundwater Elevation: *259.62 feet msl*
Drilling Company: *Alliance Environmental, Inc.*	Total Depth: *66.0 feet*
Geologist: *J. Kingsbury*	Well Screen: *36 to 46 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
55										
60			5	80	BG		SC SM			
65								Soil boring terminated at 66.0'.	202.9	bentonite plug
70										
75										
80										
85										
90										
95										
100										

GEOLOGICAL LOGGING SYSTEMS

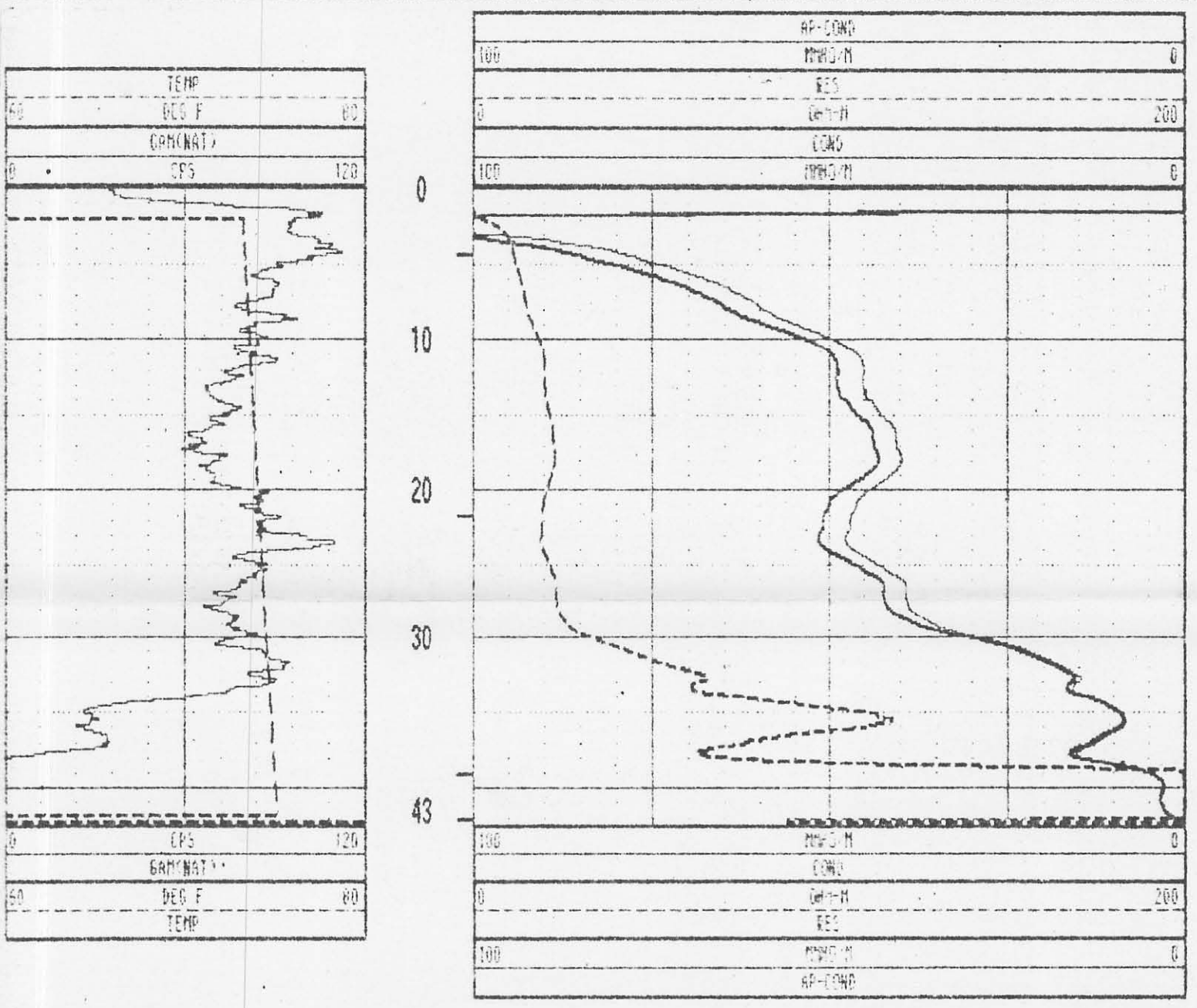
OBGG12UF

COMPANY	: ENSAFE,ALLEN & HOSHALL			OTHER SERVICES:	
WELL	: OBGG12UF			9511	
LOCATION/FIELD	: NAS MEMPHIS			RUN ONE	
COUNTY	: SHELBY			OPEN	
STATE	: TENNESSEE				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 05/21/96	PERMANENT DATUM	: GL	ELEVATIONS	
DEPTH DRILLER	: 46 .	ELEV. PERM. DATUM:		KB	:
LOG BOTTOM	: 42.50	LOG MEASURED FROM:	GL	DF	: -
LOG TOP	: -2.30	DRL MEASURED FROM:	GL	GL	: 268.9
CASING DRILLER	: 46	LOGGING UNIT	: 05		
CASING TYPE	: PVC	FIELD OFFICE	: BLUEFIELD		
CASING THICKNESS	: .25	RECORDED BY	: J T GILBERT		
BIT SIZE	: 8	BOREHOLE FLUID	: WATER	FILE	: ORIGIN
MAGNETIC DECL.	: -	RM	:	TYPE	: 9511C
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:	LOG	: 2
FLUID DENSITY	: 1.2	MATRIX DELTA T	:	PLOT	: 9510C
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:	THRESH	: 9000

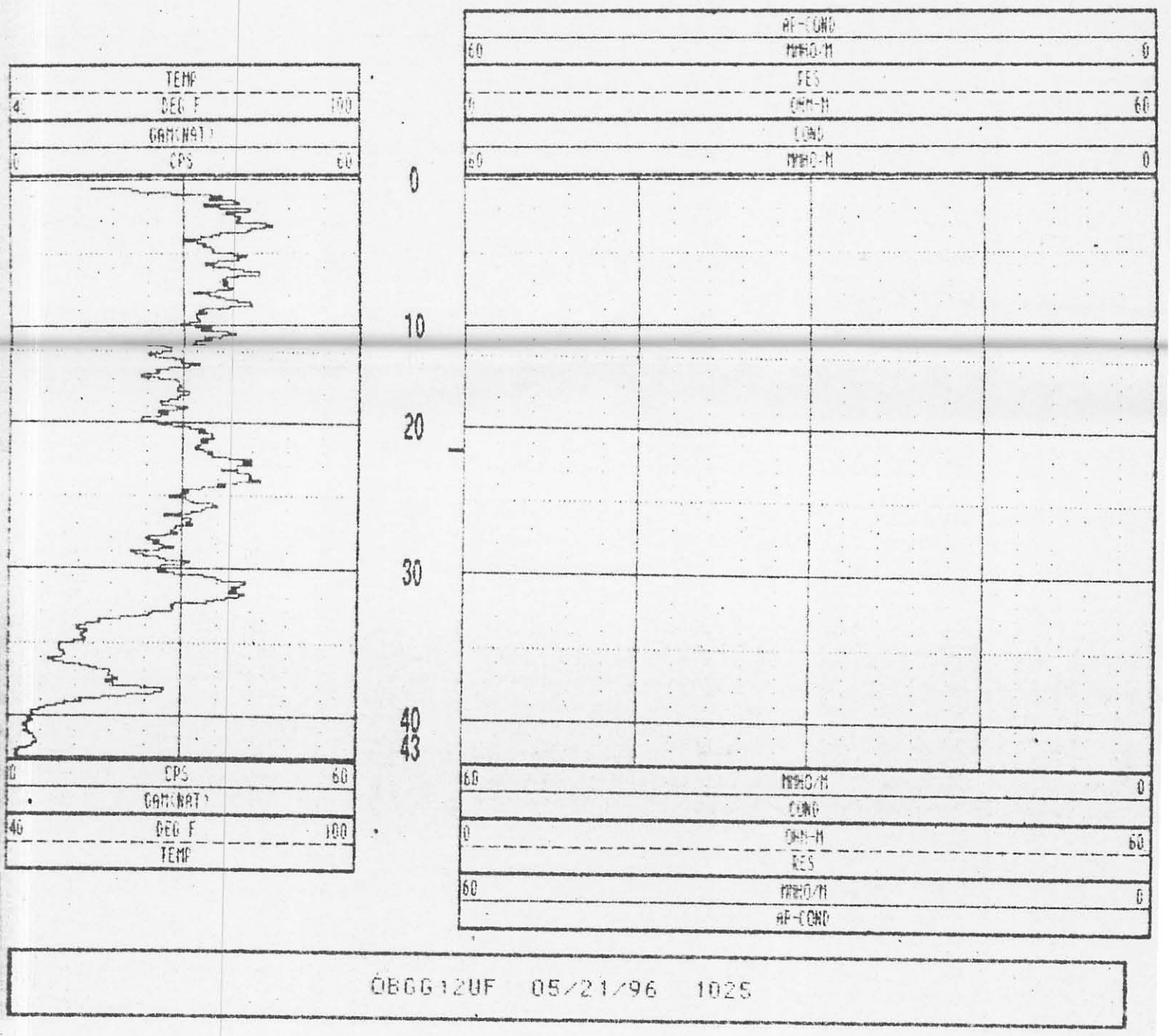
REMARKS :

ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



OBGG12UF 05/21/96 0936



OBGG12UF 05/21/96 1025

GEOLOGICAL LOGGING SYSTEMS

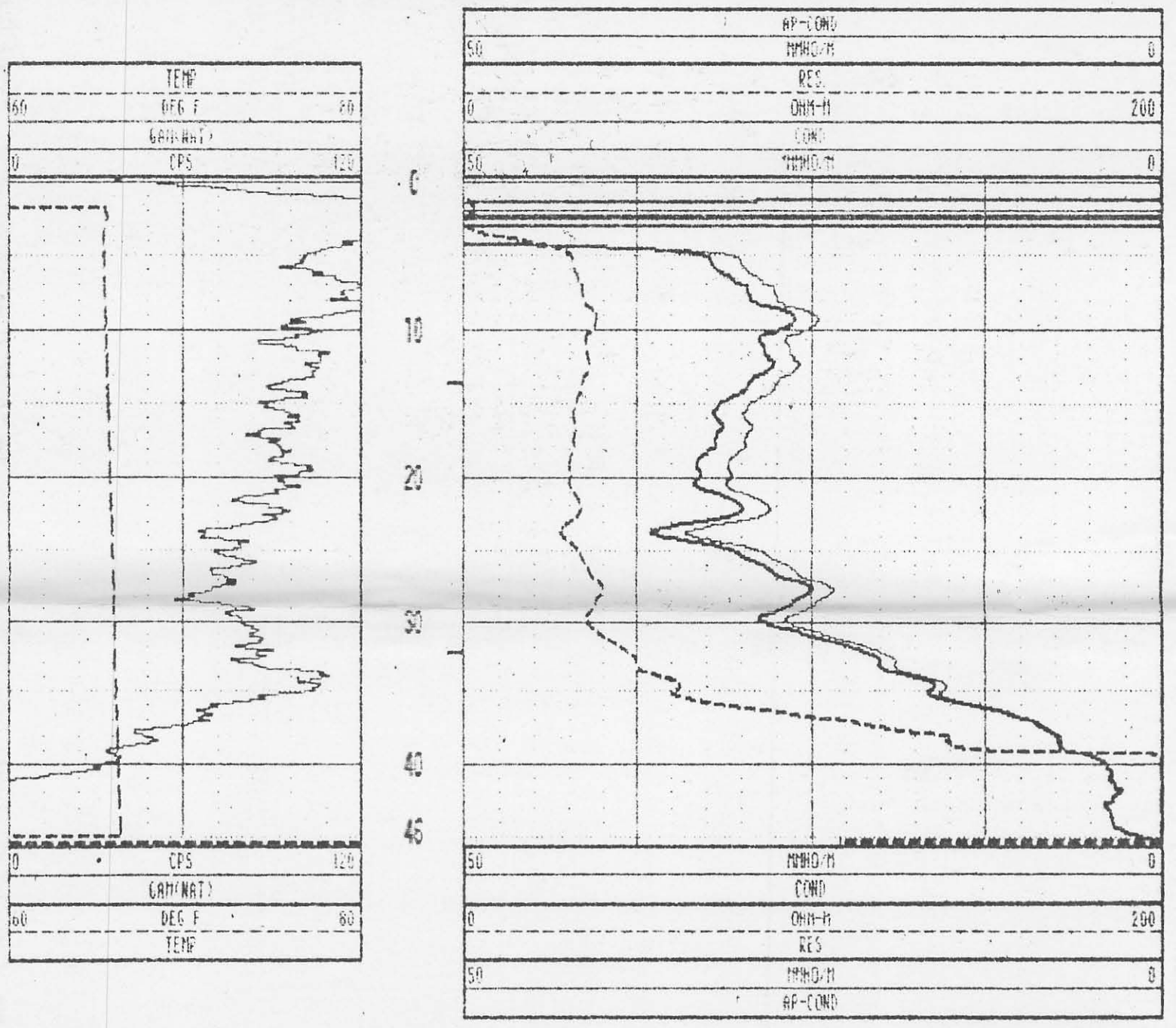
OBGG11UA

COMPANY	: ENSAFE,ALLEN & HOSHALL					OTHER SERVICES:	
WELL	: OBGG11UA					9511	
LOCATION/FIELD	: NAS MEMPHIS					RUN ONE	
COUNTY	: SHELBY					OPEN	
STATE	: TENNESSEE						
SECTION	:	TOWNSHIP	:		RANGE	:	
DATE	: 05/21/96	PERMANENT DATUM	:	GL	ELEVATIONS		
DEPTH DRILLER	: 48	ELEV. PERM. DATUM:			KB	:	
LOG BOTTOM	: 45.60	LOG MEASURED FROM:		GL	DF	: -	
LOG TOP	: -2.60	DRL MEASURED FROM:		GL	GL	: 261.8	
CASING DRILLER	: 48	LOGGING UNIT	:	05			
CASING TYPE	: PVC	FIELD OFFICE	:	BLUEFIELD			
CASING THICKNESS	: .25	RECORDED BY	:	J T GILBERT			
BIT SIZE	: 8	BOREHOLE FLUID	:	WATER	FILE	: ORIGIN	
MAGNETIC DECL.	: -	RM	:		TYPE	: 9511C	
MATRIX DENSITY	: 2.65	RM TEMPERATURE	:		LOG	: 2	
FLUID DENSITY	: 1.2	MATRIX DELTA T	:		PLOT	: 9510C	
NEUTRON MATRIX	: SANDSTONE	FLUID DELTA T	:		THRESH	: 9000	

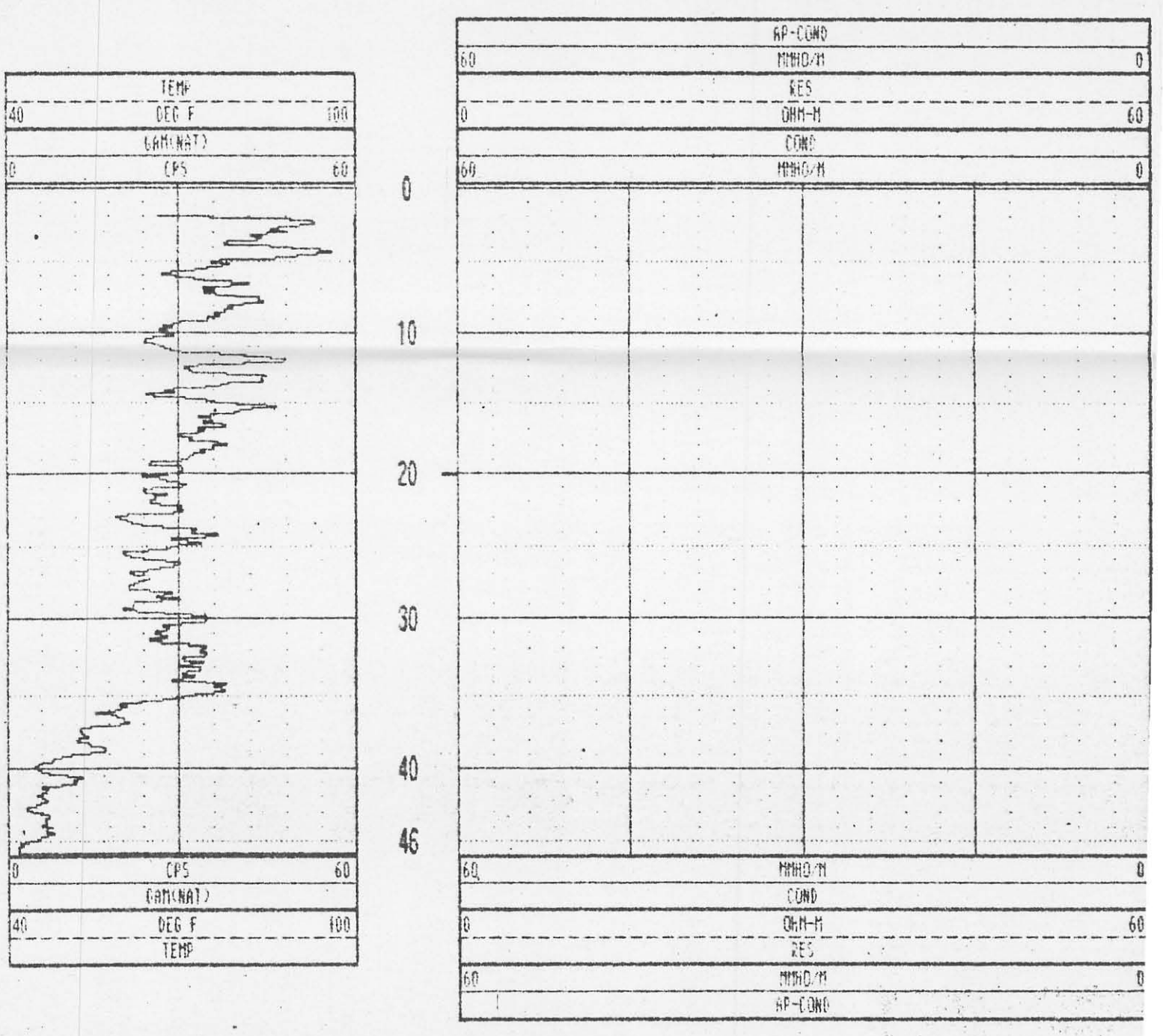
REMARKS :

ELECTRIC LOG INTERPRETATION IS EMPIRICAL IN NATURE. EXTREME HOLE COND WILL MAKE COMPLETELY ACCURATE INTERPRETATIONS DIFFICULT.

