137532

R-33-2-9-27

FINAL REMEDIAL INVESTIGATION REPORT

VOLUME II OF III: APPENDICES

C&R BATTERY SITE
CHESTERFIELD COUNTY, VIRGINIA

EPA WORK ASSIGNMENT NUMBER 37-01-3LP4
CONTRACT NUMBER 68-W8-0037

NUS PROJECT NUMBER 9851

JANUARY 1990

AR301629

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APPENDICES

APPENDIX A

DRILLING AND MONITORING WELL DATA AND MINERALOGICAL DATA FOR SOIL

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APPENDIX A-1

SOIL BORING DESCRIPTION LOGS

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: SOØ1
PROJECT NO.: 9851 — DATE: 9-22-88 — DRILLER: JIM ROCHFORD
ELEVATION: 44.80 — FIELD GEOLOGIST: RICK BETHEL
WATER LEVEL DATA:
(Date, Time & Conditions) HOT, SUNNY, CLEAR, SLT BREEZE 0-10 mph winds from E, 80-90°F

TIME	SAMPLE NO.	SAMPLE NO. & TYPE OR ROD	DEPTH (ft) OR RUN NO.	BLOWS/6" OR ROD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS CLASSIFICATION	REMARKS
1032	SOØ1	00/SS	0-2'	6 5 5 6	1.5/2.0		STIFF	TAN	SILT AND FINE SAND, SOME CLAY	ML	DAMP, TOP 2" TOPSOIL SILT w/ BAT. CSG; + WOOD, SLT H-BOW ODOR ROOTLETS
1040	SOØ1	03/SS	3-5'	6 7 12 19	2.0/2.0		VERY STIFF	TAN w/ GRAY MOT.	SILT AND FINE SAND, TR. CLAY	ML	BAT. CSG WOOD CHIP. FL RNG @ 3' QTZ PEBBLE 3'4" MOIST ROOTLETS
1102	SOØ1	06/SS	6-8'	11 19 28 33	2.0/2.0		HARD	OR. w/ GRAY MOT.	SILT AND FINE SAND	ML	DAMP + MICACEOUS NO PLAST. TR. ROOTLETS COBBLE @ 8' DRVD ON DRILLER
1115	SOØ1	09/SS	9-11'	5 6 12 16	2.0/2.0		VERY STIFF	TAN w/ GRAY MOT.	SILT AND FINE SAND, TR CLAY	ML	MOIST, MICACEOUS, 1 RND PEBBLE
1131	SOØ1	13/SS	13-15	14 15 30 20	1.8/2.0		HARD	TAN w/ GRAY + OR. MOT.	SILT AND FINE SAND, SOME CLAY	ML	MOIST, MICACEOUS, SLT. PLASTICITY
						TD 15'					

REMARKS: RIG: CME 75 DRILLING METHOD: H.S. AUGERS - 4¼" ID, 6½" OD
SAMPLED w/ 3" ID 2' LONG SPLIT SPOON DRIVEN w/ 140 lb HAMMER
DROPPED 30" BORING COMPLETED @ 1135 9-22-88

BORING SOØ1
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AR301634

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: SØ2

PROJECT NO.: 9851 — DATE: 9-22-88 — DRILLER: JIM ROCHFORD

ELEVATION: 4546' — FIELD GEOLOGIST: RICK BETHEL

WATER LEVEL DATA:

(Date, Time & Conditions) HOT, SUNNY, Clear, SW Breeze 80-90° F

TIME	SAMPLE NO.	SAMPLE NO. & TYPE OR RUN NO.	DEPTH (FT.) OR RUN NO.	BLOWS/6" OR RQD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (DEPTH, FT.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS SOIL CONSISTENCY	REMARKS
0845	SØ2-	00 SS	0-2'	5 11 7 9	1.5/2.0		VERY STIFF	TAN	SILT W/ CLAY AND FINE	ML	BAT. CSGs to 1' in loam soil, silt had slt H₂SO₄ odor; trace small qtz pebbles, damp
									SAND		
0856	SØ2-	03 SS	3-5	11 14 26 20	1.2/2.0		HARD	TAN	SILT AND FINE SAND	ML	DAMP, BAT CSGs Present Rootlets
									SOME CLAY		
0915	SØ2	06 SS	6-8'	11 11 20 24	1.8/2.0		HARD	TAN OR GRAY + OR. MOT.	SILT AND FINE SAND	ML	DAMP, SLT. PLAST., FOUND 1 PIECE OF BATT. CSG
									TR. CLAY AND GRAVEL		
0929	SØ2	09 SS	9-11'	11 19 25 27	1.9/2.0		HARD	TAN- OR. w/ GRAY MOT	SILT AND FINE SAND	ML	MOIST, TR. ROOTLETS, BLK COALIFIED AREAS MICACEOUS
0946	SØ2	13 SS	13-15	10 16 17 22	2.0/2.0		HARD	TAN + GRAY OR. MOT.	SILT AND FINE SAND,	ML	MOIST, SLT PLAST. OCCAS. RND. QTZ PEBBLE
						TD 15'			TR. CLAY		

REMARKS: RIG: CME 75, DRILLING METHOD: H.S. AUGERS + 4¼" ID, 6½" OD, SAMPLED USING 3" ID, 2' LONG Split Spoon driven w/ 140# HAMMER DROPPED 30". Complete boring at 0950 9-22-88

BORING SØ2

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AR301635

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: SØØ3
PROJECT NO.: 9951 — DATE: 9-22-88 — DRILLER: JIM ROCKFORD
ELEVATION: 43.98' — FIELD GEOLOGIST: RICK BETHEL
WATER LEVEL DATA:
(Date, Time & Conditions) 1350, 9-22-88, Hot, Sunny, Elev., Sl. Breeze, 0-10 mph, fr. SE, 85°F

TIME	SAMPLE NO.	SAMPLE NO. & TYPE OR ROD	DEPTH (FT.) OR RUN NO.	BLOWS/ 6" OR ROD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (DEPTH, FT.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
1356	SØØ3	00 SS	0-2'	6 5 8 6	1.7 / 2.0		STIFF	TAN w/ OR. MOT	SILT AND FINE SAND, TR. CLAY	ML	TOP 6" DEC LOAMY SOIL w/ ROOTLETS, WOOD, SOME BATT CGS. DAMP TO MOIST THRUOUT V. SLT. PLAST. FG STAINED DEP 2' ROOTS.
1419	SØØ3	03 SS	3-5'	6 8 12 16	2.0 / 2.0		VERY STIFF	TAN-OR. w/ GRAY MOT.	SILT AND FINE SAND, SOME CLAY	ML	MOIST, SLT PLAST. OCCAS CALCIFIED (REACTS) +ROOTS SLT. H2S, ODOR
1425	SØØ3	06 SS	6-8'	8 9 14 22	2.0 / 2.0		VERY STIFF	TAN OR. w/ GRAY MOT.	SILT AND FINE SAND, TR TO SOME CLAY	ML	MOIST, SLT. PLAST., SOME ROOTLETS, MICACEOUS
1433	SØØ3	09 SS	9-11'	7 10 15 19	1.8 / 2.0			GRAY w/ TAN OR MOT.	SILT AND FINE SAND SOME CLAY	ML	MOIST TO V. MOIST, ROOTS, OCCAS. MED. PEBBLES, MICACEOUS,
1448	SØØ3	13 SS	13-15'	8 11 10 11	2.0 / 2.0	T.D. 15'	VERY STIFF	TAN & GRAY	SILT AND FINE SAND, TR. TO SOME CLAY, LENSE OF SAND + GRAVEL	ML/ SW	MOIST, MICACEOUS, SLT. PLAST, 0.5' LAYER OF DRY CRS. TO FINE SD + GRAV, FE STAINED SAT. BELOW SANDY/GR. w/ SILT

REMARKS Rig: CME 75. Drilling Method: H.S. Augers - 4¼" ID, 6½" OD: Sampled w/ a 3" OD, 2' Long split spoon driven w/ 140# Hammer dropped 30". Boring completed @ 1500.

BORING SØØ3

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AR301636

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: SO@4
PROJECT NO.: 9851 — DATE: 9-21-88 — DRILLER: JIM ROCHFORD
ELEVATION: 44.53' — FIELD GEOLOGIST: RICK BETHEL
WATER LEVEL DATA :
(Date, Time & Conditions)

TIME	SAMPLE NO.	SAMPLE NO. & TYPE OR CORE	DEPTH (FT.) OR RUN NO.	BLOWS/6" OR RQD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (DEPTH, FT.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	ORGANIC CONSTITUENTS (USCS)	REMARKS
1536	SO@4-	00 SS	0-2'	5 14	1.7 2.0				FILL		BATT. CASE 0-1' in LOAMY SOIL ROOTLETS, DAMP
				15 6			VERY STIFF	LT. BRN	SILT AND CLAY	ML	
1545	SO@4-	03 SS	3-5	15 10	1.8 2.0		VERY STIFF	LT. BRN	SILT AND CLAY, SOME	ML	PLASTIC STICKY, DAMP, MICACEOUS
				14 26					FINE SAND		
											HIT COBBLE @ 6' COULD NOT SAMPLE, DRILLED TO 7'
1600	SO@4-	04 SS	7-9'	8 13	1.9 2.0		VERY STIFF	LT BRN TO GRAY	SILT AND FINE SAND	ML	MOIST SLT. PLAST. XCAS RND. QTZ PEBBLE
				18 23				W OR MOT.	TR CLAY		W SLT. PLAST.
1614	SO@4	09 SS	9-11'	5 7	1.9 2.0	color change	STIFF	LT. BRN TO GRAY MOT.	SILT AND FINE SAND	ML	MOIST TO SAT. @ 10' (PERCHED)
				9 11			-	GRAY W/ SLT OR MOT.	TR. CLAY		
1629	SO@4	13 SS	13-15	10 9	2.0 2.0		VERY STIFF	TAN TO GRAY	SILT AND FINE SAND	ML	SAT. (PERCHED)
				10 14				SOFT OR MOT.	TR. CLAY		
						T.D. 15'					

REMARKS RIG: CME 75, DRILLING METHOD: H.S. Augers 4¼"ID, 6½"OD
SAMPLED USING 3"ID, 2' LONG SPLIT SPOON DRIVEN W/ 140# HAMMER DROPPED 30" Completed Boring @ 1640

BORING SO@4

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AR301637

BORING LOG — **NUS CORPORATION**

PROJECT: C&R Battery — BORING NO.: S005
PROJECT NO.: 9851 — DATE: 9/15/88 — DRILLER: Jim Rockford
ELEVATION: 43.40 — FIELD GEOLOGIST: Jon Lewis
WATER LEVEL DATA:
(Date, Time & Conditions) 9/15/88; start 1724, finish ~1934; lt breeze, low 70s, clear

Time	Sample No.	SAMPLE NO. & TYPE OR RQD	DEPTH (ft.) OR RUN NO.	BLOWS/6" OR RQD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (Depth ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK CORE RECOVERY	REMARKS
1724	S005-	00/SS	0-2	3/7, 13/17	1.5/2.0		M. DENSE	DK GRAY w/ minor OR	Silt	ML	Battery casing frags. Hi % organics, Fe stringers Dry
1734	S005-	03/SS	3-5	7/7, 8/15	1.7/2.0		V. STIFF	GRAY w/OR MOTLG	Silt w/ FN Sand	ML	Cohesive, Moist Fe stained stringers
1742	S005-	06/SS	6-8	6/8, 15/15	1.3/2.0		V. STIFF	GRAY w/ OR MOTLG	Silt w/ FN Sand	ML	Sm. Batt. Casing Frags. Several gravel size grains. Moist, Cohesive
1751	S005-	09/SS	9-11	8/9, 14/14	1.9/2.0		V. STIFF	GRAY w/ OR MOTLG	Silt w/ FN Sand	ML	Rare gravel clasts (QTZ) Moist Cohesive
1803	S005-	13/SS	13-15	3/5, 8/11	1.7/2.0		M. STIFF	GRAY w/ some OR	Silt w/ minor FN Sand	ML	Cohesive, Moist. Coarse Grained micas. Rare Fe stringers
1819	S005-	20/SS	20-22	5/9, 18/39	1.8/2.0		M. DENSE	LT GRAY to LT BRN	FN to MED SAND grades to	SM	Mica rich, Moist Angula
									MED to CRS SAND and GRAVEL	GM	Sand grains.

REMARKS Drilling completed with CME 75 using 4¼" ID, 6½" OD H.S. augers. Samples collected using 3" x 2' split spoon (SS) driven with a 140 lb hammer dropped 30"
- No water in the borehole. T.D. 40'. Tape measure dropped to 42" through split spoon hole.

BORING S005
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AR301638

BORING LOG — **NUS CORPORATION**

PROJECT: C&R Battery — BORING NO.: S005
PROJECT NO.: 9851 — DATE: 9/15/88 — DRILLER: Tim Rockford
ELEVATION: — FIELD GEOLOGIST: Jon Lewis
WATER LEVEL DATA: (Date, Time & Conditions) see page 1

Time	Sample No.	SAMPLE NO. & TYPE OR ROD	DEPTH (Ft.) OR RUN NO.	BLOWS/ 6" OR ROD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (Depth Ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK CORE SCLASS	REMARKS
1832	S005-	25/SS	25-27	7 6 9 14	2.0/2.0		STIFF	GRAY to DK GRAY OR at Top	Silt w/ Clay	CL	Cohesive, Damp. Top 0.2' is siltier and orange w/ sm fe nodules. The rest is damp gray silt w/ clay w/ sm., dry, white nodules disseminated throughout.
1848	S005-	30/SS	30-32	20 21 23 17	2.0/2.0		STIFF HARD	GRAY w/ OR and Buff zone	Silt w/ FN Sand, Some Clay in last 0.5'	ML	After 28' driller says v. stiff. Top 0.2' oxidized, bottom 1.8' reducing.
1905	S005-	35/SS	35-37	19 h 12 45	2.0/2.0		M DENSE	OR and LT GRAY	FN to MED Sand, some Silt.	ML SC	Gray silt w/ sand at top 0.5'. Buff silt w/ sand ~ 0.1'. 0.3' orange sandy silt FE stained zone. Bottom 1.2' is gray silt w/ tn sand (minor clay) Buff and orange horizon is dry and friable. Remainder moist and cohesive
1928	S005-	40/SS	40-42	38 13 17 19	1.2/2.0	~H8' TD 42'	M. DENSE	OR	GRAVEL w/ SAND	GM	Damp. Top 0.4' is gray, silt w/ FN sand. The rest is Gray and orange fn-med sand. Fe stain in pockets

REMARKS

BORING S005

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AR301639

BORING LOG — **NUS CORPORATION**

PROJECT: C&S Battery — BORING NO.: S005
PROJECT NO.: 9851 — DATE: 9/15/88 — DRILLER: Jim Rochford
ELEVATION: — FIELD GEOLOGIST: Jon Lewis
WATER LEVEL DATA: See page 1
(Date, Time & Conditions)

SAMPLE NO. & TYPE OR TCD	DEPTH (Ft.) OR RUN NO.	BLOWS/ 6" OR RQD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, Ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	MATERIAL DESCRIPTION: COLOR	MATERIAL DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK CORE SCALE	REMARKS
									Wet. Poorly sorted,
									Qtz gravel and sand.
									Fe stained Fn-CRs
									sand matrix. Pebble
									is largest grain size

REMARKS

BORING S005

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AR301640

BORING LOG — **NUS CORPORATION**

PROJECT: C&R Battery — BORING NO.: 5005-A *
PROJECT NO.: 9851 — DATE: 9/15/88 — DRILLER: Jim Rochford
ELEVATION: 43.34 — FIELD GEOLOGIST: Jon Lewis
WATER LEVEL DATA:
(Date, Time & Conditions) 9/15/88; start 1700, finish 1710; sunny, lt breeze, 70s.

SAMPLE NUMBER	SAMPLE NO. & TYPE OR RQD	DEPTH (FT.) OR RUN NO.	BLOWS/6" OR RQD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (DEPTH, FT.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK CONSISTENCY	REMARKS
1702	5005-00 / SS	0-2	9 / 11 / 21 / 20	1.8 / 2.0		DENSE	GRAY w/ DK OR	Silt w/ Sand, minor clay		Hi % organics. Battery casing frags. Cause some black zones. Dry, Friable, Fe stained stringers. Sl moist
1710	5005-03 / SS	3-5	9 / 7 / 8 / 13	1.9 / 2.0		V. Stiff	GRAY w/ OR MOTLG	Silt		
					TD 5'					

REMARKS Drilling accomplished with a CME 75 using 4¼" ID, 6½" OD H.S. Augers. Samples obtained with a 3" diam. x 2' split spoon (ss), driven with a 140 lb hammer dropped 30".

BORING 5005-A

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* This hole was originally designated 5005 but due to poor recovery it was abandoned. The two samples collected (5005-00 and 5005-03) will be analyzed for EP Tox.

AR301641

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: SØ86
PROJECT NO.: 9851 — DATE: 9-26-88 — DRILLER: JIM ROCHFORD
ELEVATION: 44.52' — FIELD GEOLOGIST: RICK BETHEL
WATER LEVEL DATA:
(Date, Time & Conditions) HOT, SUNNY, CLEAR, CALM 80° F

TIME	SAMPLE NO.	SAMPLE NO. & TYPE OR ROD	DEPTH (Ft.) OR RUN NO.	BLOWS/6" OR ROD (%)	SAMPLE RECOVERY (SAMPLE LENGTH)	LITHOLOGY CHANGE (Depth, Ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK CORE CLASS	REMARKS
410	SØ86	00 SS	0-2'	5 27 17 11	1.4 2.0		HARD	TAN	LOAM SILT AND FINE SAND	ML	BAT. CSG FRGS. 0-1', ROOTLETS, DAMP
1420	SØ86	03 SS	3-5'	12 7 8 14	1.7 2.0		STIFF	TAN SR. W/ GRAY LAM.	SILT AND FINE SAND, TR. CLAY	ML	SLT. PLAST. DAMP, ROOTLETS
1437	SØ86	06 SS	6-8'	10 15 19 21	2.0 2.0	SILTY CHANGE	HARD	TAN GRAY W/OR. MOT.	SILT AND FINE SAND	ML	DAMP, MICACEOUS, TR. ROOTLETS, NO PLAST.
1450	SØ86	09 SS	9-11'	19 11 15 17	2.0 2.0		VERY STIFF	GRAY W OR. MOT.	SILT AND FINE SAND, SOME TO TR. CLAY	ML	V. MOIST, MICACEOUS SLT. PLAST, TR ROOTLETS
1459	SØ86	13 SS	13-15'	6 6 6 8	2.0 2.0		STIFF	GRAY W SR. MOT.	SILT AND FINE SAND, SOME CLAY	ML	MOIST TO SAT. V. MICACEOUS V. PLAST TO SLT. PLAST SLTLY STICKY
						TD 15'					

REMARKS R16: CME 75, DRILLING METHOD: 4¼" ID, 6½" OD H.S. AUGERS. SAMPLED USING 3" ID, 2' LONG SPLIT SPOON DRIVEN W/ 140LB HAMMER DROPPED 30". BORING COMPLETED @ 1510 9-26-88

BORING SØ86

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AR301642

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: S007
PROJECT NO.: 9851 — DATE: 9-21-88 — DRILLER: JIM ROCHFORD
ELEVATION: 44.03 — FIELD GEOLOGIST: RICK BETHEL
WATER LEVEL DATA:
(Date, Time & Conditions) 0855, 9-21-88 HOT, SUNNY, CLEAR BREEZE 0-10 mph winds from NE

TIME	SAMPLE NO.	SAMPLE NO. & TYPE OR CORE	DEPTH (ft.) OR RUN NO.	BLOWS/6" OR RQD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (DEPTH, ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS CONSISTENCY	REMARKS
0855	S007-	00 SS	0-2'	6 7 15 13	1.6 / 2.0			BRN TO BLACK	FILL (SILT AND FINE SAND)		TOP .5' Brn soil w/ white lines mixed. Bottom 1.5 from bag. Csg w/ blk stained soil, H_2S odor
0903	S007- S007-03-D	03 SS	3-5'	14 5 7 11	1.4 / 2.0		STIFF	GRAY w/ OR MOT.	SILT AND FINE SAND, SOME CLAY	ML	MOIST, H_2S odor, Brn csg in top 6". PLASTIC
0917	S007-	06 SS	6-8'	8 8 12 12	1.9 / 2.0		VERY STIFF	GRAY w/ OR. MOT.	SILT AND FINE SAND, SOME TO TR. CLAY	ML	MOIST, SLT PLASTIC.
0928	S007-	09 SS	9-11	7 9 16 28	1.8 / 2.0		VERY STIFF	GRAY w/ OR MOT	SILT AND FINE SAND, TR. TO SOME CLAY	ML	MOIST, CLAY CONTENT DIMINISHED W/ DEPTH
1043	S007-	13 SS	13-15	6 9 15 16	1.9 / 2.0		VERY STIFF	GRAY w/ OR MOT.	SILT AND FINE SAND	ML	MOIST, NON PLAST. MICACEOUS
						TD 15'					

REMARKS: Rig: CME 75; Drilling Method: 4¼" ID, 6½" OD H.S. Augers sampling w/ a 3" ID 2' long split spoon driven w/ a 140 lb. Hammer dropped 30" completed boring at 0950.

BORING 9007

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AR301643

BORING LOG — **NUS CORPORATION**

PROJECT: C+R Battery — BORING NO.: S008
PROJECT NO.: 9851 — DATE: 9/21/88 — DRILLER: Jim ROCHFORD
ELEVATION: 44.98' — FIELD GEOLOGIST:
WATER LEVEL DATA:
(Date, Time & Conditions) 1027 — HOT, SUNNY, CLEAR, High Breeze

TIME	SAMPLE NO.	SAMPLE NO. & TYPE OR RQD	DEPTH (FT.) OR RUN NO.	BLOWS/6" OR RQD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (DEPTH, FT.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	UNIFIED SOIL CLASS. OR ROCK CONTACTS	REMARKS
022	S008	00/SS	0-2	3/3	1.5/2.0		VERY STIFF	BRN	FILL		BATT. CASES + LIME RICH SOIL 0-1', DRY.
				13/11				DRK BRN	SILT AND FINE SAND	ML	1-2' DAMP, NO PLAST., ROOTLETS MINOR MICA SLT HGT% ORG
1031	S008	03/SS	3-5	9/7	2.0/2.0		VERY STIFF	TAN W/ GRAY MOT.	SILT AND FINE SAND	ML	DAMP TR. ROOTLETS MICA PRESENT, SOME BAT. CASES, BUT MAY HAVE FALLEN INTO HOLE FROM ABOVE
				9/21							
1043	S008	06/SS	6-8	14/22	2.0/2.0		HARD	TAN W/ OR-GRY MOT.	SILT AND FINE SAND, TR. CLAY	ML	DAMP, MICA PRESENT, FEW BAT. CASES, NOT PROBABLY FELL INTO HOLE FROM ABOVE V. SLT. PLAST.
				29/40							
1100	S008	09/SS	9-11	7/10	2.0/2.0		VERY STIFF	TAN W/ OR+GRAY MOT.	SILT AND FINE SAND, TR. CLAY	ML	DAMP SLT PLAST. SOME MICA PRESENT
				16/22							
1125	S008	13/SS	13-15	3/5		COLOR CHANGE		TAN W/ OR GRAY	SILT AND FINE SAND,	ML	MOIST - V MOIST MICACEOUS, SLT. PLAST
				9/12				GRAY W/ OR. MOT.	TR TO SOME CLAY		
						TD 15'					

REMARKS: R16: CME 75 using 4¼" ID, 6½" OD H.S. Augers, sampling using a 3" ID, 2' Long split spoon driven w/ a 140 lb Hammer Dropped 30"
Boring complete @ 1130 9-21-88

BORING S008

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AR301644

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: SO09
PROJECT NO.: 9061 — DATE: 9-21-88 — DRILLER: JIM ROCHFORD
ELEVATION: 43.63' — FIELD GEOLOGIST: RICK BETHEL
WATER LEVEL DATA:
(Date, Time & Conditions) 1400 9-21-88 Hot, Sunny Clear Slt. Breeze

TIME	SAMPLE NO.	SAMPLE NO. & TYPE OR RUN NO.	DEPTH (ft.) OR RUN NO.	BLOWS/6" OR RQD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth/ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	BORING USCS CLASSIFICATIONS	REMARKS
1405	SO09-	09/SS	0-2'	10/14	1.6/2.0				FILL		Top 5" loamy soil, 5-10" crushed BAT Casg 1-2'
				16/19				DRK GRAY	SILT AND FINE SAND	ML	Grey silt + sand damp slt plast, odor metallic
								w/ BLK STREAK:			No plant
1413	SO09-	03/SS	3-5'	13/8	2.0/2.0		VERY STIFF	GRAY w/	SILT AND FINE SAND	ML	DAMP, FOUND 1/2" QTZ PEBBLE SLT. PLAST. ROOTLETS
				12/17				OR. MOT.	TR. CLAY		
1430	SO09-	06/SS	6-8'	9/13	1.9/2.0		HARD	GRAY w/	SILT AND FINE SAND	ML	DAMP, NO PLAST. TR. GRAV. RND. QTZ PEBBLE
				20/26				OR. MOT.			
1438	SO09	09/SS	9-11'	8/9	1.9/2.0		VERY STIFF	GRAY w/ OR.	SILT AND FINE SAND	ML	DAMP, V. SLT. PLAST. LITTLE MICA
				13/16				MOT.	TR. CLAY		
1455	SO09	13/SS	13-15'	6/5	1.9/2.0		STIFF	GRAY w/	SILT AND FINE SAND	ML	DAMP TO MOIST SLT. PLAST. MICACEOUS
				7/10				OR. MOT	TR. CLAY		
						TD 15'					

REMARKS: Rig CME 75 Drilling Method: H.S. Augers 4½" ID, 6½" OD
Sample method: 3" ID, 2' long split spoon driven w/ 140# Hammer dropped 30" Complete boring @ 1505 9-21-88

BORING SO09

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AR301645

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: S010
PROJECT NO.: 9851 — DATE: 9-20-88 — DRILLER: JIM ROCHFORD
ELEVATION: NA — FIELD GEOLOGIST: RICK BETHEL
WATER LEVEL DATA:
(Date, Time & Conditions) HOT, SUNNY, VARIABLE CLOUDS, 92°F 5-10 mph winds from SE 30.07" Bar. Pres:

TIME	SAMPLE NO.	SAMPLE NO. & TYPE OR RQD	DEPTH (Ft.) OR RUN NO.	BLOWS/6" OR RQD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, Ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK CORE CLASS	REMARKS
1555	S010-	00/SS	0-2'	7 24 16 11	1.5/2.0			DK. BRN BTR	FILL		ABUND. BATT. CSGS., LIME MIXED W/ SOIL
							HARD	TAN	SILT AND FINE SAND	ML	ROOTLETS, DAMP, NO PLAST.
1605	S010-	03/SS	3-5'	17 7 8 11	1.9/2.0		STIFF	TAN TO OR. + GRAY	SILT AND FINE SAND	ML	ABUND. BATT. CSGS. TO 4' MOIST TO DAMP OR MOT. @ 4'-5' NO PLAST
1627	S010-	06/SS	6-8'	15 19 23 29	2.0/2.0		HARD	GRAY OR MOT.	SILT AND FINE SAND, TR. CLAY	ML	MOIST, ROOTLETS, TR. MICA
1636	S010	09/SS	9-11'	13 15 19 26	2.0/2.0			TAN-OR TO GRAY OR MOT.	SILT AND FINE SAND TR. CLAY	ML "	MOIST, TAN-OR. @ 9-10', GRAY W/OR MOT. 10-11', MICACEOUS V. SLT. PLAST.
1655	S010	13/SS	13-15	9 13 18 15	1.8/2.0		VERY STIFF	OR-TAN TO GRAY	Silt and FINE SAND. Some mottle appearance	ML	TR CLAY TO 14' 14-15' NO TR CLAY
						T.D. 15'			below 14', more clay		MOIST, TR. MICA

REMARKS: RIG: CME 75 samples collected using 3" I.D. 2' Long split spoon driven w/ a 140 LB HAMMER Dropped 30". Drilling method 4¼" I.D. 6⅝" O.D. H.S. Augers Drilled to 15', sample to 15'
HOLE COMPLETED AT 1707 HR

BORING S010
PAGE 1 OF 1

AR301646

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: SO-11
PROJECT NO.: 9851 — DATE: 9-20-88 — DRILLER: JIM ROCHFORD
ELEVATION: 45.72' — FIELD GEOLOGIST: RICK BETHEL
WATER LEVEL DATA: NO WATER
(Date, Time & Conditions) 0900 (9-20). Warm, Clear, Sunny, Slt. breeze 5-10 mph from SE. Bar. Press 30.07"

TIME	SAMPLE NO.	SAMPLE NO. & TYPE OR ROD	DEPTH (ft.) OR RUN NO.	BLOWS/ 6" OR ROD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	BROKEN SPECIMENS	REMARKS
0759	SO11-00	SS	0-2'	5 14 9 11	1.7 / 2.0		VERY STIFF	BROWN	SILT AND FINE SAND	ML	DAMP, NO PLAST., WHITE LIME AT TOP 6". BATT. CSGS THRU OUT ROOTLETS
0807	SO11-02	SS	3-5'	6 7 13 16	1.7 / 2.0		VERY STIFF	BRN TO ORANGE W/ GRAY MOTTLG.	SILT AND FINE SAND	ML	DAMP, TOP 6" CONTAINS BATT. CSGS. AND GRAVEL. BECOMES OR. @ 3.5'
0830	SO11-04	SS	6-8'	7 9 16 23	2.0 / 2.0		VERY STIFF	ORANGE AND GRAY	SILT AND FINE SAND TR TO SOME CLAY	ML	ORANGE FROM 6-7' W/ BATT. CSGS. SLT. PLAST. BECOMES GRAY W/ OR. MOT. 7-8' NO PLAST. MOIST THRU OUT
0838	SO11-03	SS	9-11	8 12 14 18	2.0 / 2.0		VERY STIFF	GRAY W/ OR. MOTLG.	SILT AND FINE SAND TR TO SOME CLAY	ML	MOIST, SLT. PLAST. AND STICKY @ BOT 2 INS. CLAY W/ DEPTH
0854	SO11-13	SS	13-15	6 4 6 7	2.0 / 2.0	TD 15'		GRAY W/ OR MOTLG.	SILT AND FINE SAND TR TO SOME CLAY	ML	V. MOIST, SLT. PLASTICITY MICACEOUS

REMARKS: Rig: CME 75, sampled using 3" diam. 2' long split spoon driven w/ 140 lb. Hammer dropped 30". Drilled to 13', sampled to 15'. No water encountered. Hole complete 9-20-88 @ 0900.

BORING SO11

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BORING LOG — **NUS CORPORATION**

PROJECT: C & R Battery — BORING NO.: S012
PROJECT NO.: 9851 — DATE: 9/19/88 — DRILLER: Jim Rochford
ELEVATION: 44.66 — FIELD GEOLOGIST: Jon Lewis
WATER LEVEL DATA: No water in the borehole at 1500
(Date, Time & Conditions) 9/19/88; start: 1358, finish: ~1503; partly cloudy, lt breeze, hi 70s, humid

TIME	SAMPLE No.	SAMPLE NO. & TYPE OR RUN NO.	DEPTH (Ft.) OR RUN NO.	BLOWS/6" OR RQD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, Ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	GRAPHIC CONTACT	REMARKS
1400	S012-	00 / SS	0-2	10 / 10 / 21 / 22	1.6 / 2.0	Fill	HARD	OR and BLK w WHT MOTLG some GRN	SILT w/ FN-CRS SAND and GRAVEL = Fill	ML	Batt casing frags. Mixed lime and gravel from 1.2-2'. Hi % organics. Damp. All fill.
1418	S012-	03 / SS	3-5	10 / 7 / 6 / 8	1.6 / 2.0		STIFF	OR w/ some GRAY	SILT w/ FN-MED SAND	ML	Damp. Moisture inc w/ depth. Some gravel. Some batt. casing frags., organic debris, some cobbles.
1430	S012-	06 / SS	6-8	9 / 12 / 19 / 26	1.9 / 2.0		HARD	OR w/ LT GRAY MOTLG	SILT w/ FN SAND	ML	SL damp, some batt. casing frags., TR organic debris, friable
1441	S012-	09 / SS	9-11	14 / 19 / 24 / 30	2.0 / 2.0		HARD	OR w/ GRAY MOTLG	SILT w/ FN SAND	ML	One cobble sized rock frag., Tr. oxidized organic debris-rootlets (?). Friable
1456	S012-	13 / SS	13-15	8 / 11 / 13 / 17	2.0 / 2.0		V. STIFF	OR w/ some GRAY and GRAY	SILT w/ FN SAND	ML	Moist, v. moist at ~15'. OR at top, gray from ~14-15'.
						TD 15'					

REMARKS: Drilling done with a CME 75 using 4¼" ID, 6¼" OD, H.S. augers. Samples collected with a 3" x 2' split spoon (SS) driven with a 140 lb. hammer dropped 30".
— TD 13', spoon driven 13'-15'.

BORING S012
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AR301648

BORING LOG — **NUS CORPORATION**

PROJECT: C & A Battery — BORING NO.: S013
PROJECT NO.: 9351 — DATE: 9/16/88 — DRILLER: Jim Rochford
ELEVATION: 44.80 — FIELD GEOLOGIST: Jon Lewis
WATER LEVEL DATA: No water in the borehole @ 1743
(Date, Time & Conditions) 9/16/88; start 1450, finish ~1730; ptly sunny, 70s, lt. breeze

TIME	SAMPLE No.	SAMPLE NO. & TYPE OR COD	DEPTH (ft.) OR RUN NO.	BLOWS/6" OR ROD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	MATERIAL DESCRIPTION: COLOR	MATERIAL DESCRIPTION: MATERIAL CLASSIFICATION	BORAGE USCS CLASSIFICATION	REMARKS
											Silt, sand, and gravel 0-0.5' Concrete from 0.5'-1.5'
1512	S013-	01 SS	1.5-3	16 24 21	1.1 / 1.5		HARD	LT BRN to LT OR	SILT w/ FN SAND	ML	Sl. Damp.
1524	S013-	03 SS	3-5	7 8 12 15	2.0 / 2.0		V. STIFF	LT OR w/ Tr OR	SILT w/ FN SAND	ML	Tr. organic debris, sm pockets of OR Fe oxide, moist
1538	S013-	06 SS	6-8	6 11 18 24	2.0 / 2.0		V. STIFF	GRAY w/ OR MOTLG	SILT w/ FN SAND	ML	Moist, hi % Fe stain, friable, visible mica
1549	S013-	09 SS	9-11	7 9 16 20	2.0 / 2.0		V. STIFF	GRAY w/ OR MOTLG	SILT w/ FN SAND	ML	moist, hi % Fe stain, Tr small Fe oxide pods minor organics, visible mica
-02	S013-	13 SS	13-15	8 7 11 12	2.0 / 2.0		V. STIFF	GRAY w/ OR MOTLG	SILT w/ FN SAND	ML	moist, hi % Fe stain, minor small Fe pods, minor organics, visible mica
1613	S013-	20 SS	20-22	4 4 7 10	2.0 / 2.0	▽ OR GRAY	STIFF	OR and GRAY	SILT w/ FN SAND	ML	Saturated from 21'-22'. OR above 21', GRAY below, Fe stain above 21'

REMARKS Drilling done with CME 75 using 4¼" ID, 6½" OD, H.S. Augers. Sampling done with 3" x 2' split spoon (SS) driven with a 140 lb weight driven 30"
- 21'-22' SS sample saturated
- T.D. of boring 40'. SS sampled from 40'-42'.

BORING S013
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AR301649

BORING LOG — **NUS CORPORATION**

PROJECT: C & R Battery — BORING NO.: S013
PROJECT NO.: 9851 — DATE: 9/16/88 — DRILLER: Jim Rochford
ELEVATION: — FIELD GEOLOGIST: Jon Lewis
WATER LEVEL DATA: — (Date, Time & Conditions) see page 1

TIME	SAMPLE No.	SAMPLE NO. & TYPE OR CORE	DEPTH (FT.) OR RUN NO.	BLOWS/6" OR ROD (%)	SAMPLE RECOVERY - SAMPLE LENGTH	LITHOLOGY CHANGE (DASHED FT.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK CORE CLASS	REMARKS
1631	S013-	25/SS	25-27	11 16 21 24	2.0/2.0		HARD	GRAY and OR	SILT w/ FN SAND and SILT	ML	25'-26': v. moist. Fe stained
											26-26.5': same, some granules
											26.5-27': damp, grey, reduced(?) silt, cohesive
											no sand below 26.5'
1648	S013-	30/SS	30-32	13 19 15 19	2.0/2.0		HARD	OR w/ some GRAY	SILT and FN SAND	ML	Hi % Fe stain. 3" of pebbly and sandy silt @ 31.5' (QTZ pebbles). Damp, sl. friable.
1707	S013-	35/SS	35-36.5	25 48 75	1.5/1.5		HARD	OR w/ TR LT GRAY	SILT w/ FN SAND	ML	Sampler refusal @ 36.5'. Dry, friable. Hi % Fe stain. Thinly laminated LT Grey and orange zone @ ~ 36'
1727	S013-	40/SS	40-42	16 15 33 37	1.7/2.0		DENSE	OR and LT GRAY MOTLE	MED to CRS SAND with GRAVEL	GM	Poorly sorted, Damp below 41.5', dry above, Fe stain greater in damp interval, QTZ cobbles. Angular sand grains
						TD 42'					

REMARKS

BORING S013

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AR301650

BORING LOG — **NUS CORPORATION**

PROJECT: C & R Battery — BORING NO.: S014
PROJECT NO.: 9851 — DATE: 9/19/88 — DRILLER: Jim Rochford
ELEVATION: 4449' — FIELD GEOLOGIST: Jon Lewis
WATER LEVEL DATA: No water in borehole at 1709
(Date, Time & Conditions) 9/19/88, start: 1557, finish: ~1710; mostly cloudy, lt. breeze, low 80s.