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS



OBGG11UA 05/21/96 976



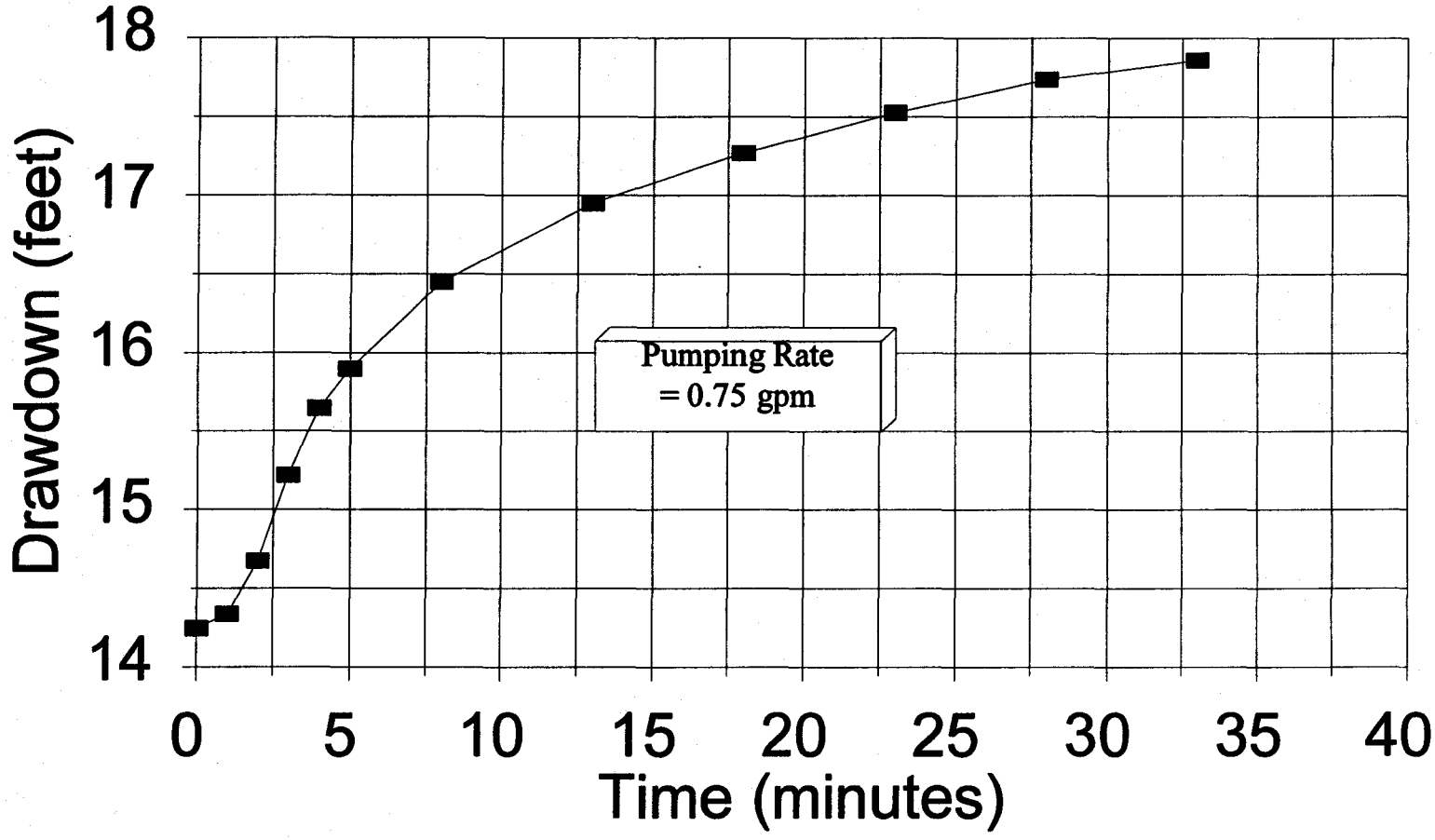
OBGG11UA 05/21/96 1025

Appendix D

Assembly E Specific Capacity Test Results and Data Input Files

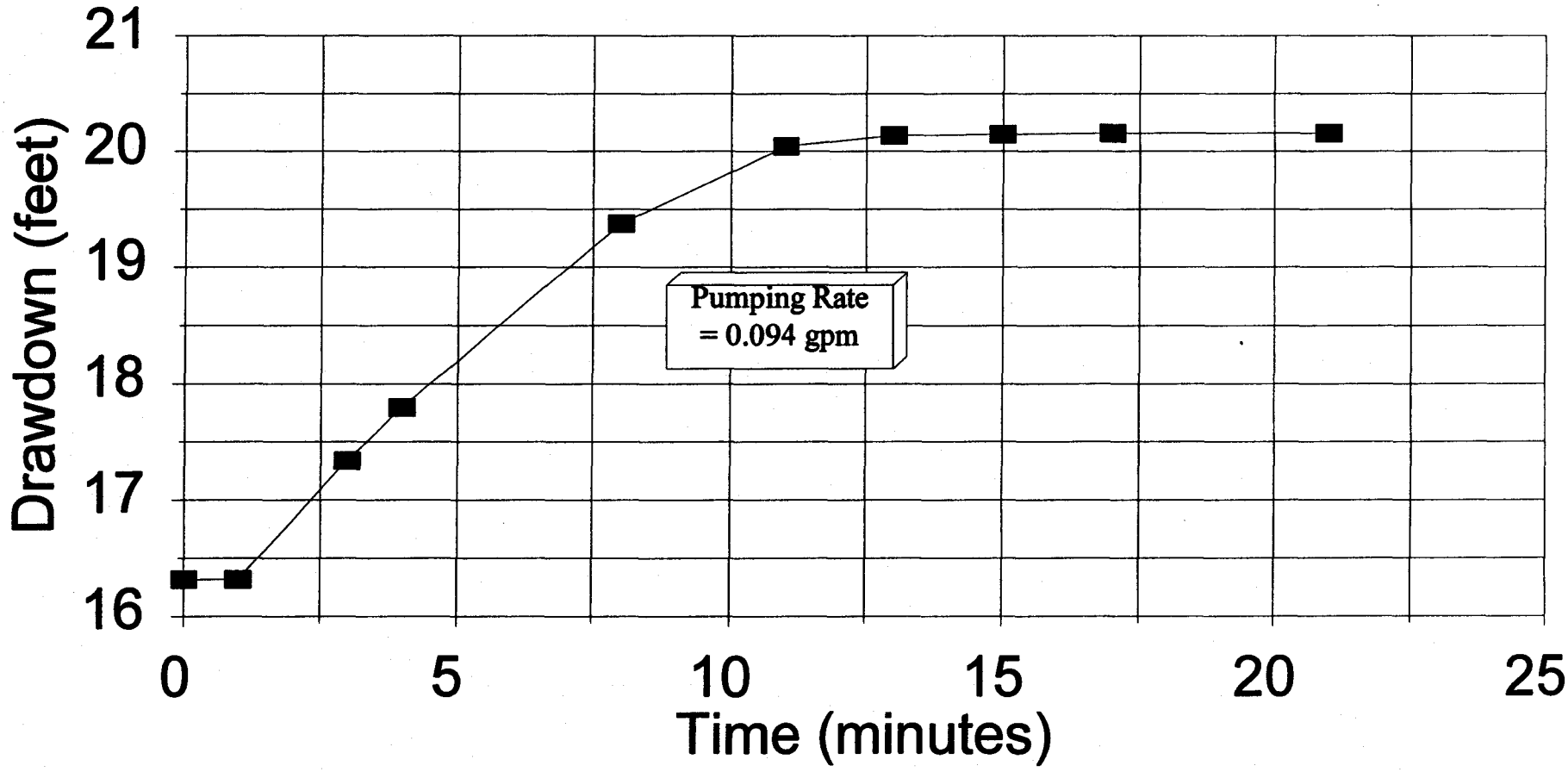
Specific Capacity Test

002G03DA



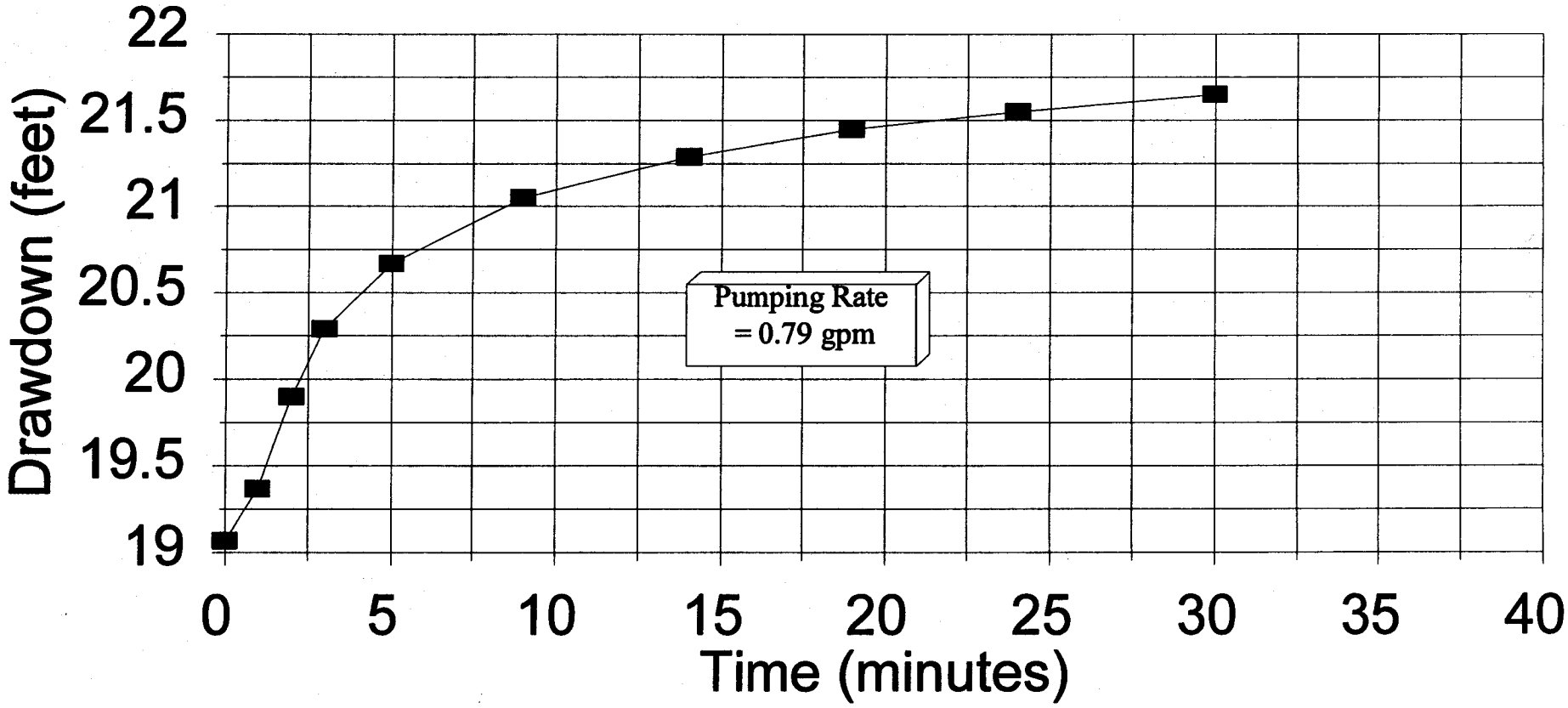
Specific Capacity Test

002G03UA



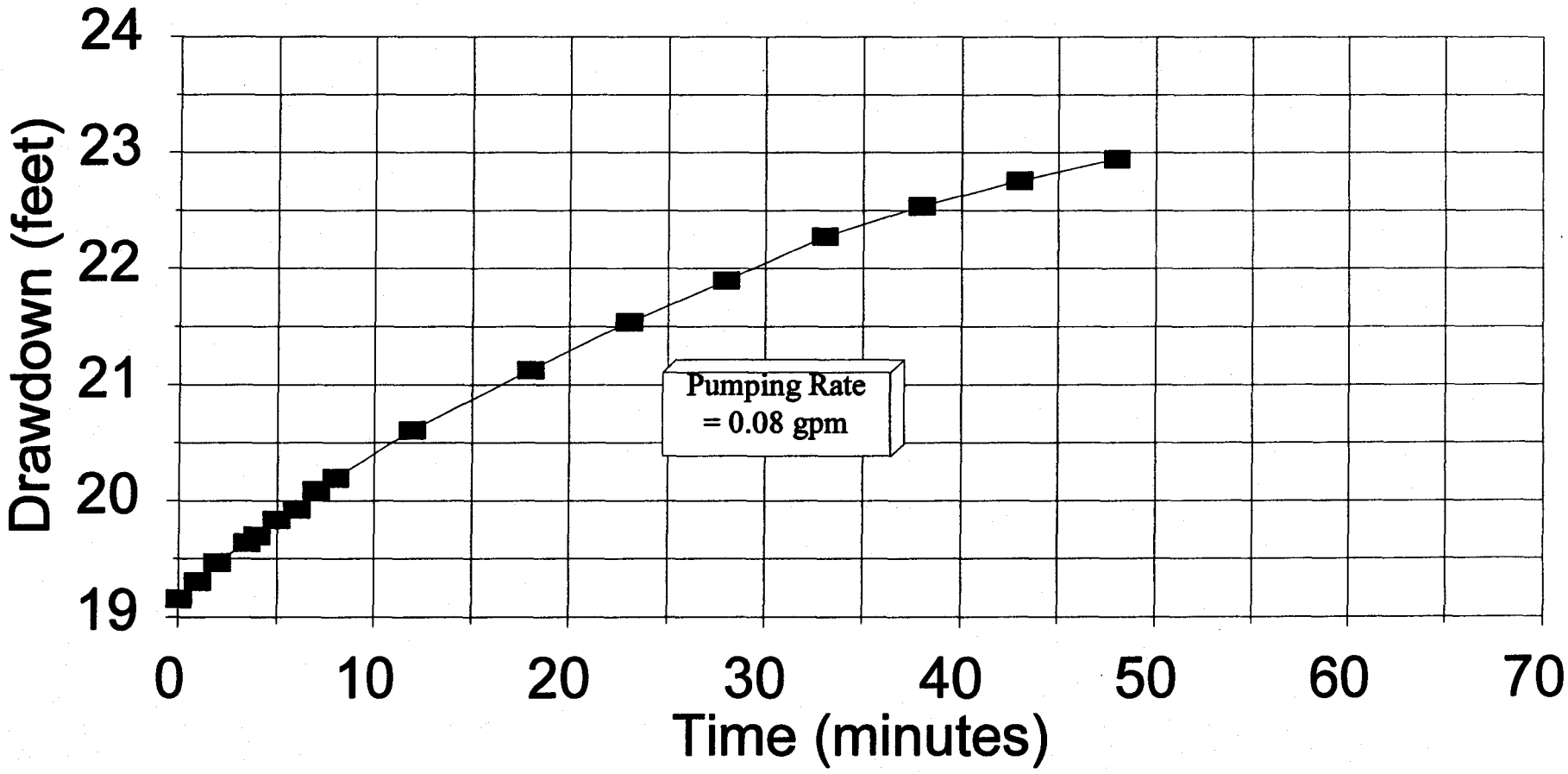
Specific Capacity Test

002G09DA



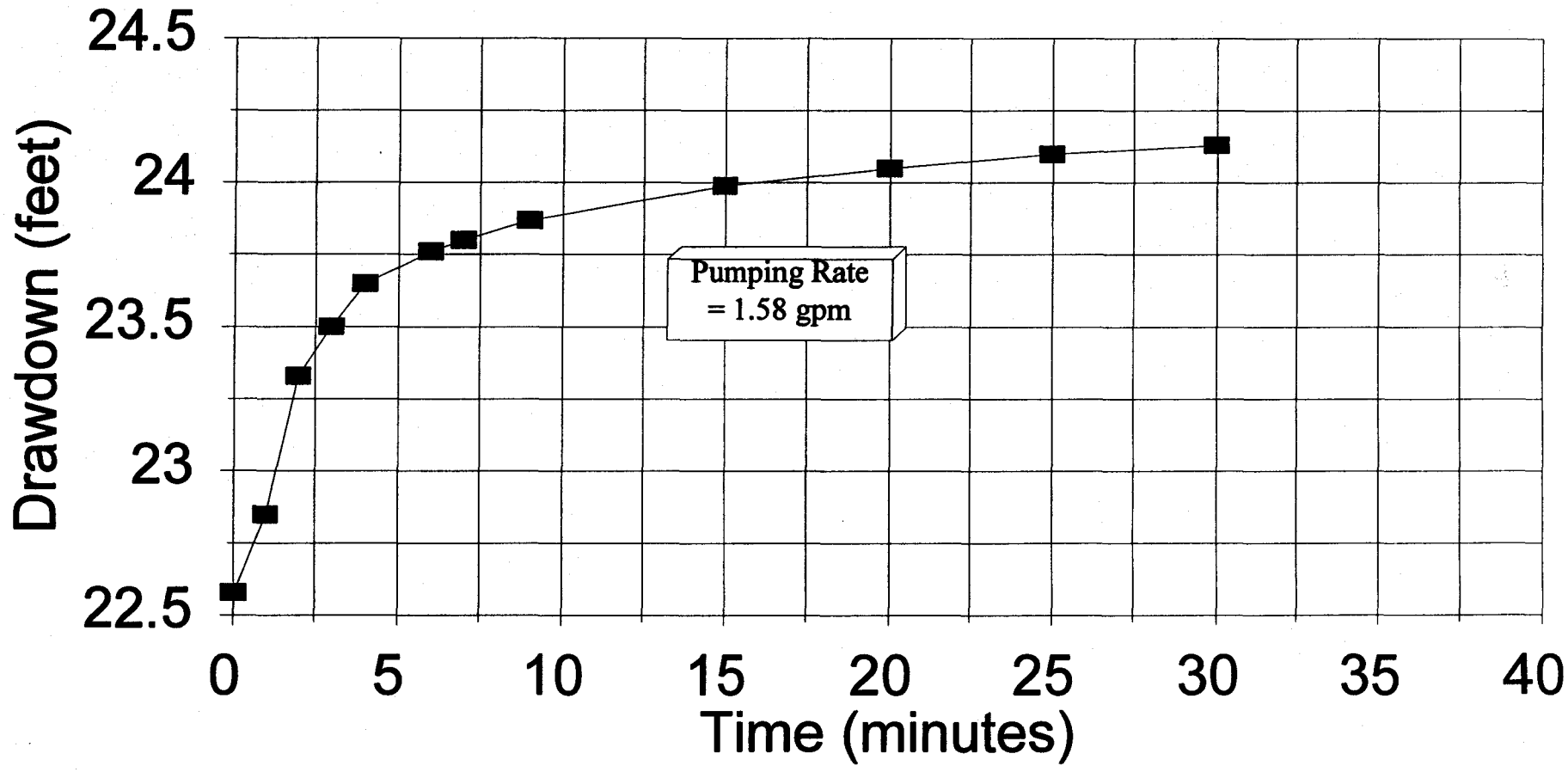
Specific Capacity Test

002G09UA



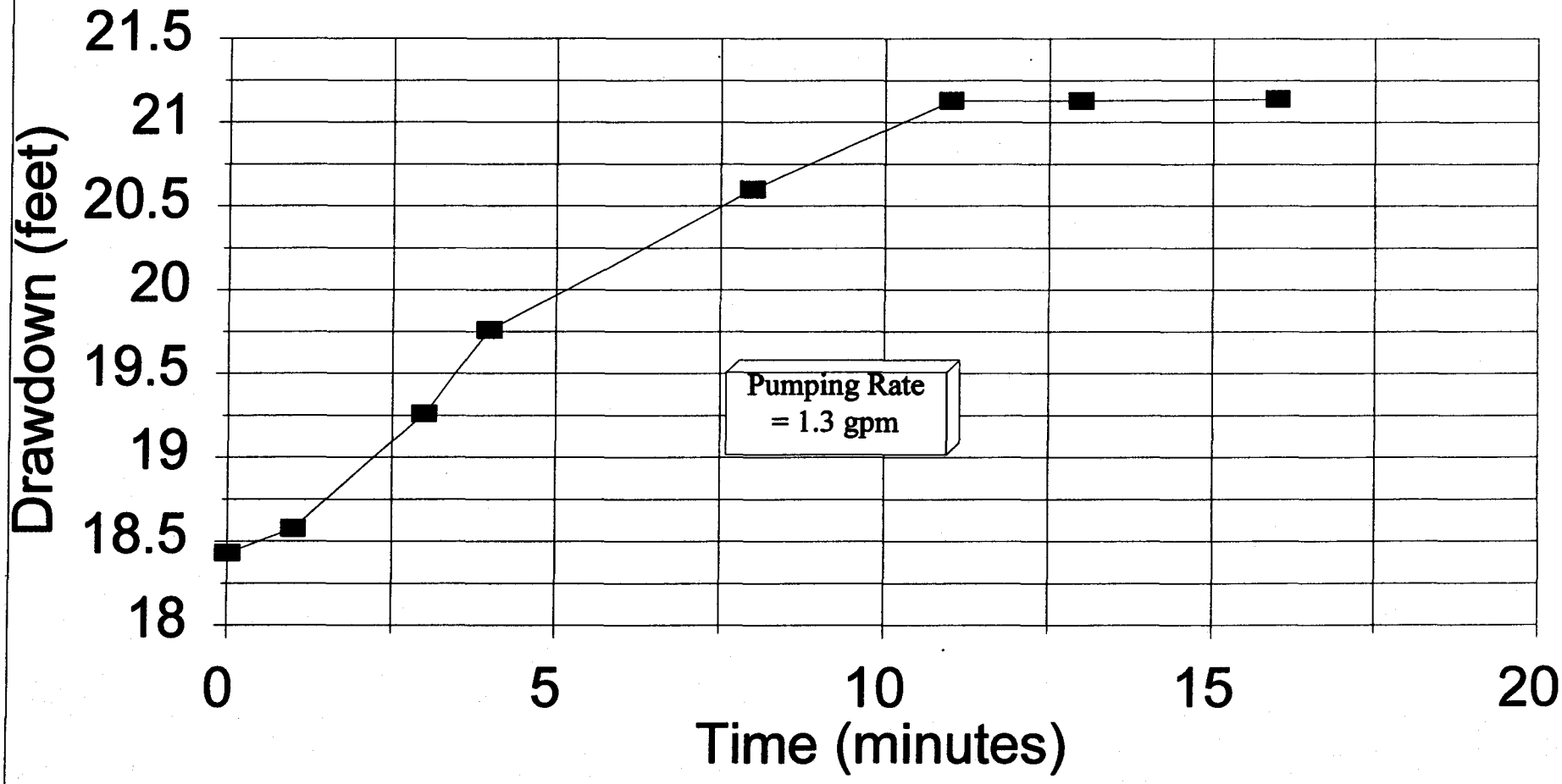
Specific Capacity Test

009G01DA



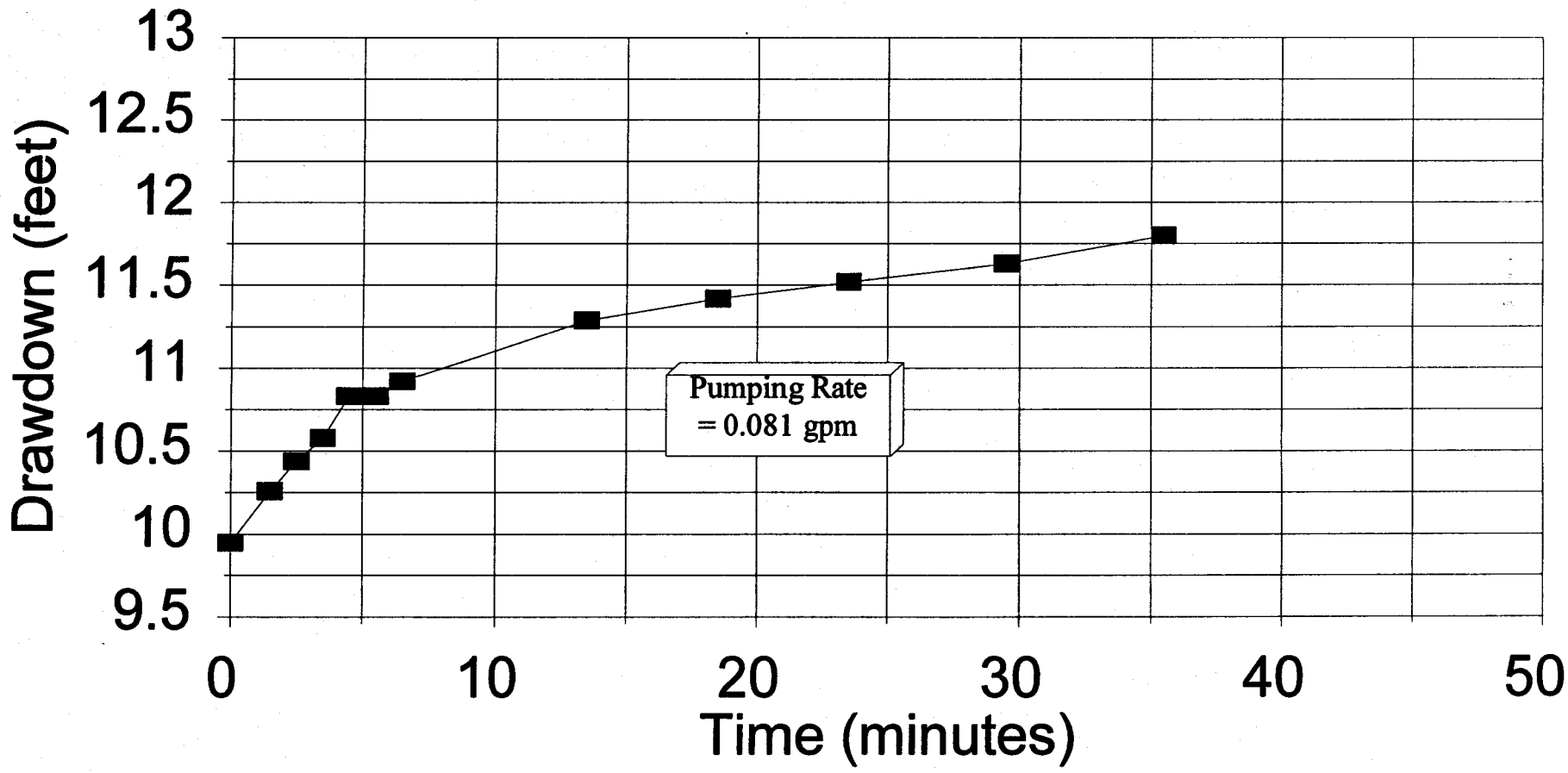
Specific Capacity Test