TIME	SAMPLE No	SAMPLE NO. & TYPE OR 100	DEPTH (FT.) OR RUN NO.	BLOWS/6" OR RQD (%)	SAMPLE RECOVERY/SAMPLE LENGTH	LITHOLOGY CHANGE (DEPTH, FT.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS GRAPHICS	REMARKS
1600	S014-	00/SS	0-2	7, 12, 22, 30	1.7/2.0	Fill	HARD	GRAY and OR	SILT, FN-CRS SAND, and GRAVEL = Fill	ML	Hi % batt casing frags. Rope, plastic and other trash. Damp. Metal (Pb?) fragment
1618	S014-	03/SS	3-5	13, 8, 9, 11	1.6/2.0	Fill	V. STIFF	DK GRAY and OR w/ GRAY MOTLG	SILT, FN-CRS SAND, and GRAVEL = Fill	ML	Hi % batt casing frags., cobble sized rock frags. Organic debris OR/GRAY Brown 4.5-5', coarse fraction absent below 4.5'.
1634	S014-	06/SS	6-8	6, 11, 17, 23	2.0/2.0		V. STIFF	OR w/ GRAY MOTLG	SILT w/ FN SAND	ML	Damp. Some organic debris. Stiff.
1648	S014-	09/SS	9-11	9, 10, 14, 19	2.0/2.0		V. STIFF	OR w/ GRAY MOTLG and DK GRAY w/ some OR	SILT w/ FN SAND	ML	Moist. DK gray below 10'. TR pebble sized rock frags. Fe encrusted, gray vert tubes - roots (?). TR batt. fragments.
16	S014-	13/SS	13-15	11, 11, 11, 11	2.0/2.0		V. STIFF	OR w/ some GRAY and DK GRAY	SILT w/ FN SAND	ML	Moist. 3" cobble of QTZ at ~14.5'. DK GRAY from 14-15'. Sl. plastic. TR organics. Fe oxide nods incr. w/ depth
						TD 15'					

REMARKS: Drilled with a CME 75 using 4¼" ID, 6½ OD, H.S. augers. Sampled with a 3" x 2' split spoon (ss) driven with a 140 lb hammer dropped.
-TD 13', spoon driven 13'-15'.

BORING S014
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AR301651

BORING LOG — NUS CORPORATION

PROJECT: CHRBATTERY
PROJECT NO.: 9851
DATE: 3-28-89
BORING NO: SO-14A
DRILLER: HARDIN-HUBER, INC. SONWILEY
ELEVATION:
FIELD GEOLOGIST: KIM KAAL
WATER LEVEL DATA: 40'
(Date, Time & Conditions) clear, ~70° Light Breeze

SAMPLE NO & TYPE OR ROD	DEPTH (FT) OR RUN NO	BLOWS 6" OR ROD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS CODE	REMARKS
0845	0-2		/24	Concrete		DK Gray	Blackish Sandy Gravelly Fill Battery Casings		FIRST SPLIT SPOON TAKEN AT 20 FT. DESCRIPTION FROM
	3-5		/24			DRN BRN	Silty Clay w/SAND	MH CH	0-20ft. ON CUTTINGS
	6-8		/24			DRN	FSND + Silt w/Clay	MH	
	9-11		/24			GRAY BRN	Silt + Clay w/F.SND	MH CH	
	13-15		/24			GRAY +BRN	Silt + FSND, TR CL, w/ CL	ML	
0908									
0915	37	20-22	2/8 9/14 /24		MED DENSE	MED LT GRAY	M-F SND, W/F Gravel Tr silt. Hornbl. Mica SUB R. GR	SW	MOIST. TR FE2O3 HARD WEATH. GR=QUARTZ

REMARKS: Drilled Borehole using 3¼" ID AUGERS. 3" OD Split spoons Driven using 300lb Hammer. Drill Rig Mobile B-61

BORING SO-14A
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AR301652

BORING LOG — NUS CORPORATION

PROJECT: CHR BATTERY
PROJECT NO.: 9851
ELEVATION:
WATER LEVEL DATA
(Date, Time & Conditions) clear, LIGHT breeze 70°

DATE: 3-28-89
FIELD GEOLOGIST: KIM KAAL

BORING NO: SO-14A
DRILLER: HARDIN-HUBER, INC.

	SAMPLE NO & TYPE	DEPTH (FT)	BLOWS 6" OR 400 (*)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth Ft)	MATERIAL DESCRIPTION* SOIL DENSITY CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
0923	39	25-27	2/3	24/		MED	MTLD GRAY	CLAY, WITH SILT, TRACE	CH	MOIST TRACE O
			6/10	/24		FIRM		PLAST. TRACE ORG. TRACE MICA		
0931	39	30-32	2/8	24/		MED	MTLD ORN	F. SND, TR SILT & CL.	SP	MOIST TRACE O
			10/12	/24		DENSE	BRN	TRACE FEO2 WEATH TRACE ORG.		MICA
0942	40	35-37	3/7	17/		MED	MTLD ORN	F-C SAND, WITH GR,	SW	MOIST GRAVEL TRACE O
			7/9	/24		DENSE	BRN	TR SILT. TRACE FEO2 WEATH TRACE		MAINLY SUBR. QUAR
0947	41	40-42	9/9	24/	B.O.H.	MED	MTLD ORN	F-C SAND GRAVEL, TRACE	SW	WET TRACE O
			12/15	/24		DENSE	BRN	FEO2 WEATH. MICA TRACE ORG	SW	GR S. SUBR. QUARTZ
		45-47		/24						

REMARKS

BORING SO-14A

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* See Legend on Back

AR301653

BORING LOG — **NUS CORPORATION**

PROJECT: C & R BATTERY — BORING NO.: S015.
PROJECT NO.: 9851 — DATE: 9-20-88 — DRILLER: JIM ROCKFORD
ELEVATION: 45.53 — FIELD GEOLOGIST: RICK BETHEL
WATER LEVEL DATA: NO WATER
(Date, Time & Conditions) 1000 (9-20) Warm, Clear, Sunny, Slt. Breeze, 5-10mph winds from SE. Bar Press 30.07"

TIME	SAMPLE NO.	SAMPLE NO. & TYPE OR ROD	DEPTH (FT.) OR RUN NO.	BLOWS/6" OR ROD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (DEPTH, FT.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	BORE HOLE CONSTRUCTION	REMARKS
0949	S015-	00 SS	0-2'	10 / 22 / 39 / 17	1.6 / 2.0		HARD*	GRAY & TAN	FILL, SILT AND FINE SAND	ML	0-1.5' gray silty sand w/ dispersed gravel* 1.5-2.0 fine sand DAMP, NO PLASTICITY SATT. CGS SPARSELY DISPERSED THRUOUT
0956	S015-	03 SS	3-5'	4 / 6 / 9 / 15	1.5 / 2.0		STIFF	ORANGE TAN	SILT AND FINE SAND, SOME To TR. CLAY	ML	SAT. AT TOP 3", MOIST BELOW, SLT. PLAST, SLT. SHEEN SLT. MOTTLE GRAY W/ COARSER MAT. (WORM BURROWS) CRS. TO FINE GRAY SAND @ TOP 3" MICACEOUS THRU OUT
1005	S015-	06 SS	6-8'	7 / 12 / 19 / 24	2.0 / 2.0		HARD	OR-TAN TO GRAY W/ DEPTH	SILT AND FINE SAND, SOME To TR. CLAY	ML	MOIST, MORE CLAY @ TOP 6", FOUND SMALL PEBBLE @ 7'
1017	S015	09 SS	9-11'	9 / 11 / 12 / 13	2.0 / 2.0		VERY STIFF	OR-TAN TO GRAY W/ DEPTH	SILT AND FINE SAND, TR. CLAY AND GRAVEL	ML	MOIST, SLT. To NO PLAST. SOME MICA PRESENT WORM BURROWS INFILLED W/ COARSER GRAY MAT. A FEW ETC. PEBBLES 10-11'
1041	S015	13 SS	13-15	3 / 5 / 6 / 8	2.0 / 2.0		STIFF	OR-TAN	SILT AND FINE SAND, TR. CLAY & GR., MORE SAND W/ Depth	ML	HOLE IS DRY, SAMPLE MOIST ORANGE MAT. / gray
						T.D. 15'					

REMARKS: RIG: CME 75; collected samples using a 3" ID, 2' Long split spoon driven w/ a 140 lb Hammer dropped 30" Drilled to 13', sampled to 15'. Hole complete at 1050, 9-20

BORING S0-15

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AR301654

BORING LOG — **NUS CORPORATION**

PROJECT: C+R Battery — BORING NO.: S016
PROJECT NO.: 9851 — DATE: 9/20/88 — DRILLER: Jim Rochford
ELEVATION: 45.30' — FIELD GEOLOGIST: S. Barnick
WATER LEVEL DATA:
(Date, Time & Conditions) 13 HA (9-20) Hazy + warm, light sprinkle

TIME	SAMPLE NO.	SAMPLE NO. & TYPE OR CORE	DEPTH (FT.) OR RUN NO.	BLOWS/6" OR ROD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (DEPTH, FT.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK CONSISTS	REMARKS
	S016	00/SS	0-2	19 / 48 / 72	1.3/2.0		Very dense	GRAY-BROWN	Gravel w/ sand med-	GW	4"/50 Blows
									coarse gr., tr to		Plastic Debris
									little silt (Fill)		GR. Ø 1/2"-2"
1400	S016	03/SS	3-5	8 / 7 / 8 / 15	1.7/2.0		STIFF	BROWN	coarse to med sand,		
								GRAY to	some silt grading	ML	sample damp
								TAN OR	into fine sand and		some mottling
1413	S016	06/SS	6-8'	8 / 19 / 22 / 39	2.0/2.0		HARD	DARK GRAY	silt. to clay		texture
								to TAN OR	Silt w/ fine sand	ML	Damp, MOTTLED
									some med sand		ORGE to LGS
1431	S016	09/SS	9-11	9 / 35 / 24 / 32	2.0/2.0		Hard	TAN	to coarse sand & gr.		To. Mica's
								OR tr gr	Silt and fine Sand, tr	ML	well rounded gravel
									clay & gr		mottled w/ depth apparance
									↓		more lt. gr color
1448	S016	13/SS	13-15	15 / 11 / 14 / 28	2.0/2.0		HARD	TAN ORANGE	↓	ML	(less mottle) w/ depth
						T.D. 15'					- More sand &
											Mica, less mot
											Damp

REMARKS: Rig: CME 75, sampled using 3" Ø, 2' long split spoons driven w/ 140 lb Hammer dropped 30", Drilled to 13', Sampled to 15'. Hole completed at 1454. No WATER. Drilling method: 4 1/4" ID, 6 1/2" OD H.S. Augers

BORING S016

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AR301655

BORING LOG — **NUS CORPORATION**

PROJECT: C.E.R. Battery — BORING NO.: S017
PROJECT NO.: 9851 — DATE: 9/14/88 — DRILLER: Jim Rochford
ELEVATION: 44.81 — FIELD GEOLOGIST: Jon Lewis
WATER LEVEL DATA: ~40' below grade @ 1743
(Date, Time & Conditions) 9/14/88; start 1459, finish ~1745; partly cloudy, 70s

TIME	SAMPLE No.	SAMPLE NO. & TYPE OR TCC	DEPTH (Ft.) OR RUN NO.	BLOWS/ 6" OR RQD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, Ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS ORGANICS	REMARKS
1501	S017-	00 SS	0-2	9 / 13 / 15 / 18	1.7 / 2.0		V. STIFF	BLK to DK GREEN	SILT and FN SAND TR / CLAY, Mixed GRAVEL Fill	ML	Batt. casing frags., LS / Gravel, Damp, Fe stain - Organics
1520	S017-	03 SS	3-5	6 / 8 / 8 / 8	1.3 / 2.0		V. STIFF	GRAY w/ OR MOTLG	SILT with minor CLAY	ML	SL cohesive, Damp, Fe stain w/ Fe nodules. Obvious Acidic odor (sewage?)
1534	S017-	06 SS	6-8	7 / 13 / 16 / 75	1.3 / 2.0		V. STIFF	GRAY w/ OR MOTLG	SILT with CLAY, Minor FN SAND, TR GRAVEL	ML	Minor organics
1547	S017-	09 SS	9-11	7 / 8 / 13 / 16	1.8 / 2.0		V. STIFF	GRAY w/ OR MOTLG	SILT with CLAY, Minor V. FN SAND	ML	Moist, Fe stained stringers, minor organics, Fe stain decr. with depth
1602	S017-	13 SS	13-15	9 / 9 / 13 / 15	1.8 / 2.0		V. STIFF	GRAY w/ Minor OR Stain	SILT with V. FN SAND	ML	Minor Fe stained balls
1624	S017-	20 SS	20-22	7 / 7 / 7 / 10	1.7 / 2.0	↓	DENSE	GRAY w/ OR MOTLG	FN SAND and SILT. / Minor CLAY	SC	Moist, one pebble sized LS clast. Fe stained balls. V. Sl. cohesive, Qtz dominated sand

REMARKS: Drilled w/ CME 75 using 4¼" ID, 6½ OD, H.S. Augers. 3" x 2' split spoon (SS) sampler driven with 140 lb. hammer dropped 30".
- This borehole installed ~2' SE. of S017-A

BORING S017
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AR301656

BORING LOG — **NUS CORPORATION**

PROJECT: C and R Battery — BORING NO.: S017
PROJECT NO.: 9851 — DATE: 9/14/88 — DRILLER: Jim Rochford
ELEVATION: — FIELD GEOLOGIST: Jan Lewis
WATER LEVEL DATA:
(Date, Time & Conditions) see page 1

	SAMPLE NO. & TYPE OR 100	DEPTH (Ft.) OR RUN NO.	BLOWS/6" OR 400 (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, Ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	GROUP SYMBOLS USCS	REMARKS
1636	S017 - 25 SS	25-27	16 17 17 31	2.0 2.0		HARD	DK GRAY +o OR	SILT w/ CLAY	CL	Plastic, V. Dense, minor Fe stained spots. Moist, visible mica
1653	S017 - 30 SS	30-32	18 18 26 24	1.7 2.0	↓	DENSE	GRAY w/ OR MOTLG	FN SAND w/ SILT. Minor CLAY	SC	SI cohesive, Moist
1707	S017 - 35 SS	35-37	8 10 21 16	1.7 2.0	↓	M. DENSE	OR and LT GRAY	FN SAND and SILT (OR) and CRS SAND w/ GRAVEL (Lt Grey)	SM GM	Coarsens w/ depth, Orange at top to gray at bottom, CRS sand is poorly sorted. Rare cobbles
1730	S017 - 40 SS	40-42	16 16 36 61	2.0 2.0	9-14-88 ▽ TD 42'	V. DENSE	LT GRAY and OR	CRS to FN SAND w/ GRAVELS. V. minor SILT	SM	Saturated at ~ 41.5' Fe stained w/ Fe oxide granules in the saturated zone.

REMARKS Drilled w/ equip listed on page 1.

BORING S017

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BORING LOG — **NUS CORPORATION**

PROJECT: C & R Battery — BORING NO.: S017-A *
PROJECT NO.: 9851 — DATE: 9/14/88 — DRILLER: Jim Rockford
ELEVATION: 44.59' — FIELD GEOLOGIST: Jon Lewis
WATER LEVEL DATA:
(Date, Time & Conditions) 9/14/88; Start 1430, finish ~ 1444; partly sunny, lt breeze, hi 70s

Time	Sample No.	SAMPLE NO. & TYPE OR ROD	DEPTH (ft.) OR RUN NO.	BLOWS/6" OR ROD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK CORE	REMARKS
1433	S017-	00 / SS	0-2	7 / 11 / 16 / 16	1.2 / 2.0		V. Stiff	BLK to	Silt and Fine Sand, TR Clay.	ML	Battery casing frags.
								DK GREEN	Mixed gravel fill.		LS gravel. Damp to moist. Iron stain. Organics
1445	S017-	03 / SS	3-5	12 / 8 / 5 / 7	1.1 / 2.0		V. Stiff	GRAY w/ OR	Silt with minor clay.	ML	Sl. cohesive. Damp. Fe stain w/ Fe nodules
						TD 5.0'		MTLG			Obvious Acrylic Odor

REMARKS * This borehole was initially named S017 but due to poor recovery it was abandoned. Next boring will be used to collect soil for EP Toxicity.
- Drilled with CME 75; 4¼" ID, 6½" OD H.S. Augers.
3" Diam, 2' split spoon (ss) sampler driven with 140 lb weight dropped 30".

BORING S017
PAGE 1 OF 1

AR301658

BORING LOG — **NUS CORPORATION**

PROJECT: C-R BATTERY — BORING NO.: SO18
PROJECT NO.: 9851 — DATE: 9-26-88 — DRILLER: JIM ROCHFORD
ELEVATION: 45.29 — FIELD GEOLOGIST: RICK BETHEL
WATER LEVEL DATA:
(Date, Time & Conditions)

TIME	SAMPLE NO.	SAMPLE NO. & TYPE OR RQD	DEPTH (FT.) OR RUN NO.	BLOWS/6" OR RQD (%)	SAMPLE RECOVERY/SAMPLE LENGTH	LITHOLOGY CHANGE (DEPTH, FT.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	GROUNDWATER CONDITIONS	REMARKS
1610	SO18	00/SS	0-2'	8/14	1.6/2.0		MED. DENSE	DRK GRAY	FILL	(SW)	MOIST TO SAT. SAND + GRAV. BAT. CSG. FILL
				14/13							
1620	SO18	03/SS	3-5'	4/3	1.9/2.0		MED. STIFF	GRAY TAN W/ OR MOT.	SILT AND FINE SAND / TR. CLAY	ML	MOIST, PLAST. FESTANING FILL TO 4'
				5/9							
1635	SO18	06/SS	6-8'	4/7	1.5/2.0		HARD	GRAY W/ OR MOT.	SILT AND FINE SAND / SOME CLAY	ML	DAMP, 1 RND. QTZ PEBBLE SOME MICA
				55/4							
1650	SO18	09/SS	9-11	16/11	2.0/2.0		HARD	GRAY W/ MOT.	SILT AND FINE SAND / TR. CLAY	ML	DAMP, OCCAS. RND. QTZ PEBBLES, V SLT PLAST, ROOTLETS OCCAS.
				21/35							
1703	SO18	13/SS	13-15'	8/7	2.0/2.0		VERY STIFF	GRAY W/ MOT.	SILT AND FINE SAND / TR. CLAY	ML	MOIST TO SAT.
				11/16							
						TD 15'					

REMARKS: RIG: CME 75, DRILLING METHOD: 4¼" ID, 6½" OD H.S. Auger
SAMPLED W/ A 3" ID, 2' LONG split spoon driven w/ 140 lb. Hammer
Dropped 30" Boring completed @ 1715 9-26-88

BORING SO18

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AR301659

BORING LOG — **NUS CORPORATION**

PROJECT: C & R Battery — BORING NO.: S019
PROJECT NO.: 9851 — DATE: 9/18/88 — DRILLER: Jim Rockford
ELEVATION: 45.86' — FIELD GEOLOGIST: Jon Lewis
WATER LEVEL DATA: No water in the borehole @ 1657.
(Date, Time & Conditions) 9/18/88; start: 1532 finish: ~1648 ; mostly sunny, lt breeze, low 80s, humid

TIME	SAMPLE NO.	SAMPLE NO. & TYPE OR CORE	DEPTH (Ft.) OR RUN NO.	BLOWS/6" OR RQD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, Ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	GRAPHIC CONTACTS	REMARKS
1534	S019-	00 / SS	0-2	11 / 26 / 10 / 9	1.2 / 2.0		HARD	OR to LT BRN	SILT w/ FN SAND, some CRS and granule size QTZ	ML	Battery casing frags, hi %, organic debris. Batt. frags cont. at ~2'. Fill material mixed near surface
						↑ BATTERY CASINGS					
1544	S019-	03 / SS	3-5	13 / 7 / 5 / 7	1.0 / 2.0		STIFF	LT OR	SILT w/ FN SAND	ML	Moist, some battery casings
1609	S019-	06 / SS	6-8	12 / 16 / 25 / 24	20 / 2.0		HARD	OR w some LT GRAY MOTLG	SILT w/ FN SAND	ML	Moist, TR organics, slightly cohesive.
1625	S019-	09 / SS	9-11	16 / 21 / 24 / 34	2.0 / 2.0		HARD	OR and OR w LT GRAY MOTL	SILT w/ FN SAND	ML	Slightly damp, OR @ top 10" OR/LT GRAY below. Vert burrows (?) w/ gray cores and Fe stained outers.
41	S019-	13 / SS	13-15	7 / 8 / 14 / 14	2.0 / 2.0		V. STIFF	OR and GRAY w/ TR OR	SILT w/ FN SAND, TR QTZ GRANULES and PEBBLES	ML	Damp, moisture incr. sl. with depth. TR QTZ pebbles & granules, TR organic debris. OR from 13-14, GRAY below.
						TD 15'					

REMARKS Drilling done with CME 75 using 4¼" ID, 6½" OD, H.S. augers. Sampling done with a 3" x 2' split spoon (SS) driven with a 140 lb hammer dropped 30"
- TD 13', Spoon driven from 13'-15'

BORING S019
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AR301660

BORING LOG — **NUS CORPORATION**

PROJECT: C.E.R. Battery — BORING NO.: 5020
PROJECT NO.: 9851 — DATE: 9/14/88 — DRILLER: Jim Rochford
ELEVATION: 45.79' — FIELD GEOLOGIST: Jon Lewis
WATER LEVEL DATA: Water level at 2.0' below grade @ 1246
(Date, Time & Conditions) 9/14/88; start: 1054, finish ~1225, ptly cloudy, lt. breeze, low 70s.

TIME	SAMPLE No.	SAMPLE NO. & TYPE OR CORE	DEPTH (Ft.) OR RUN NO.	BLOWS 6" OR RQD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, Ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS SOIL CONSISTENCY	REMARKS
1053	5020-	00/SS	0-2	18/26 (26, 10)	1.2/2.0		HARD	OR	SILT w/ FN-CRS SAND	ML	Dry, friable, battery casing fragments, Hi% organics.
1116	5020-	03/SS	3-5	14/5 (5, 5)	1.3/2.0	▽ 5' BATT CASINGS	M. STIFF	BLK and DK GRAY-GREEN	SILT w/ FN SAND	ML	1" zone of saturated, black batt casings ~ 4'. Below is dk gray-green and moist (not saturated)
1131	5020-	06/SS	6-8	5/7 (12, 20)	2.0/2.0		V. STIFF	LT GRAY w/ OR MOTLG	SILT w/ FN SAND, TR CLAY	ML	Orgdnics, moist incr @ 6'.
1150	5020-	09/SS	9-11	7/12 (32, 40)	2.0/2.0		HARD	OR w/ LT GRAY MOTLG	SILT w/ FN SAND	ML	Moist, cohesive. Outside of sample saturated due to perched water. Stiff
1219	5020-	13/SS	13-15	10/10 (12, 13)	1.8/2.0	TD 15'	V. STIFF	OR w/ LT GRAY MOTLG and GRAY-DK GRAY	SILT w/ FN SAND	ML	Cohesive, v. moist, stiff. Fe stain more conc. at ~11', with less moisture and Fe encrusted gray tubes - burrows (?). V. moist, GRAY-DK GRAY horizon below ~14.8'.

REMARKS Drilling done with a CME 75 using 4¼" ID, 6½ OD, H.S. augers. Sampled with a 3" x 2' split spoon (SS) driven with a 140 lb hammer dropped 30".

- At ~3' the auger cuttings brought up wet battery casing fragments.
- Water perched @ ~4' on battery casing accumulation (~1" thick).
- TD 13'. Spoon driven 13-15'.

BORING 5020

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AR301661

BORING LOG — **NUS CORPORATION**

PROJECT: C & R Battery — BORING NO.: S021
PROJECT NO.: 9851 — DATE: 9/19/88 — DRILLER: Jim Rochford
ELEVATION: 45.76' — FIELD GEOLOGIST: Jon Lewis
WATER LEVEL DATA: Hole dry @ 0951
(Date, Time & Conditions) 9/19/88 ; start: 0843 ., finish: ~0954 ; partly cloudy, high 60s, humid

TIME	SAMPLE NO	SAMPLE NO. & TYPE OR RUN NO.	DEPTH (Ft.) OR RUN NO.	BLOWS/6" OR ROD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, Ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS SOIL CONSISTS	REMARKS
0845	S021-	02 SS	0-2	12 / 10 / 12 / 16	1.3 / 2.0		V. STIFF	OR	SILT w/ FN SAND,	ML	Battery casing frags,
									GRAVEL from ~0-3"		damp, hi % organics, TR
											QTZ Granules on ? cond.
0901	S021-	03 SS	3-5	17 / 26 / 16 / 13	.5 / 2.0		HARD	GRAY and OR	SILT w/ FN SAND	ML	Battery casing frags, damp
0913	S021-	06 SS	6-8	10 / 12 / 18 / 26	2.0 / 2.0		HARD	GRAY w/ OR MOTLD	SILT w/ FN SAND	ML	Battery casing frags, damp
											TR dk OR Fe Oxide.
0936	S021-	09 SS	9-11	8 / 12 / 16 / 21	2.0 / 2.0		V. STIFF	LT GRAY w/ some OR	SILT w/ FN SAND	ML	Damp, somewhat cohesive,
											OR decr. w/ depth. OR
											crust around gray tubes: - burrows(?). TR Organics
0951	S021-	13 SS	13-15	7 / 11 / 13 / 14	2.0 / 2.0		V. STIFF	GRAY w/ some OR	SILT w/ FN SAND	ML	QTZ cobble and granules ~ 14.5'
						TD 15'					Fe crusted gray tubes
											Somewhat cohesive. Moist.
											Harder w/ depth.

REMARKS Drilling done with a CME 75 using 4¼" ID, 6½" OD, H.S. augers. Sampling done with a 3"x2' split spoon (ss) driven with a 140 lb. hammer dropped 30".
-TD 13', spoon advanced from 13-15'.

BORING S021

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AR301662

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: S022
PROJECT NO.: 9851 — DATE: 9-14-88 — DRILLER: JIM ROCHFORD
ELEVATION: 45.46' — FIELD GEOLOGIST: RICK BETHEL
WATER LEVEL DATA:
(Date, Time & Conditions) Begin @ 0800, overcast, calm, AM 70°F

TIME	SAMPLE NO.	SAMPLE NO. & TYPE OR ROD	DEPTH (ft.) OR RUN NO.	BLOWS/6" OR ROD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK CORE RECOVERY	REMARKS
0825	S022-	01/SS	0-2	16 20 24 17	1.9/2.0		HARD	DRK BRN	SILT AND FINE SAND, SOME GRAVEL	ML	ABUNDANT BATT. CASINGS MOIST, NONPLASTIC
0835	S022-	03/SS	3-5	16 8 5 5	1.7/2.0		STIFF	DRK BRN TO LT. BRN OR MOT.	SILT AND CLAY W/ SOME FINE GR. SAND, TR. GRAV.	CH/ML	SOME BATT. CSGS. AT 0.5'. PLASTICITY HIGH SOME BATT. CSGS TO 3.5' ROOTLETS PRESENT
0845	S022-	06/SS	6-8	6 8 15 21	2.0/2.0		V. STIFF	GRAY W/ OR MOTLG.	SILT AND FINE SAND, TR. CLAY	ML	SLT. TO NO PLASTICITY MOIST, FE STAINS
0855	S022-	09/SS	9-11	7 10 17 18	2.0/2.0		V. STIFF	GRAY W/ OR MOTLG.	SILT W/ FINE SAND, TR. CLAY	ML	MOIST, SLT TO NO PLASTICITY FE STAINS, FOUND 1 PEBBLE
0910	S022-	13/SS	13-15	6 6 9 12	2.0/2.0		STIFF	GRAY W/ OR MOTLG.	SILT W/ FINE SAND, SOME CLAY	ML	MOIST, SLT. PLASTICITY COHESIVE
0930	S022	20/SS	20-22	3 5 7 9	2.0/2.0		MED. DENSE	GRAY W/ OR.	FINE TO MED SAND, SOME SILT AND GRAVEL	SW	V. MOIST, NO PLASTICITY PEBBLES (QTZ); FE STAINS MICACEOUS GRAV. @ 23'

REMARKS Drilled using CME 75, 4¼" ID, 6½" OD H.S. AUGERS, 3" DIAM 2' SPLIT SPOON(SS) DRIVEN W/ 140 LB HAMMER DROPPED 30"

BORING S022

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AR301663

BORING LOG — **NUS CORPORATION**

PROJECT: C-R BATTERY — BORING NO.: SO22
PROJECT NO.: 9051 — DATE: 9-14-88 — DRILLER: JIM ROCKFORD
ELEVATION: — FIELD GEOLOGIST: RICK BETHEL
WATER LEVEL DATA:
(Date, Time & Conditions)

	SAMPLE NO. & TYPE OR ROD	DEPTH (Ft.) OR RUN NO.	BLOWS/6" OR ROD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, Ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	BORO USCS CONS CKS	REMARKS
0940	SO22-SS 25	25'	50/2"	0	Perched ▽ 9-14-88	V. DENSE	LT. BRN w/ ORANGE	CRS. TO FINE SAND + GRAVEL	SW/ GW	NO RECOVERY IN SPOON, SATURATED, PERCHED .35' RECOVERY IN SPOON, HIGH FE STAINS
0955	SO22-SS 26	26-	50/.35	.35/2.0						NO GRAV. BELOW 27'
1010	SO22 SS 30	30-32	13/20	2.0/2.0		HARD	LT BRN w/ ORANGE	CRS. TO FINE SAND	SW	MOIST, NO GRAV. VERY UNCONSOL.
1025	SO22 SS 35	35-37	9/11/13/25	2.0/2.0		RED. DENSE	ORANGE AND GRAY	FINE TO CRS. SAND	SW	MOIST HIGH FE STAINS VERY UNCONSOL. HIT GRAV. @ 27'
1040	SO22 SS 40	40-42	29/44/50/3	1.4/2.0	TD 42 DRY		LT BRN w/ ORANGE	GRAVEL AND FINE TO CRS. SAND	GW/ SW	MOIST.

REMARKS SEE P.1 SOIL BORING ADVANCED TO 40' TOOK LAST SPOON 40-42'

BORING SO22

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AR301664

BORING LOG — **NUS CORPORATION**

PROJECT: C & R Battery — BORING NO.: S023
PROJECT NO.: 9851 — DATE: 9/17/88 — DRILLER: Jim Rochford
ELEVATION: 44.01' — FIELD GEOLOGIST: Jon Lewis
WATER LEVEL DATA: No water in hole @ 1540
(Date, Time & Conditions) 9/17/88; Start: 1433; finish: ~1530; lt breeze, cloudy, low 70s.

TIME	SAMPLE No	SAMPLE NO. & TYPE OR ROD	DEPTH (ft.) OR RUN NO.	BLOWS/6" OR ROD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS SOIL OR ROCK CONSIST.	REMARKS
1434	S023-	00 / SS	0-2	9 / 3 / 5 / 6	1.6 / 2.0		STIFF	DK GRAY to GREENISH BLACK	SILT w/ FN SAND	ML	Hi % organics, Moist, LT OR at 1.9-2.0'
1442	S023-	03 / SS	3-5	7 / 7 / 13 / 16	1.6 / 2.0		V. STIFF	DK GRAY and OR w/ some LT GRAY	SILT w/ FN SAND	ML	Organic debris, DK GRAY from 3-4'. Gray around root debris.
1456	S023-	06 / SS	6-8	6 / 13 / 23 / 31	2.0 / 2.0		HARD	GRAY w/ OR MOTLG	SILT w/ FN SAND	ML	Moist, thin laminae @ 6.5-7'-alternating gray and orange. Fe stained tubes-burrows(?) or roots (?)
1509	S023-	09 / SS	9-11	8 / 11 / 13 / 20	1.7 / 2.0		V. STIFF	GRAY w/ OR MOTLG	SILT w/ FN SAND	ML	Moist, QTZ pebbles (several) @ ~10.6'. Fe stained tubes - burrows(?).
1527	S023-	13 / SS	13-15	10 / 11 / 18 / 23	.8 / 2.0	TD 15'	V. STIFF	LT OR	SILT w/ FN SAND	ML	Minor organic debris.

REMARKS: Drilling done with a CME 75 using 4¼" ID, 6½" OD, H.S. augers. Samples collected with a 3" x 2' split spoon (SS) driven with a 140 lb hammer dropped 30".
- Augered to 13'. Spoon driven from 13'-15'

BORING S023

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AR301665

BORING LOG — **NUS CORPORATION**

PROJECT: C & R Battery — BORING NO.: S024
PROJECT NO.: 9851 — DATE: 9/17/88 — DRILLER: Jim Rochford
ELEVATION: 44.98 — FIELD GEOLOGIST: Jon Lewis
WATER LEVEL DATA: No water in hole @ 1242
(Date, Time & Conditions) 9/17/88; start: 1132, finish: ~1230; lt rain, low 70s

TIME	SAMPLE NO	SAMPLE NO. & TYPE OR 100	DEPTH (FT.) OR RUN NO.	BLOWS 6" OR ROD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (DEPTH, FT.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
1141	S024-	00 SS	0.5-2	17 / 19 / 18	1.1 / 1.5		HARD	LT OR to LT BRN	SILT w/ FN SAND	ML	Dry, friable, Fe stain, minor organics.
1151	S024-	03 SS	3-5	24 / 17 / 17 / 18	1.1 / 2.0		V. STIFF	OR w/ LT OR MOTLG	SILT w/ FN SAND	ML	Minor organic debris, dry, friable, several QTZ sand grains, visible micas
1204	S024-	06 SS	6-8	16 / 20 / 24 / 34	1.7 / 2.0		HARD	OR and OR w/ LT GRAY MOTLG	SILT w/ FN SAND	ML	Dry, pebbles imbedded @ ~7' (QTZ), orange from ~6-7', Hi % Fe stain
1215	S024-	09 SS	9-11	15 / 12 / 22 / 24	1.9 / 2.0		V. STIFF	LT GRAY w/ OR MOTLG	SILT w/ FN SAND	ML	friable. Sl. damp, worm (bioturbation) burrings (?) w/ reduced cores & oxidized (Fe) rims.
1229	S024-	13 SS	13-15	8 / 12 / 15 / 19	1.8 / 2.0	TD 15'	V. STIFF	OR and LT GRAY	SILT w/ FN SAND	ML	Moist, Hi % Fe oxide @ 14.5-15'. Tubular Fe Oxide burrows (?) that are vertical - similar to last sample but w/o gray, reduced (?) cores. Gray interval from 13.5-14.5'

REMARKS Drilling done with CME 75 using 4¼" ID, 6½" OD, H.S. augers. Samples obtained with a 3" x 2' split spoon (SS) driven with a 140 lb hammer dropped 30".

-TD 13', spoon driven 13-15

- Burrows (?) may be root tubes or other organic debris relics.

BORING S024

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AR301666

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: MW4-1 / SO 25
PROJECT NO.: 7951 — DATE: 9-1-88 — DRILLER: JIM ROCHFORD
ELEVATION: 49.14' — FIELD GEOLOGIST: KIM KAAL
WATER LEVEL DATA: 20.0', 34.5', 42.5', 37'
(Date, Time & Conditions) 9-1: Drilled to 56' 0830 - 1900 Sunny 85°F Slight Breeze

TIME	SAMPLE NO.	SAMPLE NO. & TYPE OR CORE	DEPTH (FT) OR RUN NO.	BLOWS/6" OR ROD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (DEPTH, FT) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK CORE SECTION	REMARKS
0845	S025-	00	0-2'	12 13 17 10	1.3 / 2.0		VERY STIFF (COHESIVE)	GRAY-BRN MOTTLED	FINE SAND AND SILT LITTLE ORGANICS	SP-ML	BATTERY CASING SHARDS MOIST, NON PLASTIC
0910	S025-	03	3-5'	9 9 11 12	0.9 / 2.0		VERY STIFF	GRAY-BRN	FINE SAND WITH SILT, TR. ORGANICS	SP	BATTERY CASING SHARDS 2" TO 1/4" DIAM. MOIST
1055	S025-	06	6-8'	9 13 11 13	2.0 / 2.0		VERY STIFF	MOTTLED BRN+ GRAY	FINE SAND AND SILT	SP-ML	HOMOGENEOUS, MOIST, NO BAT. CASING SHARDS, LOW TO NON PLAST., NO ORG.
1110	S025	09	9-11'	24 58 16 20	1.6 / 2.0		HARD	MOTTLED BRN+ GRAY, REDDISH	FINE TO MED SAND WITH SILT	SP-ML	RUB. GRAVEL (LIMESTONE) @ 9.5' HOMOG. TOUGH, LOW PLAST., MOIST, Fe STAINS 10-11'
1130	S025-	13	13-15	6 5 7 12	2.0 / 2.0		STIFF	MOTTLED BRN+ GRAY, REDDISH	FINE TO MED SAND WITH SILT, SOME FINE TO CRS. GRAVEL	SP-ML	MOIST, IRNOUS & GRAV SOME Fe STAINING
1150	S025	20	20-22	7 10 33 60	1.6 / 2.0	▽ 9-1-88	DENSE	MOTTLED BRN+ GRAY, REDDISH	FINE TO CRS SAND, TR. GRAVEL	SP	HEAVY RED Fe STAINING V. HARD 21-22' MOIST
1435	S025-	22	22-24						SHELBY TUBE		

REMARKS: DRILL RIG: CME 75 DRILLING METHOD: H.S. AUGER: 6¼" ID, 10" OD. SAMPLED W/ 3" ID, 2' LONG SPLIT SPOON DRIVEN W/ 140 LB. HAMMER DROPPED 30". MONITORED W/ HNU & OVA. WELL INSTALLED MONITORING WELL 9-2-88.

BORING MW4-1/S025

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AR301667

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: MW4-1 / SO25
PROJECT NO.: 9851 — DATE: 9-1-88 — DRILLER: JIM ROCHFORD
ELEVATION: — FIELD GEOLOGIST: Kim Kaal
WATER LEVEL DATA:
(Date, Time & Conditions) SUNNY, 85°, SLIGHT BREEZE

TIME	SAMPLE #	SAMPLE NO. & TYPE OR RQD	DEPTH (Ft.) OR RUN NO.	BLOWS/ 6" OR RQD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (Depth/Ft.) OR SCREENED INTERVAL	SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	U S C S / ROCKS	REMARKS
1500	SO25-	25	25-27	7 / 8 / 10 / 47	1.6 / 2.0		STIFF	MOTTLED BRN & GRAY	MEDIUM TO FINE SAND AND TRACE COARSE GRAVEL SILT, SOME CLAY, PLASTIC	SP-ML	WET BATTERY SHARDS, HOMOGENEOUS VERY HARD TO 29.0
1515	SO25-	30	30-32	14 / 21 / 30 / 28	2.0 / 2.0		VERY STIFF	MOTTLED BRN, REDDISH GRAY	FINE TO COARSE SAND, SOME SILT, TRACE CLAY SLIGHT CEMENTATION AT 31.0	SM	MOIST. BATTERY SHARDS ROCK FRAGMENTS-SANDSTONE PARTIALLY IRON OXIDE STAINED 31-32
1635	SO25-	33	33-35			9-1-88			SHELBY TUBE		
1645	SO25-	35	35-37	10 / 26 / 50 / 38	2.0 / 2.0	9-2-88	DENSE (GRANULAR)	THICK BANDS LT TO DK BRN-GRAY	FINE TO COARSE SAND, SOME MEDIUM WELL ROUNDED GRAVEL	SW-	WATER POURS ON GROUND FROM OUTSIDE OF TUBES WET. SOME BLACK STAIN SPOTS AT 36.5'. FEOX STAINS.
1710	SO25-	40	40-42	9 / 10 / 10 / 13	2.0 / 2.0	9-2-88 / 9-1-88	MED. DENSE	LT TO DK. BRN	FINE TO COARSE SAND, SOME MEDIUM WELL ROUNDED GRAVEL	SW	SATURATED. HOMOGENEOUS. TRACE FINE COLOR BANDS
1740			45-47	[illegible]	1.3 / 2.0		DENSE	LT TO DK RED BRN	FINE TO COARSE SAND AND GRAVEL, well rounded	SW-GW	SATURATED. IRON OXIDE STAINS.

REMARKS: See p. 1

BORING MW4-1

BORING LOG — **NUS CORPORATION**

PROJECT: CTR Battery — BORING NO.: MW4-1/SOIL
PROJECT NO.: 9851 — DATE: 9-1-88 — DRILLER: JIM ROCKFORD
ELEVATION: — FIELD GEOLOGIST: K.M. KAC
WATER LEVEL DATA:
(Date, Time & Conditions) SUNNY, 70°

SAMPLE NO. & TYPE OR RUN	DEPTH (ft.) OR RUN NO.	BLOWS/6" OR RQD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK CLASS	REMARKS
	50-52	51 54	2.0 /		DENSE	MOTTLED LT. TO DK	FINE TO COARSE GRAVEL AND	GW	WELL ROUNDED PEBBLES
		44 61	/ 2.0			BRN + RED	SAND, IRON OXIDE STAINS		OF VARIOUS LITHOLOGIES
	55-57	39 39	1.5 /	BOH	DENSE	MTLD LT. TO	FINE TO COARSE SAND, WITH	SW	WELL ROUNDED PEBBLES
		5 15	/ 2.0			DK. BRN	GRAVEL, IRON OXIDE STAINS		ESTIMATED
				70.57'					

REMARKS: TOTAL DEPTH OF BORING = 55.0', COMPLETED 9-1-88
Set 10' screen to 52' (2" well)

BORING MW4-1

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AR301669

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: SB25A
PROJECT NO.: 9851 — DATE: 9-1-88 — DRILLER: JIM RICHFORD
ELEVATION: — FIELD GEOLOGIST: Kim KAAL
WATER LEVEL DATA:
(Date, Time & Conditions) 9-1-88 DRILLED 0.0' TO 8.0. 1000-1030

SAMPLE NO. & TYPE OR RQD	DEPTH (FT.) OR RUN NO.	BLOWS 6" OR RQD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, Ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK CLASS	REMARKS
	0-2'								
	3-5'								
	6-8'								
				TD 8'					BOTTOM OF HOLE 8.0'

REMARKS FOR MATERIAL CLASSIFICATION DETAILS TO 8.0 FEET, REFER TO SB25 BORING LOG.

BORING SB25A

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AR301670

BORING LOG — **NUS CORPORATION**

PROJECT: C-4 R BATTERY — BORING NO.: MW1-1 / SO26
PROJECT NO.: 9851 — DATE: 9-6-88 — DRILLER: JIM ROCHFORD
ELEVATION: 49.14' — FIELD GEOLOGIST: KIM KAAL
WATER LEVEL DATA: 42.5 FT, 53.5 FT
(Date, Time & Conditions) OVERCAST, 70° BEGIN DRILLING AT 1415 FINISH AT 1930 - 9-6-88
BEGIN DRILLING 0730 FINISH DR. 1 NK 5304-7-88 BEGIN DRILLING 1020 FINISH 1445 9-8-88

TIME	SAMPLE NUMBER	SAMPLE NO. & TYPE OR ROD	DEPTH (FT.) OR RUN NO.	BLOWS/6" OR ROD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (DEPTH, FT.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK CLASS	REMARKS
1435	SO26	00	0-2	5/11	1.4/		ST. FF	BROWN	SILT WITH FINE SAND,	ML	ORGANICS, MOIST
				14/16	/2.0				TRACE MED. GRAVEL, NONPLAST.		HOMOGENEOUS.
1440	SO26	03	3-5	1/13	1.5/		STIFF	BROWN	SILT WITH FINE SAND,	ML	ORGANICS, MOIST
				16/20	/2.0				TRACE MED. GR. NONPLAST.		HOMOGENEOUS
1500	SO26	06	6-8	13/17	1.6/		STIFF-	MTLD LT. TO	SILT WITH FINE SAND, TR.	ML	MOIST, HOMOGENEOUS
				99/26	/2.0		V. STIFF	DK. BRN	MED GRAVEL, NONPLAST, ORGANIC		
1510	SO26	09	9-11	10/10	1.6/		STIFF	MOTTLED LIGHT	RED TO FINE SAND, SOME CLAY,	ML	SECONDARY FE OXIDE MOIST ORGANICS
				17/19	/2.0			GRAY+ BRN	LITTLE SILT, LOW PLAST. MICACEOUS	SW	COARSE SAND, POOLY GRADED
1530	SO26	13	13-14								PUSHED SHELBY TUBE, BENT TUBE AFTER 1 PT PENETRATION
1555	SO26	14	14-16	9/13	1.6/		STIFF	MTLD LT. GRAY & BRN	MEDIUM TO FINE SAND,	SP	SECONDARY FE OXIDE
				9/9	/2.0			GRAY	LITTLE SILT AND CLAY, LOW PLAST. MICACEOUS		MOIST. TEXT. HOMOGENEOUS
1615	SO26	16	16-18								SHELBY TUBE TAKEN
											16-18
1630	SO26	20	20-22	20/66/19	.9/		HARD	MTLD BRN+	COARSE TO FINE SAND AND	SW-	SPOON REFUSAL AT
					/0.9		DENSE	GRAY	GRAVEL, TRACE FE OXIDE	GW	20.5' WET. WELL ROUNDED GRAVEL

REMARKS 140 POUND HAMMER WITH 30" DROP USED TO AQUIRE SPLIT SPOON SAMPLES. 3" ø SPLIT SPOON SAMPLER. DRILLER - CME 75
REFER TO SAMPLE LOG SHEETS FOR SB26 FOR DETAILS ON SAMPLES.
ADVANCED FOR INSIDE HOLLOW STEM AUGERS. BORING ANNULUS IS 10± INCHES. ID OF AUGERS IS 6 1/4"
WELL COMPLETED 9-9-88

BORING MW1-1
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AR301671

BORING LOG — **NUS CORPORATION**

PROJECT: C&E BATTERY — BORING NO.: MW 1-1 / SO-26
PROJECT NO.: 9851 — DATE: 9-6-88 — DRILLER: JIMROCH FORD
ELEVATION: — FIELD GEOLOGIST: Kim KAAL
WATER LEVEL DATA: —
(Date, Time & Conditions) —

TIME	SAMPLE NO.	SAMPLE NO. & TYPE OR ROD	DEPTH (Ft.) OR RUN NO.	BLOWS/6" OR ROD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, Ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/CONSISTENCY OR ROCK HARDNESS	MATERIAL DESCRIPTION: COLOR	MATERIAL DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK CONSIST.	REMARKS
1650	SO26	25	25-27	3/4	2.0/	—	STIFF	BRN-GRAY	CLAY WITH SILT, HOMOGENEOUS	CH	MOIST
				11/14	/2.0			+BRN MOTTLED	HIGH PLASTICITY, TRACE ORGANICS		
1715	SO26	27	27-29								SHELBY TUBE TAKEN 27-29'
1735	SO26	30	30-32	9/14	2.0/		VERY	GRAY	SILT WITH CLAY, TRACE	ML	MOIST, HOMOGENEOUS
				20/25	/2.0		STIFF	BRN MOTTLED	FINE SAND, LOW-MOD. PLAST		
1755	SO26	35	35-37	11/13	2.0/		STIFF	GRAY-BRN	SILT WITH CLAY, TRACE FINE SAND, LOW-MOD. PLAST	ML	MOIST, HOMOGENEOUS
				17/20	/2.0						
1810	SO26	40	41-42	9/9	2.0/		STIFF	GRAY	SILT AND CLAY, MOD-	CH	MOIST-WET
				10/11	/2.0			BRN	HIGH PLASTICITY,		HOMOGENEOUS
						9-6-88					
1845		45	45-47	3/5	2.0/		SOFT-	GRAY-	SILT AND CLAY, MOD-	CH	MOIST-HOMOGENE-
				3/4	/2.0		STIFF	BRN	HIGH PLASTICITY		OUS

REMARKS: See p. 1

BORING MW 1-1

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AR301672

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: MW1-1 / S026
PROJECT NO.: 9851 — DATE: 9-6-88, 9-7-88 — DRILLER: J M ROCHFORD
ELEVATION: — FIELD GEOLOGIST: KIM KARL
WATER LEVEL DATA: — TIME
(Date, Time & Conditions)

TIME	SAMPLE NO. & TYPE OR ROD	DEPTH (FT.) OR RUN NO.	BLOWS 6" OR ROD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (DEPTH, FT.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK CLASS	REMARKS
1910		50-52	6 7 10 17	1.0 2.0		SOFT	BRN-GRAY	SILT WITH CLAY, LITTLE M.S. AND TRACE GRAVEL	MH	MOIST
1930 9-6-88					7.6 FT.					
9-7-88 0730		55-57	5 5 7 9	2.0 2.0		SOFT	GRAY	MEDIUM FINE SAND CLAY	SW	WET
								CLAY, SOME S.I. TRACE GRAVEL	CH	MOIST
										SAND BEGINS
1000	A	60-62	30 31 25 36	1.7 2.0		DENSE	MED BROWN	FINE TO COARSE SAND AND	SW	SATURATED GRAVEL
						GRANULAR	BRN GRAY	GRAVEL, WELL ROUNDED GRAVEL	GW	MAINLY QUARTZITE
										HOLE CAVED UP TO
										54 FT.
9-7-88 0920										
9-8-88 1115		65-67	24 47 50/4	1.6 1.4		VERY DENSE	MED BROWN GRAY	FINE TO COARSE SAND AND GRAVEL, WELL ROUNDED GR.		HARD LOCAL CEMENTATION STONES UP TO 4" DIA.
										9-7-88
1245										
		70-72								
					TD 72'					

REMARKS: Drill Rig CME 75; Sampled w/ a 2" Long 3" ID split spoon driven w/ a 140 # Hamm dropped 30"

BORING MW1-1

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BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: MW3-1 / SO27

PROJECT NO.: 9851 — DATE: 9-10-88 — DRILLER: JIM ROCKFORD

ELEVATION: 43.81' — FIELD GEOLOGIST: RICK BETHEL

WATER LEVEL DATA: ~42'

(Date, Time & Conditions) Clear, Sunny, 70°F (AM), 85°F PM, Began drilling @ 0930

TIME	SAMPLE NUMBER	SAMPLE NO. & TYPE OR RQD	DEPTH (FT.) OR RUN NO.	BLOWS/6" OR RQD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (DEPTH, FT.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	MATERIAL DESCRIPTION: COLOR	MATERIAL DESCRIPTION: MATERIAL CLASSIFICATION	BORO. SOIL CONSIST.	REMARKS
0935	S-1	SS	0-2'	2 5 7 8	1.9/2.0		STIFF	TAN TO BRN	SILT W FINE SAND	ML	ROOTS, TOP 6 SAT. DUE TO PPTN. MOIST. 2.5-3' NON PLASTIC
0945	SO27-02	ST	2-4								MAX PSI 350 LBS PUSHING SHELBY TUBE
1010	S-2	SS	5-7	12 26 37 61	2.0/2.0		V. STIFF	LT. BRN W/ GRAY MOTTLING	SILT W FINE TO MED SAND TR GRAVEL	ML	MOIST INC. IN GRAIN SIZE W/ DEPTH, OCCAS ROOTS, NON PLASTIC
1020	S-3	SS	10-12	22 50 61	1.8/1.5		HARD	LT. BRN W/ GRAY MOTTLING	MED. TO FINE SAND, SOME CLAY, LITTLE SILT	ML SW	MOIST, ORGANICS, SLT. PLASTICITY, MICACEOUS
1035	S-4	SS	15-17	19 19 20 25	2.0/2.0		HARD	GRAY W ORANGE MOTTLING	MED. TO FINE SAND, LITTLE SILT AND CLAY, TR. GRAVEL	ML-SW	SECONDARY FE OXIDE STAINING, DAMP NO PLASTICITY, HOMOGEN, MICACEOUS
1055	S-5	SS	20-22	10 18 9 10			MED. DENSE	LT. GRAY	COARSE TO FINE SAND TR. SILT, MICACEOUS	SW	DAMP, NO PLASTICITY NON COHESIVE, SOME FE STAINING (ORANGE) GRAVEL @ 23' (FROM DRILLERS)

REMARKS: DRILL RIG - CME 75, HOLLOW STEM AUGERS: 4¼" ID, ~6½" OD SPLG. USING 2' LONG, 3" ID SPLIT SPOON DRIVEN W/ A 140 LB. HAMMER DROPPED 30", well complete 9-11-88

BORING MW3-1/SO27

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AR301674

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: MW3-1 / SO27
PROJECT NO.: 9851 — DATE: 9-10-88 — DRILLER: JIM ROCHFORD
ELEVATION: — FIELD GEOLOGIST: RICK BETHEL
WATER LEVEL DATA:
(Date, Time & Conditions) SEE P.1

TIME	SAMPLE NUMBER	SAMPLE NO. & TYPE OR RQD	DEPTH (Ft.) OR RUN NO.	BLOWS/6" OR RQD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, Ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	BORE HOLE USCS CONFLICTS	REMARKS
1215	S-6	SS	25-27	2 3 8 6	1.7 / 2.0			LT BRN	MED TO FINE SAND AND SILT	SW	BRND LITH. CONTACT AT 25.5 INDICATED BY ORANGE BAND (in) FE STAIN
							LOOSE	GRAY	SILT WITH CLAY, SOME SAND	ML	MICACEOUS SILT SLT. PLASTICITY
						TUBING ▽ 9-10-88					
1250	S027-30	ST	30-31		1.0 / 2.0				COARSE TO FINE SAND	SW-	REFUSAL W/ S.T. @ 31' BOTTOM SATURATED
								GRAY	AND GRAVEL	GW	
											POSS SILT/CLAY SEAM BETWN 31-35'
1315	S-7	SS	35-37	21 11 10 12	1.8 / 2.0		MED DENSE*	LT BRN W/ORANGE	COARSE TO FINE SAND AND	SW	WELL ROUNDED PEBBLES MOIST V. LOOSE*
									GRAVEL	GW	BAND OF CRS. SAND + GR. ~0.5" THICK AT 36' W/ FE STAINING, REMAINING SM. PREDOM. SAND
1325	S-8	SS	40-42	49 14 71 —	1.5 / 2.0	▽ 9-10-88	VERY DENSE*	RED & ORANGE	GRAVEL AND COARSE TO	GW	SATURATED; HIGH FE STAINING (RED-ORANGE) IN WATER + MAT.; VERY LOOSE (UNCONSOL)*
									FINE SAND	SW	
1350	S-9	SS	45-47	33 16 —	1.0 / 2.0		VERY DENSE*				

REMARKS See P. 1

BORING MW3-1 / SO27

PAGE 2 OF 3

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: MW3-1 / S027
PROJECT NO.: 9951 — DATE: 9-10-88 — DRILLER: JIM ROCHFORD
ELEVATION: — FIELD GEOLOGIST: RICK BETHEL
WATER LEVEL DATA:
(Date, Time & Conditions) See P.1

TIME	SAMPLE NUMBER	SAMPLE NO. & TYPE OR COD	DEPTH (ft.) OR RUN NO.	BLOWS/ 6" OR COD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	MATERIAL DESCRIPTION: COLOR	MATERIAL DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK CLASS	REMARKS
1420	S40	SS	50-52	31 15/4			VERY DENSE*	BRN.	COARSE TO FINE SAND AND	SW	VERY LOOSE UNCONS.*
									GRAVEL	GW	SATURATED PEBBLE; WELL ROUNDED QTZ/FELD
						TD 52'					

REMARKS See P.1 INSTALLED WELL TO 50' SCREEN SGT FROM 40-50' ±SWL @ 41' 9-10-88 Drilled to 51', sampled to 52'

BORING MW3-1/S027

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AR301676

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: MW2-1 / SO28
PROJECT NO.: 9851 — DATE: 9-12-88 — DRILLER: JIM ROCHFORD
ELEVATION: 45.45' — FIELD GEOLOGIST: RICK BETHEL
WATER LEVEL DATA: ~43'
(Date, Time & Conditions) CLEAR, SUNNY, 85°F winds 0-10 mph from N. start @ 1615 9-12-88

TIME	SAMPLE NO.	SAMPLE NO. & TYPE OR CORE RUN NO.	DEPTH (ft.) OR RUN NO.	BLOWS/6" OR ROD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	BORE HOLE SAMPLE CORE CHIPS	REMARKS
1615	SO28-00	SS	0-2'	4/8, 8/9	1.4/2.0		VERY STIFF	GRAY w/ ORANGE MOTTLING	SILT w/ FINE SAND, TR CLAY	ML	SAT. DUE TO RECENT RAIN. BATT. CASING PRESENT. ROOTS PRESENT. NONPLASTIC
1625	SO28-03	SS	3-5'	6/5, 3/4	1.8/2.0		MED. STIFF	GRAY w/ ORANGE MOTTLING	SILT w/ FINE SAND, SOME CLAY	ML	MOIST, BATT. CASING + ROOTS PRESENT, SLT PLASTICITY
1635	SO28-06	SS	6-8'	6/7, 17/26	2.0/2.0		VERY STIFF	GRAY w/ ORANGE MOTTLING	SILT w/ FINESAND AND CLAY	ML	MOIST. ROOTLETS PRESENT INCREASED PLASTICITY
1643	SO28-09	SS	9-11	9/8, 12/15	2.0/2.0		VERY STIFF	GRAY	SILT AND FINE TO MED GRAINED SAND, SOME CLAY	ML	SATURATED TO MOIST SLT. PLASTICITY (PERCHED WATER) HIT GRAVELS @ 12' (DS) BASED ON DRILLERS
1655	SO28-15	SS	13-15	5/8, 11/13	2.0/2.0		VERY STIFF	GRAY w/ OR. MOTTLES.	MED TO FINE SAND AND SILT, TR. CLAY	ML	MOIST. V. SLT. PLASTICITY INC. GRAIN SIZE W/ DEPTH
1710	SO28-20	SS	20-22	5/7, 8/11				GRAY w/ OR. STREAKS	MED TO FINE GR. SAND AND SILT	ML/SW	1" SEAMS OF SAND (2) IN SAMPLE, MICACEOUS NON PLASTIC
											HIT GRAVEL AT 23.5'

REMARKS: DRILL RIG: CME 75 SAMPLED USING A 3" ID SPLIT SPOON (2' LONG) DRIVEN W/ A 140 LB HAMMER DROPPED 30" Using Hollow Stem Augers: 6¼ ID, Annulus is 10"±, well completed 9-13-88.

BORING MW2-1 / SO28

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AR301677

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: MW2-1 / SO28
PROJECT NO.: 9851 — DATE: 9-12-88 — DRILLER: JIM ROCHFORD
ELEVATION: — FIELD GEOLOGIST: RICK BETHEL
WATER LEVEL DATA: S.W.L. P. 1
(Date, Time & Conditions)

TIME	SAMPLE NO. & TYPE OR RQD	DEPTH (FT.) OR RUN NO.	BLOWS 6" OR RQD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, Ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK CLASS	REMARKS
										GRAVEL RICH ZONE - COULD NOT OBTAIN SPL. @ 25'
1750	SO28-26 SS	26-28	21 / 21	2.0 / 2.0		HARD	GRAY + ORANGE W/ BLK	SILT AND FINE TO MED GR	ML	TOP 3" BRIGHT ORANGE W/ BLK DRY, BRITTLE, REMAINDER
			32 / 38				W/ BLK	SAND, SOME TO TR. CLAY		GRAY W/OR, MOIST, SLT. PLASTICITY
										DARK RED-OR. ZONE @
1815	SO28-30 SS	30-32	16 / 17	2.0 / 2.0		DENSE	ORANGE			TOP 6" BOUNDARY OF LITH CHANGE, DAMP COARSENS
			19 / 19				LT. BRN W/ OR.	CRS. TO FINE SAND	SW	W/ DEPTH, MICACEOUS V. UNICONSOL
1840	SO28-35 SS	35-37	19 / 22	2.0 / 2.0		V. DENSE	LT BRN W/ OR	CRS, TO FINE SAND TR.	SW	TOP 6" CRS SAND ORANGE FE STAINS, FINE TO CRS
			32 / 50					GRAVEL		W/ GR @ 35.5 VERY UNICONSOL
1915	SO28-40 SS	40-42	11 / 14	2.0 / 2.0			LT. BRN W/ OR.	MED TO FINE GR SAND	SW	TOP OF SPOON CONTAINED CRS. SAND + GRAV. (3")
9-12-88			15 / 32							MOIST, V. UNICONSOL.
					▽ 9-13-88					
0750	S11 SS	45-47	57 / 65	1.8 / 2.0		V. DENSE	LT. BRN W/ OR	COARSE TO FINE SAND AND	SW/	SATURATED, Rounded Pebbles FE STAINED
9-13-88			62					GRAVEL	GW	* VERY UNCONSOL. HIGH BLOW COUNTS DUE TO GRAVEL

REMARKS See P. 1

BORING MW2-1/SO28

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: MW2-1 / 5028
PROJECT NO.: 9851 — DATE: 9-13-88 — DRILLER: JIM ROCKFORD
ELEVATION: — FIELD GEOLOGIST: RICK BETHEL
WATER LEVEL DATA:
(Date, Time & Conditions) Sunny, clear, 85°F, started 0730, 9-13-88 @ 40'

TIME	SAMPLE NO.	SAMPLE NO. & TYPE OR RUN NO.	DEPTH (FT.) OR RUN NO.	BLOWS/6" OR RQD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (DEPTH, FT.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	MATERIAL DESCRIPTION: COLOR	MATERIAL DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK CONSISTENCY	REMARKS
0820	S-12	SS	S0-S2	36 / 18	1.7 / 2.0		V. DENSE*	LT BRN WY OR	COARSE TO FINE SAND +	SW	SAT. VERY UNCONSOL. HIGH BLOW CNT: DUE
									GRAVEL	GW	TO GRAVEL* FG STAINED ROUNDED PEBBLES
						TD 53'					

REMARKS See P.1 Total depth @ 53' set 10' screen to 53' Drillers drilled to 54' due to running sands to set well @ 53'

BORING MW2-1/5028

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AR301679

BORING LOG — NUS CORPORATION

PROJECT: GRBATTERY — BORING NO: SO-31
PROJECT NO.: 9851 — DATE: 3-22-89 — DRILLER: HARDIN-HUBER, INC. DON WILLEY, DAVE AUSTIN
ELEVATION: — FIELD GEOLOGIST: KIM KAAL
WATER LEVEL DATA: Reached at 11 Ft
(Date, Time & Conditions) Clear, ~75° Breezy ~ 10 mph

TIME START	SAMPLE NO & TYPE OR ROD	DEPTH (FT) OR RUN NO	BLOWS 6" OR ROD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, Ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS CONSISTENCY	REMARKS
1342	22	0-2	1/5	20		MED DENSE	MTLD BRN	FILL TO 3' CONTAINS SMALL BRICK CHUNKS		COARSE GRAINED SAND & GRAVEL
			4/4	24			LT BRN	SHADES COARSE SAND & GRAVEL		MOIST OIL ODOR MICA
1344	23	3-5	1/3	24		SOFT	MTLD ORN-BRN	SILT + CLAY, TR SAND HIGH PLAST	CH	OIL ODOR. GRADES FROM
			4/4	24			GRAY	PLAST. HOMO. TR ORG.	MH	OIL MOIST. MICA
1402	24	6-8	2/5	24		SOFT- MED STIFF	MTLD ORN BRN	SILT + CLAY, TR F. SAND HIGH PLAST	CH-MH	SLIGHT OIL ODOR. MICA MOIST
			4/12	24			GRAY	F. SAND, WITH SILT LOW PLAST	SP	FEO2 WEATHERING HOMOG. TR ORG.
1407	25	9-11	6/6	24		MED	ORN-BRN	F. SAND + SILT, TR CLAY	SP-	TR FEO2 WEATHER
			11/13	24	▽	STIFF	MOTTLED	NONPLASTIC. HOMOG. TR ORG.	ML	MICA MOIST
1411	26	13-15	4/6	24	BOH	MED	MTLD GRAY+	FINE TO MED. SAND WITH	SP-	MOIST-WET FEO2
			9/12	24		STIFF	BRN	SILT. NONPLASTIC. HOMOG.		MEDIUM MICA
		20-22								
				24						

REMARKS: DRILL RIG-MOBILE B-61, DRILLED WITH 3¼" ID HOLLOW STEM AUGERS
3" ϕ SPLIT SPOON DRIVEN 2 FT w/ 300 lb HAMMER DROPPED 18".
OD

BORING SO-31
PAGE 1 - 1

AR301680

BORING LOG — **NUS CORPORATION**

PROJECT: CORBATTERY — BORING NO: SD-32
PROJECT NO.: 9851 — DATE: 3-22-89 — DRILLER: HARDIN-HUBER, INC. DON WILLEY, DAN GAUSTIN
ELEVATION: — FIELD GEOLOGIST: KIM KAAL
WATER LEVEL DATA:
(Date, Time & Conditions) 3-22-89, PARTLY CLOUDY ~40°, 10 MPH WIND EAST

TIME	SAMPLE NO. & TYPE OR ROD	DEPTH (FT) OR RUN NO	BLOWS 6" OR ROD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (DEPTH, FT.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS SOURCES	REMARKS
1019	17	0-2	10/14	12/		DENSE	MTLD DK.	GRAVEL FILL (FINE TO COARSE) AND		OIL ODOR, [illegible]
			10/9	/24			GRAY-BRN	FINE TO COARSE SAND WITH GRAVEL		STAIN [illegible]
								CASING SHARDS.		SI [illegible]
1021	18	3-5	3/2	24/		MED	MTLD ORNG.	FINE SAND AND SILT [redacted]	MH	MOIST, POSSIBLE [illegible]
			5/16	/24		SOFT	BRN	CLAY. SOME ORGANICS. HOMOG.		FE2 [illegible]
										MICA
1027	19	6-8	5/7	24/		MED	MTLD ORNG	SILT WITH FINE SAND, TR	ML	LOW PLAST. FE2 [illegible]
			9/12	/24		STIFF-STIFF	BRN	CLAY HOMOG. TR. ORG.		MICA MOIST
										EXTRA VOLUME TAKEN
1032	20	9-11	5/3	24/		MED STIFF	MTLD ORNG	SILT WITH FINE SAND, TR CL	ML	FE2 WEATHERING MICA
			10/12	/24		STIFF	BRN	HOMOG. LOW PLAST. TR ORG.	SP	MOIST
1043	21	13-15	3/4	24/		MED STIFF	MTLD ORNG	FINE SAND WITH SILT, TR CL.	SP	FE2 [illegible]
			8/9	/24			BRN	NON PLASTIC. TR ORG. HOMOG		MOIST
		20-22		30						
				/24						

REMARKS: BATTERY CASINGS COME UP WITH AUGERS FROM 2½ FT. DOWN. DRILLED WITH 3¼" ID HOLLOW STEM AUGERS. SPLIT SPOONS DRIVEN USING 300 LB HAMMER DRIVEN 2 FT. 3" SPLIT SPOONS USED. DRILL RIG = MOBILE B61. TOOK EXTRA SURFACE SAMPLE DUE TO POOR RECOVERY AT 0-2 FT. INTERVAL

BORING SD-32
PAGE 1 . 1

AR301681

BORING LOG **NUS CORPORATION**

PROJECT: GR BATTERY
PROJECT NO.: 9851 DATE: 3-22-89
ELEVATION:
FIELD GEOLOGIST: KIM KAAL
WATER LEVEL DATA: N/A
(Date, Time & Conditions) 3-22-89, 35° 10mph winds from EAST

BORING NO. SO-33
DRILLER: HARDIN-HUBER, INC. DON WILLEY

TIME START	SAMPLE NO. & TYPE OR RQD	DEPTH (FT) OR RUN NO.	BLOWS 6" OR RQD (%)	SAMPLE RECOVERY / SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, ft.) OR SCREENED INTERVAL	SOIL DENSITY / CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	U S C S	REMARKS
0809	11,12	0-2	4 / 4	21		MED	BRN	Fill TOP 6 inches mixed Sand + Gravel material	SP	MOTTLED homog. moist. Low-Med
			4 / 5	24		SOFT	ORNG BRN	SILT, TR CL, F. SND + F. GRAVEL. LTL. ORG.	ML	FeO2 WEATH. PLAST. DUP. SAMPLE
0811	13	3-5	4 / 7	24			MOTTLED ORNG	SILT, TR F. SND + CLAY. BLK ORG.	ML	MOIST. BLK. ORG SPOTS
			11 / 13	24		STIFF	BRN	HOMOGEN. NON PLASTIC		FE OXIDE Color.
0820	14	6-8	4 / 6	24		STIFF	MOTTLED ORNG	(TOP 3" SILT + COARSE SND) SILT	ML	MOIST. SOME ORG SPOT. MICA
			9 / 12	24			BRN	SOME F. SND + CL. HOMOG.		FE OXIDE Color LOW PLAST.
0830	15	9-11	2 / 20	18		STIFF -	MTLD ORNG	SILT, SOME F. SND, TR. CL. HOMOG.	ML	MOIST. Fe oxide stained
			15 / 8	24		V. STIFF	BRN	BLK. ORG. SPOTS LOW PLAST.		IN SPOTS. MICA
0836	16	13-15	4 / 10	24	BOH	MED. STIFF	MTLD ORNG	FINE SAND, SOME SILT, TR CL + F.	SP	HOMOG. MOIST
			9 / 11	24			BRN	GR. LITTLE ORG. SPOTS. FEO2 STAINS		NON-PLASTIC MICA
		20-22		[illegible]						
				24						

REMARKS: Drillers: Don Willey, Dave Austin. Drill Rig - Mobile B-61. Drilling with 3¼" ID Hollow Stem Augers. USED 300 lb HAMMER TO DRIVE 3" Split SPOON 2 FT.

BORING SO-33

PAGE 1 of 1

BORING LOG — **NUS CORPORATION**

PROJECT: CHARTTERY — BORING NO: SB-34
PROJECT NO.: 9851 — DATE: 3-27-89 — DRILLER: HARDIN-HUBER, INC.
ELEVATION: — FIELD GEOLOGIST: KIM KAMLET
WATER LEVEL DATA: Perched at 6.0 (3-27-89)
(Date, Time & Conditions) clear, 70° WIND 15 MPH-SE.