009G03DA



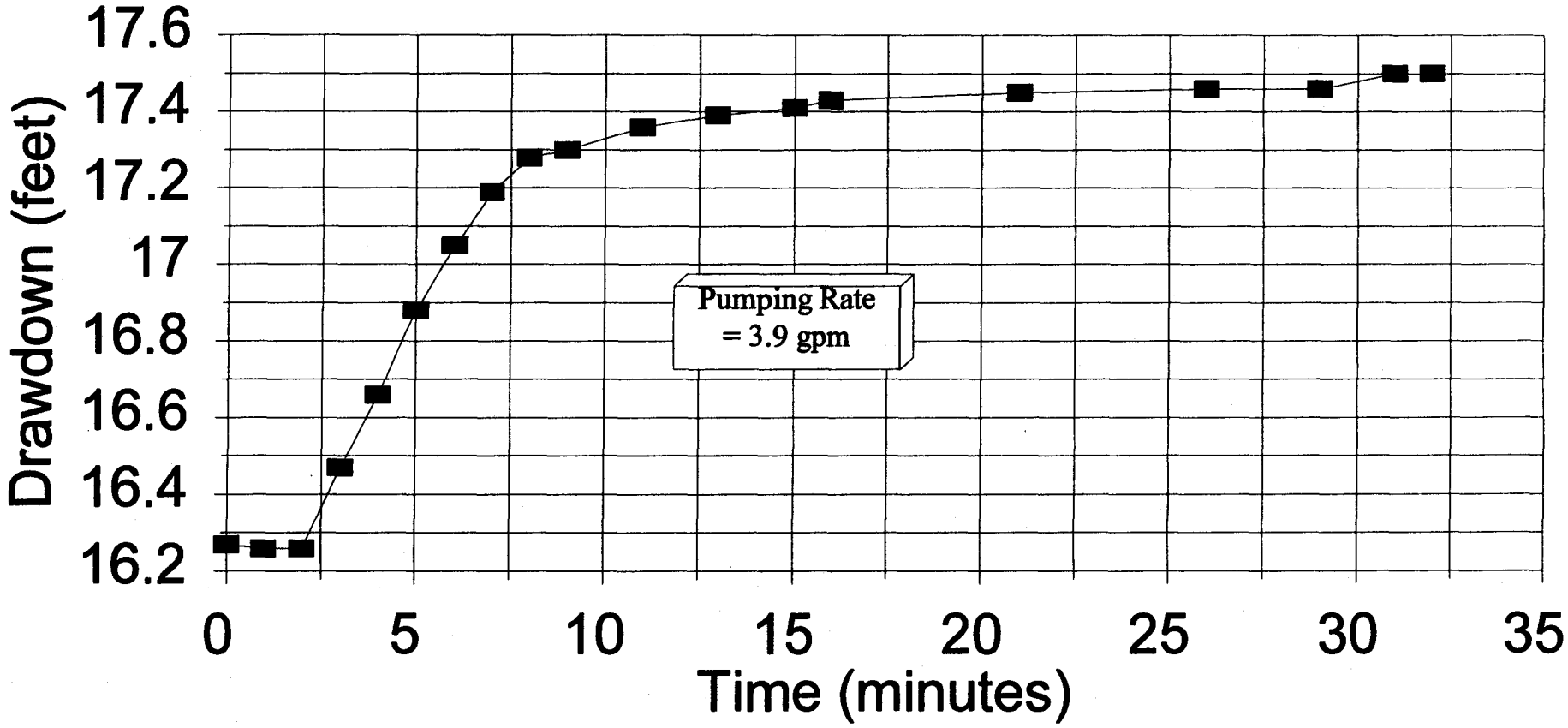
Specific Capacity Test

014G07LF



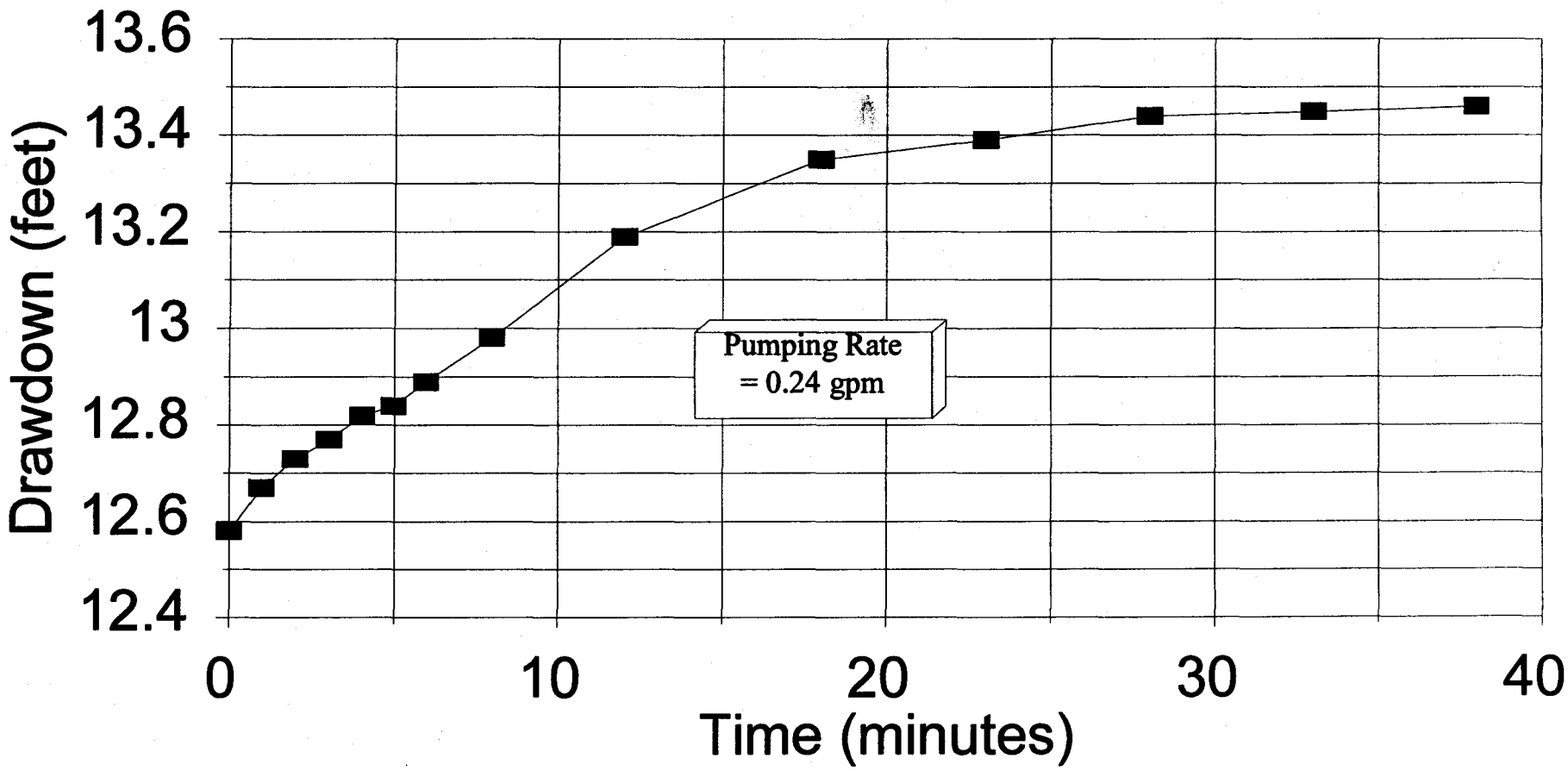
Specific Capacity Test

059G03UF



Specific Capacity Test

065G06DA



TGUESS -- Version 1.2

****

AQUIFER PROPERTIES AS DETERMINED BY ANALYSIS OF SPECIFIC CAPACITIES

****

WELL NUMBER.....= 2G03UA

INPUT DATA (English units):

WELL DIAMETER (IN OR M)	2
STATIC WATER LEVEL (FT OR M)	16.32
DEPTH TO WATER DURING TEST (FT OR M)	20.14
DURATION OF THE TEST (HRS)	.22
PUMPING RATE (GPM OR CUB.M/S)	.094
THICKNESS OF AQUIFER (FT OR M)	12
OPEN INTERVAL (SCREEN LENGTH; FT OR M)	10
STORAGE COEFFICIENT	.000696
WELL LOSS COEFFICIENT	1

RESULTS:

SPECIFIC CAPACITY (GPM/FT OR SQ.M/S)	2.460733E-02
TRANSMISSIVITY (SQ FT/SEC OR SQ.M/S)	4.77337E-05
HYDRAULIC CONDUCTIVITY (FT/SEC OR M/S)	3.977808E-06
NUMBER OF ITERATIONS	3

WELL NUMBER.....= 2G03DA

INPUT DATA (English units):

WELL DIAMETER (IN OR M)	2
STATIC WATER LEVEL (FT OR M)	14.25
DEPTH TO WATER DURING TEST (FT OR M)	17.86
DURATION OF THE TEST (HRS)	.55
PUMPING RATE (GPM OR CUB.M/S)	.75
THICKNESS OF AQUIFER (FT OR M)	19
OPEN INTERVAL (SCREEN LENGTH; FT OR M)	10
STORAGE COEFFICIENT	.0000228
WELL LOSS COEFFICIENT	1

RESULTS:

SPECIFIC CAPACITY (GPM/FT OR SQ.M/S)	.2077564
TRANSMISSIVITY (SQ FT/SEC OR SQ.M/S)	8.833193E-04
HYDRAULIC CONDUCTIVITY (FT/SEC OR M/S)	4.649049E-05
NUMBER OF ITERATIONS	3

WELL NUMBER.....= 2 609UA

INPUT DATA (English units):

WELL DIAMETER (IN OR M)	2
STATIC WATER LEVEL (FT OR M)	19.16
DEPTH TO WATER DURING TEST (FT OR M)	23.5
DURATION OF THE TEST (HRS)	1.166
PUMPING RATE (GPM OR CUB.M/S)	.08
THICKNESS OF AQUIFER (FT OR M)	5
OPEN INTERVAL (SCREEN LENGTH; FT OR M)	5
STORAGE COEFFICIENT	.000006
WELL LOSS COEFFICIENT	1

RESULTS:

SPECIFIC CAPACITY (GPM/FT OR SQ.M/S)	1.843318E-02
TRANSMISSIVITY (SQ FT/SEC OR SQ.M/S)	5.3305E-05
HYDRAULIC CONDUCTIVITY (FT/SEC OR M/S)	1.0661E-05
NUMBER OF ITERATIONS	2

WELL NUMBER.....= 2 609DA

INPUT DATA (English units):

WELL DIAMETER (IN OR M)	2
STATIC WATER LEVEL (FT OR M)	19.07
DEPTH TO WATER DURING TEST (FT OR M)	21.65
DURATION OF THE TEST (HRS)	.5
PUMPING RATE (GPM OR CUB.M/S)	.79
THICKNESS OF AQUIFER (FT OR M)	15
OPEN INTERVAL (SCREEN LENGTH; FT OR M)	10
STORAGE COEFFICIENT	.000018
WELL LOSS COEFFICIENT	1

RESULTS:

SPECIFIC CAPACITY (GPM/FT OR SQ.M/S)	.3062019
TRANSMISSIVITY (SQ FT/SEC OR SQ.M/S)	1.132542E-03
HYDRAULIC CONDUCTIVITY (FT/SEC OR M/S)	7.550278E-05
NUMBER OF ITERATIONS	3

WELL NUMBER.....= 9601DA

INPUT DATA (English units):

WELL DIAMETER (IN OR M)	2
STATIC WATER LEVEL (FT OR M)	22.58
DEPTH TO WATER DURING TEST (FT OR M)	24.13
DURATION OF THE TEST (HRS)	.5
PUMPING RATE (GPM OR CUB.M/S)	1.58
THICKNESS OF AQUIFER (FT OR M)	17
OPEN INTERVAL (SCREEN LENGTH; FT OR M)	10
STORAGE COEFFICIENT	.00002
WELL LOSS COEFFICIENT	1

RESULTS:

SPECIFIC CAPACITY (GPM/FT OR SQ.M/S)	1.019364
TRANSMISSIVITY (SQ FT/SEC OR SQ.M/S)	4.302742E-03
HYDRAULIC CONDUCTIVITY (FT/SEC OR M/S)	2.531025E-04
NUMBER OF ITERATIONS	3

WELL NUMBER.....= 9603DA

INPUT DATA (English units):

WELL DIAMETER (IN OR M)	2
STATIC WATER LEVEL (FT OR M)	18.43
DEPTH TO WATER DURING TEST (FT OR M)	21.13
DURATION OF THE TEST (HRS)	.18
PUMPING RATE (GPM OR CUB.M/S)	1.3
THICKNESS OF AQUIFER (FT OR M)	21
OPEN INTERVAL (SCREEN LENGTH; FT OR M)	10
STORAGE COEFFICIENT	.0000252
WELL LOSS COEFFICIENT	1

RESULTS:

SPECIFIC CAPACITY (GPM/FT OR SQ.M/S)	.4814832
TRANSMISSIVITY (SQ FT/SEC OR SQ.M/S)	2.176555E-03
HYDRAULIC CONDUCTIVITY (FT/SEC OR M/S)	1.036455E-04
NUMBER OF ITERATIONS	3

WELL NUMBER.....= 14 G07LF

INPUT DATA (English units):

WELL DIAMETER (IN OR M)	2
STATIC WATER LEVEL (FT OR M)	9.95
DEPTH TO WATER DURING TEST (FT OR M)	11.63
DURATION OF THE TEST (HRS)	.49
PUMPING RATE (GPM OR CUB.M/S)	.081
THICKNESS OF AQUIFER (FT OR M)	12
OPEN INTERVAL (SCREEN LENGTH; FT OR M)	10
STORAGE COEFFICIENT	.0000144
WELL LOSS COEFFICIENT	1

RESULTS:

SPECIFIC CAPACITY (GPM/FT OR SQ.M/S)	4.821428E-02
TRANSMISSIVITY (SQ FT/SEC OR SQ.M/S)	1.428461E-04
HYDRAULIC CONDUCTIVITY (FT/SEC OR M/S)	1.190384E-05
NUMBER OF ITERATIONS	3

WELL NUMBER.....= 59G03UF

INPUT DATA (English units):

WELL DIAMETER (IN OR M)	2
STATIC WATER LEVEL (FT OR M)	16.27
DEPTH TO WATER DURING TEST (FT OR M)	17.45
DURATION OF THE TEST (HRS)	.35
PUMPING RATE (GPM OR CUB.M/S)	3.9
THICKNESS OF AQUIFER (FT OR M)	33
OPEN INTERVAL (SCREEN LENGTH; FT OR M)	10
STORAGE COEFFICIENT	.00004
WELL LOSS COEFFICIENT	1

RESULTS:

SPECIFIC CAPACITY (GPM/FT OR SQ.M/S)	3.305295
TRANSMISSIVITY (SQ FT/SEC OR SQ.M/S)	2.299535E-02
HYDRAULIC CONDUCTIVITY (FT/SEC OR M/S)	6.968288E-04
NUMBER OF ITERATIONS	4

WELL NUMBER.....= 65 606 DA

INPUT DATA (English units):

WELL DIAMETER (IN OR M).....=	2
STATIC WATER LEVEL (FT OR M).....=	12.58
DEPTH TO WATER DURING TEST (FT OR M).....=	13.44
DURATION OF THE TEST (HRS).....=	.47
PUMPING RATE (GPM OR CUB.M/S).....=	.24
THICKNESS OF AQUIFER (FT OR M).....=	13
OPEN INTERVAL (SCREEN LENGTH; FT OR M)....=	10
STORAGE COEFFICIENT.....=	.0000156
WELL LOSS COEFFICIENT.....=	1

RESULTS:

SPECIFIC CAPACITY (GPM/FT OR SQ.M/S).....=	.27907
TRANSMISSIVITY (SQ FT/SEC OR SQ.M/S).....=	9.494165E-04
HYDRAULIC CONDUCTIVITY (FT/SEC OR M/S)....=	7.303204E-05
NUMBER OF ITERATIONS.....=	3

Appendix E

Assembly E Investigative-Derived Waste Technical Memorandums

EnSafe / Allen & Hoshall

a joint venture for professional services

Program Management Office
Shelby Oaks Plaza
5909 Shelby Oaks Dr.
Suite 201
Memphis, TN 38134
Phone (901) 383-9115
Fax (901) 383-1743

EnSafe/Allen & Hoshall Branch Offices:

Charleston
935 Houston Northcutt Blvd.
Suite 113
Mt. Pleasant, SC 29464
Phone (803) 884-0029
Fax (803) 856-0107

Cincinnati
400 TechneCenter Dr.
Suite 301
[illegible]rd, OH 45150
[illegible](513) 248-8449
[illegible]513) 248-8447

Pensacola
2114 Airport Blvd.
Suite 1150
Pensacola, FL 32504
Phone (904) 479-4595
Fax (904) 479-9120

Norfolk
303 Butler Farm Road
Suite 113
Hampton, VA 23666
Phone (804) 766-9556
Fax (804) 766-9558

Raleigh
5540 Centerview Drive
Suite 205
Raleigh, NC 27606
Phone (919) 851-1886
Fax (919) 851-4043

Nashville
311 Plus Park Blvd.
Suite 130
Nashville, TN 37217
Phone (615) 399-8800
Fax (615) 399-7467

[illegible]s
[illegible]ller Drive
[illegible]26
Irving, TX 75038
Phone (214) 791-3222
Fax (214) 791-0405

MEMORANDUM

TO: Rob Williamson
NSA Memphis Public Works Environmental Division

Mark Taylor
SOUTHNAVFACENGCOM

FROM: Robert Smith RS
EnSafe/Allen & Hoshall

SUBJECT: Characterization of Investigation-Derived Waste from Assembly E SWMUs: NSA Memphis RFI, Millington, Tennessee; CT0-106

DATE: October 14, 1996

Beginning in November 1995, EnSafe/Allen & Hoshall conducted a RCRA Facility Investigation at Naval Support Activity (NSA) Memphis. Investigation derived waste (IDW) was generated during the investigation.

The IDW consisted of two types of media: soil/formation material, and water. The water was generated from activities such as decontamination of soil and groundwater sampling equipment, development of groundwater monitoring wells, and purging of the monitoring wells prior to sampling. The water was contained in a 2,000 gallon polyethylene tank at Facility S-775. Each time the tank reached its capacity, a sample was collected by E/A&H for analysis by an offsite laboratory for waste characterization parameters. The analytical results from the IDW characterization were then submitted to the City of Millington's contracted engineer, Mr. James Cox of Fisher & Arnold Engineering for discharge approval. Upon receiving discharge approval from Mr. Cox, the contents of the tank were discharged to the sanitary sewer system via an onsite oil/water separator. The 2,000 gallon tank has been cycled a total of 13 times since the beginning of the Assembly E investigation.

The second media type, soil/formation material, was generated during drilling activities, which included drilling spoils and soil/mud generated during the decontamination of the drilling and sampling equipment. Formation material consisted of all subsurface material (sand, gravel, clay) brought to the surface during the drilling/sampling activities. All material generated was containerized in 168 DOT-approved, lined, 55-gallon drums, and were properly labeled and staged in the NSA Memphis IDW storage area (Facility N-1665), where they presently remain. During a recent inspection of the IDW containers, E/A&H found that all labels

placed on the drums have become illegible preventing the correlation of individual drums with specific boring locations. This IDW characterization has been conducted as a basis for disposal and is based the on the concentrations of compounds detected in the Assembly E soil borings.

CHARACTERIZATION

A total of 101 compounds were detected during the Assembly E RFI Investigation. Each compound has been characterized based on the U.S. Environmental Protection Agency (USEPA) Hazardous Waste Rules as outlined in Title 40 of the Code of Federal Regulations, Part 261 (40 CFR 261), and the guidelines set forth by Tennessee Department of Environment and Conservation (TDEC), Division of Solid Waste Management (DSWM).

Of the 101 compounds detected, the following six compounds were defined in 40 CFR 261.30 as being "F-listed" hazardous wastes. F-listed wastes, by definition, are compounds from specific sources, which have been listed due to their Hazard Code (i.e., Toxicity, Ignitability, Corrosivity). The criteria for the selection of these compounds, as well as the USEPA Region III Risk-Based Concentration (RBC) and pertinent ignitability data, is presented in Table 1:

Table 1

NSA Memphis RFI; Assembly E IDW Characterization

F-Listed Wastes

Compound	Hazardous Waste Code as defined in 40 CFR 261	Maximum Detected Concentration (µg/kg)	Residential RBC (µg/kg)	Flashpoint (ignitability) (°C/°F))	Selection Criteria as defined in 40 CFR 261
Trichloroethylene	F001	19.0	58,000	N/A	Toxicity
Methylene Chloride	F002	5.0	85,000	N/A	Toxicity
Tetrachloroethene	F002	23.0	12,000	N/A	Toxicity
4-methyl-2-pentanone (MIBK)	F003	170	N/A	17.8°C/64°F	Ignitability
Acetone	F003	48000	7,800,000	0°C/0°F	Ignitability
2-butanone (MEK)	F005	3600	47,000,000	-8.75°C/16°F	Ignitability, Toxicity

Notes:

N/A = Data not available

According to 40 CFR 261.3(a)(2)(iii), "A solid waste, as defined in § 261.2, is a hazardous waste if....it is a mixture of a solid waste and a hazardous waste that is listed in Subpart D of this part solely because it exhibits one or more of the characteristics of hazardous waste identified in subpart C of this part, ***unless the resultant mixture no longer exhibits any characteristics of hazardous waste identified in subpart C of this part.....***"

According to 40 CFR 261.30, the F001 and F002 wastes (trichloroethylene, methylene chloride, and tetrachloroethene) were listed due to their toxicity, and the F005 waste (MEK) was listed due to its toxicity and ignitability. Also, according to 40 CFR 261.30, the F003 (MIBK and Acetone)

wastes were listed due to their ignitability. Because of the low contaminant concentrations detected and the medium (i.e., soil) in which they are contained, soil found at the Assembly E SWMUs does not exhibit the ignitable characteristic. However, because toxicity cannot be physically defined as ignitability can, it would be difficult to prove that the soil/F001, soil/F002, and soil/F005 mixtures are not toxic.

The Land Disposal Restriction (LDR) Guide #5 provides the following discussion of the Contained-In Interpretation (USEPA Office of Solid Waste Management dated November 13, 1986). "The contained-in policy states that any mixture of a non-solid waste and a RCRA listed hazardous waste must be managed as a hazardous waste as long as the material contains (i.e., is above health based levels) the listed hazardous waste." The contained in policy was developed to address contaminated environmental media (i.e., soil, groundwater, surface water), as opposed to the mixture rule which governs mixtures of hazardous and solid wastes. E/A&H has previously confirmed that TDEC's DSWM concurs with and applies the USEPA contained-in policy using RBCs as health-based levels.

Characterization of the soil/formation material generated during the RFI will be based on the contained in policy. Past disposal of soil at NSA Memphis has also applied the contained-in policy in this situation (Memorandum, *Characterization of Investigation Derived Waste from Assembly A SWMUs;* CTO-094; June 6, 1995). A comparison of the soil boring data to the residential RBCs for soil (Table 1) shows that the maximum concentrations of the potentially listed hazardous wastes contained in the IDW do not exceed the health-based risk levels.

Petroleum Constituents

As part of the full scan analytical parameter list associated with the investigation, each sample collected was submitted for total petroleum hydrocarbon (TPH) analysis using the Tennessee-

modified USEPA methods 8015 for gasoline range organics (GRO) and diesel range organics (DRO). The maximum detected concentrations of TPH-GRO and TPH-DRO were 260 mg/kg and 650 mg/kg, respectively; however, the average detected concentrations of TPH-GRO and TPH-DRO were 7.5 mg/kg and 49.8 mg/kg, respectively; with 4% of the samples analyzed exceeding 100 mg/kg TPH. Because labels on the drums containing the IDW are illegible, individual sample results cannot be correlated to the representative IDW on a drum by drum basis. Therefore, all IDW must be characterized together as one unit; for this reason, the average of all detected results was used in the characterization process. Based on the low average concentration of petroleum constituents detected, and the infrequency of detections exceeding 100 mg/kg of TPH, the material would not meet the TDEC DSWM criteria for a petroleum contaminated soil of 100 mg/kg TPH.

NON-HAZARDOUS IDW DISPOSAL

Options for the disposal of the non-hazardous IDW include:

1. All soil and formation material can be spread or buried at an existing SWMU (e.g., Salvage Yard #2, SWMU 41) on property being retained by the Navy, preferably in a single, predetermined area to facilitate future locating and sampling of the material, if necessary. The spreading of this material at an existing SWMU would eliminate the potential for creating a future SWMU and material handling activities should blend the IDW, creating a more homogeneous mixture, which would be more representative of the average concentrations discussed previously.

2. All soil can be sent to a TDEC-approved, non-hazardous landfill.

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Memorandum

Date: January 24, 1997

To: NSA Memphis, BRAC Cleanup Team

From: Robert Smith, E/A&H

Re: Assembly E IDW Drum Screening Results

E/A&H has recently completed the drum screening activities associated with the NSA Memphis Assembly E investigation derived waste (IDW). The drum screening, conducted at the request of the BCT, was in response to the *Characterization of Investigation-Derived Waste from Assembly E SWMUs* memorandum (E/A&H, October 14, 1996) which stated that 4% of the samples collected during the Assembly E RFI contained petroleum hydrocarbon concentrations exceeding 100 mg/kg.

The screening activities were conducted following the procedures outlined in the *Drum Screening Procedures, Assembly E IDW* memorandum (E/A&H, December 9, 1996) presented to the BCT, with one procedural change made at the request of Mr. Jim Morrison (Tennessee Department of Environment and Conservation [TDEC]). In addition to collecting headspace data from each drum, a sample was also collected from each drum and placed in an air tight bag (i.e., zip-lock), and the contents of the bag were subsequently screened using a flame ionization detector (FID).

At the request of TDEC, their office was notified prior to beginning any screening activities; however, due to technical difficulties associated with the instruments (i.e, PID, FID), no work was performed while TDEC was on site.