	SAMPLE NO. & TYPE OR ROD	DEPTH (ft) OR RUN NO.	BLOWS 6" OR ROD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS CODES	REMARKS
1422	32	0-2	2/3	24/		SOFT	ORN BRN	SILT WITH CLAY, TR SND-F LOW TO med	ML	HOMOG - MOIST
			3/4	/24				PLAST. TOP 4" HIGH ORG.		LTL. FEO2 WEATH HNU 0 ppm
1424	33	3-5	2/4	24/		med	MTLD BRN	SLT, WLL. F SND MED-	ML-	HOMOG - MOIST TR.
			4/3	/24		SOFT	BRN	HIGH PLAST. LTL. ORG. BIKSAND	MH	FEO2 WEATH. HNU 0 ppm MICA
1437	34	6-8	3/5	24/		MED	MTLD	SLT+F. SND, WDY CL. HIGH- MOD.	mH	WET-MOIST TR FEO2
			7/9	/24		SOFT	BRN+GRY	PLAST. LTL. ORG. HOMOG.	SP	WEATH. HNU 0 ppm MICA
1444	35	9-11	3/5	24/		MED	MTLD BRN	SLT+FSND, LTL. CL. MOD PL.	MH-	WET TR FEO2 WEATH
			8/10	/24		SOFT		TR. ORG. HOMOG MICA	ML	HNU 0-.1 ppm
1453	36	13-15	15/10	10/	BOH	STIFF	MTLD BRN	FSND W SILT TR F. GR	SP-	MICA · LOW PLAST
			12/10	/24			BRN+ GRY	HOMOG. ORG FEO2 WEATH	ML	MOIST HNU 0 ppm
		20-22								

REMARKS: Drilled borehole w/ 3¼ in ID AUGERS. Sampled with 3" OD split spoon Driven with a 300 lb Hammer. Driller = mobile B-61

BORING SB-34

PAGE 1 . 1

AR301683

BORING LOG — NUS CORPORATION

PROJECT: C+R BATTERY
PROJECT NO.: 9851 DATE: 3-21-89
ELEVATION: FIELD GEOLOGIST: Kim Kaal
WATER LEVEL DATA: ~6' Parched
(Date, Time & Conditions) Cloudy, 50° winds E ~5mph 3-21-89

BORING NO SD-35
DRILLER: HARDIN-HUBER, INC. Don Willey

Time	Sample No. & Type or RQD	Depth (Ft.) or Run No.	Blows/6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density Consistency or Rock Hardness	Color	Material Classification	USCS	Remarks
511	6	0-2	2 / 4	24 / 24		MED	MTLD ORNGE	3" Fill; Silt, Some clay + F. SND - TOP 6"	ML	[illegible]
			4 / 5			SOFT	BRN	Homogeneous, Varied - Moist, LOW-MOD PLAST.	MH	[illegible]
										MOD. MOIST
1515	7	3-5	2 / 3	24 / 24		MED	MTLD	Clayey SILT, Little Finesand	MH	mica, [illegible]
			3 / 4			SOFT	ORNG BRN	Black organic mottling, Homog.		Plasticity, [illegible]
1525	8	6-8	3 / 5	24 / 24	3-21-89	Med.	MTLD.	SILT Some clay, becoming fine	MH-	mica, WET LOW-HIGH PLAST
			7 / 11			STIFF	ORNG BRN	Sand + silt, little clay bottom foot	ML	Bottom foot Varied [illegible]
1530	9	9-11	2 / 3	24 / 24		med	MTLD	TOP 1 Ft Clay and SILT High plast.	OH	mica, TOP FOOT = WET, BOTTOM = [illegible]
			6 / 9			Soft-Soft	ORNG. BRN	Bottom 1 Ft Silt + some Fine sand, Little clay	MH	Very moist. [illegible]
										augers [illegible]
										Sounds like [illegible]
1535 Finish drilling	10	13-15	6 / 4	24 / 24	BOH	Med soft	MTLD ORNG	Silt with finesand + clay.	MH-	Mica WET [illegible]
			6 / 6				BRN	(more sandy bottom 1 ft) High ORG	ML	LOW-HIGH PLAST.
										FeO2 weathering
										stains throughout
		20-22		24						

REMARKS: Drill Rig Mobile B-61. Driller Don Willey, Dave Austin. Drilled 13 FT (5 split spoons) with 3" Ø split spoon. Driven with a 300 lb Hammer 2 FT. Drilled with hollow stem augers (3¼ [illegible]

BORING SD-35
PAGE 1 of 1

AR301684

BORING LOG — NUS CORPORATION

PROJECT: CHRBATTERY — BORING NO: SD-36
PROJECT NO.: 9851 — DATE: 3-21-89 — DRILLER: HARDIN-HUBER, INC.
ELEVATION: — FIELD GEOLOGIST: KIM KAAL
WATER LEVEL DATA: N/A
(Date, Time & Conditions) 45°, Overcast ... SD-5 mtg, start ... @ 3-21-89

SAMPLE NO. & TYPE OR ROD	DEPTH (ft) OR RUN NO.	BLOWS 6" OR ROD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth, ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	UNIFIED SOIL CONSISTENCY	REMARKS
begin ME 1115									
1	0-2	11/8	18/		Med	Orange	SILT, Trace Clay & Fine	ML	[illegible]
		9/7	/24		ST. SOFT-STIFF	BRN	Sand. Some Org. TOP 3"		Mod moist.
							Gravel Fill. Low plasticity		
1122	2	3-5	4/6	21/	Med Stiff	Orange	SLT, TR Cl + F SND. Homog. Slight Low	ML	Mod moist.
			3/3	/24		BRN	Black mottling from org + plast		Tr. Mica
1132	3	6-8	2/2	21/	Med SOFT	Orange	SLT, TR Cl + F. SND. Homog Slight	ML	Mod moist. COH.
			6/8	/24	Med Stiff	BRN	Black mottling (org.) Low plast		Tr mica
1135	4	9-11	4/6	24/	Med. Stiff	Mottled Orange	SLT, TR Cl. F. SND Homog.	ML	Mod moist cohes.
			7/10	/24		BRN	Ltl. org Low plast.		Tr. Mica
1146	5	13-15	3/6	24/	BOH Med	Mottled	SLT, some F. Sand, TR Cl.	ML	Mod moist. ? coh.
			9/7	/24	Stiff	Orange BRN	Homog. Ltl org. Mod. plast.	MH	Tr. Mica
END TIME							Lighter BRN fine sand in spots.		Fe2 weathering stains throughout
		20-22							

REMARKS: 300 lb Hammer used to drive 3" ϕ Split spoon w/ 18" drop
Location corner of Capitol Oil Co. Drill Rig Mobile B-61 drillers Don Willey, Dave Austin
Drilled with 3¼" ID Hollowstem Augers

BORING SD-36
PAGE 1 of 1

AR301685

BORING LOG — **NUS CORPORATION**

PROJECT: CHRBattery — BORING NO: MW5-1, SO-37
PROJECT NO.: 9851 — DATE: 3-23-89 — DRILLER: HARDIN-HUBER, INC. Downey
ELEVATION: — FIELD GEOLOGIST: KIM KAAL
WATER LEVEL DATA: 45 Ft (3-23-89)
(Date, Time & Conditions) 3-23-89, Drizzle ~40° OVERCAST

TIME BEGINS	SAMPLE NO. & TYPE OR ROD	DEPTH (ft) OR RUN NO.	BLOWS 6" OR ROD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth ft.) OR SCREENED INTERVAL	MATERIAL DESCRIPTION: SOIL DENSITY CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS SOIL CONSISTENCY	REMARKS
0836		0-2	9/21	11/24		STIFF	BRN MOTTED	TOP 4" SAND AND CLAY WITH SILT	CL	
			9/6				+ GRY	FINE SAND & SILT — TR. GRAVEL	CH	
0839		3-5	3/5	24/24	SIL- + CLAY	MED	BRN. BRN +	CLAY AND SILT, TR F. SND.	CH	TR. FEO2 WEATH. MOIST.
			9/12			STIFF	GRAY MOTTLED	ORG. MOD PLAST. HOMOG	MH	
0851		6-8	4/12	19/24		STIFF	MTLD BRN. BRN + GRAY	SILT WITH CLAY, TR F. SND	ML	MOIST. TR ORG.
			15/21					LOW-MOD PLAST. HOMOG.	CL	FEO2 WEATH.
0900		9-11	4/6	24/24		STIFF	MTLD BRN	SILT AND CLAY, TR F. SND	CL	MOIST MICA. FEO2
			12/15				BRN GRAY	MOD-LOW PLAST. HOMOG.	ML	WEATH. MICA.
					CLAY					
0917		13-15	5/10	24/24	CLAY + SAND	MED	MTLD VARVED	CLAY + F SND, SOME SILT	CH	FINE LAMINATIONS MOIST.
			7/9			STIFF	BROWN GRAY	MOD-HIGH PLAST. HOMOG.	CH	MICA FEO2
0935	27	20-22	3/3			SOFT	MOT. BROWN	CLAY AND F-MED SND	SP	MOIST-WET MICA
			4/6				BROWN GRAY	HIGH PLAST. VARVED. HETEROG.	CH	TR. BLK. ORG.

REMARKS: SAMPLE INTERVALS 0-2, 3-5, 6-8, 9-11 & 13-15 WERE TAKEN WITH A 2" SPLIT SPOON, DRIVEN WITH A 140 lb Hammer. The remaining samples were taken with a 3" split spoon driven with a 300 lb hammer. DRILL RIG = MOBILE B-61
Drilling completed using 4 1/4" ID Hollowstem Augers

BORING MW5-1, SO-37
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AR301686

BORING LOG NUS CORPORATION

PROJECT: C+R BATTERY
PROJECT NO.: 9851
ELEVATION:
WATER LEVEL DATA
(Date, Time & Conditions) overcast, Light Rain ~35° Snow, wind ~10mph EAST

DATE: 3-23-89
FIELD GEOLOGIST: Kim KAAL

BORING NO MW5-1/SO-37
DRILLER: HARDIN-HUBER, INC.

Time	Sample No. & Type	Depth (ft.)	Blows 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth ft)	Soil Density Consistency or Rock Hardness	Color	Material Classification	USCS	Remarks
0950	29	25-27	2 / 6 / 9 / 12	24 / 24		MED. STIFF	GRAY- mottled gray	Clay, some s.t w/F. SND. MOD-...	CH	moist, ... FeO2 ...
1009	29	30-32	5 / 6 / 8 / 9	24 / 24	Sand Coarsens Down-ward	MED STIFF	mottled gray + ORN BRN	FINE SAND some silt & clay. Slightly varved. FeO2 weath	SP	MOIST, ... MICA
1032	30	35-37	6 / 10 / 10 / 20	24 / 24	SND Gravel	MED DENSE	LT BRN + ORN BRN	FINE TO MED. SAND, Tr silt. Coarsely varved, ...	SW-SP	MOIST, FeO2 weath. Varies, Quartzite ...
1052	31	40-42	16 / 30 / 27 / 27	24 / 24		DENSE	LT. BRN-ORN. BRN	Fine to coarse SND + GRVL. Blueish quartzite gravels.	SW	moist-wet, Hetero. FeO2 weath. well rounded ...
1110		45-47	[illegible]	24	▽	DENSE	LT BRN-ORN BRN	C SND + F-C GRAV. Gravel Subround. Quartzite, LTL FeO2 weath	SP-SW	Spoon wet Saturat Heterog.

REMARKS

BORING MW5-1, SO-

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* See Legend on Back

AR301687

BORING LOG — **NUS CORPORATION**

PROJECT: C+R BATTERY — BORING NO.: MW5-1 / SO-37
PROJECT NO.: 9651 — DATE: 3-23-89 — DRILLER: HARDIN-HUBER INC. DON WILLEY
ELEVATION: — FIELD GEOLOGIST: Kim KAAL
WATER LEVEL DATA:
(Date, Time & Conditions) LIGHT SNOW ~35°, RAIN

SAMPLE NO. & TYPE	DEPTH (ft.)	BLOWS/6" OR RQD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth ft.)	MATERIAL DESCRIPTION* SOIL DENSITY/ CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
1125	50-52	11/32	24/		VERY	LT. BRN.	C SAND AND F-C GRS	SP	SPOON WET-SATURATED
		34/32	/24		DENSE	ORN BRN	Subrounded, mainly quartz,	GW	WATER ORN-BRN color.
1147	55-57	10/15	24/	BOH.	DENSE	LT. BRN-	C-M SAND, F-C GR.	SW-	SATURATED ORN-
		17/20	/24			ORN BRN.	Subrown. Quartz. Gravel	GW	BRN water, FEW WOOD

REMARKS

BORING MW5-1, SO-37

* See Legend on Back

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AR301688

APPENDIX A-2

MONITORING WELL CONSTRUCTION DETAILS

NUS CORPORATION
A Halliburton Company

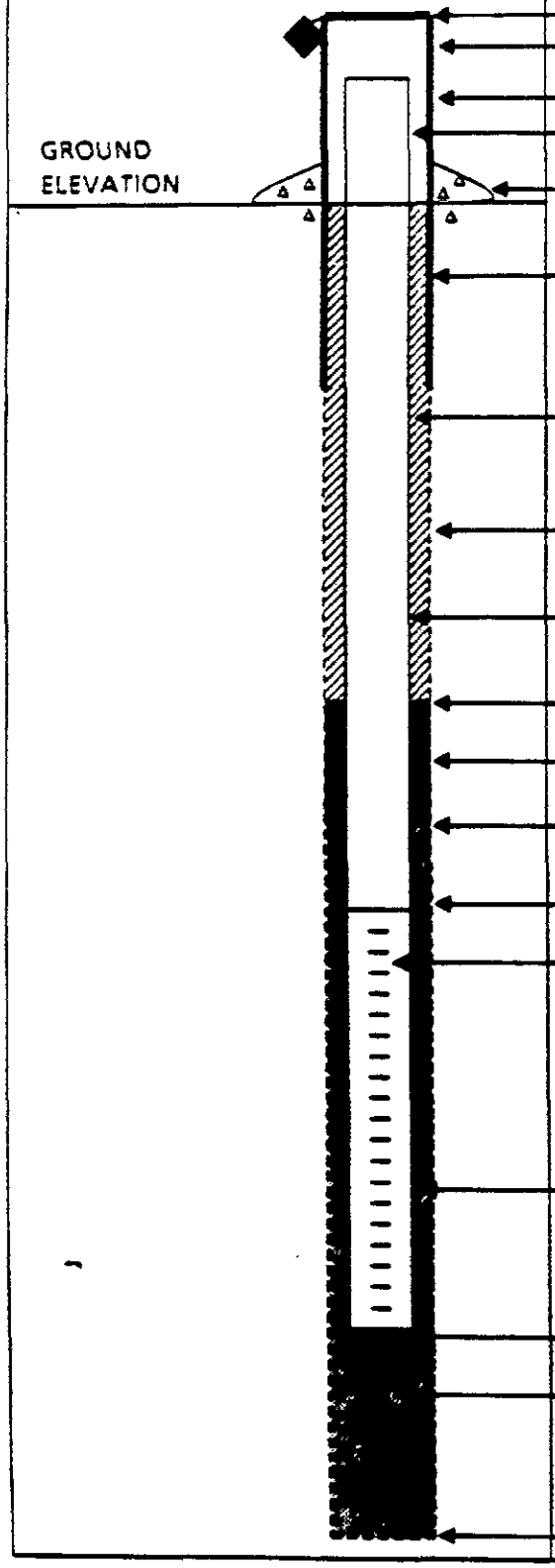
BORING NO MW 1-1

OVERBURDEN
MONITORING WELL SHEET

PROJECT C+R BATTERY
PROJECT NO. 9851
ELEVATION 49.14
FIELD GEOLOGIST Kim KAAL

LOCATION Richmond, VA
BORING MW1-1
DATE 9-9-88

DRILLER Jim Rochford
DRILLING METHOD Hollow Stem Auger
DEVELOPMENT METHOD



ELEVATION OF TOP OF SURFACE CASING: 51.08
ELEVATION OF TOP OF RISER PIPE: 50.97
STICK - UP TOP OF SURFACE CASING: 1.94
STICK - UP RISER PIPE: 1.83
TYPE OF SURFACE SEAL: Cement / bentonite grout
I.D. OF SURFACE CASING:
TYPE OF SURFACE CASING: Steel
RISER PIPE I.D. 2"
TYPE OF RISER PIPE: schedule 40 PVC
BOREHOLE DIAMETER: 10"
TYPE OF BACKFILL: Cement, bentonite grout
ELEVATION / DEPTH TOP OF SEAL: 2.14 / 47.0
TYPE OF SEAL: Baroid Aqua Gel, bentonite slurry + bentonite pellets
DEPTH TOP OF SAND PACK: -7.86 / 57.0
ELEVATION / DEPTH TOP OF SCREEN: -9.36 / 58.5
TYPE OF SCREEN: schedule 40 PVC
SLOT SIZE x LENGTH: 20 slot x 10'
I.D. OF SCREEN: 2"
TYPE OF SAND PACK: Best Silica Sand with a fine gravel layer at 57'-56'
ELEVATION / DEPTH BOTTOM OF SCREEN: -19.36 / 68.5
ELEVATION / DEPTH BOTTOM OF SAND PACK: -20.86 / 70.0
TYPE OF BACKFILL BELOW OBSERVATION WELL: Sand from formation caved in.
ELEVATION / DEPTH OF HOLE: -20.86 / 70.0

NUS CORPORATION
A Halliburton Company

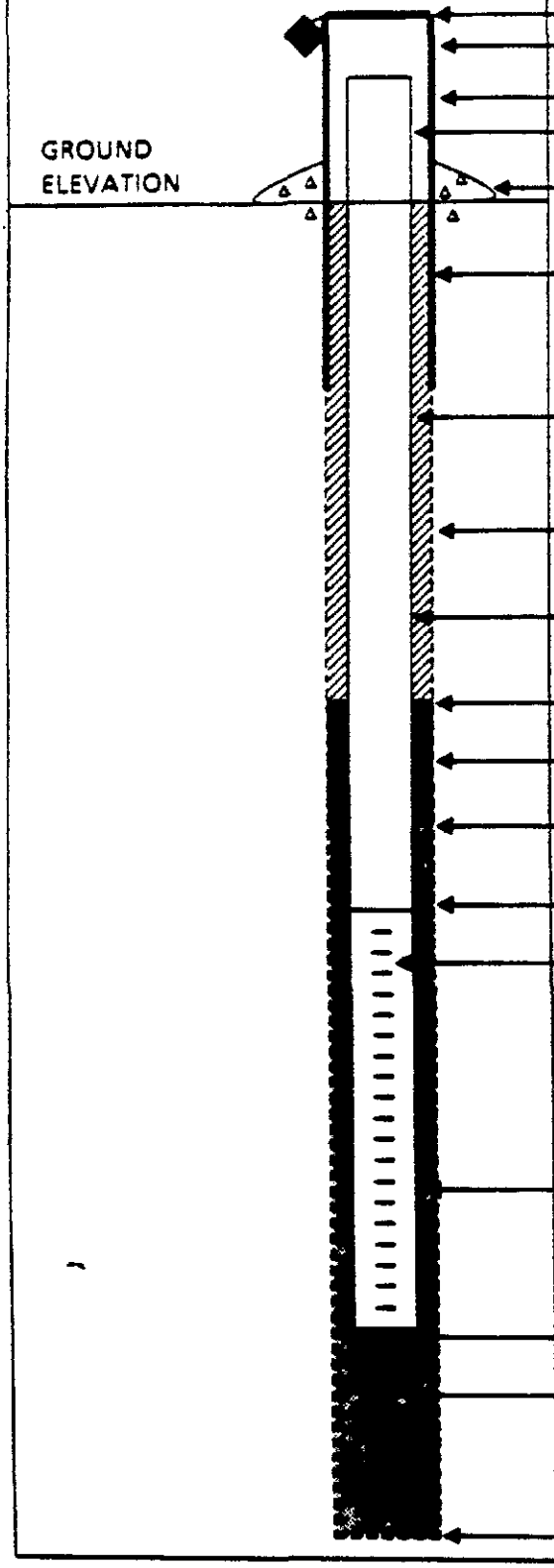
BORING NO MW 2-1

OVERBURDEN
MONITORING WELL SHEET

PROJECT C+R Battery
PROJECT NO. 9851
ELEVATION 45.45
FIELD GEOLOGIST Rick Bethel

LOCATION Richmond, VA
BORING MW 2-1
DATE 9-13-88

DRILLER Jim Rochford
DRILLING METHOD Hollow Stem Auger
DEVELOPMENT METHOD Bail



ELEVATION OF TOP OF SURFACE CASING: 47.48
ELEVATION OF TOP OF RISER PIPE: 47.36
STICK - UP TOP OF SURFACE CASING: 2.03
STICK - UP RISER PIPE: 1.91
TYPE OF SURFACE SEAL: Cement / bentonite grout
I.D. OF SURFACE CASING: 4"
TYPE OF SURFACE CASING: Steel
RISER PIPE I.D. 2"
TYPE OF RISER PIPE: Schedule 40 PVC
BOREHOLE DIAMETER: 10"
TYPE OF BACKFILL: Cement / bentonite grout
ELEVATION / DEPTH TOP OF SEAL: 8.45 / 37.0
TYPE OF SEAL: Bentonite Pellets
DEPTH TOP OF SAND PACK: 5.45 / 40.0
ELEVATION / DEPTH TOP OF SCREEN: 2.45 / 43.0
TYPE OF SCREEN: Schedule 40 PVC
SLOT SIZE x LENGTH: 20 slot x 10
I.D. OF SCREEN: 2"
TYPE OF SAND PACK: Best Silica Sand
ELEVATION / DEPTH BOTTOM OF SCREEN: -7.55 / 53.0
ELEVATION / DEPTH BOTTOM OF SAND PACK: -7.55 / 53.0
TYPE OF BACKFILL BELOW OBSERVATION WELL: Hole caved in to 53'
ELEVATION / DEPTH OF HOLE: -7.85 / 53.3

AR301691

NUS CORPORATION
A Halliburton Company

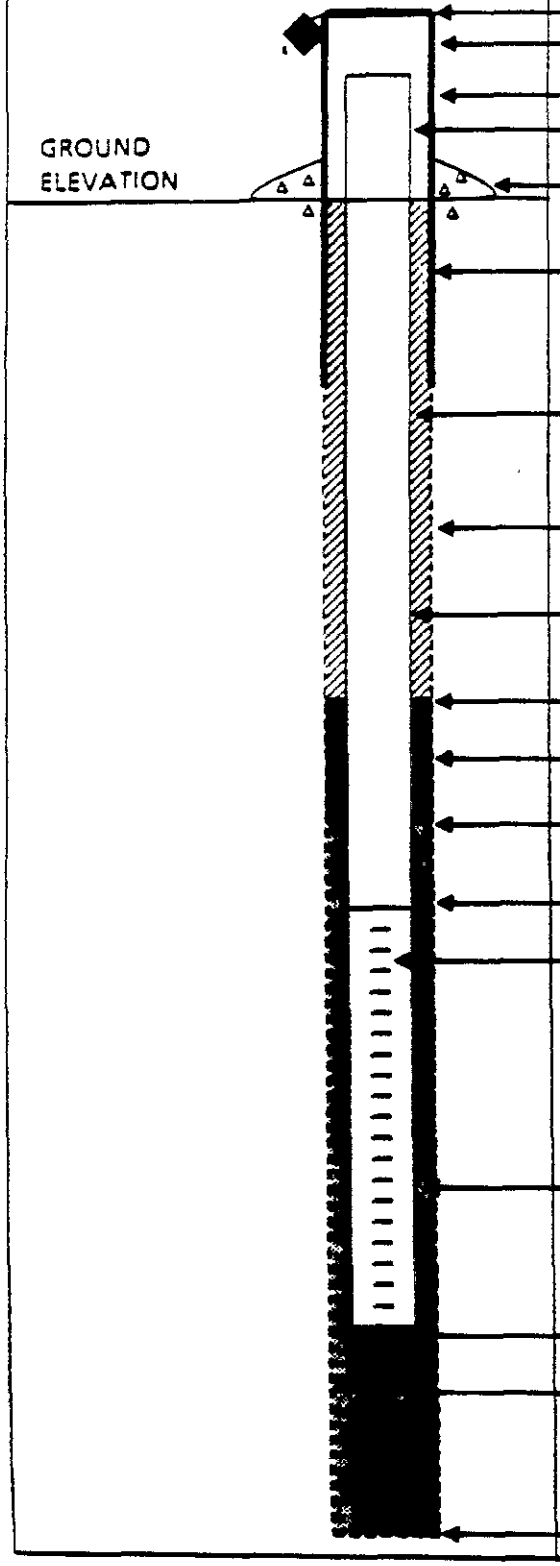
BORING NO. MW3-1

OVERBURDEN
MONITORING WELL SHEET

PROJECT C+R Battery
PROJECT NO. 9851
ELEVATION 43.81
FIELD GEOLOGIST Rick Bethel

LOCATION Richmond, VA
BORING MW3-1
DATE 9-10-88

DRILLER Jim Rochford
DRILLING METHOD Hollow Stem Auger
DEVELOPMENT METHOD Bail



ELEVATION OF TOP OF SURFACE CASING: 45.57
ELEVATION OF TOP OF RISER PIPE: 45.44
STICK - UP TOP OF SURFACE CASING: 1.76
STICK - UP RISER PIPE: 1.63
TYPE OF SURFACE SEAL: Cement / bentonite grout
I.D. OF SURFACE CASING: 4"
TYPE OF SURFACE CASING: Steel
RISER PIPE I.D. 2"
TYPE OF RISER PIPE: Schedule 40 PVC
BOREHOLE DIAMETER: 6.5"
TYPE OF BACKFILL: Cement / bentonite grout
ELEVATION / DEPTH TOP OF SEAL: 10.81 / 33.0
TYPE OF SEAL: Bentonite slurry and bentonite pellets
DEPTH TOP OF SAND PACK: 6.11 / 37.7
ELEVATION / DEPTH TOP OF SCREEN: 3.81 / 40.0
TYPE OF SCREEN: Schedule 40 PVC
SLOT SIZE x LENGTH: 20 slot x 10'
I.D. OF SCREEN: 2"
TYPE OF SAND PACK: Best Silica Sand
ELEVATION / DEPTH BOTTOM OF SCREEN: -6.19 / 50.0
ELEVATION / DEPTH BOTTOM OF SAND PACK: -6.19 / 50.0
TYPE OF BACKFILL BELOW OBSERVATION WELL: Hole caved in to 50'
ELEVATION / DEPTH OF HOLE: -6.19 / 50.0

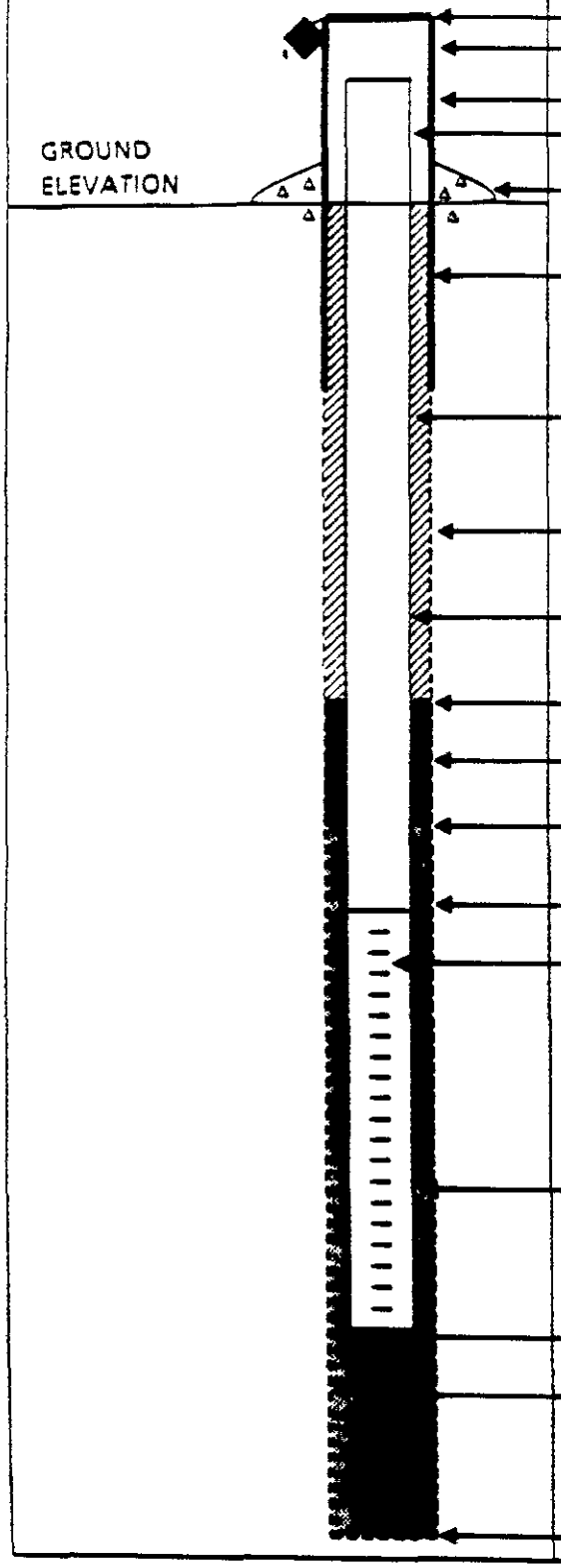
AR301692

NUS CORPORATION
A Halliburton Company

OVERBURDEN MONITORING WELL SHEET

PROJECT C+R Battery
PROJECT NO. 9851
ELEVATION 44.66
FIELD GEOLOGIST Kim Kaal
LOCATION Richmond, VA
BORING MW4-1
DATE 9-2-88

DRILLER Jim Rochford
DRILLING METHOD Hollow Stem Auger
DEVELOPMENT METHOD Bail



ELEVATION OF TOP OF SURFACE CASING: 46.65
ELEVATION OF TOP OF RISER PIPE: 46.53
STICK - UP TOP OF SURFACE CASING: 1.99
STICK - UP RISER PIPE: 1.87
TYPE OF SURFACE SEAL: Cement / bentonite grout
I.D. OF SURFACE CASING: 4"
TYPE OF SURFACE CASING: Steel
RISER PIPE I.D. 2"
TYPE OF RISER PIPE: Schedule 40 PVC
BOREHOLE DIAMETER: 10"
TYPE OF BACKFILL: Cement / bentonite grout
ELEVATION / DEPTH TOP OF SEAL: 8.16 / 36.5
TYPE OF SEAL: Bentonite Pellets
DEPTH TOP OF SAND PACK: 5.66 / 39.0
ELEVATION / DEPTH TOP OF SCREEN: 2.66 / 42.0
TYPE OF SCREEN: schedule 40 PVC
SLOT SIZE x LENGTH: 20 slot x 10'
I.D. OF SCREEN: 2"
TYPE OF SAND PACK: Best Silica Sand
ELEVATION / DEPTH BOTTOM OF SCREEN: -7.34 / 52.0
ELEVATION / DEPTH BOTTOM OF SAND PACK: -10.34 / 55.0
TYPE OF BACKFILL BELOW OBSERVATION WELL: Sand
ELEVATION / DEPTH OF HOLE: -10.34 / 55.0

MW5-1

BORING NO. SB-37

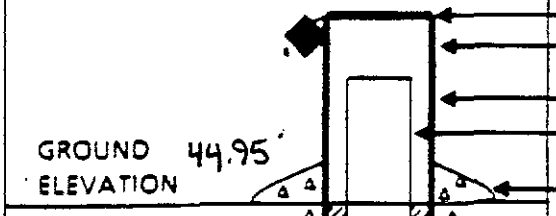
NUS CORPORATION
A Halliburton Company

OVERBURDEN
MONITORING WELL SHEET

PROJECT G&R Battery
PROJECT NO. 9851
ELEVATION
FIELD GEOLOGIST Kim Kaal

LOCATION MW 5-1
BORING SB37
DATE 2-23-89

DRILLER Donnelley DF
DRILLING METHOD Hollow stem auger
DEVELOPMENT METHOD Air Lift



ELEVATION OF TOP OF SURFACE CASING: 47.41'
ELEVATION OF TOP OF RISER PIPE: 47.22'
STICK - UP TOP OF SURFACE CASING: 2.0
STICK - UP RISER PIPE: 1.5
TYPE OF SURFACE SEAL: Cement
I.D. OF SURFACE CASING: 4"
TYPE OF SURFACE CASING: Locking Stainless steel
RISER PIPE I.D. 2"
TYPE OF RISER PIPE: Schedule 40 PVC
BOREHOLE DIAMETER: 6"
TYPE OF BACKFILL: Cement / Bentonite Grout
ELEVATION / DEPTH TOP OF SEAL: 3.95'/41.0
TYPE OF SEAL: Bentonite pellets
DEPTH TOP OF SAND PACK: 42.5
ELEVATION / DEPTH TOP OF SCREEN: -0.05/45.0
TYPE OF SCREEN: 20 slot schedule 40 PVC
SLOT SIZE x LENGTH: 20 slot x 10'
I.D. OF SCREEN: 2"
TYPE OF SAND PACK: Morie #2 SAND - Silica
ELEVATION / DEPTH BOTTOM OF SCREEN: -10.05/55.0
ELEVATION / DEPTH BOTTOM OF SAND PACK: -12.05/57.0
TYPE OF BACKFILL BELOW OBSERVATION WELL: N/A
ELEVATION / DEPTH OF HOLE: -12.05/57.0

APPENDIX A-3

MINERALOGICAL DATA FOR SOIL

PEI ASSOCIATES, INC.
11499 CHESTER ROAD
CINCINNATI, OHIO 45246
(513) 782-4700
TELECOPIER (513) 782-4807

JAN 3 0 1989

Rec'd 1-19-89

January 4, 1988

Mr. Paul H. Leonard
U.S. Environmental Protection Agency
Region III
841 Chestnut Building
Philadelphia, Pennsylvania 19107

Re: EPA Contract No. 68-03-3413
Work Assignment No. 1-19J
Initial Sample Characterization Results for the C&R Battery Site
PN 3741-19-1J

Dear Paul:

Enclosed are the initial physical and chemical sample characterization results for the C&R Battery site in Chesterfield County, Virginia. The soil is a carbonate composed of approximately 55 percent sand, 31 percent silt, and 14 percent clay. The pH is moderately alkaline (9.3). The average concentration of total lead is about 7.6 percent, and EP toxicity lead averages 418 ppm. The predominant lead species is hydrocerussite ($Pb_3(CO_3)_2(OH)_2$). Calcium, aluminum, and iron (naturally occurring soil elements) also are present in significant amounts.

If you have any questions concerning these data, please call me or John Schabron of Western Research Institute.

Sincerely,

PEI ASSOCIATES, INC.

Judy L. Hessling

Judy L. Hessling
Work Assignment Manager

Enclosures

PEI Associates, Inc.
11499 Chester Rd.
Cincinnati, OH 45246
(513) 782-4700

Client: USEPA
Lead sites job

Project No.: 3741-19-J
Requisition No.: 11-096
Date Received: 11/11/88
Sampled by: PEI
Date Reported: 12/13/88

Attn: c/o Judy Hessling

Sample: C&R Site soil
PEI Numbers 03 and 04

ug/g unless noted

	A		B	
Moisture, %	16.1		18.9	
pH, SU	9.21		9.46	
Fluoride, mg/g	0.31		0.27	
Sulfide, mg/g	6		<6	
Cyanide	<0.02		0.08	
TOC	5,710		8,320	
Sodium CEC, ug/g as Na	7,650	33.3 mg/100g	9,150	39.8 mg/100g
EP leachable lead, mg/L (Determined by Method of Additions)	383		454	
Aluminum	4,680		4,720	
Antimony	440		<4	
Arsenic	48.2		19.7	
Barium	60.0		74.5	
Beryllium	<0.07		0.16	
Cadmium	4.48		4.93	
Calcium	53,100		62,700	
Chromium	7.4		10.4	
Cobalt	<0.8		3.0	
Copper	36.0		18.9	
Iron	5,830		5,760	
Lead	82,800		68,900	
Magnesium	939		959	
Manganese	53.8		120	
Mercury	<0.14		0.19	
Nickel	5.34		5.03	
Potassium	537		539	
Selenium	<0.08		<0.08	
Silver	1.4		1.0	
Sodium	79.6		83.3	
Thallium	<7		9	
Vanadium	10.8		11.5	
Zinc	25.0		22.7	

Submitted by:

Western Research Institute
P.O. Box 3395, University Station
Laramie, Wyoming 82071
307 721-2011

December 21, 1988

Mr. Jack Nobis
PEI Associates
11499 Chester Road
Cincinnati, Ohio 45246

Dear Mr. Nobis:

Attached are the mineralogic analysis, grain size, and humic acid results from ten samples submitted to WRI. Please contact me if you have any questions or comments.

Sincerely,

for JFS

John F. Schabron, Ph.D.
Manager,
Analytical Research Division

Mineralogic Analysis

<-------- Sample---------> PEI	WRI	Mineral Identification
Schuylkill (A-2)	88_328	quartz, calcite, cerussite*, smectite
Gould (A-2)	88_329	quartz, Na,Ca feldspar, anglesite, plattnerite, lead, smectite, illite
→ CAR (A-2) ~~Gould (A-2)~~	88_330	quartz, calcite, hydrocerussite*, bassanite, plagioclase, illite, smectite
NL Industries (A-2)	88_331	quartz, calcite, cerussite*, bassanite, lead, illite, kaolinite
Gould (A-2) ~~C & R (A-2)~~	88_332	anglesite, plattnerite, lead, quartz, illite, smectite
→ CAR (A-7) ~~Schuylkill (A-7)~~	88_333	quartz, calcite, hydrocerussite*, bassanite, plagioclase, illite, smectite
Gould (A-7)	88_334	anglesite, plattnerite, lead, quartz, illite, smectite
Gould (A-7)	88_335	quartz, anorthite, anglesite, plattnerite, lead, smectite, illite
NL Industries (A-7)	88_336	quartz, calcite, cerussite*, bassanite, lead, illite, kaolinite
Schuylkill (A-7) ~~C & R (A-7)~~	88_337	quartz, calcite, cerussite*, smectite

Mineral Code

quartz SiO_2
calcite $CaCO_3$
plagioclase $(Na,Ca)AlSi_3O_8$
anorthite $(Ca,Na)AlSi_3O_8$
anglesite $PbSO_4$
cerussite $PbCO_3$*
hydrocerussite $Pb_3(CO_3)_2(OH)_2$*
plattnerite PbO_2
bassanite $CaSO_4..5H_2O$
illite K-Al-Si-O-H
smectite Na-Ca-Al-Si-O-H
kaolinite $Al_2Si_2O_5(OH)_4$
lead (metal) Pb

Note:

* The XRD patterns and crystalline structures for the minerals cerussite and hydrocerussite are very similar differing only in the degree of hydration. Additionally, the mineral leadhillite $Pb_4SO_4(CO_3)_2(OH)_2$ is very similar in structure to cerussite and hydrocerussite differing by the substitution of SO_4 into the crystalline form. It is very possible that leadhillite was present in some or all of the samples that contained cerussite or hydrocerussite, but was masked by other peaks or below detection limits.

Particle Size Analysis

PEI Sample	Sand	Silt	Clay
	<----------wt %---------->		
Schuylkill (A-2)	85	7	8
	89	5	6
Gould (A-2)	49	47	4
	53	43	4
Gould (A-2)	90	6	4
	91	5	4
NL Industries (A-2)	70	16	14
	71	17	12
C & R (A-2)	56	33	11
	52	31	17
Schuylkill (A-7)	87	6	7
	88	5	7
Gould (A-7)	57	38	5
	47	48	5
Gould (A-7)	90	6	4
	92	4	4
NL Industries (A-7)	68	17	15
	68	17	15
C & R (A-7)	56	28	16
	56	31	13

Humic Acid Analysis

PEI Sample	Humic Acid wt %
Schuylkill (A-2)	.77
	.84
Gould (A-2)	.02
	.02
Gould (A-2)	<.01
	.02
NL Industries (A-2)	.39
	.42
C & R (A-2)	1.69
	1.35
Schuylkill (A-7)	.77
	.67
Gould (A-7)	.33
	.16
Gould (A-7)	.74
	1.06
NL Industries (A-7)	.35
	.22
C & R (A-7)	.06
	.07
control	.04
control	.03
blank	<.01
blank	<.01

X-RAY DIFFRACTION ANALYSIS

Date: 12/16/88

Source: PEI

Sample Identification: 88_330

Identified Phase(s):

1. QUARTZ
2. CALCITE
3. HYDROCERUSSITE ($Pb_3(CO_3)_2(OH)_2$)
4. BASSANITE ($CaSO_4 \cdot .5H_2O$)
5. PLAGIOCLASE (Trace)
6. ILLITE
7. SMECTITE (Trace)
8.
9.
10.
11.
12.
13.
14.
15.

Comments:

Carbonate

AR301703

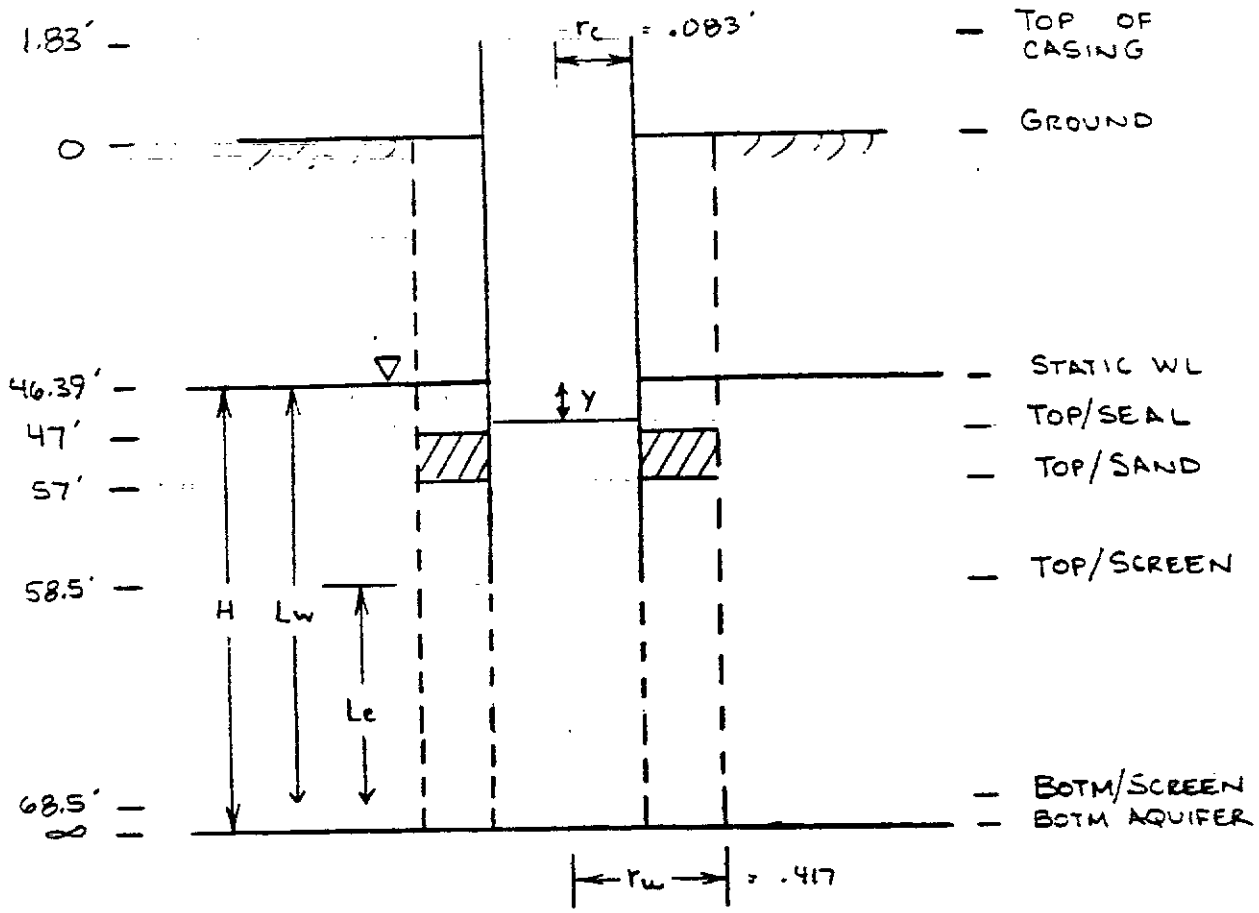
APPENDIX B

DATA FROM SLUG TESTS AND CALCULATION SHEETS FOR HYDRAULIC CONDUCTIVITY

CLIENT	FILE NO.	BY.	PAGE 1 OF 4
C+R BATTERY	9851	RDB	
SUBJECT. SLUG TEST CALC's. MW 1-1		CHECKED BY. MLM 12/15/88	DATE

CALCULATIONS: (BOUWER & RICE)

DEPTH (FT.) WELL CONSTRUCTION



$H = \infty$

$L_w = 68.5 - 46.4' = 22.1'$

$L_e = 68.5 - 58.5 = 10.0'$

$r_c = 0.083'$

$r_w = 0.417'$

$L_e/r_w = 10/.417 = 24$

$A = 2.25$

$B = 0.32$

$C =$

AR301705

CLIENT: C+R BATTERY	FILE NO.: 9851	BY: RDB	PAGE 2 OF 4
SUBJECT: SLUG TEST CALC'S.		CHECKED BY: MLM 12/15/88	DATE:

$$\ln Re/r_w = \left[\frac{1.1}{\ln(L_w/r_w)} + \frac{A + B\ln[(H-L_w)/r_w]}{L_e/r_w}\right]^{-1}$$

$$\ln Re/r_w = \left[\frac{1.1}{\ln(22.1/0.417)} + \frac{2.25 + 0.32\ln[(\infty - 22.1)/0.417]}{10/0.417}\right]^{-1}$$

$$\ln Re/r_w = \left[\quad 0.277 + \quad 0.174 \quad\right]^{-1}$$

$$\ln Re/r_w = 2.21$$

$$K = \frac{r_c^2 \ln(Re/r_w)}{2L_e} \cdot \frac{1}{t} \ln Y_0/Y_t$$

$$K = \frac{(.083)^2(\ 2.21\ )}{2(\ 10\ )} \cdot \frac{1}{0.5} \ln\left(\frac{1.2}{0.24}\right)$$

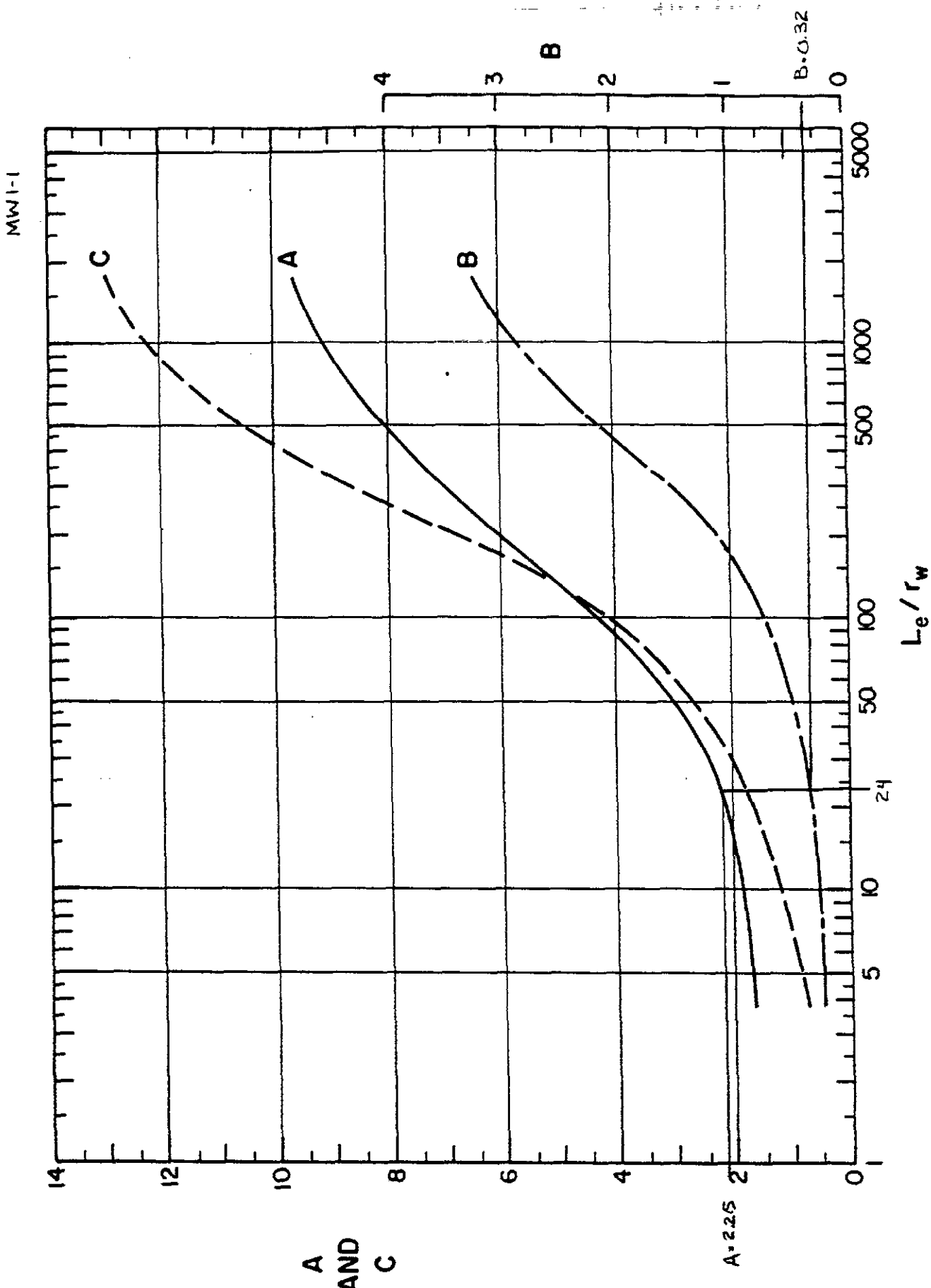
$$K = (\ 7.61 \times 10^{-4}\ )(\ 2\ )(\ 1.61\ )$$

$$K = 2.45 \times 10^{-3}\ \text{Ft/min.}$$

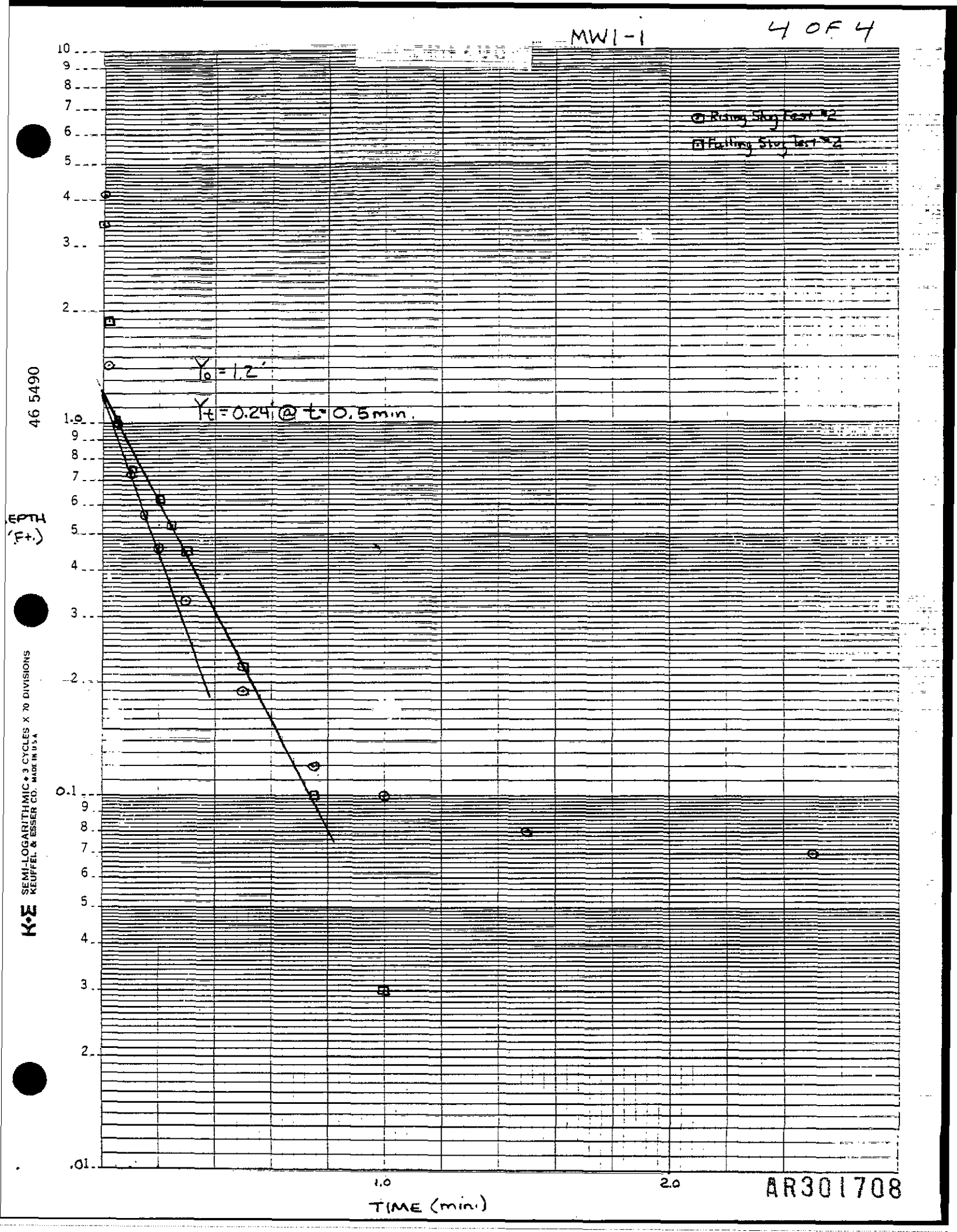
$$K = 1.24 \times 10^{-3}\ \text{cm/sec.}$$

$$T = K \cdot H =$$

AR301706


MW1-1
A AND C
B
A
B
C
L_e / r_w
B=0.32
A=2.25
24
0
2
4
6
8
10
12
14
0
1
2
3
4
5
10
50
100
500
1000
5000

MW1-1


Rising Slug Test #2
Falling Slug Test #2
$Y_o = 1.2'$
$Y_t = 0.24'$ @ $t = 0.5$ min.
10
9
8
7
6
5
4
3
2
1.0
9
8
7
6
5
4
3
2
0.1
9
8
7
6
5
4
3
2
.01
1.0
2.0
TIME (min.)
DEPTH (Ft.)
46 5490
K+E SEMI-LOGARITHMIC • 3 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

Falling Head Slug Test : Test #2

MW1-1

SE1000B
Environmental Logger
09/26 17:41

Unit# 00000 Test# 7

INPUT 1: Level (F)

Reference	0.00
Scale factor	10.04
Offset	0.00

Step# 0 09/26 15:47

Elapsed Time	Value
0.0000	3.45
0.0033	2.64
0.0066	1.45
0.0099	1.77
0.0133	2.25
0.0166	2.07
0.0200	1.87
0.0233	1.74
0.0266	0.48
0.0300	0.69
0.0333	1.17
0.0500	1.03
0.0666	0.94
0.0833	0.89
0.1000	0.85
0.1166	0.80
0.1333	0.76
0.1500	0.72
0.1666	0.69
0.1833	0.65
0.2000	0.62
0.2166	0.58
0.2333	0.56
0.2500	0.53
0.2666	0.50
0.2833	0.47
0.3000	0.45
0.3166	0.43
0.3333	0.40
0.4167	0.31
0.5000	0.24
0.5833	0.18
0.6667	0.13
0.7500	0.10
0.8333	0.07
0.9167	0.05
1.0000	0.03

Falling Head Slug Test : Test #2

MW1-1

Elapsed Time		UAlue
1.0833		0.02
1.1667		0.01
1.2500		0.00
1.3333		0.00
1.4166	-	0.00
1.5000	-	0.01
1.5833	-	0.01
1.6667	-	0.01
1.7500	-	0.01
1.8333	-	0.01
1.9167	-	0.01
2.0000	-	0.02

END

RISING HEAD SLUG TEST: TEST 2

MW1-1

SE1000B
Environmental Logger
09/26 17:42

Unit# 00000 Test# 2

INPUT 1: Level (F)

Reference	0.00
Scale factor	10.04
Offset	0.00

Step# 0 09/26 15:50

Elapsed Time	Value
0.0000	4.12
0.0033	2.61
0.0066	2.16
0.0099	0.60
0.0133	0.06
0.0166	1.23
0.0200	1.43
0.0233	1.35
0.0266	1.15
0.0300	1.16
0.0333	1.13
0.0500	0.99
0.0666	0.89
0.0833	0.80
0.1000	0.73
0.1166	0.66
0.1333	0.61
0.1500	0.56
0.1666	0.52
0.1833	0.49
0.2000	0.46
0.2166	0.43
0.2333	0.41
0.2500	0.39
0.2666	0.37
0.2833	0.35
0.3000	0.33
0.3166	0.32
0.3333	0.30
0.4167	0.24
0.5000	0.19
0.5833	0.16
0.6667	0.14

RISING HEAD SLUG TEST: TEST 2

MW1-1

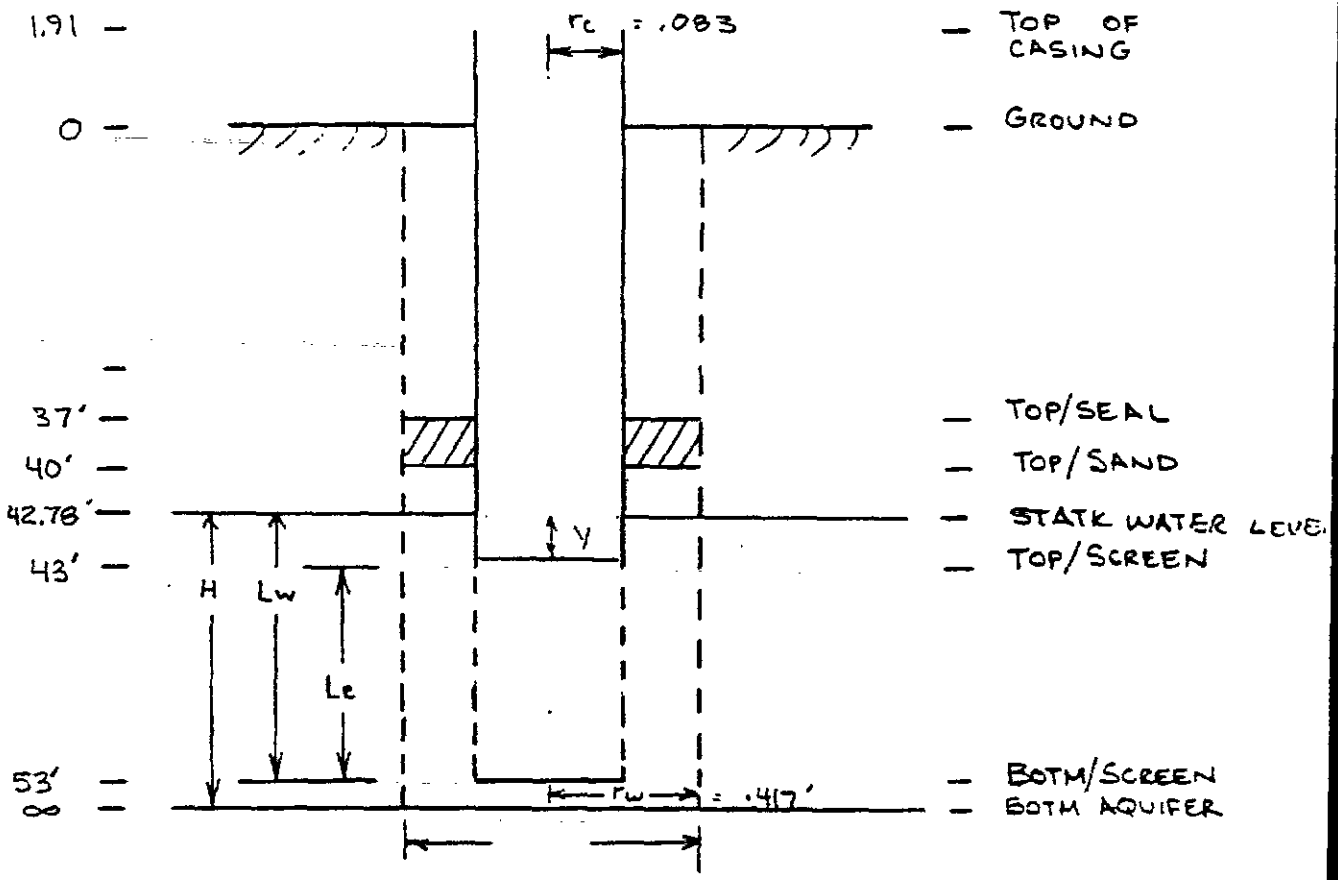
ELAPSED TIME		VALUE
0.7500	-	0.12
0.8333	-	0.11
0.9167	-	0.11
1.0000	-	0.10
1.0833	-	0.09
1.1667	-	0.09
1.2500	-	0.09
1.3333	-	0.08
1.4166	-	0.08
1.5000	-	0.08
1.5833	-	0.08
1.6667	-	0.08
1.7500	-	0.08
1.8333	-	0.07
1.9167	-	0.08
2.0000	-	0.08
2.5000	-	0.07

END

CLIENT: C+R BATTERY	FILE NO.: 9851	BY: RDB	PAGE 1 OF 4
SUBJECT: SLUG TEST CALC'S. MW2-1		CHECKED BY: MLM 12/15/88	DATE:

CALCULATIONS: (BOUWER & RICE)

DEPTH (FT.) WELL CONSTRUCTION



$H = \infty$

$L_w = 53 - 42.8 = 10.2'$

$L_e = 53 - 43 = 10.0'$

$r_c = 0.083'$

$r_w = 0.417'$

$L_e/r_w = 10/.417 = 24$

$A = 2.25$

$B = 0.32$

$C =$

CLIENT: C+R BATTERY	FILE NO.: 9851	BY: RDB	PAGE 2 OF 4
SUBJECT: SLUG TEST CALC'S. MW2-1		CHECKED BY: MLM 12/15/88	DATE:

$$\ln Re/r_w = \left[\frac{1.1}{\ln(L_w/r_w)} + \frac{A + B\ln[(H-L_w)/r_w]}{L_e/r_w}\right]^{-1}$$

$$\ln Re/r_w = \left[\frac{1.1}{\ln(10.2/.417)} + \frac{2.25 + 0.32\ln[(\infty - 10.2)/.417]}{24}\right]^{-1} \quad \infty \approx 6$$

$$\ln Re/r_w = \left[\ 0.344 + 0.174\ \right]^{-1}$$

$$\ln Re/r_w = 1.93$$

$$K = \frac{r_c^2 \ln(Re/r_w)}{2L_e} \cdot \frac{1}{t} \ln Y_0/Y_t$$

$$K = \frac{(.083)^2(1.93)}{2(10)} \cdot \frac{1}{0.2} \ln\left(\frac{0.855}{0.378}\right)$$

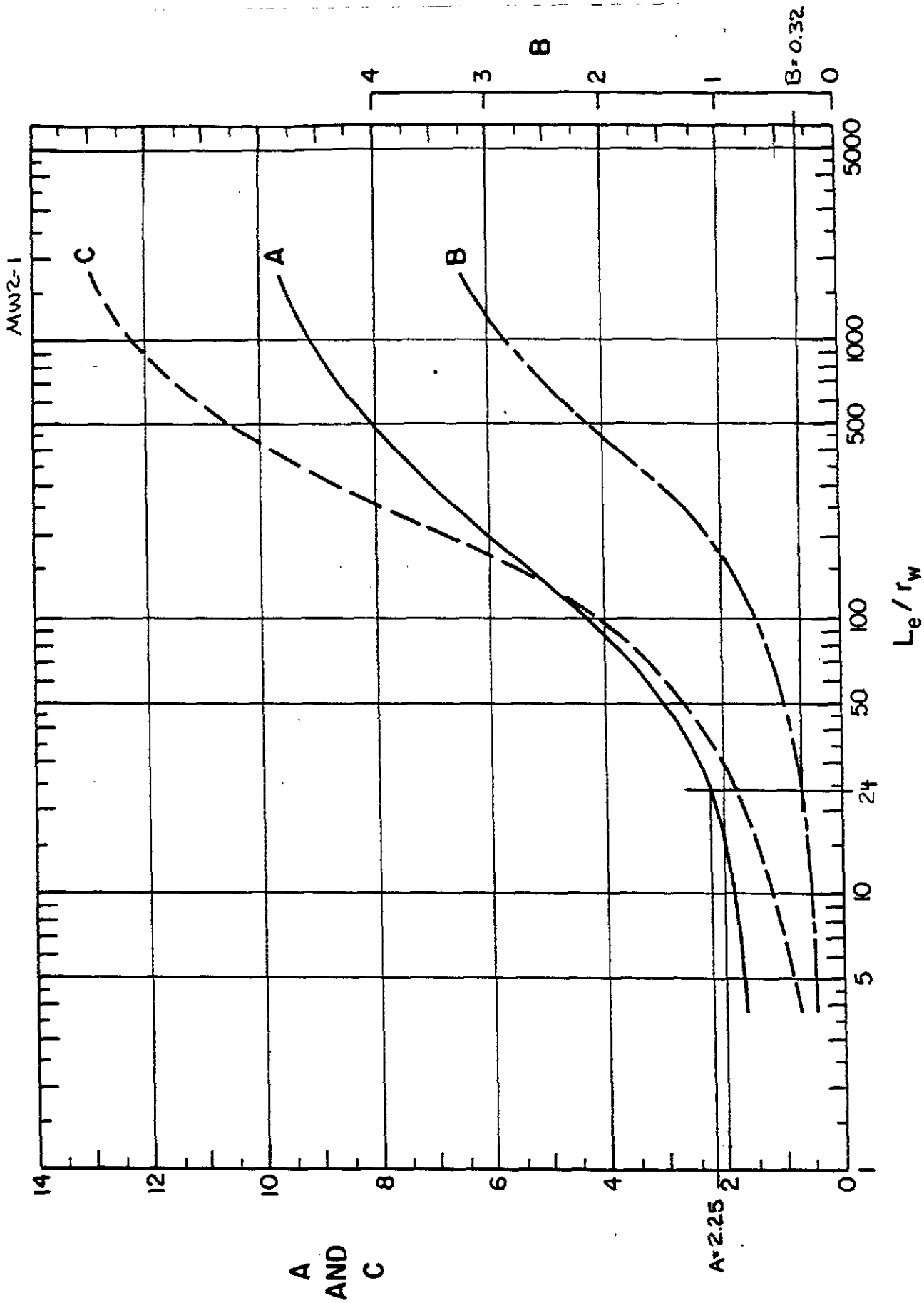
$$K = (6.65 \times 10^{-4})(5)(0.816)$$

$$K = 2.71 \times 10^{-3} \text{ ft/min}$$

$$K = 1.38 \times 10^{-3} \text{ cm/sec.}$$

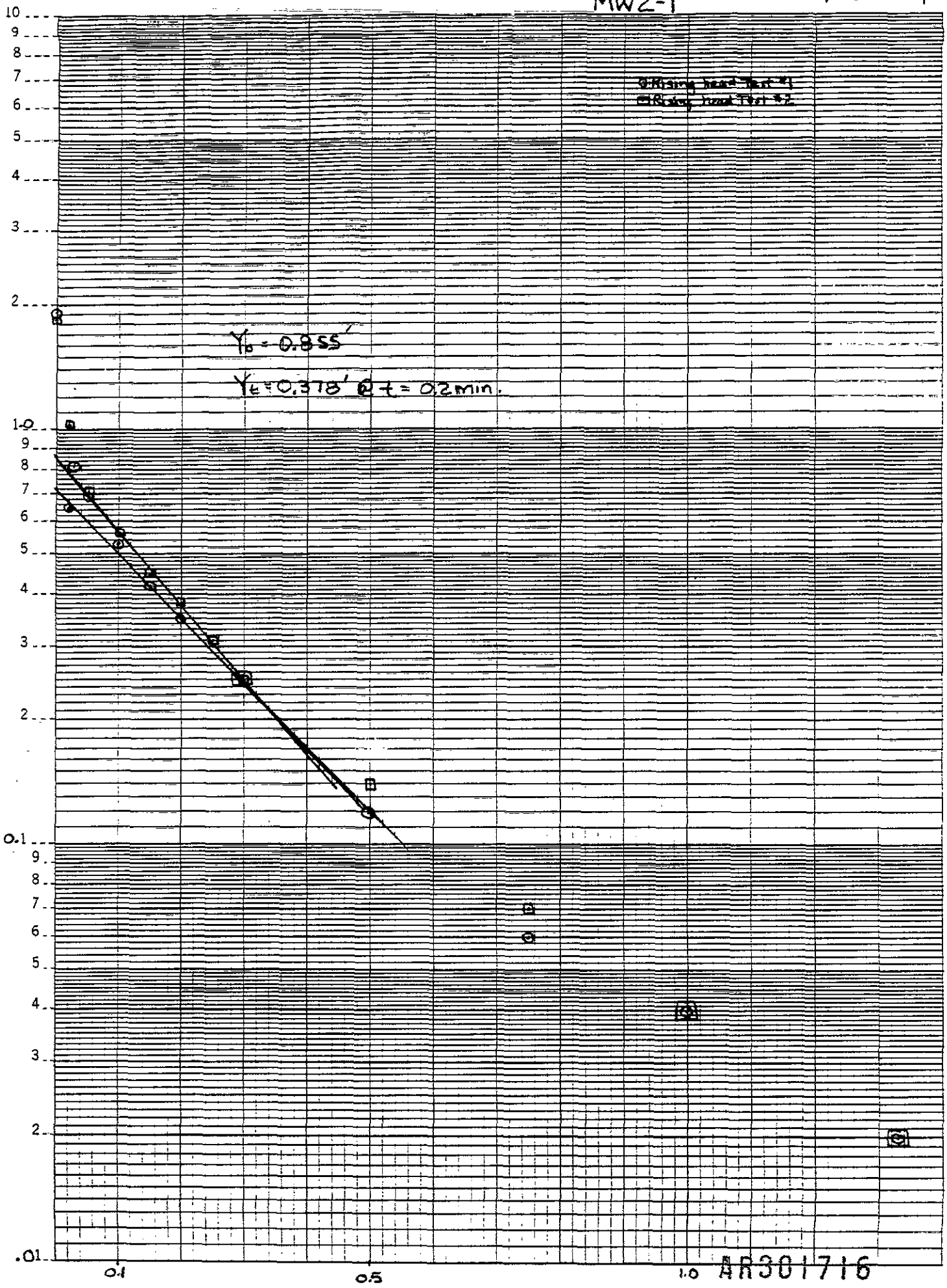
$$T = K \cdot H =$$

AR301714


MW2-1
C
A
B
B
4
3
2
1
B=0.32
0
5000
1000
500
100
50
24
10
5
1
L_e / r_w
14
12
10
8
6
4
2
0
A=2.25
A AND C

MW2-1

4 OF 4



46 5490

SEMI-LOGARITHMIC • 3 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

K•E

AR301716

RISING HEAD SLUG TEST : TEST 1

MW2-1

SE1000B
Environmental Logger
09/26 17:38

Unit# 00000 Test# 5

INPUT 1: Level (F)

Reference	0.00
Scale factor	10.04
Offset	0.00

Step# 0 09/26 15:10

Elapsed Time		Value
0.0000	-	1.91
0.0033	-	1.74
0.0066	-	1.86
0.0099	-	1.59
0.0133	-	0.80
0.0166	-	0.73
0.0200	-	0.65
0.0233	-	0.85
0.0266	-	0.88
0.0300	-	0.82
0.0333	-	0.73
0.0500	-	0.69
0.0666	-	0.63
0.0833	-	0.58
0.1000	-	0.53
0.1166	-	0.49
0.1333	-	0.45
0.1500	-	0.42
0.1666	-	0.40
0.1833	-	0.38
0.2000	-	0.35
0.2166	-	0.33
0.2333	-	0.31
0.2500	-	0.29
0.2666	-	0.27
0.2833	-	0.25
0.3000	-	0.25
0.3166	-	0.23
0.3333	-	0.22
0.4167	-	0.17
0.5000	-	0.12
0.5833	-	0.10
0.6667	-	0.08
0.7500	-	0.06
0.8333	-	0.05
0.9167	-	0.04
1.0000	-	0.04

RISING HEAD SLUG TEST : TEST 1

MW 2-1

ELAPSED TIME		VALUE
1.0833	-	0.03
1.1667	-	0.03
1.2500	-	0.02
1.3333	-	0.02
1.4166	-	0.02
1.5000	-	0.02
1.5833	-	0.01
1.6667	-	0.01
1.7500	-	0.01
1.8333	-	0.01
1.9167	-	0.01
2.0000	-	0.01

END

Rising Head Slug Test : Test #2

MW 2-1

SE1000B
Environmental Logger
09/26 17:39

Unit# 00000 Test# 6

INPUT 1: Level (F)

Reference	0.00
Scale factor	10.04
Offset	0.00

Step# 0 09/26 15:17

Elapsed Time	Value
0.0000	1.84
0.0033	1.27
0.0066	0.51
0.0099	0.51
0.0133	0.84
0.0166	1.09
0.0200	1.02
0.0233	0.82
0.0266	0.70
0.0300	0.74
0.0333	0.82
0.0500	0.71
0.0666	0.65
0.0833	0.60
0.1000	0.56
0.1166	0.52
0.1333	0.48
0.1500	0.45
0.1666	0.42
0.1833	0.40
0.2000	0.38
0.2166	0.35
0.2333	0.33
0.2500	0.31
0.2666	0.29
0.2833	0.27
0.3000	0.25
0.3166	0.24
0.3333	0.23
0.4167	0.18
0.5000	0.14
0.5833	0.11
0.6667	0.09
0.7500	0.07
0.8333	0.06
0.9167	0.05
1.0000	0.04

Rising Head Slug Test: Slug Test #2

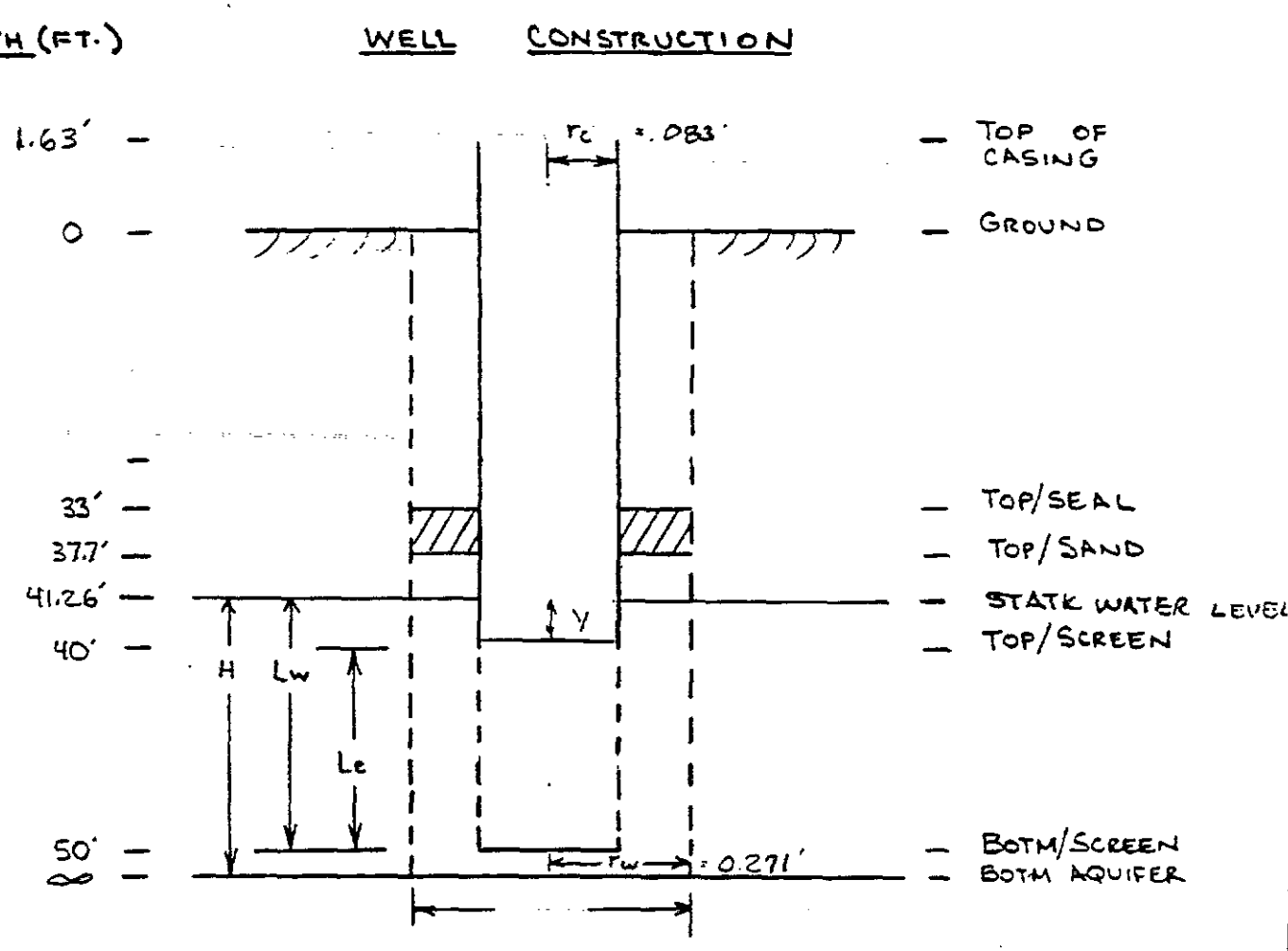
MW2-2

Elapsed Time		Value
1.0833	-	0.03
1.1667	-	0.03
1.2500	-	0.02
1.3333	-	0.02
1.4166	-	0.02
1.5000	-	0.02
1.5833	-	0.02
1.6667	-	0.01
1.7500	-	0.01
1.8333	-	0.01
1.9167	-	0.01