The data, presented in the attached table and associated graph, indicate that 6 out of the 160 (3.75%) drums screened exhibited elevated organic vapor concentrations in relation to the rest of the drums. Due to varying factors associated with organic vapor readings and containerized soil (i.e., painted surfaces on the interior of the drum, moisture, etc.), the organic vapor levels detected may or may not be indicative of the petroleum concentration of the drum contents.

The available disposal options for the Assembly E IDW include onsite disposal (identical to the Assembly A IDW), however, the petroleum levels in the soil may need to be confirmed by collecting samples of the material contained in the 6 drums exhibiting elevated headspace readings. If the BCT decides the data is needed, composite samples will be collected from each drum using a stainless steel hand auger to allow the samplers to obtain material from 3 points within the material contained in each drum. These composite samples, a total of 6, would be submitted for total petroleum hydrocarbon analysis by EPA Method 418.1.

Should the analytical data indicate that the petroleum levels of any of the drums exceed the current TDEC definition of a petroleum contaminated soil (presently 100 ppm TPH), that drum will be segregated for disposal under the TDEC Special Waste Policy. The remaining soil may be spread onsite, at a location agreed upon by the NSA Memphis Public Works Office and the BCT.

Naval Support Activity Memphis RCRA Facility Investigation
Assembly E Investigation Derived Waste Drum Organic Vapor Screening Log (ppm)

Drum	Headspace	Baggie
1	73	2
2	600	1600
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	27	0
9	0	0
10	10	0
11	4	3100
12	0	0
13	0	0
14	0	< 1
15	0	0
16	7700	0
17	0	0
18	0	0
19	0	0
20	0	0
21	0	0
22	0	0
23	0	0
24	0	0
25	0	0
26	0	0
27	0	0
28	0	0
29	0	0
30	0	0
31	0	0
32	13	7
33	20	45
34	0	0
35	0	0
36	< 1	< 1

Naval Support Activity Memphis RCRA Facility Investigation
Assembly E Investigation Derived Waste Drum Organic Vapor Screening Log (ppm)

Drum	Headspace	Baggie
37	0	< 1
38	0	3
39	5	< 1
40	< 1	0
41	< 1	0
42	< 1	0
43	< 1	0
44	< 1	0
45	0	0
46	0	0
47	0	< 1
48	0	0
49	0	0
50	0	0
51	0	0
52	0	0
53	0	0
54	0	0
55	0	0
56	0	0
57	0	0
58	0	0
59	0	0
60	0	0
61	0	0
62	0	0
63	0	4257
64	0	0
65	0	0
66	0	0
67	0	0
68	0	0
69	4651	217
70	2	0
71	0	0
72	0	0
73	0	0

Naval Support Activity Memphis RCRA Facility Investigation
Assembly E Investigation Derived Waste Drum Organic Vapor Screening Log (ppm)

Drum	Headspace	Baggie
74	165	83
75	0	730
76	0	0
77	0	0
78	0	0
79	0	0
80	0	0
81	0	0
82	0	0
83	0	0
84	110	105
85	0	0
86	0	0
87	0	0
88	0	0
89	0	0
90	0	0
91	0	0
92	0	0
93	0	0
94	0	0
95	0	0
96	0	0
97	222	0
98	8	0
99	0	0
100	0	0
101	0	0
102	0	238
103	0	0
104	-	-
105	-	-
106	0	0
107	0	0
108	0	0
109	0	0
110	-	-

Naval Support Activity Memphis RCRA Facility Investigation
Assembly E Investigation Derived Waste Drum Organic Vapor Screening Log (ppm)

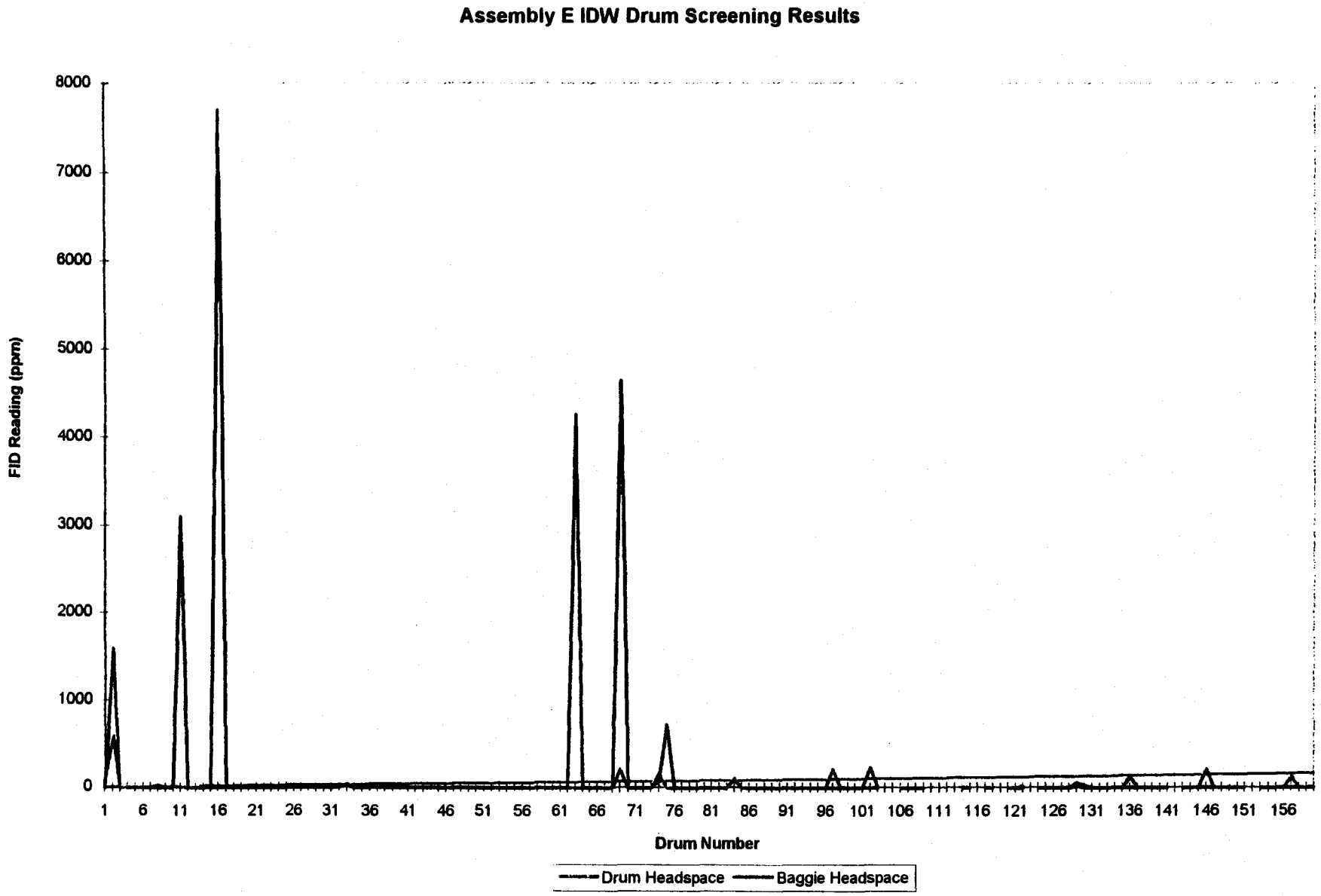
Drum	Headspace	Baggie
111	–	–
112	0	0
113	–	–
114	5	0
115	0	0
116	–	–
117	0	0
118	0	0
119	–	–
120	0	0
121	0	0
122	20	0
123	–	–
124	0	0
125	0	0
126	0	0
127	0	0
128	0	0
129	57	14
130	29	0
131	0	0
132	0	0
133	0	0
134	0	0
135	0	0
136	121	0
137	0	0
138	0	0
139	0	0
140	0	0
141	0	0
142	–	–
143	0	0
144	0	0
145	0	0
146	224	0
147	0	0

Naval Support Activity Memphis RCRA Facility Investigation
Assembly E Investigation Derived Waste Drum Organic Vapor Screening Log (ppm)

Drum	Headspace	Baggie
148	0	0
149	0	0
150	0	0
151	0	0
152	-	-
153	0	0
154	0	0
155	0	0
156	0	0
157	123	0
158	0	0
159	0	0
160	13	0

Notes:
- = Data not available due to inaccessibility to drum, or drum contained waste plastic sheeting.
Bolded items indicate elevated organic vapor readings, relative to all drums screened.

NSA Memphis Assembly E IDW Screening Results



Appendix F

Technical Memorandum — General Human Health Risk Assessment

TECHNICAL MEMORANDUM

TO: Mark Taylor/David Porter, SOUTHDIV
Tonya Barker/Rob Williamson, NSA Memphis
Brian Donaldson, USEPA
Jim Morrison, TDEC
Jack Carmichael, USGS
Brenda Duggar, MSCHD
E/A&H Project Team

FROM: Brian Mulhearn, E/A&H

DATE: February 4, 1997

RE: Revision 1 General Human Health Risk Assessment (HHRA) Approach for NSA Memphis

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This memorandum discusses the general HHRA approach for NSA Memphis and incorporates USEPA's suggestions received during the January 28, 1997 Base Realignment and Closure (BRAC) Cleanup Team meeting. This text will not be reproduced in subsequent HHRAs with the exception of the final report, where the text will be included as an appendix. Initially, HHRAs will include only site-specific information and will reference this memorandum, reducing the bulk necessary to present site-specific risk information to risk managers. Deviations from these general methods will be justified and discussed in site-specific HHRAs.

1 BASELINE RISK ASSESSMENT

1.1 Introduction

A baseline risk assessment (BRA) establishes a baseline of risk to facilitate risk management decisions. Risk is the estimated potential for toxic effects on actual or hypothetical human or ecological receptors, while baseline risk refers to risk arising from exposures to chemicals assuming site conditions remain unchanged. BRAs are used by risk managers to decide if remedial actions are necessary and to determine the extent of remediation necessary to reduce the risk to acceptable levels. Generally, a BRA is divided into two sections, one assessing human health risk, and a second addressing ecological risk. This section addresses generally applied HHRA methods, while ecological risk assessment methods will be addressed in the site-specific assessments. Data management and analysis methods which will be used to reach the conclusions of site-specific HHRAs are discussed below. The following sections describe the methods, procedures, considerations, toxicological information, and related uncertainties possibly affecting HHRAs at NSA Memphis.

1.2 Background

The site background will be summarized in this section of the site-specific HHRAs.

2 General Guidance

HHRAs will generally be prepared in accordance with the guidelines set forth in the following documents, although some may not apply to every site:

- *Provisional Guidance for Quantitative Risk Assessment of PAHs*, U.S. Environmental Protection Agency, ECAO-CIN-842, EPA/600/BP92/001C, July 1993.

- *Risk Assessment Guidance for Superfund (RAGS), Volume I – Human Health Evaluation Manual, Part A*, U.S. Environmental Protection Agency/Office of Emergency and Remedial Response (OERR), EPA/540/1-89/002, December 1989 (Interim).

- *RAGS, Volume I — Human Health Evaluation Manual, (Part B, Development of Risk-Based Preliminary Remediation Goals)*, USEPA/OERR, EPA/540/R92/003, December 1991 (Interim).

- *RAGS, Volume I — Human Health Evaluation Manual, Supplemental Guidance — Standard Default Exposure Factors — Interim Final,* EPA/OERR, Office of Solid Waste and Emergency Response (OSWER) Directive: 9285.6-03, March 25, 1991. (RAGS Supplement).

- *RAGS, Volume I — Human Health Evaluation Manual, Supplemental Guidance-Dermal Risk Assessment — Interim Guidance,* EPA/OERR, August 18, 1992. (Supplemental Dermal Guidance).

- Supplemental Guidance to RAGS: Region IV Bulletin, *Development of Health-Based Preliminary Remediation Goals, Remedial Goal Options (RGO) and Remediation Levels* (Supplemental RGO Guidance).

- Supplemental Guidance to RAGS: Region IV Bulletin, *Provisional Guidance of Quantitative Risk Assessment of PAHs* (EPA Document EPA/600/R-93-089 July 1993).

- *Supplemental Guidance to RAGS: Calculating the Concentration Term*, May 1992.

- USEPA Region III *Selecting Exposure Routes and Contaminants of Concern by Risk-Based Table*, March 18, 1994, (RBC Screening Tables).

- USEPA Region III *Risk-Based Concentration Table*, January 1995, and subsequent versions (USEPA 1995).

2.1 Objectives

The objectives of the BRA will be to:

- Characterize the source media and determine the chemicals of potential concern (COPCs) for affected environmental media.

- Identify potential receptors and quantify their potential exposures under current and future conditions for all affected environmental media.

- Qualitatively and quantitatively evaluate the adverse effects associated with the site-specific COPCs in each medium.

- Characterize the baseline carcinogenic and noncarcinogenic risks associated with exposure to environmental media at the site(s) under current and future land use conditions.

- Evaluate the uncertainties related to exposure predictions, toxicological data, and resulting carcinogenic risk and noncarcinogenic hazard estimations.

- Establish Remedial Goal Options (RGOs) for chemicals of concern (COC) in each environmental medium based on risk/hazard to facilitate risk management decision-making.

The value of the risk assessment as a basis for making remedial decisions and determining whether detected site concentrations have the potential for toxic effects or increased cancer incidences depends upon adequately characterizing chemical contamination. Variables considered in characterizing the study area and its associated risk will include the amount, type, and location of sources; the pathways of exposure (media type and migration routes); and the type, sensitivities, exposure duration, and dynamics of the exposed populations (receptors). Sampling activities

typically consist of collecting surface (0 to 1-foot interval) and subsurface soil samples, and groundwater samples from monitoring wells installed in various water-bearing zones.

2.2 Organization

A human health risk assessment, as defined by RAGS Part A, includes the following steps:

- *Site characterization*: evaluation of data regarding site geography, geology, hydrogeology, climate, and demographics.

- *Data collection*: analysis of environmental media samples, including background/reference samples.

- *Data evaluation*: statistical analysis of analytical data to identify the nature and extent of contamination and to establish a preliminary list of COPCs based on risk-based and background screening. This list will subsequently be refined to identify COCs.

- *Exposure assessment*: identification of potential receptors under current and predicted conditions and potential exposure pathways, and calculation/quantitation of exposure point concentrations and chemical intakes.

- *Toxicity assessment*: qualitative evaluation of the adverse effects of the COPCs, and quantitative estimate of the relationship between exposure and severity or probability of effect.

- *Risk characterization*: combination of the output of the exposure and the toxicity assessments to quantify the total noncancer and cancer risk to the hypothetical receptors.

- *Uncertainty*: discussion and evaluation of the areas of recognized uncertainty in human health risk assessments in addition to medium - and exposure pathway-specific influences.

- *Risk/hazard summary*: presentation and discussion of the results of the quantification of exposure (risk and hazard) for the potential receptors and their exposure pathways identified under the current and future conditions.

- *RGOs*: computation of exposure concentrations corresponding to risk projections within the USEPA target risk range of 1E-6 to 1E-4 for carcinogenic COCs and hazard quotient goals of 0.1, 1, and 3 for noncarcinogenic COCs.

3 Site Characterization

When performing a HHRA, environmental media data are compiled to determine potential site-related chemicals and exposures as outlined in RAGS Part A. The steps identifying COPCs are discussed below.

3.1 Data Sources

The number of samples collected from each medium will be detailed in this section of the site-specific HHRAs, and tables will show which sample designations will be included and how data are grouped (when applicable). In addition, the analytical methods, the name of the analyzing laboratory, and data quality objectives will be referenced at this point in the HHRA.

3.2 Data Validation

Data validation is an after-the-fact, independent, systematic process of evaluating data and comparing them to established criteria to confirm they are of the technical quality necessary to support the decisions made in the RFI process. Parameters specific to the data are reviewed to determine whether they meet the stipulated DQOs. The quality objectives address five principal

parameters: precision, accuracy, completeness, comparability, and representativeness. To verify that these objectives are met, field measurements, sampling and handling procedures, laboratory analysis and reporting, and nonconformances and discrepancies in the data are examined to determine compliance with appropriate and applicable procedures.

Data for NSA Memphis will be validated in accordance with the methods outlined in the *Comprehensive RFI Work Plan* (E/A&H, 1994b). The data validation report will be referenced in this section of the HHRA.

3.3 Management of Site-Related Data

All environmental sampling data will be evaluated for suitability for use in the quantitative BRA. Data obtained via the following methods will be considered inappropriate:

- Analytical methods that are not specific for a particular chemical, such as total organic carbon, total organic halogen, or TPH (design parameter samples).

- Field screening instruments including total organic vapor monitoring units and organic vapor analyzers.

Additional data excluded will be detailed in the site-specific HHRAs.

Limitations of analytical results will be addressed in HHRAs by including estimated concentration values for reported nondetects. A nondetect indicates that the analyte was not detected above the practical quantitation limit of the sample ("U" qualified results), which is determined by the analytical method, the instrument used, and possible matrix interferences. However, a nondetected analyte could exist at a concentration between zero and the quantitation limit. For this reason, one-half the "U" value could serve as an unbiased estimate of the nondetect. Because the

estimated values of "J" qualified hits are frequently much lower than the sample quantitation limits of "U" qualified nondetects for organic compounds, one-half of each "U" value will be compared to one-half of the lowest hit (normally "J" qualified) at the same site. The lesser of these two values will be used as the best estimate of the concentration potentially present below the sample quantitation limit, and will be inserted into the adjusted dataset. For inorganic chemicals, the rule is simpler: One-half of each "U" value will be used to represent the concentration of the corresponding sample when compiling the adjusted dataset. If two nondetects are reported for any one location (a result of QA/QC samples), one-half the lesser of the "U" values will be compared to the lowest hit at the site (for organics, as above) or applied directly (for inorganics) to estimate a concentration value to be used in the NSA Memphis risk calculations. If a parameter is not detected at a site, neither data management method will be applied, and the parameter will not be considered in screening or formal assessment.