END

CLIENT: C+R BATTERY	FILE NO.: 9851	BY: RDB	PAGE 1 OF 4
SUBJECT: SLUG TEST CALC's. MW3-1		CHECKED BY: MLM 12/15/88	DATE:

CALCULATIONS: (BOUWER & RICE)



H = ∞

Lw = 8.7'

Le = 8.7' (Top of screen above SWL)

r_c = .083'

r_w = .271'

L_e/r_w = 8.7/.271 = 32

A = 2.50

B = 0.39

C =

NUS CORPORATION AND SUBSIDIARIES		STANDARD CALCULATION SHEET	
CLIENT: C+R BATTERY	FILE NO.: 9851	BY: RDB	PAGE 2 OF 4
SUBJECT: SLUG TEST CALC'S. MW3-1		CHECKED BY: MLM 12/15/88	DATE.

$$\ln \frac{Re}{r_w} = \left[\frac{1.1}{\ln(L_w/r_w)} + \frac{A + B \ln[(H - L_w)/r_w]}{L_e/r_w} \right]^{-1}$$

$$\ln \frac{Re}{r_w} = \left[\frac{1.1}{\ln(8.7/.271)} + \frac{2.50 + 0.39 \overbrace{\ln[(\infty - 8.7)/.271]}^{6}}{32} \right]^{-1}$$

$$\ln \frac{Re}{r_w} = [\ 0.317 + 0.151\ ]^{-1}$$

$$\ln \frac{Re}{r_w} = 2.14$$

$$K = \frac{r_c^2 \ln(Re/r_w)}{2L_e} \cdot \frac{1}{t} \ln \frac{Y_0}{Y_t}$$

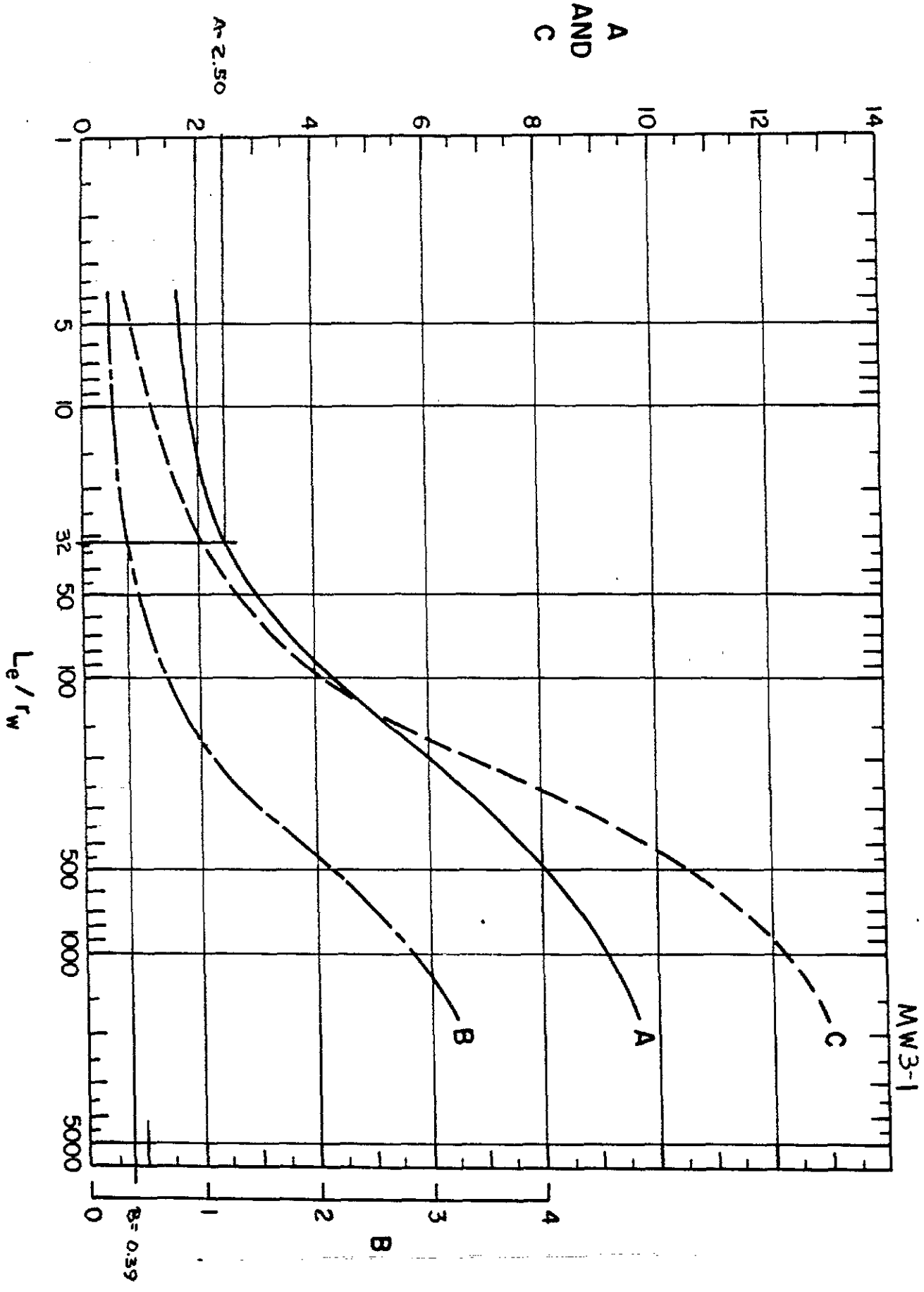
$$K = \frac{(0.083)^2 (2.14)}{2(8.7)} \cdot \frac{1}{0.75} \ln\left(\frac{1.13}{0.81}\right)$$

$$K = (8.47 \times 10^{-4})(1.33)(0.333)$$

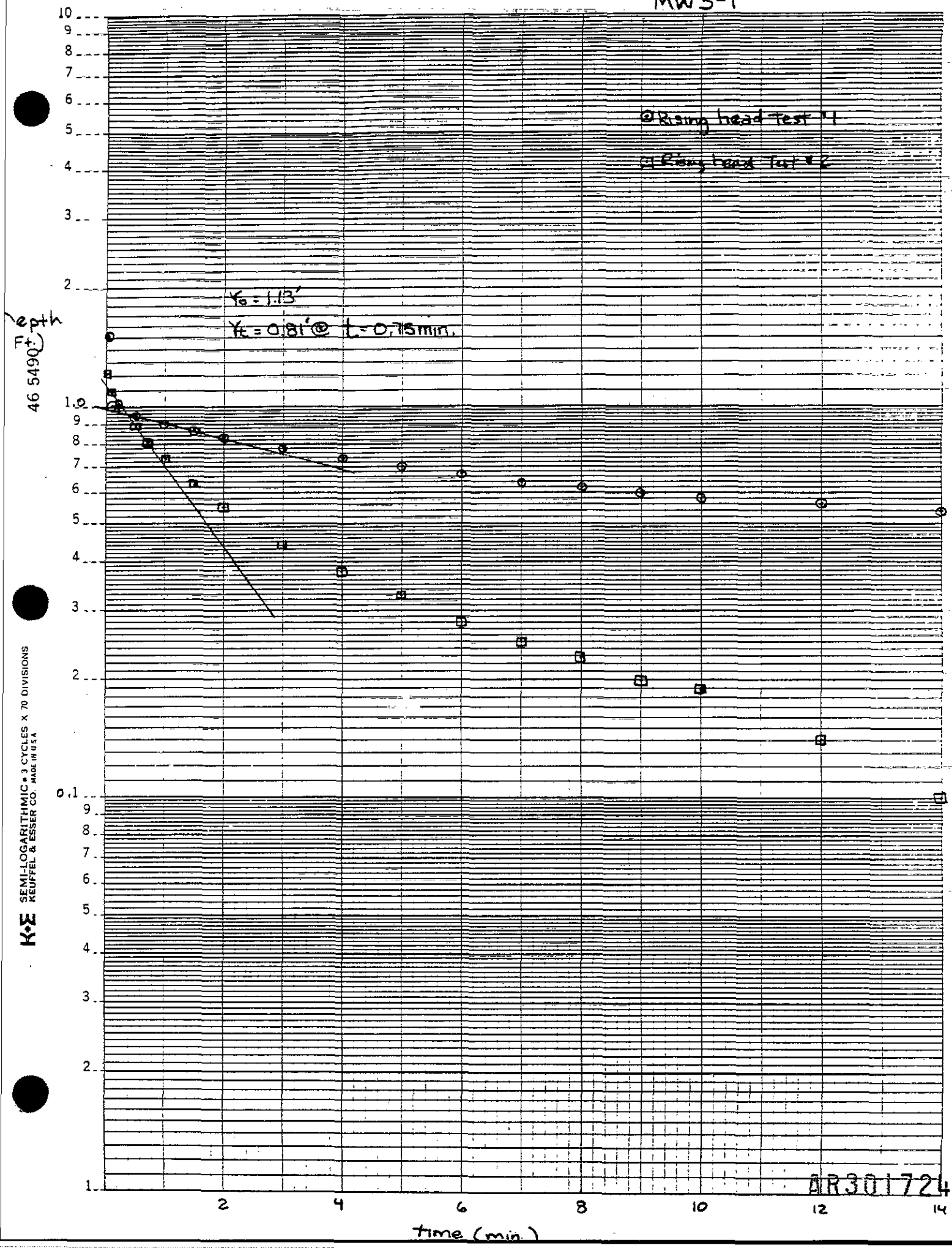
$$K = 3.75 \times 10^{-4} \text{ ft/min.}$$

$$K = 1.90 \times 10^{-4} \text{ cm/sec.}$$

$$T = K \cdot H =$$


A AND C
A=2.50
0
2
4
6
8
10
12
14
1
5
10
32
50
100
500
1000
5000
L_e / r_w
A
B
C
MW3-1
0
1
2
3
4
B
B=0.39

MW3-1



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RISING HEAD SLUG TEST: TEST 1
MW 3-1

1/2

SE1000B
Environmental Logger
09/23 14:08

Unit# 00000 Test# 1

INPUT 1: Level (F)

Reference	0.00
Scale factor	10.04
Offset	0.00

Step# 0 09/23 12:20

Elapsed Time	Value
0.0000	0.65
0.0033	1.91
0.0066	2.15
0.0099	1.12
0.0133	0.39
0.0166	1.03
0.0200	1.52 OK
0.0233	1.15
0.0266	0.78
0.0300	0.98
0.0333	1.22
0.0500	1.06
0.0666	1.00
0.0833	1.00
0.1000	1.01
0.1166	1.00
0.1333	1.00
0.1500	0.99
0.1666	0.99
0.1833	0.98
0.2000	0.98
0.2166	0.98
0.2333	0.98
0.2500	0.97
0.2666	0.97
0.2833	0.97
0.3000	0.96
0.3166	0.96
0.3333	0.96
0.4167	0.95
0.5000	0.95
0.5833	0.94
0.6667	0.93
0.7500	0.92
0.8333	0.91
0.9167	0.91
1.0000	0.90
1.0833	0.89
1.1667	0.89

RISING HEAD SLUG TEST ; TEST MW 3-1

ELAPSED TIME		VALUE
1.2500	-	0.88
1.3333	-	0.88
1.4166	-	0.87
1.5000	-	0.87
1.5833	-	0.86
1.6667	-	0.86
1.7500	-	0.85
1.8333	-	0.85
1.9167	-	0.84
2.0000	-	0.83
2.5000	-	0.81
3.0000	-	0.78
3.5000	-	0.76
4.0000	-	0.74
4.5000	-	0.72
5.0000	-	0.70
5.5000	-	0.68
6.0000	-	0.67
6.5000	-	0.65
7.0000	-	0.64
7.5000	-	0.63
8.0000	-	0.62
8.5000	-	0.61
9.0000	-	0.60
9.5000	-	0.59
10.0000	-	0.58
12.0000	-	0.56
14.0000	-	0.54
16.0000	-	0.52
18.0000	-	0.50
20.0000	-	0.49
22.0000	-	0.47
24.0000	-	0.46
26.0000	-	0.45
28.0000	-	0.44
30.0000	-	0.43
32.0000	-	0.42
34.0000	-	0.42
36.0000	-	0.41
38.0000	-	0.40
40.0000	-	0.39
42.0000	-	0.38
44.0000	-	0.37
46.0000	-	0.37
48.0000	-	0.36
50.0000	-	0.35
52.0000	-	0.35
54.0000	-	0.34
56.0000	-	0.34
58.0000	-	0.33
60.0000	-	0.33
62.0000	-	0.32
64.0000	-	0.32
66.0000	-	0.31

END

RISING HEAD SLUG TEST: TEST 2

MW3-1

SE1000B
Environmental Logger
09/29 10:19

Unit# 00000 Test# 2

INPUT 1: Level (F)

Reference	0.00
Scale factor	10.04
Offset	0.00

Step# 0 09/29 09:06

Elapsed Time	Value
0.0000	- 3.01
0.0033	- 3.99
0.0066	- 1.96
0.0099	0.19
0.0133	- 1.02
0.0166	- 2.19
0.0200	- 1.36
0.0233	- 0.64
0.0266	- 1.21
0.0300	- 1.59
0.0333	- 1.16
0.0500	- 1.07
0.0666	- 1.15
0.0833	- 1.11
0.1000	- 1.09
0.1166	- 1.08
0.1333	- 1.06
0.1500	- 1.05
0.1666	- 1.04
0.1833	- 1.03
0.2000	- 1.02
0.2166	- 1.01
0.2333	- 1.01
0.2500	- 1.00
0.2666	- 0.99
0.2833	- 0.98
0.3000	- 0.97
0.3166	- 0.96
0.3333	- 0.95
0.4167	- 0.92

ok

RISING HEAD SLUG TEST : TEST2

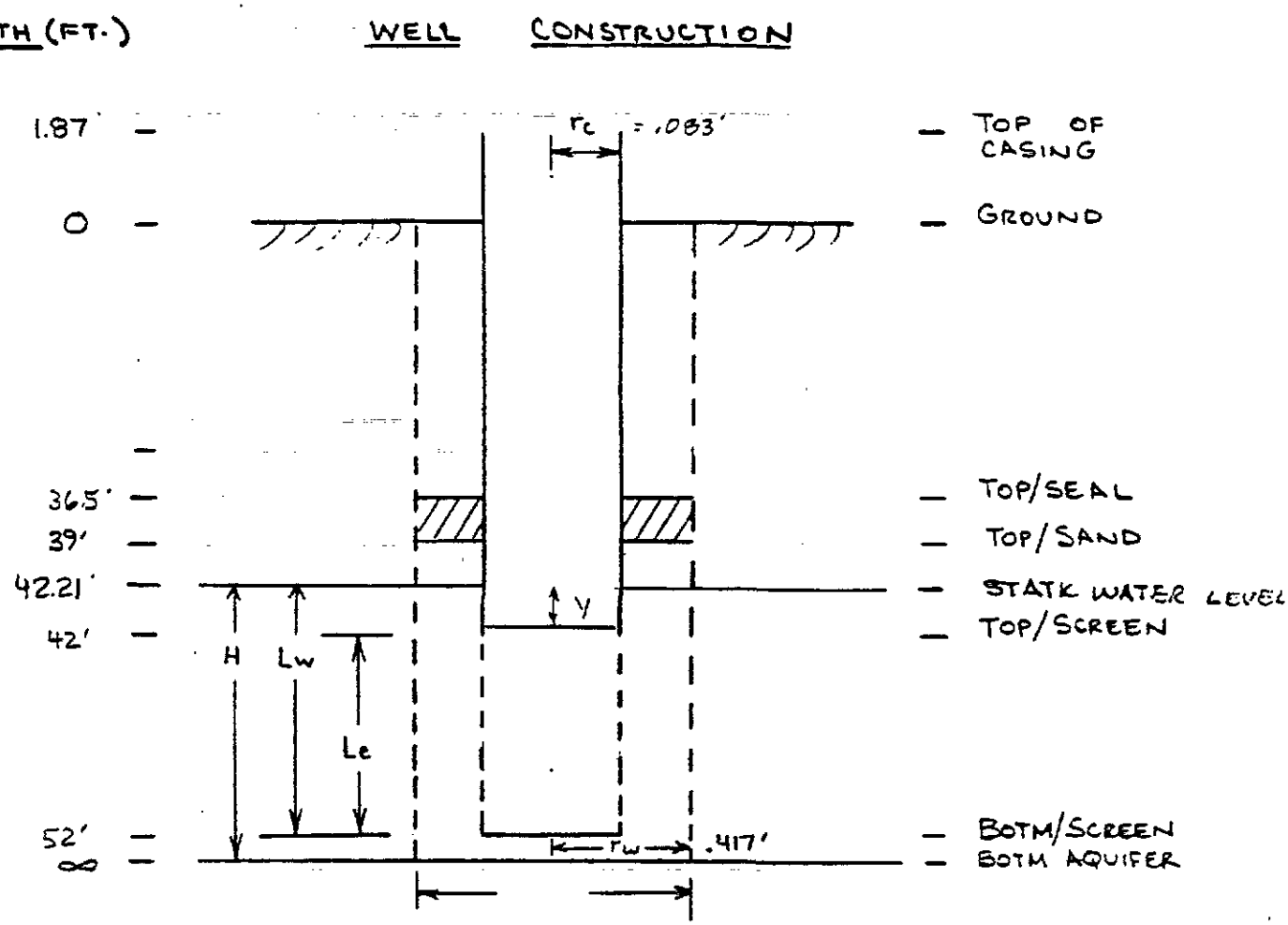
MW3-1

ELAPSED TIME		VALUE
0.5000	-	0.89
0.5833	-	0.85
0.6667	-	0.83
0.7500	-	0.81
0.8333	-	0.78
0.9167	-	0.76
1.0000	-	0.74
1.0833	-	0.71
1.1667	-	0.70
1.2500	-	0.68
1.3333	-	0.66
1.4166	-	0.64
1.5000	-	0.63
1.5833	-	0.62
1.6667	-	0.60
1.7500	-	0.59
1.8333	-	0.57
1.9167	-	0.56
2.0000	-	0.55
2.5000	-	0.49
3.0000	-	0.44
3.5000	-	0.40
4.0000	-	0.38
4.5000	-	0.35
5.0000	-	0.33
5.5000	-	0.30
6.0000	-	0.28
6.5000	-	0.26
7.0000	-	0.25
7.5000	-	0.24
8.0000	-	0.23
8.5000	-	0.22
9.0000	-	0.20
9.5000	-	0.20
10.0000	-	0.19
12.0000	-	0.14
14.0000	-	0.10
16.0000	-	0.07
18.0000	-	0.06
20.0000	-	0.04
22.0000	-	0.04
24.0000	-	0.03
26.0000	-	0.03
28.0000	-	0.02
30.0000	-	0.02
32.0000	-	0.02
34.0000	-	0.02
36.0000	-	0.02

END

CLIENT: C+R BATTERY	FILE NO.: 9851	BY: RDB	PAGE 1 OF 4
SUBJECT: SLUG TEST CALCS. MW4-1		CHECKED BY: MLM 12/15/88	DATE:

CALCULATIONS: (BOUWER & RICE)



$H = \infty$

L_w = 52 - 42.2 = 9.8'

L_e = 52 - 42.2 = 9.8' (Top of screen below S.W.L.)

r_c = .083'

r_w = .417'

L_e/r_w = 9.8/0.417 = 23.5

A = 2.24

B = 0.33

C =

CLIENT: C+R BATTERY	FILE NO.: 9851	BY: RDB	PAGE 2 OF 4
SUBJECT: SLUG TEST CALC'S. MW4-1		CHECKED BY: MLM 12/15/88	DATE:

$$\ln Re/r_w = \left[\frac{1.1}{\ln(L_w/r_w)} + \frac{A + B\ln[(H-L_w)/r_w]}{L_e/r_w}\right]^{-1}$$

$$\ln Re/r_w = \left[\frac{1.1}{\ln(9.8/.417)} + \frac{2.24 + 0.33\ln[(\infty - 9.8)/.417]^{.6}}{23.5}\right]^{-1}$$

$$\ln Re/r_w = \left[\quad 0.348 \quad + \quad 0.180 \quad\right]^{-1}$$

$$\ln Re/r_w = 1.89$$

$$K = \frac{r_c^2 \ln(Re/r_w)}{2L_e} \cdot \frac{1}{t} \ln Y_0/Y_t$$

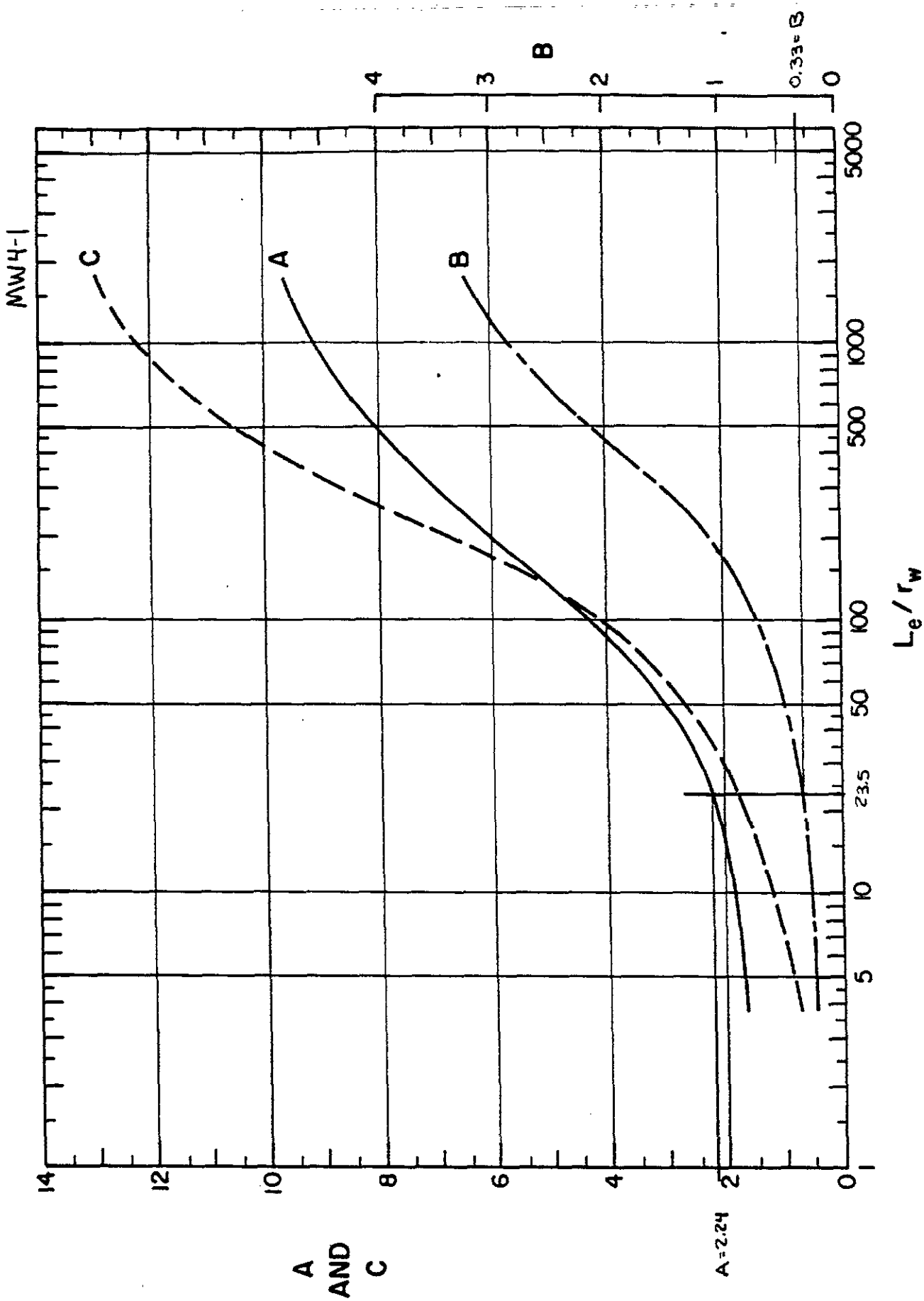
$$K = \frac{(.083)^2(\ 1.89\ )}{2(\ 9.8\ )} \cdot \frac{1}{.05} \ln\left(\frac{1.02}{0.25}\right)$$

$$K = (\ 6.64 \times 10^{-4}\ )(\ 20\ )(\ 1.41\ )$$

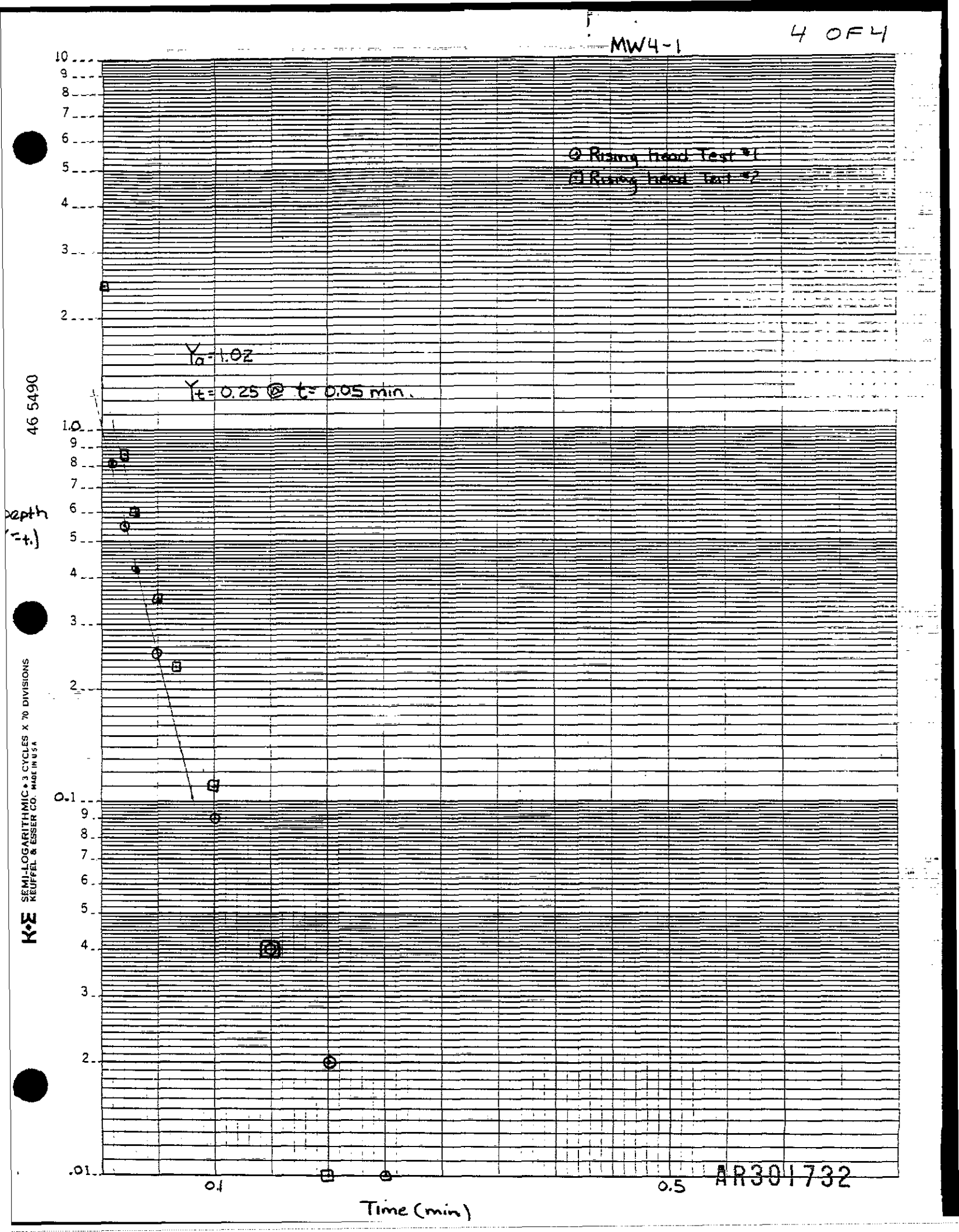
$$K = 1.87 \times 10^{-2}\ ft/min$$

$$K = 9.50 \times 10^{-3}\ cm/sec$$

$$T = K \cdot H =$$


MW4-1
C
A
B
A AND C
B
0.33=B
A=2.24
23.5
L_e / r_w
14
12
10
8
6
4
2
0
4
3
2
1
0
5000
1000
500
100
50
10
5
1

MW4-1



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RISING HEAD SLUG TEST : TEST 1

MW 4-1

SE1000B
Environmental Logger
09/26 17:34

Unit# 00000 Test# 1

INPUT 1: Level (F)

Reference	0.00
Scale factor	10.04
Offset	0.00

Step# 0 09/26 14:19

Elapsed Time		Value	
0.0000	-	0.70	
0.0033	-	0.53	OK
0.0066	-	0.88	
0.0099	-	0.81	
0.0133	-	0.68	
0.0166	-	0.59	
0.0200	-	0.55	
0.0233	-	0.50	
0.0266	-	0.45	
0.0300	-	0.42	
0.0333	-	0.38	
0.0500	-	0.25	
0.0666	-	0.18	
0.0833	-	0.12	
0.1000	-	0.09	
0.1166	-	0.06	
0.1333	-	0.05	
0.1500	-	0.04	
0.1666	-	0.03	
0.1833	-	0.02	
0.2000	-	0.02	
0.2166	-	0.01	
0.2333	-	0.01	
0.2500	-	0.01	
0.2666	-	0.01	
0.2833	-	0.01	
0.3000	-	0.01	
0.3166	-	0.01	
0.3333	-	0.01	
0.4167	-	0.00	
0.5000	-	0.00	
0.5833	-	0.00	
0.6667	-	0.00	

RISING HEAD SLUG TEST : TEST1
MW 4-1

ELAPSED TIME		VALUE
0.7500	-	0.00
0.8333	-	0.00
0.9167	-	0.00
1.0000	-	0.00
1.0833	-	0.00
1.1667	-	0.00
1.2500	-	0.00
1.3333	-	0.00
1.4166	-	0.00
1.5000	-	0.00
1.5833	-	0.00
1.6667	-	0.00
1.7500	-	0.00
1.8333	-	0.00
1.9167	-	0.00
2.0000	-	0.00
2.5000	-	0.00
3.0000	-	0.00
3.5000	-	0.00
4.0000	-	0.00
4.5000	-	0.00
5.0000	-	0.00
5.5000	-	0.00
6.0000	-	0.00
6.5000	-	0.01
7.0000	-	0.01
7.5000	-	0.01
8.0000	-	0.00
8.5000	-	0.00
9.0000	-	0.00
9.5000	-	0.00
10.0000	-	0.00
12.0000	-	0.00
14.0000	-	0.00

END

RISING HEAD SLUG TEST: TEST2
MW4-1

SE1000B
Environmental Logger
09/26 17:37

Unit# 00000 Test# 2

INPUT 1: Level (F)

Reference	0.00
Scale factor	10.04
Offset	0.00

Step# 0 09/26 14:42

Elapsed Time	Value
0.0000	0.00
0.0033	0.37
0.0066	2.08
0.0099	2.45
0.0133	0.95
0.0166	0.66 — OK
0.0200	0.86
0.0233	0.83
0.0266	0.69
0.0300	0.60
0.0333	0.55
0.0500	0.35
0.0666	0.23
0.0833	0.16
0.1000	0.11
0.1166	0.07
0.1333	0.05
0.1500	0.04
0.1666	0.03
0.1833	0.02
0.2000	0.01
0.2166	0.01
0.2333	0.01
0.2500	0.00
0.2666	0.00
0.2833	0.00
0.3000	0.00
0.3166	0.01
0.3333	0.03
0.4167	0.00
0.5000	0.00
0.5833	0.00
0.6667	0.00

RISING HEAD SLUG TEST: TEST 2

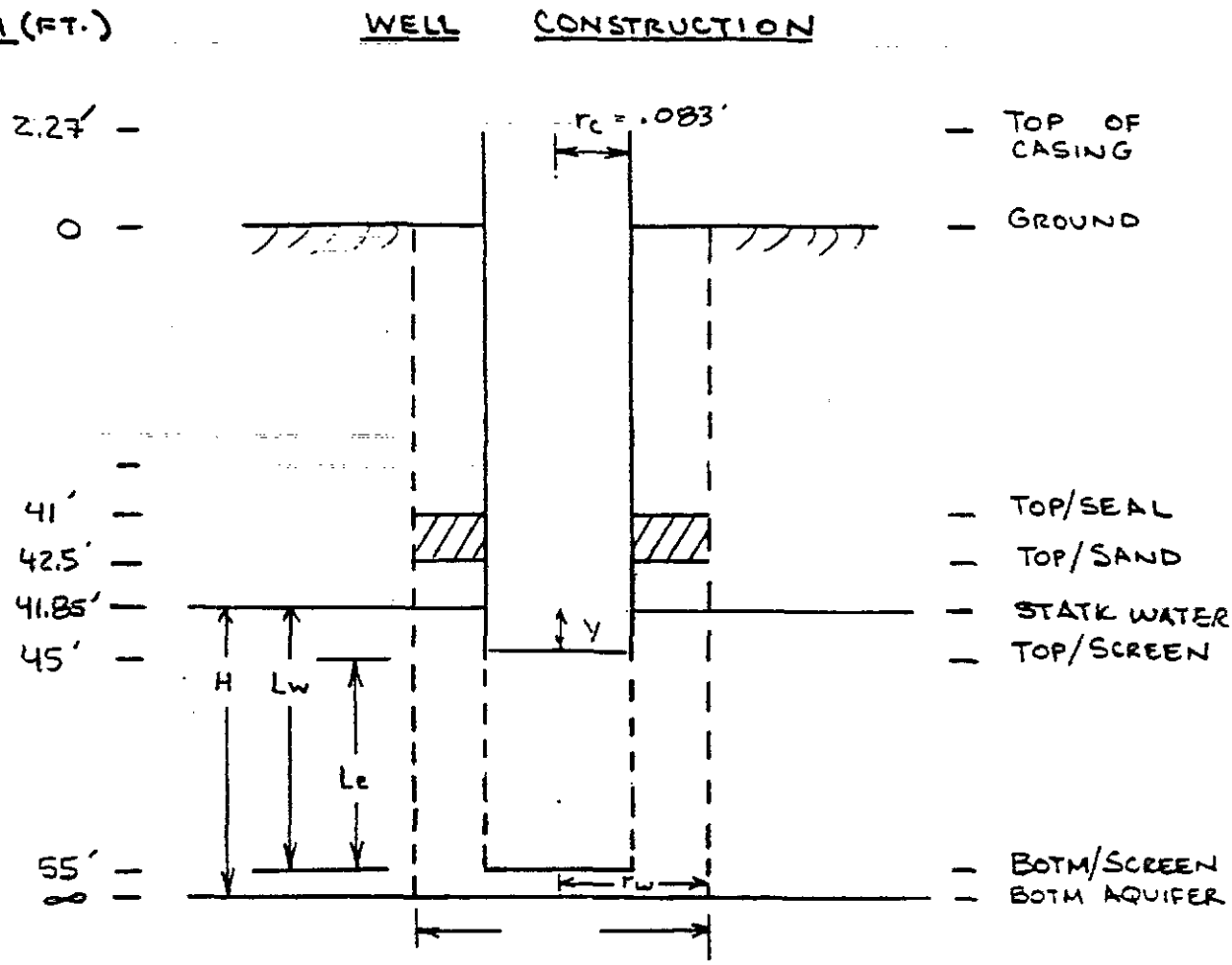
MW4-1

0.7500	0.00
0.8333	0.00
0.9167	0.00
1.0000	0.00
1.0833	0.00
1.1667	0.00
1.2500	0.00
1.3333	0.00
1.4166	0.00
1.5000	0.00
1.5833	0.00
1.6667	0.00
1.7500	0.00
1.8333	0.00
1.9167	0.00
2.0000	0.00

END

CLIENT: C+R BATTERY	FILE NO.: 9851	BY: RDB	PAGE 1 OF 4
SUBJECT: SLUG TEST CALC's. MW 5-1		CHECKED BY: KJK 6-21-89	DATE: 4-17-89

CALCULATIONS: (BOUWER & RICE)