Once the dataset is complete, statistical methods will be used to evaluate the analytical results to (1) identify COPCs and (2) establish exposure point concentrations (EPCs) at potential receptor locations. The statistical methods used in data evaluation are discussed below. The rationale used to develop this methodology and the statistical techniques is based on the following sources:

- RAGS Part A
- *Supplemental Guidance to RAGS: Calculating the Concentration Term*, May 1992
- *Statistical Methods for Environmental Pollution Monitoring* (Gilbert, 1987)

Microsoft Fox Pro and Borland[1] Quattro Pro will typically be used for data management and statistical calculations. For each set of data used to describe the concentration of chemicals in a contaminated area, the following information will be tabulated in accordance with RAGS:

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1 References to specific software products are not to be construed as an endorsement by the U.S. Navy or E/A&H.

frequency of detection, range of quantitation limits, range of detected values, and average of detected concentrations. For datasets of 10 or more, the upper confidence limit (UCL) on the mean of log-transformed values of the concentration will be presented. In accordance with RAGS, the lesser of either the maximum concentration detected or the UCL will be used to quantify potential exposure, as detailed in Section 4, Exposure Assessment.

3.4 Selection of COPCs

The substances detected (chemicals present in site samples, or CPSSs) will be screened to develop a list or group of COPCs. COPCs are, therefore, chemicals selected by comparison to screening concentrations, intrinsic toxicological properties, persistence, fate and transport characteristics, and cross-media transport potential. The nature and general extent of CPSSs will be referenced in this section of the site-specific HHRAs. To reduce the list of CPSSs and focus the risk assessment on COPCs, the following two comparisons will be performed.

3.4.1 Comparison of Site-Related Data to Risk-Based Screening Concentrations

The maximum concentrations of CPSSs detected during sampling will be compared to risk-based screening values. These values will be obtained from *Risk Based Screening Concentrations*, USEPA Region III, January through June, 1996 (and subsequent versions). As stated in the EPA Region III document, a risk goal of 1E-6 will be used to calculate screening concentrations for carcinogens. RBCs will be adjusted to reflect a target HQ of 0.1 for noncarcinogens, in accordance with USEPA Region IV *Supplemental Guidance to RAGS Bulletin 1* (USEPA, November 1995). Groundwater results will be compared to tap water screening values, and reported soil concentrations will be compared to residential soil screening values. CPSSs with maximum detected concentrations exceeding their corresponding concentrations, goals, levels, and/or standards will be evaluated further and compared to reference background concentrations. In addition, surrogate screening values based on toxicological similarities will be used if no screening value are available in USEPA's table, and surrogate screening values will be noted where applied.

The maximum concentration reported for each carcinogenic polycyclic aromatic hydrocarbon (PAH) will be compared to its corresponding screening value. In addition, all carcinogenic PAH concentrations reported at that location will be converted to the benzo(a)pyrene equivalent concentration (BEQ), which will be compared to the screening value for benzo(a)pyrene. PAH conversions will be performed using current Toxic Equivalency Factors (TEFs) for PAHs in accordance with USEPA Region IV *Supplemental Guidance to RAGS Bulletin 2* (USEPA, November 1995).

3.4.2 Comparison of Site-Related Data to Background Concentrations

Background data for NSA Memphis will be referenced in this section, or background reference concentrations from E/A&H's August 27, 1996 *Reference Concentrations* technical memorandum will be used. Following comparison to risk- and hazard-based screening values, CPSSs whose maximum detected concentrations exceeded corresponding background reference concentrations will be formally assessed in the HHRA, unless otherwise noted.

The maximum reported concentration of a CPSS will be compared to its reference background concentration (when applicable). This comparison helps account for naturally occurring elements, such as beryllium, manganese, and arsenic. Thus, risk and/or hazard associated with naturally occurring elements are not addressed where their concentrations are similar to corresponding background.

In the HHRA, if the maximum concentration of a CPSS is determined to be less than either two-times mean background or the risk-based screening values, then the CPSS will not be considered further unless deemed appropriate based on chemical-specific characteristics (e.g., degradation product with greater toxicity).

3.4.3 Elimination of Essential Elements: Calcium, Iron, Magnesium, Potassium, and Sodium

In accordance with RAGS Part A, essential elements that are potentially toxic only at extremely high concentrations may be eliminated as COPCs in a risk assessment. Specifically, an essential nutrient may be screened out if it is present at concentrations that are not associated with adverse health effects. Based on RAGS, the lack of risk-related data, and USEPA Region IV's recommendations, the following essential nutrients will not be included in HHRAs: calcium, iron, magnesium, potassium, and sodium.

Risk information usually obtained from the Integrated Risk Information System (IRIS) or Health Effects Assessment Summary Tables (HEAST) is necessary to calculate risk and hazard estimates (and risk-based screening values). This information is based on toxicological and epidemiological data which are critiqued and approved by the scientific and regulatory community (i.e., listed in IRIS and/or HEAST). Risk information (or surrogate risk information) is not always available for all CPSSs, so their risk and/or hazard will not be calculated. The results of the screening process will be tabulated in the HHRA. No risk-based screening values are available for TPH and chemical-specific analyses were performed on site samples, so exposure will not be quantified for this group of compounds. The most toxic TPH constituents would generally be included in the chemical-specific analyses.

3.4.4 Summary of COPCs

The results of the screening evaluations will be tabulated on a medium-specific basis in the site-specific HHRAs.

3.5 Estimation of Risk and Hazard

COPCs will be identified, and exposure will be estimated for these compounds. Risk/hazard will be subsequently calculated based on exposure estimates, then exposure scenarios (e.g., soil

exposure during commercial land use) exceeding USEPA acceptable limits will be identified. An exposure scenario of concern will be identified as a scenario with incremental excess lifetime cancer risk (ILCR) estimated greater than 1E-4 or a hazard index (HI) estimated greater than 1. In the next step, COPCs exceeding 1E-6 ILCR or a HQ greater than 0.1 in a scenario of concern are retained as COCs. Section 5, Toxicity Assessment, discusses cancer risk thresholds and noncancer toxicity in detail.

4 Exposure Assessment

This section of the HHRAs will determine the magnitude of contact that a potential receptor may have with site-related COPCs. Exposure assessment involves four stages:

- Characterizing the physical setting and land use of the site.
- Identifying COPC release and migration pathway(s).
- Identifying the potential receptors, under various land use or site condition scenarios, and the pathways through which they might be exposed.
- Quantifying the intake rates, or contact rates, of COPCs.

4.1 Exposure Setting and Land Use

The site setting and land use will be detailed or referenced in this section of the site-specific HHRAs. This information is used to develop appropriate exposure estimates for different land use assumptions. If the future use of the area in question is known, this information will be used to define exposure assumptions used when calculating risk (e.g., sites known to be commercially zoned will not be assessed for residential land use). Future land use will be specified with as much accuracy as possible in site-specific HHRAs, particularly for property being transferred from the Navy to the City of Millington.

4.2 Potentially Exposed Populations

This section will describe who may be exposed to contaminants in environmental media. The populations typically addressed will be one or a combination of the following: current site workers, hypothetical current site trespassers, as well as hypothetical future site residents. Because current site workers at most sites within NSA Memphis would be expected to have limited contact with contaminated media at most sites, worker-related exposure may be addressed exclusively for maximally exposed site workers, assuming the future worker scenario would be protective of both current and future site workers. Specifics will be discussed in this section of the site-specific HHRAs.

4.3 Exposure Pathways

This section will summarize how potential human receptors may be exposed to site media. In general, soil matrix-related pathways will include incidental ingestion and dermal contact. Ingestion and inhalation of volatilized contaminants will be typical groundwater exposure pathways. The hypothetical future scenarios will assume continuous, uniform exposure to current surface soil conditions and the use of site groundwater as a potable water source, unless otherwise noted in the site-specific HHRA. A table in the site-specific HHRA will justify and summarize exposure pathways and potential human receptors.

4.4 Exposure Point Concentrations

The EPC is the estimated concentration of a contaminant in an exposure medium that will be contacted by a real or hypothetical receptor. Determining the exposure point concentration depends on factors such as:

- Availability of data
- Amount of data available to perform statistical analysis
- Reference concentrations not attributed to site impacts
- Location of the potential receptor

USEPA Region IV guidance calls for assuming lognormal distributions for environmental data and the calculation of 95% UCL on the mean for use in exposure quantification. Applying the UCL is generally inappropriate with less than 10 samples. Therefore, the maximum concentrations detected will be used for all datasets with less than 10 samples. In general, outliers have been included when calculating the UCL because high values seldom appear as outliers for a lognormal distribution. Including outliers increases the overall uncertainty of the calculated risks and conservatively biases exposure estimates.

For sample sets of 10 and greater, the UCL will be calculated for a lognormal distribution as follows:

$$UCL = e^{\left(\bar{a}+0.5s_a^2 + \frac{H_{0.95}\ x\ s_a}{\sqrt{n-1}}\right)}$$

where:

$\bar{a}$	=	$\Sigma a/n$ = sample arithmetic mean of the log-transformed data, $a = \ln(x)$
s_a	=	sample standard deviation of the log-transformed data
n	=	number of samples in the data set
$H_{0.95}$	=	value for computing the one-sided upper 95% confidence limit on the lognormal mean from standard statistical tables (Gilbert, 1987)

EPCs and UCLs will be summarized and tabulated when applicable in the site-specific HHRA.

4.5 Quantification of Exposure

This section describes the models, equations, and intake model variables used to quantify doses or intakes of the COPCs for the surface soil and groundwater exposure pathways. The models are

designed to estimate route- and medium-specific factors, which are multiplied by the EPC to estimate chronic daily doses. The intake model variables generally reflect 50th or 95th percentile values which, when applied to the EPC, ensure that the estimated intakes represent the reasonable maximum exposure (RME, which is considered 95th percentile). Formulae are derived from RAGS, Part A unless otherwise indicated. Table 1 lists intake model variables used to compute chronic daily intake (CDI) for potential receptors exposed to surface soil and/or groundwater contaminants.

Because NSA Memphis is part of BRAC, future site use cannot be determined with any certainty. Therefore, the conservative assumptions will be used to account for any reasonable future use. Current reuse plans will be referenced and discussed in the site-specific HHRAs. NSA Memphis media analytical results and exposure methods have been formatted to allow exposure estimates to be fine-tuned based on actual conditions as base reuse plans materialize, and this information will be used on a site-specific basis, if known.

In accordance with USEPA's recommendations, the adult and child intake variables will be combined to estimate exposure to carcinogens. This factor is referred to as the lifetime weighted average, or LWA. The LWA considers the difference in daily ingestion rates for soil and drinking water, body weights, and exposure durations for children (ages 1 to 6) and adults (ages 7 to 31). The exposure frequency is assumed to be identical for the adult and child exposure groups, and an example is shown after the equations are presented below.

Before quantifying soil exposure, it will first be necessary to derive the appropriate fraction ingested (or contacted) (FI/FC) from contaminated area factors for each applicable COPC. These factors will be derived by evaluating the spatial distribution of COPCs. The FI/FC will be computed by estimating the maximum area affected and dividing it by the total exposure unit area. These computations will be performed conservatively to account for uncertainty associated with contaminant distributions.

Table 1
Parameters Used to Estimate CDI

Pathway Parameters	Resident Adult	Resident Child	Adult Worker	Trespassing Child (age 7-16)	Units
Surface Soil Ingestion and Dermal Contact					
Ingestion Rate (soil)	100[a]	200[a]	50[a]	100[a]	mg/day
Ingestion Rate (water)	2	1	1	NA	L/day
Exposure Frequency	350[b]	350[b]	250[b]	52[f]	days/year
Exposure Duration	24[c]	6[c]	25[c]	10[g]	years
Dermal Contact Area	4,100[a]	2,900[a]	4,100[a]	4,100[a]	cm^2
Skin Adherence Factor	1	1	1	1	mg/cm^2
Absorption Factor	0.01 (organics) 0.001 (inorganics)	0.01 (organics) 0.001 (inorganics)	0.01 (organics) 0.001 (inorganics)	0.01 (organics) 0.001 (inorganics)	unitless
Oral Absorption Efficiency	0.8 (VOCs) 0.5 (other organic compounds) 0.2 (inorganics)	0.8 (VOCs) 0.5 (other organic compounds) 0.2 (inorganics)	0.8 (VOCs) 0.5 (other organic compounds) 0.2 (inorganics)	0.8 (VOCs) 0.5 (other organic compounds) 0.2 (inorganics)	unitless
Conversion Factor	1E-6	1E-6	1E-6	1E-6	kg/mg
Body Weight	70[a]	15[a]	70[a]	45[a]	kg
Averaging Time, Noncancer	8,760[d]	2,190[d]	9,125[d]	3,650[d]	days
Averaging Time, Cancer	25,550[e]	25,550[e]	25,550[e]	25,550[e]	days

Notes:
a — USEPA (1989a) *Risk Assessment Guidance for Superfund Vol. I, Human Health Evaluation Manual (Part A).*
b — USEPA (1991b) *Risk Assessment Guidance for Superfund Vol. I: Human Health Evaluation Manual Supplemental Guidance, Standard Default Exposure Factors, Interim Final,* OSWER Directive: 9285.6-03.EPA/600/8-89/043.
c — USEPA (1991a), *Risk Assessment Guidance for Superfund: Vol. I – Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals),* OSWER Directive 9285.7-01B.
d — Calculated as the product of ED (years) x 365 days/year.
e — Calculated as the product of 70 years (assumed lifetime) x 365 days per year.
f — Assuming one day per week exposure.
g — Assuming trespassing occurs during the 10-year adolescent/teenage period.
NA — Not applicable.

The FI/FC factors modify the concentrations to more closely approximate site-wide exposure conditions for a given exposure unit area. When the UCL is used as EPC, no FI/FC adjustments will be made. In addition, CPSSs not eliminated from the HHRAs based on the screening comparisons described in Section 3.4 may be eliminated as a COPC because the UCL concentration does not exceed the corresponding background concentration or RBC. This will be discussed on a site-specific basis.

4.5.1 Surface Soil Pathway Exposure

Ingestion of COPCs in Surface Soil

Except CDI for a site resident's exposure to carcinogens, the following equation is used to estimate the ingestion of COPCs in soil:

$$CDI_s = (EPC_s)(IR)(EF)(ED)(F)(FI)/(BW)(AT)$$

where:

CDI_s = ingested dose (mg/kg-day)

EPC_s = exposure point concentration of contaminant in soil (mg/kg)

IR = ingestion rate (milligrams per day [mg/day])

EF = exposure frequency (days/year)

ED = exposure duration (years)

F = conversion factor (1E-6 kg/mg)

FI = fraction ingested from contaminated source (unitless)

BW = body weight (kg)

AT = averaging time (days)

The LWA is used to calculate carcinogenic CDI for site residents. An example of the LWA calculation is shown below for the soil ingestion pathway, and LWAs are similarly calculated for subsequent equations.

$$LWA = [(IR_a \times ED_a)/BW_a] + [(IR_c \times ED_c)/BW_c]$$

where:

LWA = lifetime weighted average

IR = ingestion rate (milligrams per day [mg/day])

ED = exposure duration (years)

BW = body weight (kg)

$_a$ = adult

$_c$ = child

Consequently, CDI for carcinogens would be calculated as follows for site residents:

$$CDI_s = (EPC_s)(EF)(LWA)(F)(FI)/(AT)$$

where:

CDI_s = ingested dose (mg/kg-day)

EPC_s = exposure point concentration of contaminant in soil (mg/kg)

EF = exposure frequency (days/year)

F = conversion factor (1E-6 kg/mg)

FI = fraction ingested from contaminated source (unitless)

AT = averaging time (days)

LWA = lifetime weighted average

Dermal Contact with COPCs in Surface Soil

The following equation is used to estimate intake due to dermal contact with COPCs in soil:

$$CDI_{sd} = (EPC_s)(CF)(EF)(ED)(F)(FC)(ABS)(AF)/(BW)(AT)$$

where:

CDI_{sd} = dermal dose (mg/kg-day)

EPC_s = exposure point concentration of contaminant in soil (mg/kg)

CF = contact factor (cm^2)

EF = exposure frequency (days/year)

ED = exposure duration (years)

F = conversion factor (1E-6 kg/mg)

FC = fraction contacted from contaminated source (unitless)

ABS = absorption factor (unitless value, specific to organic versus inorganic compounds)

AF = adherence factor (milligrams per square centimeter [mg/cm^2])

BW = body weight (kg)

AT = averaging time (days)

4.5.2 Groundwater Pathway Exposure

Ingestion and Inhalation of COPCs in Groundwater

The following equation is used to estimate the ingestion and/or inhalation of COPCs in groundwater:

$$CDI_w = (EPC_w)(IR)(EF)(ED)(FI)/(BW)(AT)$$

where:

CDI_w = ingested/inhaled dose (mg/kg-day)

EPC_w = exposure point concentration of contaminant in water (milligrams per liter [mg/L])

IR = ingestion rate (L/day)

EF = exposure frequency (days/year)

ED = exposure duration (years)

FI = fraction ingested from contaminated source (unitless)

BW = body weight (kg)

AT = averaging time (days)

HHRAs are comprised of many tables, and intake tables serve only as an intermediate check when reviewing the document. The CDI equations above can be solved assuming a concentration of 1, and the result can be used as a universal multiplier. Multipliers were developed for each typical land use scenario and are shown in Table 2. Consequently, a significant number of the tables in HHRAs can be eliminated. An example of the abbreviated CDI method is shown below:

$$CDI = (EPC)(M)$$

where:

CDI = chronic daily intake (mg/kg-day)

EPC = exposure point concentration (mg/kg or mg/L)

M = multiplier specific to the exposure scenario, land use, and potential receptor selected

Table 2
Multipliers[a] Used to Estimate Chronic Daily Intake

		Soil		Groundwater
		Ingestion	*Dermal Contact*	*Ingestion*
Exposure Scenario	**Exposure Type**	**All Chemicals**	**Organics[b]**	**All Chemicals[c]**
Resident	Noncarcinogens (adult)	1.37E-6	5.62E-7	2.74E-2
	Noncarcinogens (child)	1.28E-5	1.85E-6	6.39E-2
	Carcinogens (LWA)	1.57E-6	3.51E-7	1.49E-2
Trespasser	Noncarcinogens	3.17E-7	1.30E-7	NA
(age 7-16)	Carcinogens	4.52E-8	1.85E-8	NA
Site Worker	Noncarcinogens	4.89E-7	4.01E-7	9.78E-3
	Carcinogens	1.75E-7	1.43E-7	3.49E-3

Notes:
NA — Not applicable
LWA — Lifetime weighted average
[a] — The product of the multiplier and the exposure point concentration equals the chronic daily intake for a given chemical assuming a reasonable maximal exposure scenario.
[b] — The multiplier for inorganics is multiplied by a factor of 0.1 to account for the dermal absorption factor of 0.001 for inorganics; the multiplier for organic compounds includes the 0.01 factor.
[c] — The ingestion intake is also used to address inhalation risk in accordance with USEPA's Supplemental Guidance To RAGS Bulletin 3; ingestion risk is approximately equal to risk posed by dermal and inhalation exposure while showering, and this is applied to volatile organic compounds only.

Because multipliers can be reviewed separately, CDI will be incorporated into the risk and hazard equations and *will not be presented* in separate tables.

5 Toxicity Assessment

5.1 Carcinogenicity and Noncancer Effects

USEPA has established a classification system for rating the potential carcinogenicity of environmental contaminants based on the weight of scientific evidence. The cancer classes are described below. Cancer weight-of-evidence class "A" (human carcinogens) means that human toxicological data have shown a proven correlation between exposure and the onset of cancer (in varying forms). The "B1" classification indicates some human exposure studies have implicated the compound as a probable carcinogen. Weight-of-evidence class "B2" indicates a possible human carcinogen based on confirmatory carcinogenic laboratory animal data. Weight-of-evidence class "C" identifies possible human carcinogens, and class "D" indicates a compound not classifiable with respect to its carcinogenic potential. A class "A" compound posing risk higher than USEPA's acceptable risk range has more weight than would a class "C" compound. There is more uncertainty in the lower classifications, so the weight-of-evidence should be used by risk managers when making risk management decisions based on cancer risk.

USEPA has established slope factors (SF) for carcinogenic compounds. The SF is defined as a "plausible upper-bound estimate of the probability of a response (cancer) per unit intake of a chemical over a lifetime" (RAGS, Part A). Upper-bound estimates are more likely to overestimate cancer potential.

In addition to potential carcinogenic effects, most substances also can produce other toxic responses at doses greater than experimentally derived threshold concentrations. USEPA has derived reference dose (RfD) values for these substances. A chronic RfD is defined as, "an estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a daily exposure

concentration for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime." These toxicological values are used in risk formulae to assess the upper-bound level of cancer risk and noncancer hazard associated with exposure to a given chemical concentration.

For carcinogens, the potential risk posed by a chemical is computed by multiplying the CDI (as mg/kg-day) by the SF (in reciprocal mg/kg-day). The HQ (for noncarcinogens) is computed by dividing the CDI by the RfD. USEPA has set standard limits (or points of departure) for carcinogens and noncarcinogens to evaluate whether significant risk is posed by a chemical (or combination of chemicals). For carcinogens, the point-of-departure range is 1E-6, with a generally accepted range of 1E-6 to 1E-4. These risk values correlate with one in 10,000 (1E-4) and one in 1 million (1E-6) excess cancer incidence resulting from exposure to toxic compounds from outside the body.

For noncarcinogens, other toxic effects are generally considered possible if the HQ (or sum of HQs for a pathway-hazard index) exceeds the threshold value of 1. Although both cancer risk and noncancer hazard are generally additive only if the target organ is common to multiple chemicals, a most conservative estimate of each may be obtained by summing the individual risks or hazards, regardless of target organ. Site-specific HHRAs for NSA Memphis will take the universal summation approach for each class of toxicant. Details regarding the risk formulae applied to site data are provided in Section 6, Risk Characterization.

Critical studies used in establishing toxicity classifications by USEPA are shown in the IRIS database, which is the primary source for information necessary to estimate risk. HEAST, Fiscal Year 1995 is the secondary source for this information. In addition, USEPA's National Center for Environmental Assessment (NCEA) will be used as a source when necessary. In accordance with RAGS, a table will summarize toxicological data in the site-specific HHRAs in the form of RfDs and SFs obtained for COPCs identified in site media, as well uncertainty/modifying factors, target organs, and cancer classes (where available).

5.2 Evaluating Dermal Exposure and the Resulting Toxicity

In accordance with USEPA Region IV's *Supplemental Guidance to RAGS Bulletin 2*, dermal RfD values and SFs are derived from the corresponding oral values. As described in the supplemental guidance, the oral RfD is multiplied by an oral absorption efficiency factor (OAF), expressed as a decimal. The resulting dermal RfD is based on the absorbed dose. The RfD based on absorbed dose is the appropriate value with which to compare a dermal dose, because dermal doses are expressed as absorbed rather than administered (intake) doses. For the same reasons, a dermal SF is derived by dividing the oral SF by the OAF. The oral SF is divided rather than multiplied because SFs are expressed as reciprocal doses.

Appendix A of RAGS, Part A states that in the absence of specific data, an assumption of 5% oral absorption would be relatively conservative. *Supplemental Guidance to RAGS: Region IV Bulletin 2* indicates that in the absence of specific data, USEPA Region IV suggests an oral absorption factor of 80% for volatile organics, 50% for semivolatile organics, and 20% for inorganic chemicals. These percentages (or associated fractions) will be used in the site-specific HHRAs

5.3 Toxicity Profiles for COPCs

In accordance with RAGS, toxicological summary paragraphs will be included in the body of the HHRA text for all COPCs. Most information for the profiles will be gleaned from IRIS and HEAST. Another source of information will be NCEA. Any additional references will be noted specifically in the text. The profiles will summarize adverse effects of COPCs and the amount associated with such effects.

6 Risk Characterization

Risk characterization combines the exposure assessment and toxicity assessment results to yield qualitative and quantitative expressions of risk and/or hazard for the exposed receptors. The quantitative component expresses the probability of developing cancer, or a threshold comparison

of the estimated dose with a reference dose for noncancer effects. These quantitative estimates are developed for individual chemicals, exposure pathways, transfer media, and source media, and for each receptor for all media to which one may be exposed. The qualitative component usually involves comparing COC concentrations in media with established criteria or standards for chemicals for which there are no corresponding toxicity values. The risk characterization helps guide risk-management decisions.

Generally, the risk characterization will follow the methodology prescribed by RAGS Part A, as modified by more recent information and supplemental guidance cited in the earlier sections of this memorandum. *The USEPA methods are designed to be health-protective and tend to overestimate risk rather than underestimate it. The risk results, therefore, are generally overly conservative, because risk characterization involves summing the overestimated risk estimates.*

6.1 Risk Characterization Methodology

Potential excess risks to humans following exposure to COPCs will be estimated using methods established by USEPA, when available. As discussed above, these methods are health-protective and are likely to overestimate risk. Risks from hazardous chemicals are calculated for either carcinogenic or noncarcinogenic effects. Some carcinogenic chemicals may also pose a noncarcinogenic hazard. The potential human health effects associated with chemicals that produce carcinogenic and other toxic effects will be characterized separately, as discussed below.

6.1.1 Carcinogenic Effects of Chemicals

The risk attributed to exposure to carcinogens is estimated as the probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. In the low-dose range, which would be expected for most environmental exposures, cancer risk is estimated from the following linear equation (EPA, 1989a):

$$ILCR = (CDI)(SF)$$

where:

ILCR	=	incremental lifetime excess cancer risk, a unitless expression of the probability of developing cancer, adjusted for reference incidence
CDI	=	chronic daily intake, averaged over 70 years (mg/kg-day)
SF	=	cancer slope factor $(mg/kg\text{-}day)^{-1}$

For a given pathway with simultaneous exposure of a receptor to several carcinogens, the following equation is used to sum cancer risks:

$$Risk_p = ILCR(chem_1) + ILCR(chem_2) + \ldots ILCR(chem_i)$$

where:

$Risk_p$	=	total pathway risk of cancer incidence
$ILCR(chem_i)$	=	incremental lifetime excess cancer risk for a specific chemical

Cancer risk for a given receptor across pathways and across media is summed in the same manner.

6.1.2 Noncarcinogenic Effects of Chemicals

The risks associated with the noncarcinogenic effects of chemicals are evaluated by comparing an exposure level or intake with a reference dose. The HQ, defined as the ratio of intake to RfD, is defined as (RAGS, Part A):

$$HQ = CDI/RfD$$

where:

HQ	=	hazard quotient (unitless)
CDI	=	intake of chemical (mg/kg-day)

RfD = reference dose (mg/kg-day)

Chemical noncarcinogenic effects are evaluated on a chronic basis, using chronic RFD values. An HQ of 1 indicates that the estimated intake equals the RfD. If the HQ is greater than unity, there may be a concern for potential adverse health effects.

In the case of simultaneous exposure of a receptor to several chemicals, an HI will be calculated as the sum of the HQs by:

$$HI = HQ_1 + HQ_2 + \ldots HQ_i$$

where:

HI = Hazard Index (unitless)

HQ = Hazard Quotient (unitless)

Risk and hazard projections will be summarized in tabular format on a medium- and exposure pathway-specific basis in the HHRAs.

6.2 Surface Soil Pathways

Generally, the incidental ingestion and dermal contact pathways will be characterized for surface soil. Surface soil onsite will be evaluated under scenarios and exposure pathways outlined in the site-specific HHRAs.

6.3 Groundwater Pathways

Groundwater pathways will typically consist of ingestion and inhalation of volatilized chemicals in groundwater. The site-specific HHRAs will detail the pathways which will be addressed. Most groundwater pathways are not complete because municipal water supplies are used, and this will be discussed in the HHRAs.

6.4 COCs Identified

COCs will be identified based on cumulative (all pathway) risk and hazard projected for the sites. USEPA has established a generally acceptable risk range of 1E-4 to 1E-6, and an HI threshold of 1.0. Any COPC that is carried through the risk assessment process and found to contribute to a scenario with an ILCR in excess of 1E-4 or HI greater than 1 for any of the exposure scenarios evaluated in this risk assessment, and has an individual exposure pathway risk greater than 1E-6 or exposure pathway HQ greater than 0.1, will be referred to as a COC. A table will present the COCs identified in site-specific HHRAs.

7 Risk Uncertainty

This section will discuss the uncertainty and variability inherent in the risk assessment process in addition to site-, medium-, and exposure pathway-specific influences. Overall, uncertainties associated with the initial stages of the risk assessment process become magnified when they are combined with other uncertainties. It is not possible to eliminate all uncertainties; however, recognizing the uncertainties is fundamental to understanding and subsequently using risk assessment results.

Where chronic RME estimates of risk/hazard indicated a significant threat (e.g., ILCR greater than 1E-4) would be posed to human health, central tendency (CT) analysis may be performed. RME estimates are based on the upper bound (90th or 95th percentile) exposure assumptions, while CT estimates are based on the 50th percentile (mean or median) values. CT exposure scenarios are constructed consistent with standard CT exposure assumptions provided in *Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure-Draft* (USEPA, November 1993). CT exposure assumptions will be presented in the site-specific HHRAs, when applicable.

8 Risk Summary

Risk estimates will be presented and summarized in table form in the site-specific HHRAs.

9 Remedial Goal Options

RGOs are chemical concentrations computed to equate with specific risk and/or hazard goals that may be established for a particular site. As previously discussed, COCs are identified as any COPC that significantly contributes to a scenario of concern. RGOs will be calculated for each land use scenario with cumulative risk estimates greater than 1E-4 or cumulative hazard indices greater than 1.0. Based on this method, COCs may be identified, requiring RGO calculation. Inclusion in the RGO table does not necessarily indicate that remedial action will be required to address a specific chemical. Instead, RGOs are provided to facilitate risk-management decisions.

In accordance with USEPA Supplemental RGO Guidance, RGOs will be calculated at 1E-4, 1E-5, and 1E-6 risk levels for carcinogenic COCs and HI goals of 3, 1, and 0.1 for noncarcinogenic COCs. RGOs will be based on specific scenarios which will be identified in the site-specific HHRAs.

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Appendix G

Wildlife Toxicity Data — Baseline Risk Assessment Table

Appendix G
Wildlife Toxicity Data
Baseline Risk Assessment
Assembly E
NSA Memphis – Millington, Tennessee

Chemical	Test Species	Test Type	Duration	Effect	Oral LD_{50} (mg/kg/BW)	LOAEL (mg/kgBW/day)	Reference
SVOCs							
Anthracene	Mouse	Oral	NR	Mortality	17,000		RTECS, 1993
Benzo(a)pyrene	Rat	Oral (chronic)	Pregnancy	Sterility in offspring		40	USEPA, 1984
	Rat	Oral (chronic)	3.5 months	Reproductive		50	USEPA, 1984
	Rodents	Single oral dose	NR	Mortality	50		Eisler, 1987
Bis(2-ethylhexyl)phthalate	Rat	Oral	NR	Mortality	30,600		RTECS, 1993
	Rat	Oral	NR	Reproductive effects		7,140	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		35	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		6,000	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		17,200	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		10,000	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		9,766	RTECS, 1993
	Mouse	Oral	NR	Mortality	30,000		RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		78,880	RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		4,200	RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		50	RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		1,000	RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		2,040	RTECS, 1993
	Rabbit	Oral	NR	Mortality	34,000		RTECS, 1993
	Guinea pig	Oral	NR	Mortality	26,000		RTECS, 1993
	Guinea pig	Oral	NR	Reproductive effects		20,000	RTECS, 1993
	Mammal	Oral	NR	Reproductive effects		20,000	RTECS, 1993
	Mammal	Oral	NR	Reproductive effects		509,000	RTECS, 1993

Appendix G
Wildlife Toxicity Data
Baseline Risk Assessment
Assembly E
NSA Memphis – Millington, Tennessee

Chemical	Test Species	Test Type	Duration	Effect	Oral LD_{50} (mg/kg/BW)	LOAEL (mg/kgBW/day)	Reference
SVOCs							
Bis(2-ethylhexyl)phthalate) (Continued)	Mouse	Single oral dose		Mortality	800		RTECS, 1993 and NIOSH, 1985
	Mouse	Oral (subchronic)	13 weeks	Renal effects		125	RTECS, 1993
Butylbenzylphthalate	Rat	Oral	NR	Mortality	2,330		RTECS, 1994
	Rat	Oral	NR	Reproductive effects		21,000	RTECS, 1994
	Rat	Oral	NR	Reproductive effects		16,400	RTECS, 1994
	Rat	Oral	NR	Reproductive effects		16,400	RTECS, 1994
	Rat	Oral	NR	Reproductive effects		4,900	RTECS, 1994
	Mouse	Oral	NR	Mortality	4,170		RTECS, 1994
	Guinea Pig	Oral	NR	Mortality	13,750		RTECS, 1994
1,4-Dichlorobenzene	Rat	Oral	NR	Mortality	500		RTECS, 1994
	Rat	Oral	NR	Reproductive effects		7,500	RTECS, 1994
	Rat	Oral	NR	Reproductive effects		10,000	RTECS, 1994
	Mouse	Oral	NR	Mortality	2,950		RTECS, 1994
	Rabbit	Oral	NR	Mortality	2,830		RTECS, 1994
Di-n-butylphthalate	Rat	Oral (subchronic)	48 days	Reproductive		125	ATSDR, 1989
	Rat	Oral	1 year	Mortality		600	IRIS, 1991
Fluoranthene	Rat	Oral	NR	Mortality	2,000		RTECS, 1994
Phenanthrene	Mouse	Oral	NR	Mortality	700		RTECS, 1994
Pyrene	Rat	Single oral dose	NR	Mortality	2,700		RTECS, 1993 and NIOSH, 1985
	Mouse	Single oral dose	NR	Mortality	800		RTECS, 1993 and NIOSH, 1985

Appendix G Wildlife Toxicity Data Baseline Risk Assessment Assembly E NSA Memphis – Millington, Tennessee							
Chemical	**Test Species**	**Test Type**	**Duration**	**Effect**	**Oral LD_{50} (mg/kg/BW)**	**LOAEL (mg/kgBW/day)**	**Reference**
Pesticides/PCBs							
Aroclor 1248	Rat	Oral	NR	Mortality	11,000		RTECS, 1993
	Rabbit	Oral	NR	Reproductive effects		165	RTECS, 1993
	Monkey	Oral	NR	Reproductive effects		32	RTECS, 1993
	Monkey	Oral	NR	Reproductive effects		55	RTECS, 1993
	Monkey	Oral	NR	Reproductive effects		17	RTECS, 1993
	Monkey	Oral	NR	Reproductive effects		35	RTECS, 1993
	Monkey	Oral	NR	Reproductive effects		24	RTECS, 1993
	Monkey	Oral	NR	Reproductive effects		83	RTECS, 1993
	Chicken	Oral	8-9 weeks	Egg hatchability		4.88	USEPA, 1993
	Chicken	Oral	NR	Egg production and hatchability		9.8	USEPA, 1993
	Chicken	Maternal diet	NR	Chick growth		0.98	USEPA, 1993
	Chicken	Oral	8 weeks	Egg production and hatchability		4.9	USEPA, 1993
Aroclor 1254	Mouse	Oral	NR	Reproductive		1.53	USEPA, 1993
	Chicken	Oral (chronic)	NR	Embryonic mortality		0.9[a]	USEPA, 1993
	Rock dove	Oral (chronic)	NR	Parental incubation behavior		0.9[a]	Peakall and Peakall, 1973
	American kestrel	Oral (chronic)	69 days	Reduced sperm concentration		9	Eisler, 1986
	Mink	Oral dose of contaminated meat	160 days	Reproductive		0.096	USEPA, 1993