$H = \infty$

$L_w = 55' - 41.8' = 13.2'$

$L_e = 55' - 45' = 10'$

$r_c = 0.083'$

$r_w = 0.25'$

$L_e/r_w = 10/0.25 = 40$

$A = 2.75$

$B = 0.42$

$C =$

CLIENT: C+R BATTERY	FILE NO.: 9851	BY: RDB	PAGE 2 OF 4
SUBJECT: SLUG TEST CALC'S. MW5-1		CHECKED BY: KJK 6-21-89	DATE: 4-17-89

$$\ln Re/r_w = \left[\frac{1.1}{\ln(L_w/r_w)} + \frac{A + B\ln[(H-L_w)/r_w]}{L_e/r_w}\right]^{-1}$$

$$\ln Re/r_w = \left[\frac{1.1}{\ln(13.2/0.25)} + \frac{2.75 + 0.42\overbrace{\ln[(\infty - 13.2)/0.25]}^{=6}}{40}\right]^{-1}$$

$$\ln Re/r_w = \left[\quad 0.277 + \quad 0.132 \quad\right]^{-1}$$

$$\ln Re/r_w = 2.44$$

$$K = \frac{r_c^2 \ln(Re/r_w)}{2L_e} \cdot \frac{1}{t} \ln Y_0/Y_t$$

$$K = \frac{(0.083)^2 (\ 2.44\ )}{2(\ 10\ )} \cdot \frac{1}{0.01} \ln\left(\frac{3.62}{1.13}\right)$$

$$K = (\ 8.40 \times 10^{-4}\ )(\ 100\ )(\ 1.16\ )$$

$$K = 9.74 \times 10^{-2} \text{ ft/min.}$$

$$K = 4.95 \times 10^{-2} \text{ cm/sec}$$

$$T = K \cdot H =$$

CLIENT:	FILE NO.:	BY:	PAGE 3 OF 4
C+R BATTERY	9851	RDB	
SUBJECT:		CHECKED BY:	DATE:
SLUG TEST DATA FROM MW5-1		KJK 6-21-89	4-17-89

SE1000B
Environmental Logger
03/31 08:59

Unit# 00001 Test# 1

INPUT 1: Level (F)

Reference 0.00
Scale factor 10.04
Offset 0.00

Step# 0 03/30 15:52

Elapsed Time	Value
0.0000	- 0.01
0.0033	0.31
0.0066	0.68
0.0099	- 0.91
0.0133	- 2.00
0.0166	- 0.93
0.0200	- 0.61
0.0233	- 0.56
0.0266	- 0.82
0.0300	- 0.04
0.0333	0.18
0.0500	0.08
0.0666	- 0.04
0.0833	0.02
0.1000	0.00
0.1166	0.00
0.1333	0.00
0.1500	0.00
0.1666	0.00
0.1833	0.00
0.2000	0.00
0.2166	0.00
0.2333	0.00
0.2500	0.00

SE1000B
Environmental Logger
03/31 08:54

Unit# 00001 Test# 2

INPUT 1: Level (F)

Reference 0.00
Scale factor 10.04
Offset 0.00

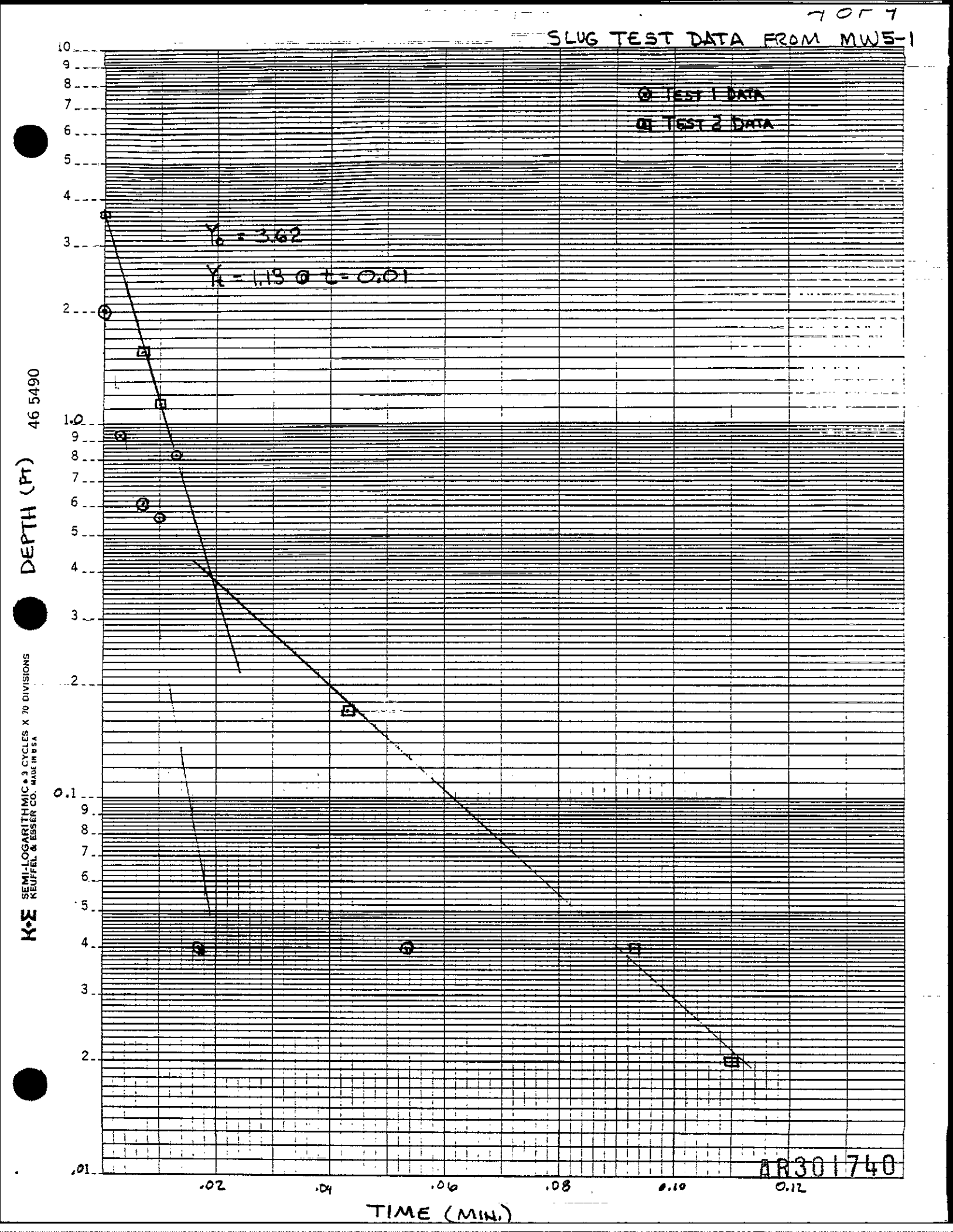
Step# 0 03/30 16:02

Elapsed Time	Value
0.0000	- 0.00
0.0033	- 0.00
0.0066	- 0.00
0.0099	- 0.00
0.0133	0.21
0.0166	0.83
0.0200	0.58
0.0233	- 3.62
0.0266	- 1.08
0.0300	- 1.57
0.0333	- 1.13
0.0500	0.50
0.0666	- 0.17
0.0833	0.01
0.1000	- 0.01
0.1166	- 0.04
0.1333	- 0.02
0.1500	- 0.02
0.1666	- 0.02
0.1833	- 0.02
0.2000	- 0.02
0.2166	- 0.02
0.2333	- 0.02
0.2500	- 0.02
0.2666	- 0.02
0.2833	- 0.02
0.3000	- 0.02
0.3166	- 0.02
0.3333	- 0.02
0.4167	- 0.02
0.5000	- 0.02

END

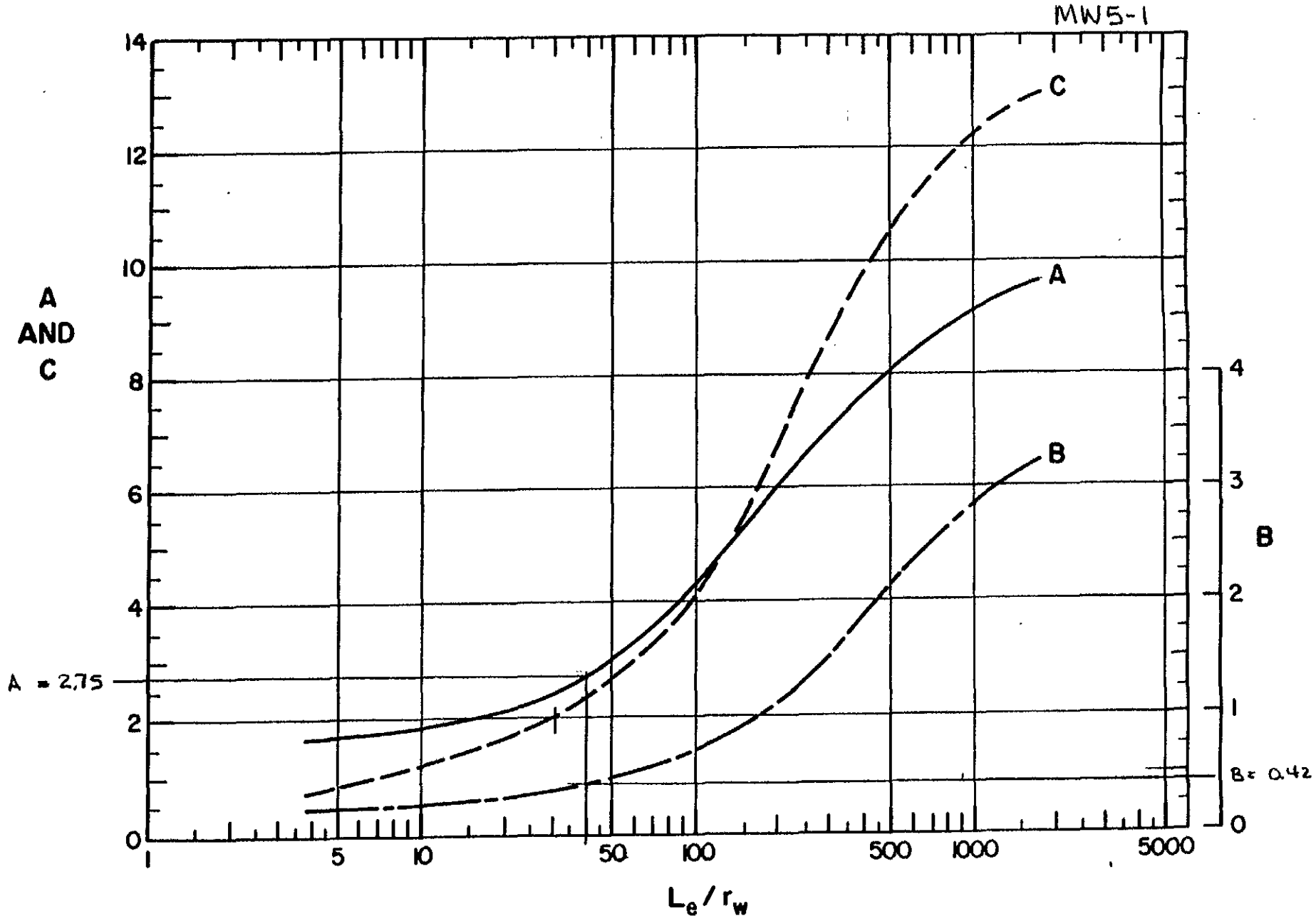
	Elapsed Time	Value
(TEST 1)	0.0000	-2.00
	0.0033	-0.93
	0.0066	-0.61
	0.0100	-0.56
	0.0133	-0.82
	0.0166	-0.04
	0.0533	-0.04
	0.0867	0.00
(TEST 2)	0.0000	-3.62
	0.0066	-1.57
	0.0100	-1.13
	0.0433	-0.17
	0.0933	-0.04
	0.1100	-0.02
	0.2000	-0.02

SLUG TEST DATA FROM MW5-1



46 5490

K·E SEMI-LOGARITHMIC • 3 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.


MW5-1
A AND C
B
C
A
B
A = 2.75
B = 0.42
0
2
4
6
8
10
12
14
0
1
2
3
4
1
5
10
50
100
500
1000
5000
L_e / r_w

BR30741

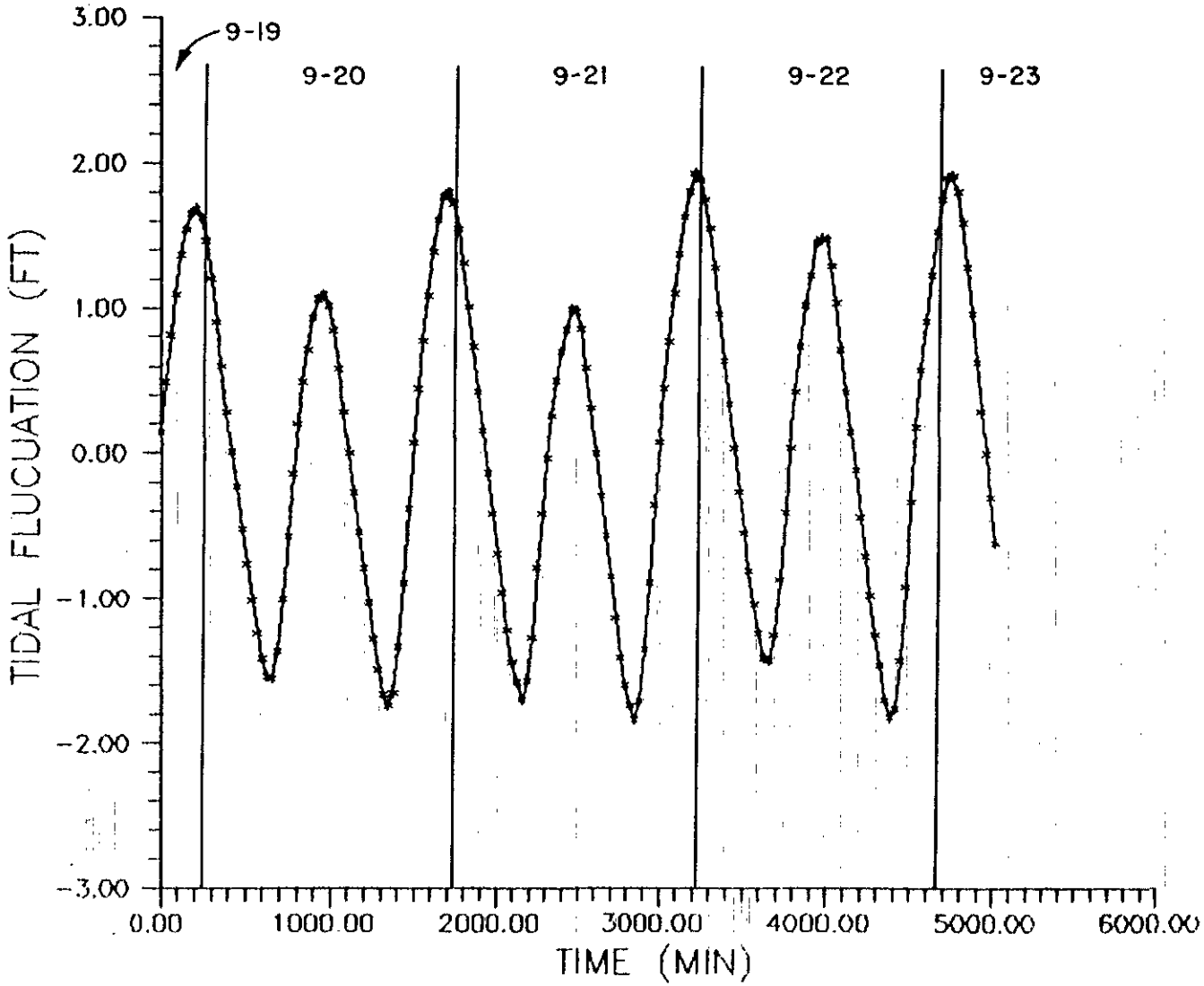
APPENDIX C

DATA COLLECTED FOR TIDAL STUDY

TABLE OF CONTENTS

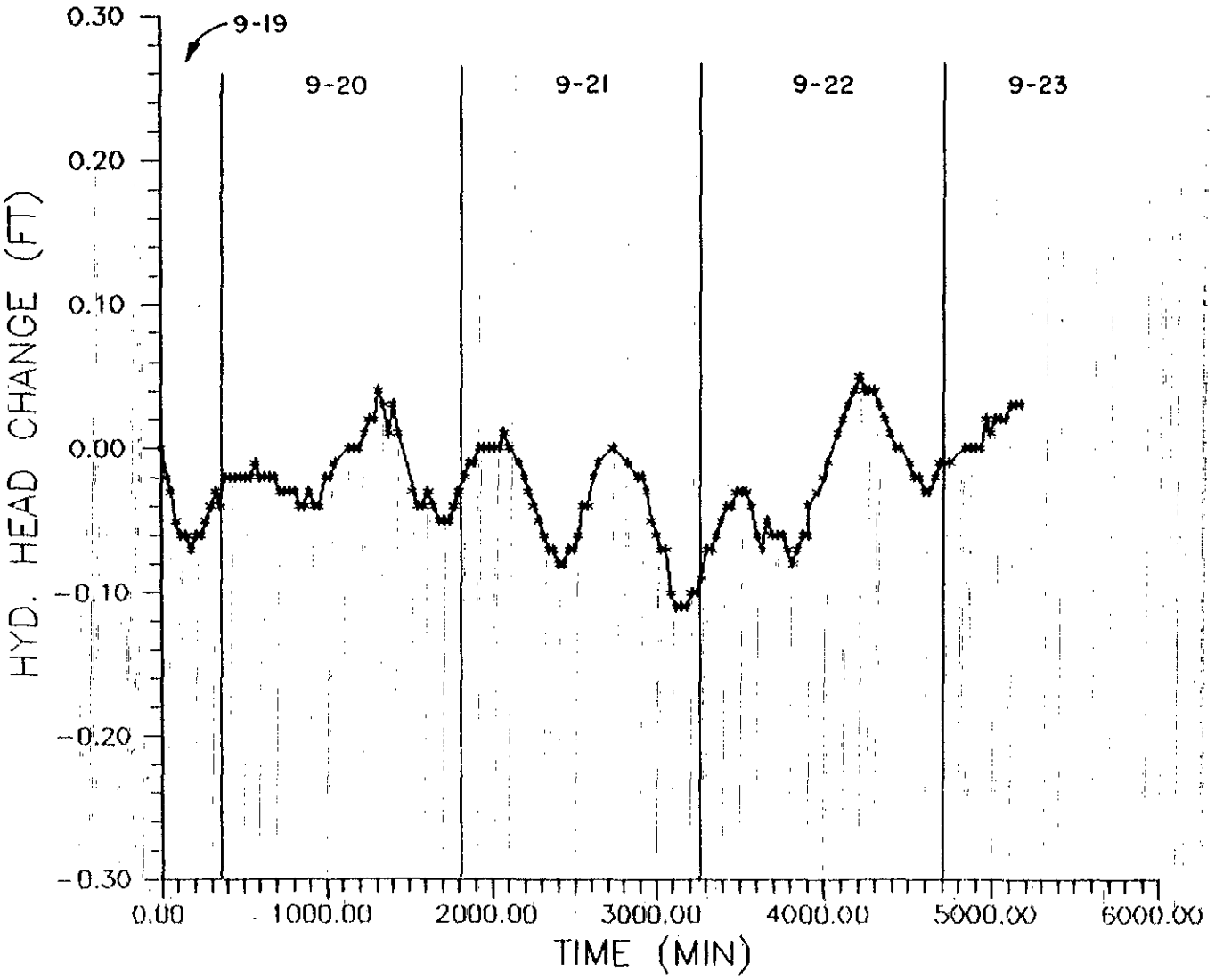
APPENDIX C-1

TIDAL STUDY DATA AND HYDROGRAPHS

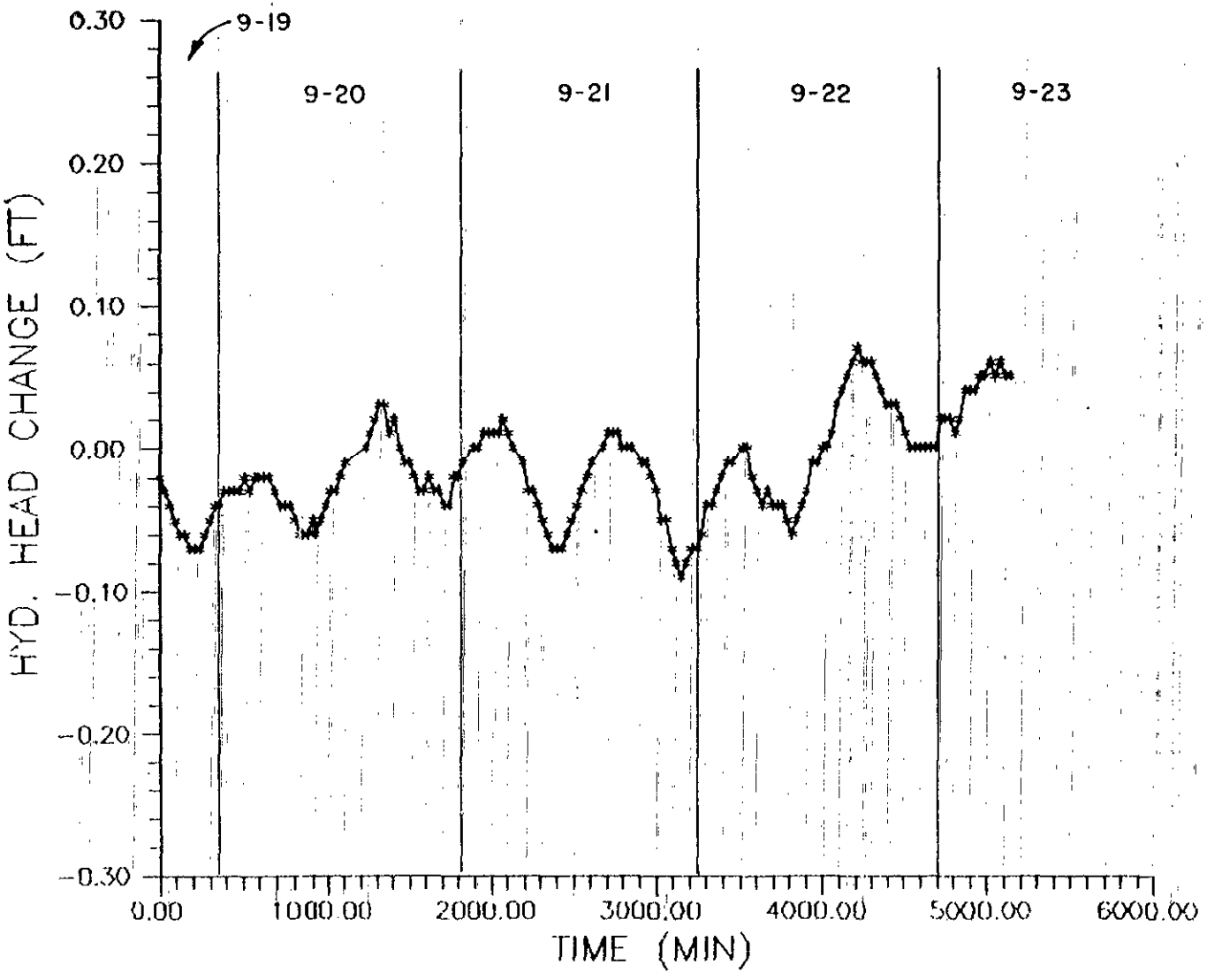


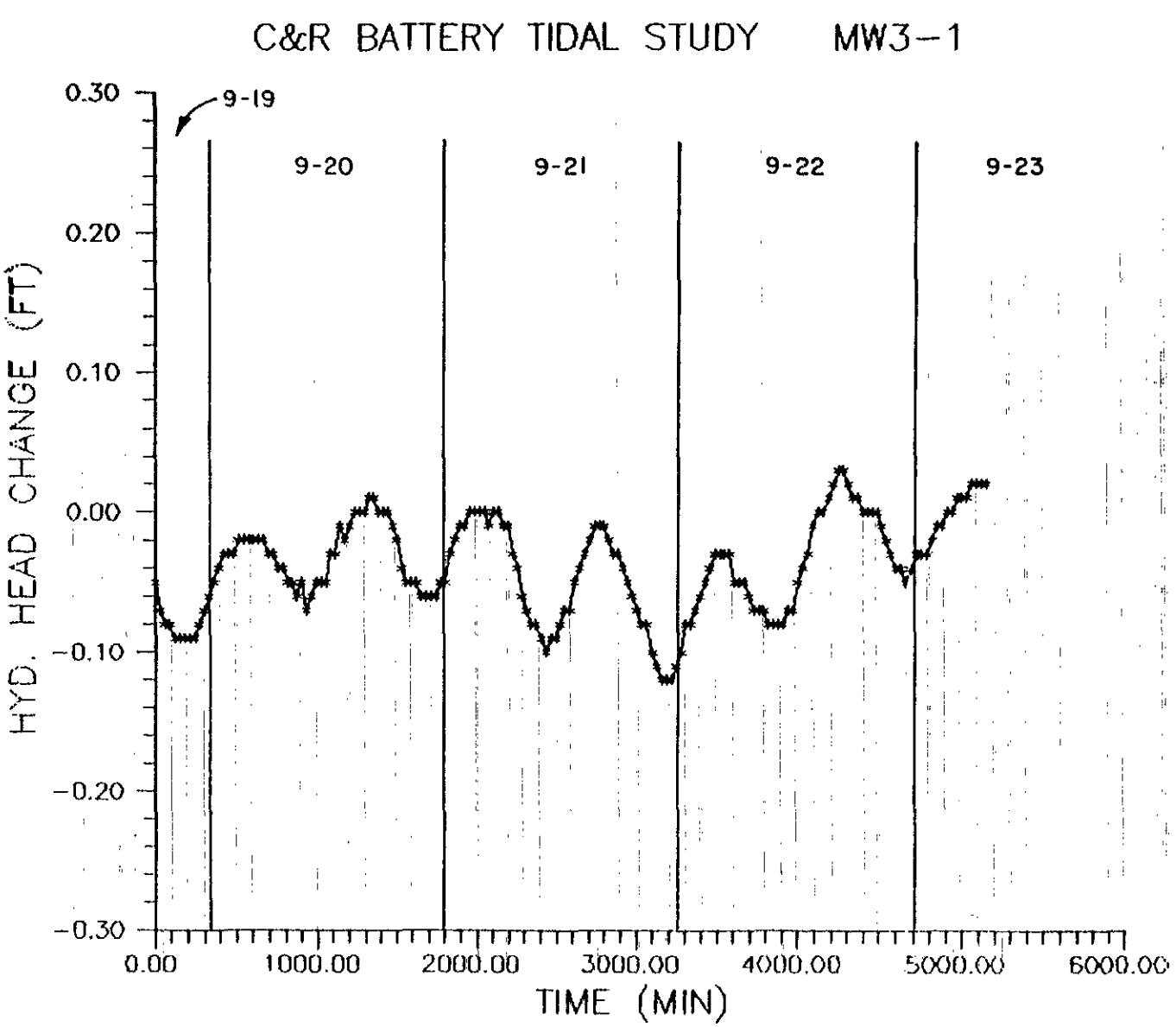
HYDROGRAPH OF JAMES RIVER
(9-19-88 TO 9-22-88)
C&R BATTERY

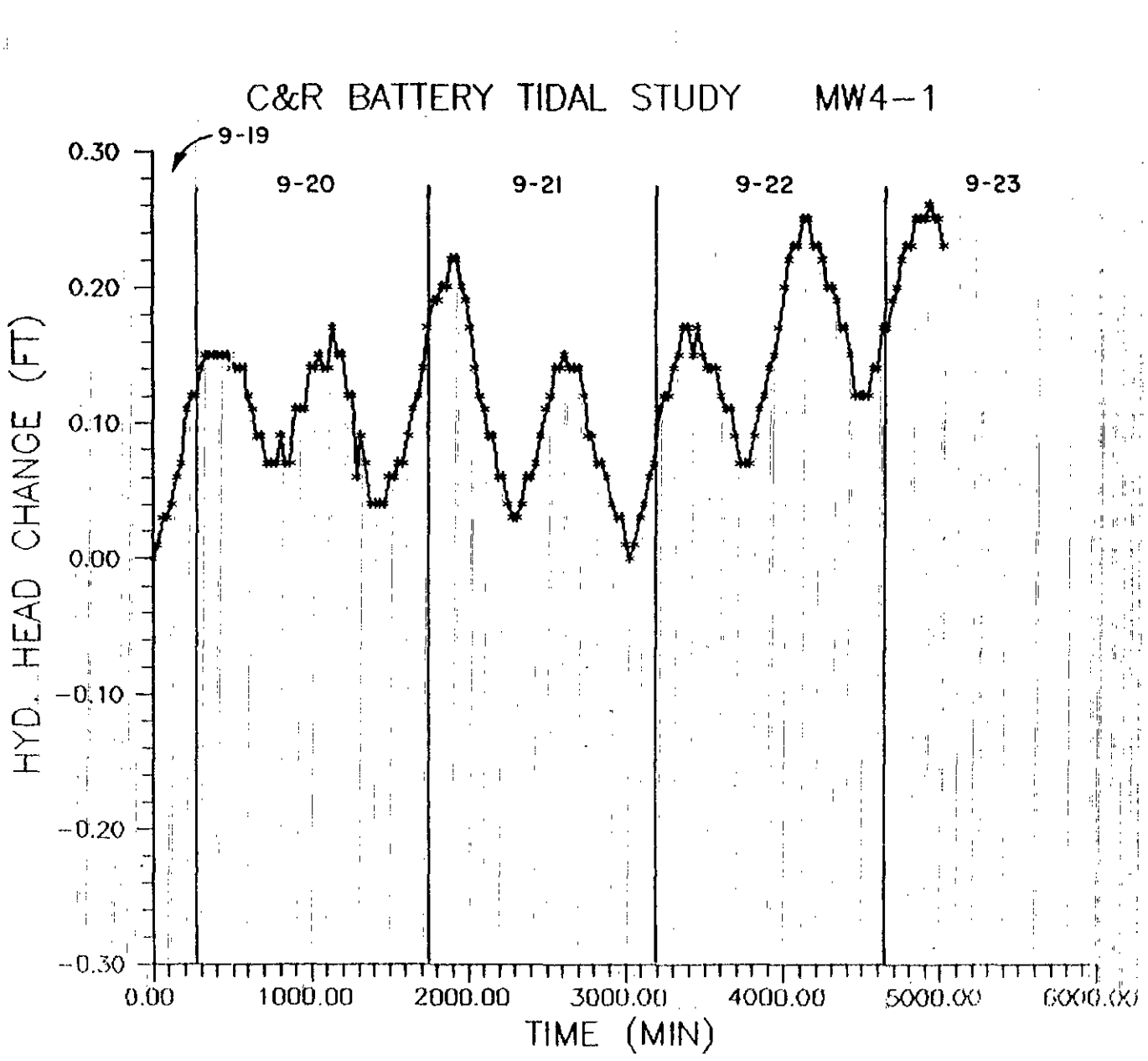
C&R BATTERY TIDAL STUDY MW1-1

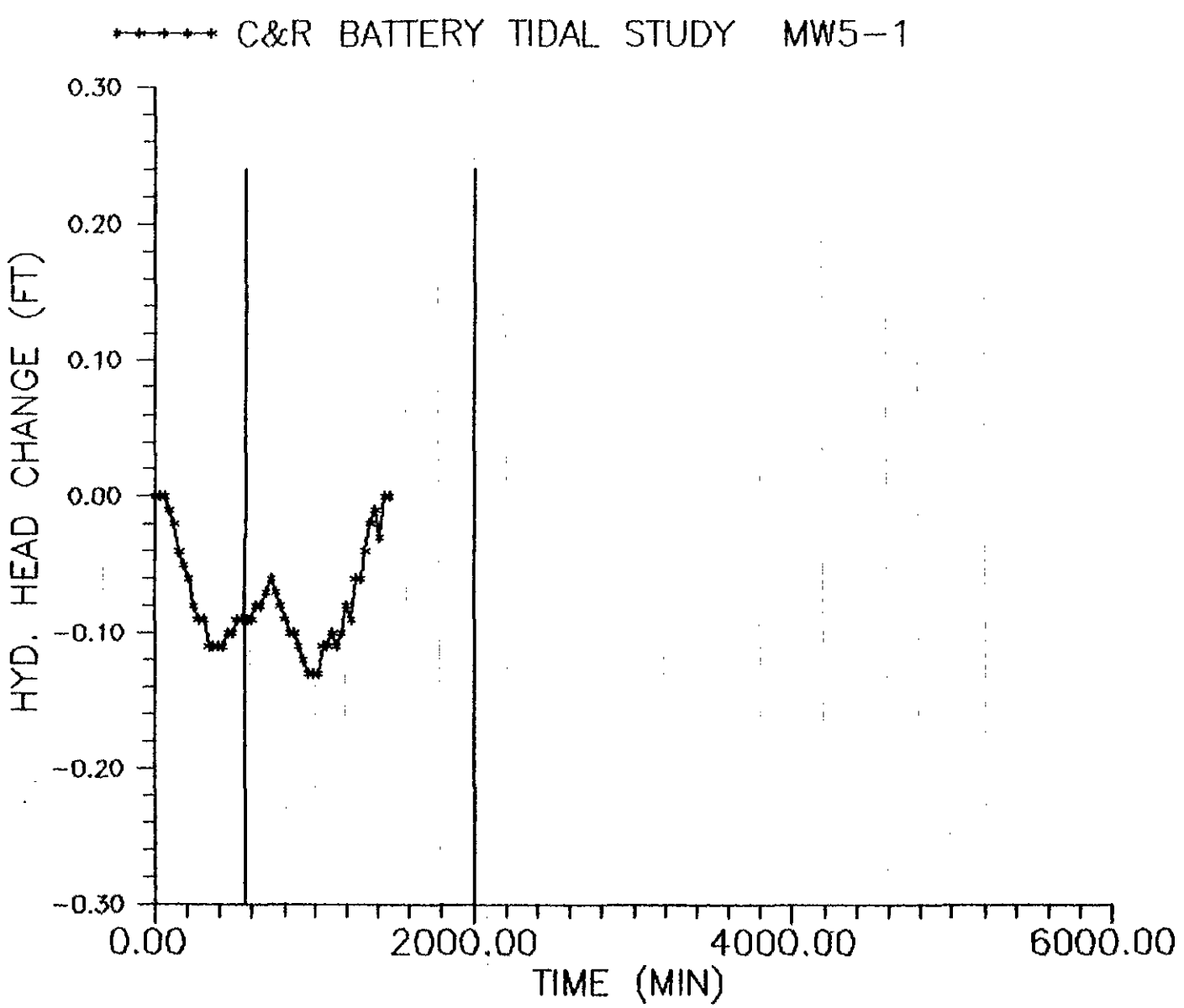


C&R BATTERY TIDAL STUDY MW2-1




C&R BATTERY TIDAL STUDY MW3-1
9-19
9-20
9-21
9-22
9-23
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
HYD. HEAD CHANGE (FT)
0.00
1000.00
2000.00
3000.00
4000.00
5000.00
6000.00
TIME (MIN)


C&R BATTERY TIDAL STUDY MW4-1
9-19
9-20
9-21
9-22
9-23
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
HYD. HEAD CHANGE (FT)
0.00
1000.00
2000.00
3000.00
4000.00
5000.00
TIME (MIN)


C&R BATTERY TIDAL STUDY MW5-1
HYD. HEAD CHANGE (FT)
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
0.00
2000.00
4000.00
6000.00
TIME (MIN)

TIDAL STUDY DATA
JAMES RIVER

Elapsed Time	Value
0.0000	0.14
30.0000	0.49
60.0000	0.81
90.0000	1.09
120.000	1.36
150.000	1.54
180.000	1.65
210.000	1.68
240.000	1.62
270.000	1.46
300.000	1.20
330.000	0.90
360.000	0.60
390.000	0.28
420.000	0.01
450.000	- 0.23
480.000	- 0.52
510.000	- 0.76
540.000	- 1.01
570.000	- 1.24
600.000	- 1.41
630.000	- 1.54
660.000	- 1.55
690.000	- 1.36
720.000	- 1.00
750.000	- 0.57
780.000	- 0.14
810.000	0.20
840.000	0.49
870.000	0.71
900.000	0.93
930.000	1.06
960.000	1.09
990.000	1.01
1020.00	0.84
1050.00	0.58
1080.00	0.28
1110.00	0.00
1140.00	- 0.27
1170.00	- 0.54
1200.00	- 0.79
1230.00	- 1.03
1260.00	- 1.28
1290.00	- 1.49
1320.00	- 1.66
1350.00	- 1.74
1380.00	- 1.65
1410.00	- 1.33
1440.00	- 0.89
1470.00	- 0.38
1500.00	0.07