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Chemical	Test Species	Test Type	Duration	Effect	Oral LD_{50} (mg/kg/BW)	LOAEL (mg/kgBW/day)	Reference
Pesticides/PCBs							
Aroclor 1260	Rat	Oral	NR	Mortality	13,15		RTECS, 1993
	Rat	Single oral dose	NR	Mortality	500		Eisler, 1986
	Rat	Single oral dose	NR	Mortality	1,300		Eisler, 1986
	Rat	Oral	NR	Reproductive effects		1,674	RTECS, 1993
	Rat	Oral (chronic)	2 generations	Reduced littler size		7.6	USEPA, 1985
	Rat	Oral (subchronic)	9 weeks	Fetal mortality; maternal toxicity		6.4	ATSDR, 1987
	Mouse	Oral	NR	Reproductive effects		74	RTECS, 1993
	Mink	Single oral dose		Mortality	4,000		Eisler, 1986
	Mink	Single oral dose		Mortality	3,000		Eisler, 1986
	Mink	Single oral dose		Mortality	750		Eisler, 1986
	Mink	Oral (subchronic)	4 months	Impaired reproduction		0.0075[b]	Newell et al., 1987
	Chicken	Oral (chronic)	NR	Embryonic mortality		0.9[a]	USEPA, 1976
Chlordane	Rat	Oral	NR	Mortality	283		RTECS, 1993
	Rat	Single oral dose		Mortality	430		Allen et al., 1979
	Rat	Single oral dose		Mortality	335		Allen et al., 1979
	Rabbit	Single oral dose		Mortality	300		Allen et al., 1979
	Rabbit	Single oral dose		Mortality	100		Allen et al., 1979
	Dog	Single oral dose		Mortality	200		Allen et al., 1979
	Goat	Single oral dose		Mortality	180		Allen et al., 1979
	Japanese quail	Oral (acute)	5 days	Mortality	35*		Hill et al., 1975
	Bobwhite	Oral (acute)	5 days	Mortality	29*		Hill et al., 1975
	Mallard	Oral (acute)	5 days	Mortality	62*		Hill et al., 1975
	Pheasant	Single oral dose		Mortality	24		USFWS, 1984

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Chemical	**Test Species**	**Test Type**	**Duration**	**Effect**	**Oral LD_{50} (mg/kg/BW)**	**LOAEL (mg/kgBW/day)**	**Reference**
Pesticides/PCBs							
4,4'-DDE	Rat	Oral	NR	Mortality	800		RTECS, 1993
	Mouse	Oral	NR	Mortality	700		RTECS, 1993
	Hamster	Oral	NR	Mortality	>5,000		RTECS, 1993
	Mallard	Oral	NR	Eggshell thinning		2.91	USEPA, 1993
	Mallard	Oral	2 years	Reproductive: embryo mortality, cracked eggs		0.58	USEPA, 1993
	Kestrel	Oral	NR	Eggshell thinning		0.39	USEPA, 1993
4,4'-DDT	Rat	Oral	NR	Mortality	87		RTECS, 1993
	Rat	Single oral dose		Mortality	100		USEPA, 1985
	Rat	Oral	NR	Reproductive		112	RTECS, 1993
	Rat	Oral	NR	Reproductive		100	RTECS, 1993
	Rat	Oral	NR	Reproductive		430	RTECS, 1993
	Rat	Oral	NR	Reproductive		1,890	RTECS, 1993
	Rat	Oral	NR	Reproductive		250	RTECS, 1993
	Rat	Oral	NR	Reproductive		50	RTECS, 1993
	Rat	Oral (chronic)	3 generations	Reproductive		0.2	IRIS, 1991
	Rat	Oral	2 years	Reproductive		2.5	USEPA, 1993
	Mouse	Oral	NR	Mortality	135		RTECS, 1993
	Mouse	Single oral dose		Mortality	200		USEPA, 1985
	Mouse	Oral	NR	Reproductive		504	RTECS, 1993
	Mouse	Oral	NR	Reproductive		81	RTECS, 1993
	Mouse	Oral	NR	Reproductive		124	RTECS, 1993
	Mouse	Oral	NR	Reproductive		148	RTECS, 1993

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Pesticides/PCBs							
4,4'-DDT (continued)	Rabbit	Oral	NR	Mortality	250		RTECS, 1993
	Rabbit	Oral	NR	Reproductive		150	RTECS, 1993
	Guinea pig	Oral	NR	Mortality	150		RTECS, 1993
	Hamster	Oral	NR	Mortality	>5,000		RTECS, 1993
	Dog	Oral	NR	Mortality	150		RTECS, 1993
	Dog	Single oral dose		Mortality	60		USEPA, 1985
	Dog	Oral	NR	Reproductive		3,540	RTECS, 1993
	Monkey	Oral	NR	Mortality	200		RTECS, 1993
	Chicken	Oral (subchronic)	10 weeks	Decreased reproductive success; toxic symptoms		91.4[a]	USEPA, 1985
	Rock dove	Single oral dose		Mortality	4,000		USFWS, 1984
	Black duck	Oral (chronic)	2 years	Reduced eggshell thickness		0.14[a]	Longcore and Stendell, 1977
	Mallard	Single oral dose		Mortality	2,240		USFWS, 1984
	Mallard	Oral (subchronic)	96 days	Reduced eggshell thickness		2.8	Longcore and Stendell, 1977
	Mallard	Oral	NR	Eggshell thinning		1.16	USEPA, 1993
	Mallard	Oral	NR	Eggshell thinning		2.91	USEPA, 1993
	Mallard	Oral	2 years	Reproductive		1.45	USEPA, 1993
	California quail	Single oral dose		Mortality	595		USFWS, 1984
	Japanese quail	Single oral dose		Mortality	841		USFWS, 1984
	Pheasant	Single oral dose		Mortality	1,334		USFWS, 1984
	Sandhill crane	Single oral dose		Mortality	1,200		USFWS, 1984

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Pesticides/PCBs							
4,4'-DDT (continued)	Kestrel	Oral (chronic)	7 wk - 1 yr	Reduced eggshell thickness		0.56[a]	USEPA, 1985
	Kestrel	Oral (chronic)	1 year	Reduced eggshell thickness		0.16[a]	Wiemeyer, et al., 1986
	Barn owl	Oral (chronic)	2 years	Reduced eggshell thickness		0.14[a]	Longcore and Stendell, 1977
Dieldrin	Mouse	Single oral dose	NR	Mortality	38		Allen et al., 1979
	Mouse	Oral (chronic)	80 weeks	Body tremors		0.33	ATSDR, 1992
	Rat	Single oral dose	NR	Mortality	46		Allen et al., 1979
	Guinea pig	Single oral dose	NR	Mortality	25		Allen et al., 1979
	Rabbit	Single oral dose	NR	Mortality	45		Allen et al., 1979
	House sparrow	Single oral dose	NR	Mortality	48		USFWS, 1984
	Chicken	Single oral dose	NR	Mortality	20		Allen et al., 1979
	Rock dove	Single oral dose	NR	Mortality	27		USFWS, 1984
	Gray partridge	Single oral dose	NR	Mortality	9		USFWS, 1984

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Chemical	Test Species	Test Type	Duration	Effect	Oral LD_{50} (mg/kg/BW)	LOAEL (mg/kgBW/day)	Reference
Dieldrin (continued)	Chukar	Single oral dose	NR	Mortality	25		USFWS, 1984
	Japanese quail	Oral (acute)	5 days	Mortality	6[a]		Hill et al., 1975
	Japanese quail	Single oral dose	NR	Mortality	70		USFWS, 1984
	California quail	Single oral dose	NR	Mortality	9		USFWS, 1984
	Bobwhite	Oral (acute)	5 days	Mortality	3[a]		Hill et al., 1975
	Pheasant	Single oral dose	NR	Mortality	79		USFWS, 1984
	Mallard	Oral (acute	5 days	Mortality	12[a]		Hill et al., 1975
	Mallard	Oral (acute)	5 days	Mortality	11[a]		Hill et al., 1975
	Mallard	Single oral dose	NR	Mortality	381		USFWS, 1984
	Whistling duck	Single oral dose	NR	Mortality	100		USFWS, 1984
	Canada goose	Single oral dose	NR	Mortality	141		USFWS, 1984
	Goat	Single oral dose	NR	Mortality	100		Allen et al., 1979
	Sheep	Single oral dose	NR	Mortality	50		Allen et al., 1979
	Cattle	Single oral dose	NR	Mortality	60		Allen et al., 1979
	Mule deer	Single oral dose	NR	Mortality	75		Allen et al., 1979
	Cat	Single oral dose	NR	Mortality	300		Allen et al., 1979
	Dog	Single oral dose	NR	Mortality	65		Allen et al., 1979
Endosulfan	Mouse	Oral (chronic)	78 weeks	Mortality		0.9	ATSDR, 1991
	Mouse	Oral (chronic)	78 weeks	Ovarian cyst development		0.26	ATSDR, 1991
	Rat	Single oral dose	NR	Mortality	24		ATSDR, 1991
	Rat	Oral (chronic)	2 years	Reduced testes weight		10	USEPA, 1980
	Mallard	Single oral dose	NR	Mortality	33		USFWS, 1984
	Mallard	Single oral dose	NR	Mortality	31.2		USFWS, 1984

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Chemical	Test Species	Test Type	Duration	Effect	Oral LD_{50} (mg/kg/BW)	LOAEL (mg/kgBW/day)	Reference
Endrin	Pheasant	Single oral dose	NR	Mortality	80		USFWS, 1984
	Mouse	Oral (chronic)	80 weeks	Mortality		0.53	ATSDR, 1990
	Dog	Oral (chronic)	19 months	Decreased weight gain		0.1	USEPA, 1985
2,3,7,8-TCDD	Northern Bobwhite	Single oral dose	NR	Mortality	0.015		Hudson et al., 1984
	Ringed Turtle Dove	Single oral dose	NR	Mortality	0.810		Hudson et al., 1984
	Mallards	Single oral dose	NR	Mortality	0.108		Hudson et al., 1984
	Chicken	Single oral dose	NR	Mortality	0.037		Kociba & Schwetz, 1982
	Guinea pig	Oral	NR	Mortality	0.002		Kociba & Schwetz, 1982
	Mouse	Oral	NR	Mortality	0.284		Kociba & Schwetz, 1982
	Guinea Pig	Single oral dose	NR	Mortality	0.0006		Harless et al., 1982
	Rat	Single oral dose	NR	Mortality	0.022		Kociba & Schwetz, 1982
	Monkey	Single oral dose	NR	Mortality	0.070		Olson et al., 1980
	Dog	Single oral dose	NR	Mortality	0.1		Kociba & Schwetz, 1982
	Mouse	Single oral dose	NR	Mortality	0.114		Kociba & Schwetz, 1982
	Rabbit	Single oral dose	NR	Mortality	0.115		Olson et al., 1980
	Hamster	Single oral dose	NR	Mortality	1.157		Kociba & Schwetz, 1982
	Rat	Oral (chronic)	NR	Reproductive effects		1.0E-05	McNulty, 1977
	Monkey	Oral (chronic)	NR	Reproductive effects		1.7E-06	Ramel, 1978
	Chicken	Oral (chronic)	21 days	Chick liver disease		0.001	NRCC 1981
Inorganics							
Aluminum	Mouse	Oral	2-3 genrtns	Reduced bodyweight gain of newborns		425	NIOSH, 1985
	Rat	Oral	15 days	Reduced growth		100	Bernuzzi, et al., 1989

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Chemical	**Test Species**	**Test Type**	**Duration**	**Effect**	**Oral LD_{50} (mg/kg/BW)**	**LOAEL (mg/kgBW/day)**	**Reference**
Arsenic	Rat	Oral	NR	Reproductive effects		0.61	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		0.58	RTECS, 1993
	Rat	Oral	NR	Mortality	763		RTECS, 1993
	Mouse	Oral	NR	Mortality	145		RTECS, 1993
Beryllium	Rat	Single oral dose	NR	Mortality	10		USEPA, 1985
Inorganics							
Cadmium	Rat	Oral	NR	Reproductive effects		155	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		220	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		21.5	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		23	RTECS, 1993
	Rat	Single oral dose		Mortality	250		Eisler, 1985
	Rat	Oral	NR	Mortality	225		RTECS, 1993
	Mouse	Oral	NR	Mortality	890		RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		448	RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		1,700	RTECS, 1993
	Guinea pig	Single oral dose		Mortality	150		Eisler, 1985
	Mallard	Oral (subchronic)	90 days	Egg production suppressed		10	Eisler, 1985
Chromium (Potassium dichromate)	Japanese quail	Oral (acute)	5 days	Mortality	126		Hill and Camardese, 1986
Copper	Rat	Single oral dose		Reproductive effects		152	NIOSH, 1985 and RTECS, 1993
	Mallard	Oral (subchronic)	29 days	NOAEL for survivorship		10.5[b]	Demayo et al., 1982

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Chemical	Test Species	Test Type	Duration	Effect	Oral LD_{50} (mg/kg/BW)	LOAEL (mg/kgBW/day)	Reference
Inorganics							
Iron	Rat	Single oral dose	NR	Mortality	319		Sax, 1984
	Mouse	Single oral dose	NR	Mortality	979		Sax, 1984
	Guinea pig	Single oral dose	NR	Mortality	1,200		Sax, 1984
Lead	Rat	Oral	NR	Reproductive effects		790	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		1,140	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		520	RTECS, 1993
	Rat	Oral	NR	Reproductive effects		1,100	RTECS, 1993
	Calf	Single oral dose	NR	Mortality	220		Eisler, 1988
	Mouse	Oral	NR	Reproductive effects		1,120	RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		6,300	RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		300	RTECS, 1993
	Mouse	Oral	NR	Reproductive effects		4,800	RTECS, 1993
	Domestic animal	Oral	NR	Reproductive effects		662	RTECS, 1993
	Mammal	Oral	NR	Reproductive effects		2,118	RTECS, 1993
	Kestrel	Diet	NR	Decreased egg laying fertility; decreased egg shell thickness		250[b]	Eisler, 1988
	Nestlings	Oral	NR	Reduced growth and brain weight; abnormal development		125	Eisler, 1988
	Japanese quail	Diet	5 days	Mortality	24,752		Hill and Camardese, 1986

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Inorganics							
Manganese	Mouse	Oral (subchronic)	90 days	Delayed growth of testes		140	ATSDR, 1990
	Mouse	Oral (chronic)	103 weeks	Mortality		4,050	ATSDR, 1990
	Rat	Single oral dose	NR	Mortality	410		ATSDR, 1990
	Rat	Oral (acute)	20 days	Mortality	225		ATSDR, 1990
	Rat	Oral (subchronic)	20 days	Decreased littler weight during gestation		3,100[b]	ATSDR, 1990
	Rat	Oral (chronic)	103 weeks	Mortality		930	ATSDR, 1990
	Guinea pig	Single oral dose	NR	Mortality	400		USEPA, 1984
Mercury	Monkey	Oral (chronic)	18 months	Weakness, rigidity		25	ATSDR, 1990
	Mouse	Single oral dose		Mortality	22		NIOSH, 1985
	Rat	Oral (chronic)	NR	Reduced fertility		0.5	Eisler, 1987
	Rat	Single oral dose		Mortality	18		NIOSH, 1985
	Pig	Oral (subchronic)	Pregnancy	High incidence of stillbirths		0.5	Eisler, 1987
	Mule deer	Single oral dose		Mortality	17.9		Eisler, 1987
	River otter	Single oral dose		Mortality	2		Eisler, 1987
	Mink	Single oral dose		Mortality	1		Eisler, 1987
	Dog	Oral (subchronic)	Pregnancy	High incidence of stillbirths		0.1	Eisler, 1987
	House sparrow	Single oral dose		Mortality	12.6		Eisler, 1987
	Rock dove	Single oral dose		Mortality	22.8		Eisler, 1987
	Chicken	Single oral dose		Mortality	20		Fimreite, 1979
	Bantam chicken	Single oral dose		Mortality	190		Fimreite, 1979

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Inorganics							
Mercury (continued)	Prairie chicken	Single oral dose		Mortality	11.5		Eisler, 1987
	Chukar	Single oral dose		Mortality	26.9		Eisler, 1987
	Corturnix	Single oral dose		Mortality	11		Eisler, 1987
	Mallard	Oral	NR	Reproduction, behavior		0.064	USEPA, 1993
	Black duck	Oral (subchronic)	28 weeks	Reproduction inhibited		0.22[a]	Eisler, 1987
	Fulvous whistling duck	Single oral dose		Mortality	37.8		Eisler, 1987
	Northern bobwhite	Single oral dose		Mortality	23.8		Eisler, 1987
	Bobwhite quail	Oral (acute)	5 days	Mortality	523		Hill et al., 1975
	Japanese quail	Single oral dose		Mortality	14.4		Eisler, 1987
	Gray partridge	Single oral dose		Mortality	17.6		Eisler, 1987
	Gray pheasant	Oral (subchronic)	30 days	Reduced reproductive ability		0.64	Eisler, 1987
	Ring-necked pheasant	Single oral dose		Mortality	11.5		Eisler, 1987
Nickel	Rat	Oral	NR	Reproductive effects		158	RTECS, 1994
		Single oral dose	NR	Mortality	67		ATSDR, 1987
Selenium	Rat	Oral	NR	Mortality	6,700		RTECS, 1993
		Oral	NR	Reproductive effects		134	RTECS, 1993
	Rat	Oral (subchronic)	3 months	Reduced hatchability		1.75	Eisler, 1985
Vanadium	Rat	Oral (acute)	5 days	Mortality	96		Hill and Camardese, 1986
Zinc	Rat	Single oral dose		Mortality	2,510		RTECS, 1993
	Rat	Oral (subchronic)	NR	Kidney toxicity		160	Llobet, et al., 1988

Notes:
LD50 = Dose resulting in 50% mortality in test population.
BW = Body weight.
LOAEL = Lowest Observed Adverse Effect Level.
NR = Not reported.
a = Converted to dose per kilogram body weight by multiplying by ingestion and dividing by body weight.
b = Estimated by applying a LOAEL-NOAEL ratio of 5 (Newell et al., 1987).