TIDAL STUDY DATA

JAMES RIVER

Elapsed Time	Value
1530.00	0.44
1560.00	0.77
1590.00	1.08
1620.00	1.38
1650.00	1.60
1680.00	1.76
1710.00	1.79
1740.00	1.71
1770.00	1.54
1800.00	1.30
1830.00	1.00
1860.00	0.73
1890.00	0.42
1920.00	0.15
1950.00	- 0.14
1980.00	- 0.42
2010.00	- 0.69
2040.00	- 0.96
2070.00	- 1.22
2100.00	- 1.44
2130.00	- 1.58
2160.00	- 1.70
2190.00	- 1.57
2220.00	- 1.27
2250.00	- 0.79
2280.00	- 0.42
2310.00	- 0.04
2340.00	0.25
2370.00	0.49
2400.00	0.69
2430.00	0.84
2460.00	0.98
2490.00	0.96
2520.00	0.84
2550.00	0.58
2580.00	0.30
2610.00	- 0.01
2640.00	- 0.30
2670.00	- 0.57
2700.00	- 0.85
2730.00	- 1.14
2760.00	- 1.41
2790.00	- 1.60
2820.00	- 1.74
2850.00	- 1.84
2880.00	- 1.71
2910.00	- 1.35
2940.00	- 0.89
2970.00	- 0.36
3000.00	0.07

TIDAL STUDY DATA
JAMES RIVER

Elapsed Time	Value
3030.00	0.44
3060.00	0.76
3090.00	1.09
3120.00	1.36
3150.00	1.62
3180.00	1.79
3210.00	1.92
3240.00	1.87
3270.00	1.74
3300.00	1.54
3330.00	1.27
3360.00	0.95
3390.00	0.63
3420.00	0.33
3450.00	0.03
3480.00	- 0.27
3510.00	- 0.55
3540.00	- 0.81
3570.00	- 1.04
3600.00	- 1.24
3630.00	- 1.41
3660.00	- 1.43
3690.00	- 1.25
3720.00	- 0.87
3750.00	- 0.41
3780.00	0.03
3810.00	0.42
3840.00	0.73
3870.00	1.01
3900.00	1.22
3930.00	1.44
3960.00	1.47
3990.00	1.46
4020.00	1.28
4050.00	1.03
4080.00	0.71
4110.00	0.42
4140.00	0.14
4170.00	- 0.12
4200.00	- 0.44
4230.00	- 0.71
4260.00	- 0.98
4290.00	- 1.25

TIDAL STUDY DATA

JAMES RIVER

Elapsed Time	Value
4320.00	- 1.46
4350.00	- 1.70
4380.00	- 1.82
4410.00	- 1.76
4440.00	- 1.43
4470.00	- 0.92
4500.00	- 0.34
4530.00	0.17
4560.00	0.57
4590.00	0.90
4620.00	1.22
4650.00	1.52
4680.00	1.74
4710.00	1.89
4740.00	1.90
4770.00	1.79
4800.00	1.58
4830.00	1.27
4860.00	0.95
4890.00	0.62
4920.00	0.28
4950.00	- 0.01
4980.00	- 0.31
5010.00	- 0.62

END

TIDAL STUDY DATA
MW1-1

TIME	DATE	Elapsed Time	Value
	(9/19)		
1800		0.0000	- 0.00
		30.0000	- 0.02
		60.0000	- 0.03
1930		90.0000	- 0.05
		120.000	- 0.06
		150.000	- 0.06
		180.000	- 0.07
		210.000	- 0.06
		240.000	- 0.06
		270.000	- 0.05
		300.000	- 0.04
		330.000	- 0.03
2400	(9/20)	360.000	- 0.04
		390.000	- 0.02
		420.000	- 0.02
		450.000	- 0.02
		480.000	- 0.02
0230		510.000	- 0.02
		540.000	- 0.02
		570.000	- 0.01
		600.000	- 0.02
		630.000	- 0.02
		660.000	- 0.02
		690.000	- 0.02
		720.000	- 0.03
		750.000	- 0.03
		780.000	- 0.03
		810.000	- 0.03
		840.000	- 0.04
0730		870.000	- 0.04
		900.000	- 0.03
		930.000	- 0.04
		960.000	- 0.04
		990.000	- 0.02
		1020.00	- 0.02
		1050.00	- 0.01
1200		1080.00	- 0.00
		1110.00	- 0.00
		1140.00	0.00
		1170.00	0.00
		1200.00	0.00
1430		1230.00	0.01
		1260.00	0.02
		1290.00	0.02
		1320.00	0.04
		1350.00	0.03
		1380.00	0.01
		1410.00	0.03
1800		1440.00	0.01
		1470.00	- 0.00
		1500.00	- 0.00
1930		1530.00	- 0.03
		1560.00	- 0.04
		1590.00	- 0.04

TIDAL STUDY DATA

MW1-1

Elapsed Time	Value
1620.00	- 0.03
1650.00	- 0.04
1680.00	- 0.05
1710.00	- 0.05
1740.00	- 0.05
1770.00	- 0.04
1800.00	- 0.03
1830.00	- 0.02
1860.00	- 0.01
1890.00	- 0.01
1920.00	0.00
1950.00	0.00
1980.00	0.00
2010.00	0.00
2040.00	0.00
2070.00	0.01
2100.00	0.00
2130.00	- 0.00
2160.00	- 0.01
2190.00	- 0.02
2220.00	- 0.03
2250.00	- 0.04
2280.00	- 0.05
2310.00	- 0.06
2340.00	- 0.07
2370.00	- 0.07
2400.00	- 0.08
2430.00	- 0.08
2460.00	- 0.07
2490.00	- 0.07
2520.00	- 0.06
2550.00	- 0.04
2580.00	- 0.04
2610.00	- 0.02
2640.00	- 0.01
2670.00	- 0.00
2700.00	- 0.00
2730.00	0.00
2760.00	- 0.00
2790.00	- 0.00
2820.00	- 0.01
2850.00	- 0.00
2880.00	- 0.02
2910.00	- 0.02
2940.00	- 0.03
2970.00	- 0.05
3000.00	- 0.06

TIDAL STUDY DATA

MW 1-1

Elapsed Time	Value
3030.00	- 0.07
3060.00	- 0.07
3090.00	- 0.10
3120.00	- 0.11
3150.00	- 0.11
3180.00	- 0.11
3210.00	- 0.10
3240.00	- 0.10
3270.00	- 0.09
3300.00	- 0.07
3330.00	- 0.07
3360.00	- 0.06
3390.00	- 0.05
3420.00	- 0.04
3450.00	- 0.04
3480.00	- 0.03
3510.00	- 0.03
3540.00	- 0.03
3570.00	- 0.04
3600.00	- 0.06
3630.00	- 0.07
3660.00	- 0.05
3690.00	- 0.06
3720.00	- 0.06
3750.00	- 0.06
3780.00	- 0.07
3810.00	- 0.08
3840.00	- 0.07
3870.00	- 0.06
3900.00	- 0.06
3900.00	- 0.04
3960.00	- 0.03
3990.00	- 0.02
4020.00	- 0.01
4050.00	- 0.00
4080.00	0.01
4110.00	0.02
4140.00	0.03
4170.00	0.04
4200.00	0.05
4230.00	0.04
4260.00	0.04
4290.00	0.04
4320.00	0.03
4350.00	0.02
4380.00	0.01
4410.00	0.00
4440.00	0.00
4470.00	- 0.00
4500.00	- 0.01

TIDAL STUDY DATA

MW1-1

Elapsed Time	Value
4530.00	- 0.02
4560.00	- 0.02
4590.00	- 0.03
4620.00	- 0.03
4650.00	- 0.02
4680.00	- 0.01
4710.00	- 0.00
4740.00	- 0.01
4770.00	- 0.00
4800.00	- 0.00
4830.00	0.00
4860.00	0.00
4890.00	0.00
4920.00	0.00
4950.00	0.02
4980.00	0.01
5010.00	0.02
5040.00	0.02
5070.00	0.02
5100.00	0.03
5130.00	0.03
5160.00	0.03
END	

TIDAL STUDY DATA

MW 2-1

Time	Date	Elapsed Time	Value
	9/12	0.0000	- 0.02
		30.0000	- 0.03
		60.0000	- 0.04
1930		90.0000	- 0.05
		120.000	- 0.06
		150.000	- 0.06
		180.000	- 0.07
		210.000	- 0.07
		240.000	- 0.07
		270.000	- 0.06
		300.000	- 0.05
	9/13	330.000	- 0.04
2400		360.000	- 0.04
		390.000	- 0.03
		420.000	- 0.03
		450.000	- 0.03
		480.000	- 0.03
0730		510.000	- 0.02
		540.000	- 0.03
		570.000	- 0.02
		600.000	- 0.02
		630.000	- 0.02
		660.000	- 0.02
		690.000	- 0.03
		720.000	- 0.04
		750.000	- 0.04
		780.000	- 0.04
		810.000	- 0.05
		840.000	- 0.06
1330		870.000	- 0.06
		900.000	- 0.05
		930.000	- 0.06
		960.000	- 0.05
		990.000	- 0.04
		1020.00	- 0.03
		1050.00	- 0.03
1730		1080.00	- 0.02
		1110.00	- 0.01
		1140.00	- 0.00
		1170.00	- 0.00
		1200.00	- 0.00
1930		1230.00	0.00
		1260.00	0.01
		1290.00	0.02
		1320.00	0.03
		1350.00	0.03
		1380.00	0.01
		1410.00	0.02
		1440.00	0.00
		1470.00	- 0.01
		1500.00	- 0.01

Tidal Study Data

MW2-1

Elapsed Time	Value
1530.00	- 0.02
1560.00	- 0.03
1590.00	- 0.03
1620.00	- 0.02
1650.00	- 0.03
1680.00	- 0.03
1710.00	- 0.04
1740.00	- 0.04
1770.00	- 0.02
1800.00	- 0.02
1830.00	- 0.01
1860.00	- 0.00
1890.00	0.00
1920.00	0.00
1950.00	0.01
1980.00	0.01
2010.00	0.01
2040.00	0.01
2070.00	0.02
2100.00	0.01
2130.00	0.00
2160.00	- 0.00
2190.00	- 0.01
2220.00	- 0.03
2250.00	- 0.03
2280.00	- 0.04
2310.00	- 0.05
2340.00	- 0.06
2370.00	- 0.07
2400.00	- 0.07
2430.00	- 0.07
2460.00	- 0.06
2490.00	- 0.05
2520.00	- 0.04
2550.00	- 0.03
2580.00	- 0.02
2610.00	- 0.01
2640.00	- 0.00
2670.00	0.00
2700.00	0.01
2730.00	0.01
2760.00	0.01
2790.00	0.00
2820.00	0.00
2850.00	0.00
2880.00	- 0.00
2910.00	- 0.01
2940.00	- 0.01
2970.00	- 0.02
3000.00	- 0.03

TIDAL STUDY DATA

Elapsed Time	Value
3030.00	- 0.05
3060.00	- 0.05
3090.00	- 0.07
3120.00	- 0.08
3150.00	- 0.09
3180.00	- 0.08
3210.00	- 0.07
3240.00	- 0.07
3270.00	- 0.06
3300.00	- 0.04
3330.00	- 0.04
3360.00	- 0.03
3390.00	- 0.02
3420.00	- 0.01
3450.00	- 0.01
3480.00	- 0.00
3510.00	- 0.00
3540.00	- 0.00
3570.00	- 0.02
3600.00	- 0.03
3630.00	- 0.04
3660.00	- 0.03
3690.00	- 0.04
3720.00	- 0.04
3750.00	- 0.04
3780.00	- 0.05
3810.00	- 0.06
3840.00	- 0.05
3870.00	- 0.04
3900.00	- 0.03
3930.00	- 0.01
3960.00	- 0.01
3990.00	0.00

TIDAL STUDY DATA

MW2-1

Elapsed Time	Value
4020.00	0.00
4050.00	0.01
4080.00	0.03
4110.00	0.04
4140.00	0.05
4170.00	0.06
4200.00	0.07
4230.00	0.06
4260.00	0.06
4290.00	0.06
4320.00	0.05
4350.00	0.04
4380.00	0.03
4410.00	0.03
4440.00	0.03
4470.00	0.02
4500.00	0.01
4530.00	0.00
4560.00	0.00
4590.00	0.00
4620.00	0.00
4650.00	0.00
4680.00	0.00
4710.00	0.02
4740.00	0.02
4770.00	0.02
4800.00	0.01
4830.00	0.02
4860.00	0.04
4890.00	0.04
4920.00	0.04
4950.00	0.05
4980.00	0.05
5010.00	0.06
5040.00	0.05
5070.00	0.06
5100.00	0.05
5130.00	0.05

END

TIDAL STUDY DATA

MW 3-1

TIME	DATE 7/17	Elapsed Time	Value
1200		0.0000	- 0.05
		30.0000	- 0.07
		60.0000	- 0.08
1730		90.0000	- 0.08
		120.000	- 0.09
		150.000	- 0.09
		180.000	- 0.09
		210.000	- 0.09
		240.000	- 0.09
		270.000	- 0.08
		300.000	- 0.07
		330.000	- 0.06
2400 - 1730		360.000	- 0.05
		390.000	- 0.04
		420.000	- 0.03
		450.000	- 0.03
		480.000	- 0.03
0230		510.000	- 0.02
		540.000	- 0.02
		570.000	- 0.02
		600.000	- 0.02
		630.000	- 0.02
		660.000	- 0.02
		690.000	- 0.03
		720.000	- 0.03
		750.000	- 0.04
		780.000	- 0.04
		810.000	- 0.05
		840.000	- 0.05
1430 - 730		870.000	- 0.06
		900.000	- 0.05
		930.000	- 0.07
		960.000	- 0.06
		990.000	- 0.05
		1020.00	- 0.05
		1050.00	- 0.05
12.		1080.00	- 0.03
		1110.00	- 0.03
		1140.00	- 0.01
		1170.00	- 0.02
		1200.00	- 0.01
1430		1230.00	- 0.00
		1260.00	0.00
		1290.00	0.00
		1320.00	0.01
		1350.00	0.01
		1380.00	0.00
		1410.00	0.00
1200		1440.00	0.00
		1470.00	- 0.01
		1500.00	- 0.02

2 = Used in Graph or data file

?

TIDAL STUDY DATA
MW 3-1

Elapsed Time	Value
-1530.00	- 0.04
1560.00	- 0.05
1590.00	- 0.05
1620.00	- 0.05
1650.00	- 0.06
1680.00	- 0.06
1710.00	- 0.06
1740.00	- 0.06
1770.00	- 0.05
1800.00	- 0.05
1830.00	- 0.03
1860.00	- 0.02
1890.00	- 0.01
1920.00	- 0.01
1950.00	- 0.00
1980.00	0.00
2010.00	0.00
2040.00	0.00
2070.00	0.01
2100.00	0.00
2130.00	- 0.00
2160.00	- 0.01
2190.00	- 0.01
2220.00	- 0.03
2250.00	- 0.04
2280.00	- 0.06
2310.00	- 0.07
2340.00	- 0.08
2370.00	- 0.08
2400.00	- 0.09
2430.00	- 0.10
2460.00	- 0.09
2490.00	- 0.09
2520.00	- 0.08
2550.00	- 0.07
2580.00	- 0.07
2610.00	- 0.05
2640.00	- 0.04
2670.00	- 0.03
2700.00	- 0.02
2730.00	- 0.01
2760.00	- 0.01
2790.00	- 0.01
2820.00	- 0.02
2850.00	- 0.03
2880.00	- 0.03
2910.00	- 0.04
2940.00	- 0.05
2970.00	- 0.06
3000.00	- 0.07

TIDAL STUDY DATA

MW 3-1

Elapsed Time	Value
3030.00	- 0.08
3060.00	- 0.08
3090.00	- 0.10
3120.00	- 0.11
3150.00	- 0.12
3180.00	- 0.12
3210.00	- 0.12
3240.00	- 0.11
3270.00	- 0.10
3300.00	- 0.08
3330.00	- 0.08
3360.00	- 0.07
3390.00	- 0.06
3420.00	- 0.05
3450.00	- 0.04
3480.00	- 0.03
3510.00	- 0.03
3540.00	- 0.03
3570.00	- 0.03
3600.00	- 0.05
3630.00	- 0.05
3660.00	- 0.05
3690.00	- 0.06
3720.00	- 0.07
3750.00	- 0.07
3780.00	- 0.07
3810.00	- 0.08
3840.00	- 0.08
3870.00	- 0.08
3900.00	- 0.08
3930.00	- 0.07
3960.00	- 0.07
3990.00	- 0.05
4020.00	- 0.04
4050.00	- 0.03
4080.00	- 0.01
4110.00	- 0.00
4140.00	0.00
4170.00	0.01
4200.00	0.02
4230.00	0.03
4260.00	0.03
4290.00	0.02
4320.00	0.01
4350.00	0.01
4380.00	0.00
4410.00	0.00
4440.00	0.00
4470.00	- 0.00
4500.00	- 0.01

TIDAL STUDY DATA

MW 3-1

Elapsed Time	Value
4530.00	- 0.02
4560.00	- 0.03
4590.00	- 0.04
4620.00	- 0.04
4650.00	- 0.05
4680.00	- 0.04
4710.00	- 0.03
4740.00	- 0.03
4770.00	- 0.03
4800.00	- 0.02
4830.00	- 0.01
4860.00	- 0.01
4890.00	- 0.00
4920.00	0.00
4950.00	0.01
4980.00	0.01
5010.00	0.01
5040.00	0.02
5070.00	0.02
t100.00	0.02
5130.00	0.02
END	

TIDAL STUDY DATA

MW4-1

Elapsed Time	Value
0.0000	0.00
30.0000	0.01
60.0000	0.03
90.0000	0.03
120.000	0.04
150.000	0.06
180.000	0.07
210.000	0.11
240.000	0.12
270.000	0.12
300.000	0.14
330.000	0.15
360.000	0.15
390.000	0.15
420.000	0.15
450.000	0.15
480.000	0.15
510.000	0.14
540.000	0.14
570.000	0.14
600.000	0.12
630.000	0.11
660.000	0.09
690.000	0.09
720.000	0.07
750.000	0.07
780.000	0.07
810.000	0.09
840.000	0.07
870.000	0.07
900.000	0.11
930.000	0.11
960.000	0.11
990.000	0.14
1020.00	0.14
1050.00	0.15
1080.00	0.14
1110.00	0.14
1140.00	0.17
1170.00	0.15
1200.00	0.15
1230.00	0.12
1260.00	0.12
1290.00	0.06
1320.00	0.09
1350.00	0.07
1380.00	0.04
1410.00	0.04
1440.00	0.04
1470.00	0.04
1500.00	0.06

TIDAL STUDY DATA
MW4-1

Elapsed Time	Value
1530.00	0.06
1560.00	0.07
1590.00	0.07
1620.00	0.09
1650.00	0.11
1680.00	0.12
1710.00	0.14
1740.00	0.17
1770.00	0.19
1800.00	0.19
1830.00	0.20
1860.00	0.20
1890.00	0.22
1920.00	0.22
1950.00	0.20
1980.00	0.19
2010.00	0.17
2040.00	0.14
2070.00	0.12
2100.00	0.11
2130.00	0.09
2160.00	0.09
2190.00	0.06
2220.00	0.06
2250.00	0.04
2280.00	0.03
2310.00	0.03
2340.00	0.04
2370.00	0.06
2400.00	0.06
2430.00	0.07
2460.00	0.09
2490.00	0.11
2520.00	0.12
2550.00	0.14
2580.00	0.14
2610.00	0.15
2640.00	0.14
2670.00	0.14
2700.00	0.14
2730.00	0.12
2760.00	0.09
2790.00	0.09
2820.00	0.07
2850.00	0.07
2880.00	0.06
2910.00	0.04
2940.00	0.03
2970.00	0.03
3000.00	0.01
3030.00	0.00
3060.00	0.01
3090.00	0.03
3120.00	0.04

TIDAL STUDY DATA

MW4-1

Elapsed Time	Value
3150.00	0.06
3180.00	0.07
3210.00	0.11
3240.00	0.12
3270.00	0.12
3300.00	0.14
3330.00	0.15
3360.00	0.17
3390.00	0.17
3420.00	0.15
3450.00	0.17
3480.00	0.15
3510.00	0.14
3540.00	0.14
3570.00	0.14
3600.00	0.12
3630.00	0.11
3660.00	0.11
3690.00	0.09
3720.00	0.07
3750.00	0.07
3780.00	0.07
3810.00	0.09
3840.00	0.11
3870.00	0.12
3900.00	0.14
3930.00	0.15
3960.00	0.17
3990.00	0.20
4020.00	0.22
4050.00	0.23
4080.00	0.23
4110.00	0.25
4140.00	0.25
4170.00	0.23
4200.00	0.23
4230.00	0.22
4260.00	0.20
4290.00	0.20
4320.00	0.19
4350.00	0.17
4380.00	0.17
4410.00	0.15
4440.00	0.12
4470.00	0.12

TIDAL STUDY DATA

MW4-1

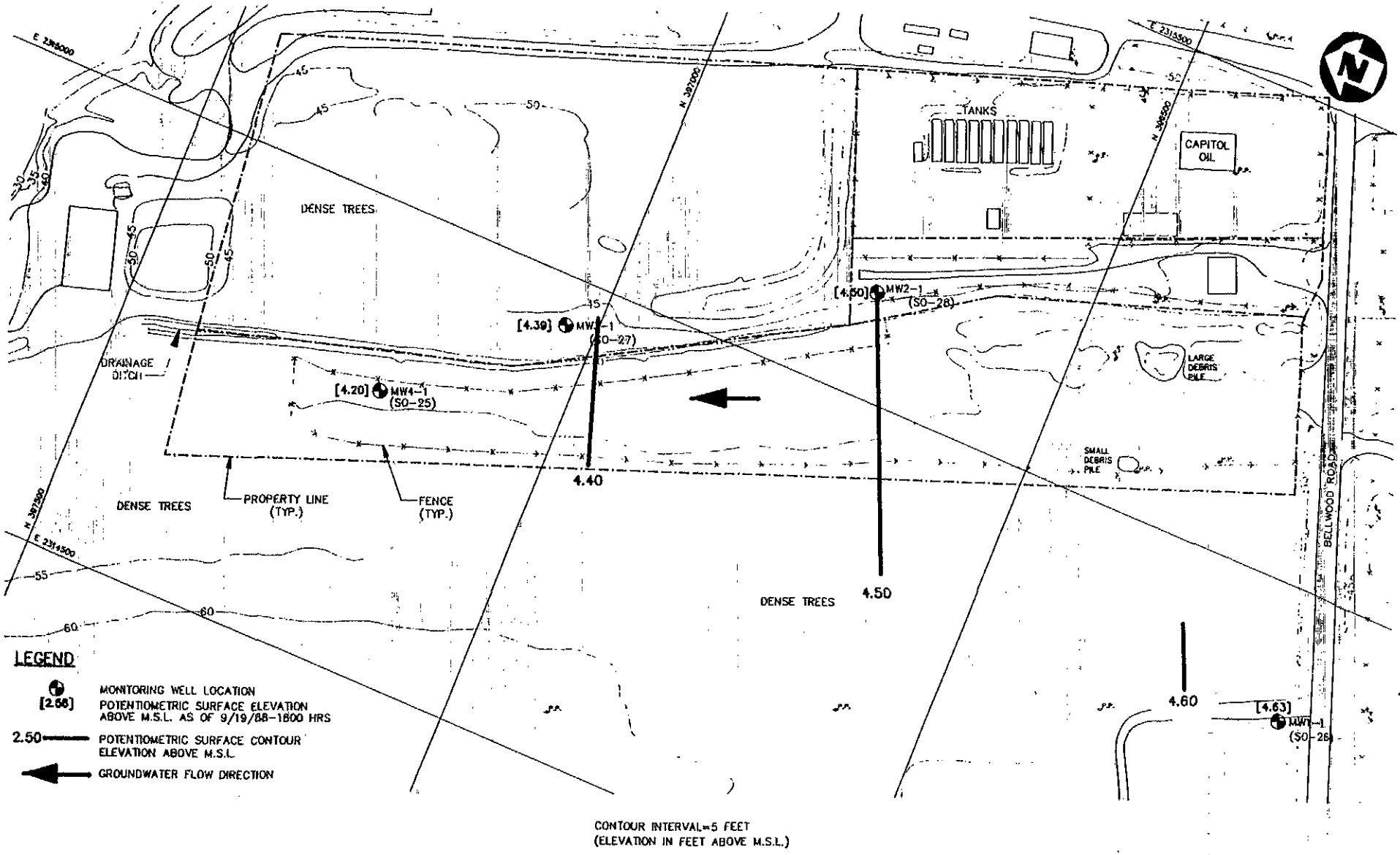
Elapsed Time	Value
4500.00	0.12
4530.00	0.12
4560.00	0.14
4590.00	0.14
4620.00	0.17
4650.00	0.17
4680.00	0.19
4710.00	0.20
4740.00	0.22
4770.00	0.23
4800.00	0.23
4830.00	0.25
4860.00	0.25
4890.00	0.25
4920.00	0.26
4950.00	0.25
4980.00	0.25
5010.00	0.23

END

APPENDIX C-2

POTENTIOMETRIC CONTOUR MAPS CONSTRUCTED FROM DATA COLLECTED DURING ONE TIDAL CYCLE

ACAD: 6851\100MARK.DWG (POTEN-19A)
(6/28/89)



CONTOUR INTERVAL=5 FEET
(ELEVATION IN FEET ABOVE M.S.L.)

FIGURE C-1

POTENTIOMETRIC SURFACE CONTOUR MAP AS OF 9/19/88-1800 HRS
C & R BATTERY SITE, CHESTERFIELD CO., VIRGINIA

0 100 200
SCALE IN FEET

NUS CORPORATION

AR301772

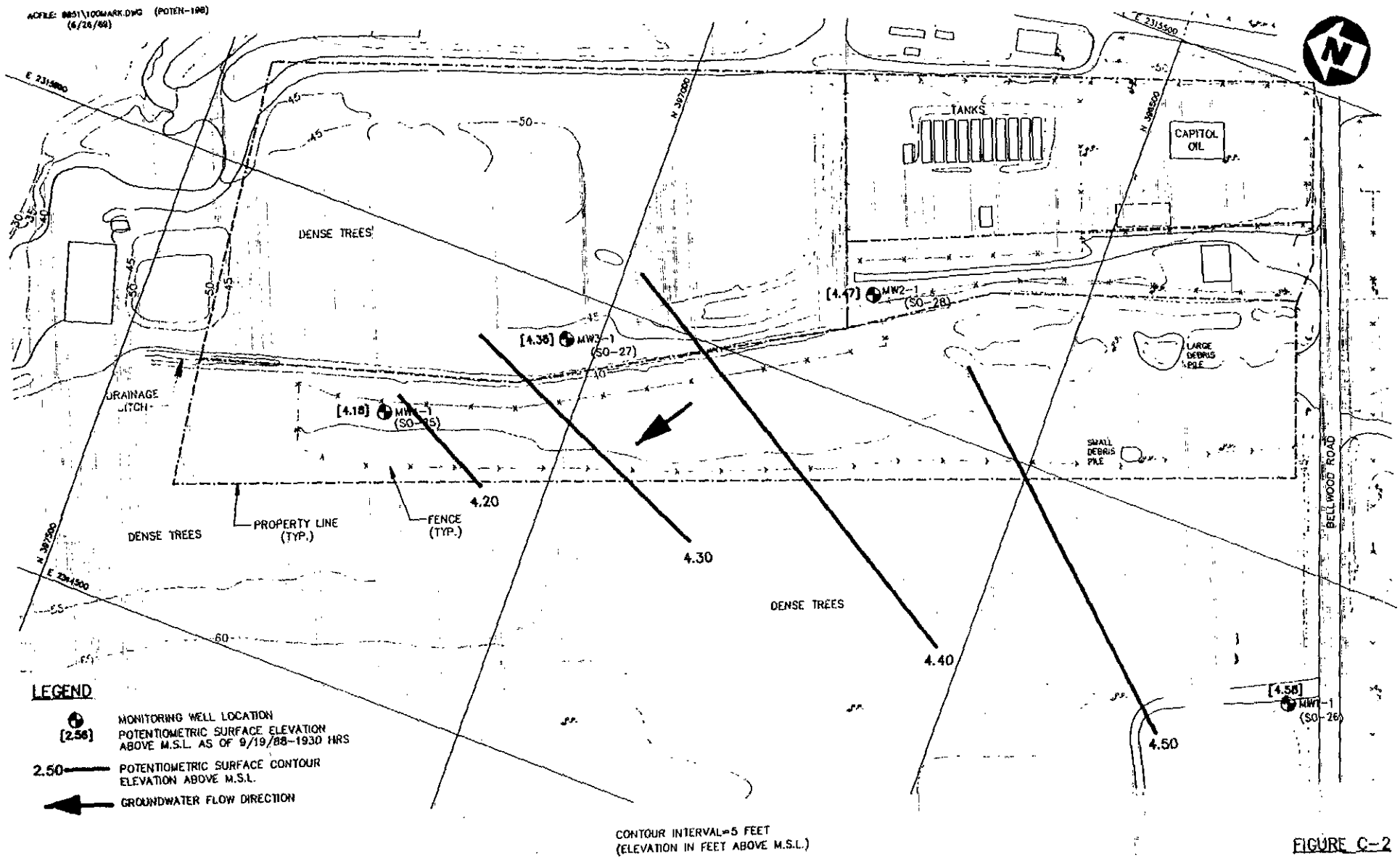


FIGURE C-2

POTENTIOMETRIC SURFACE CONTOUR MAP AS OF 9/19/88-1930 HRS
C & R BATTERY SITE, CHESTERFIELD CO., VIRGINIA

NUS CORPORATION

ACFILE: 9851\100MARK.DWG (POTEN-20A)
(8/26/89)

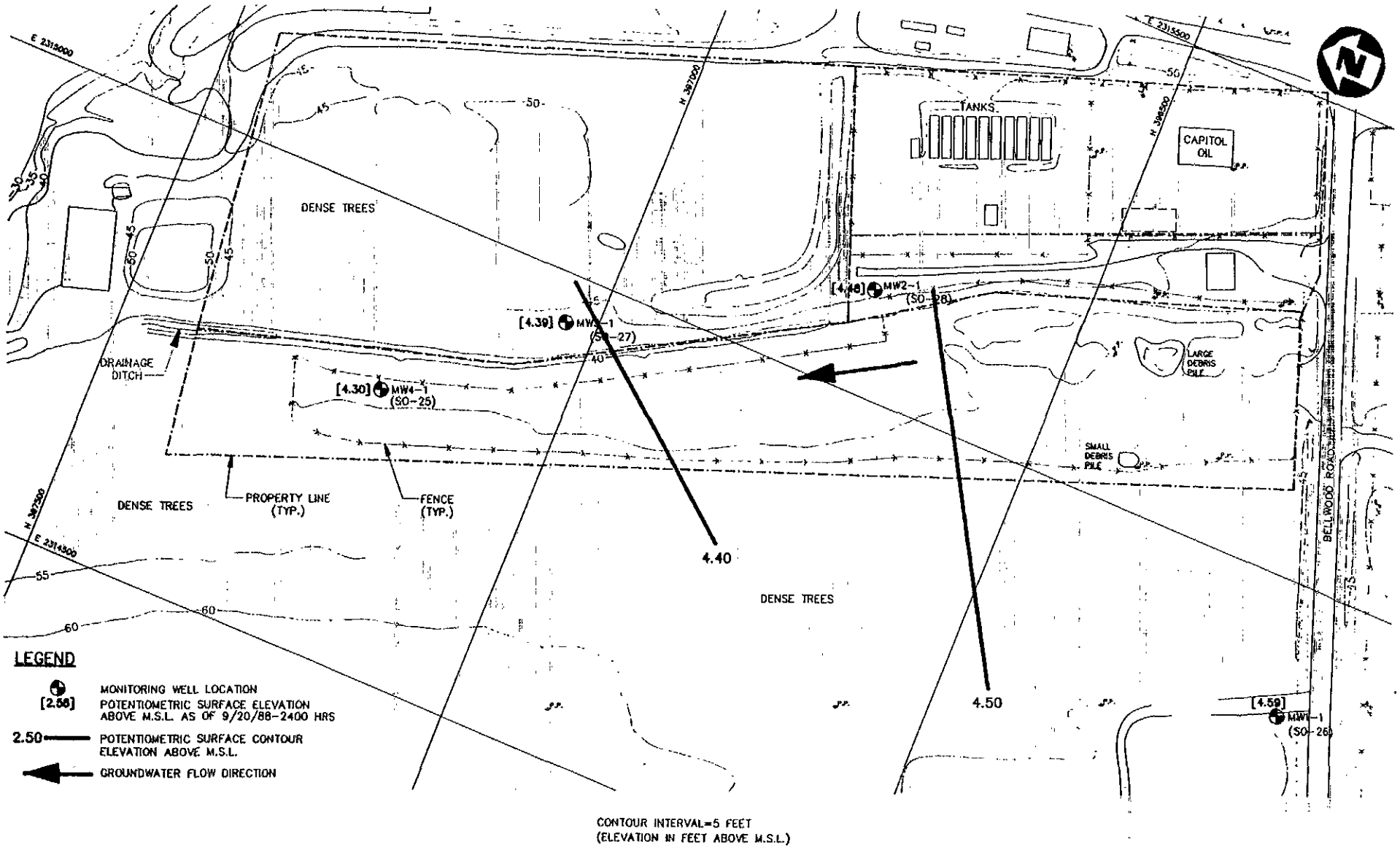


FIGURE C-3

POTENTIOMETRIC SURFACE CONTOUR MAP AS OF 9/20/88-2400 HRS
C & R BATTERY SITE, CHESTERFIELD CO., VIRGINIA

NUS CORPORATION

AR301774

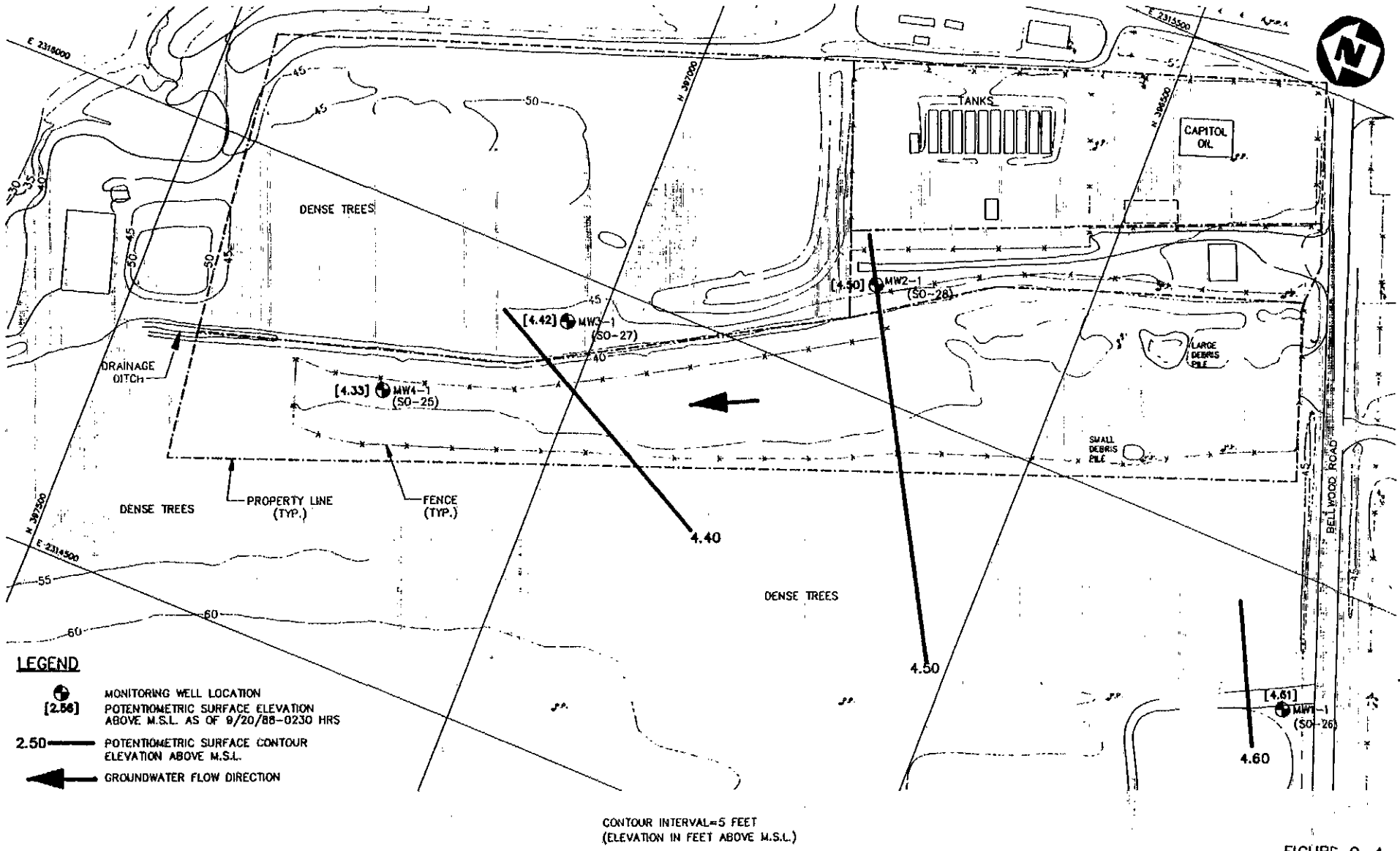


FIGURE C-4

POTENTIOMETRIC SURFACE CONTOUR MAP AS OF 9/20/88-0230 HRS
C & R BATTERY SITE, CHESTERFIELD CO., VIRGINIA

0 100 200
SCALE IN FEET

NUS CORPORATION

AR301775

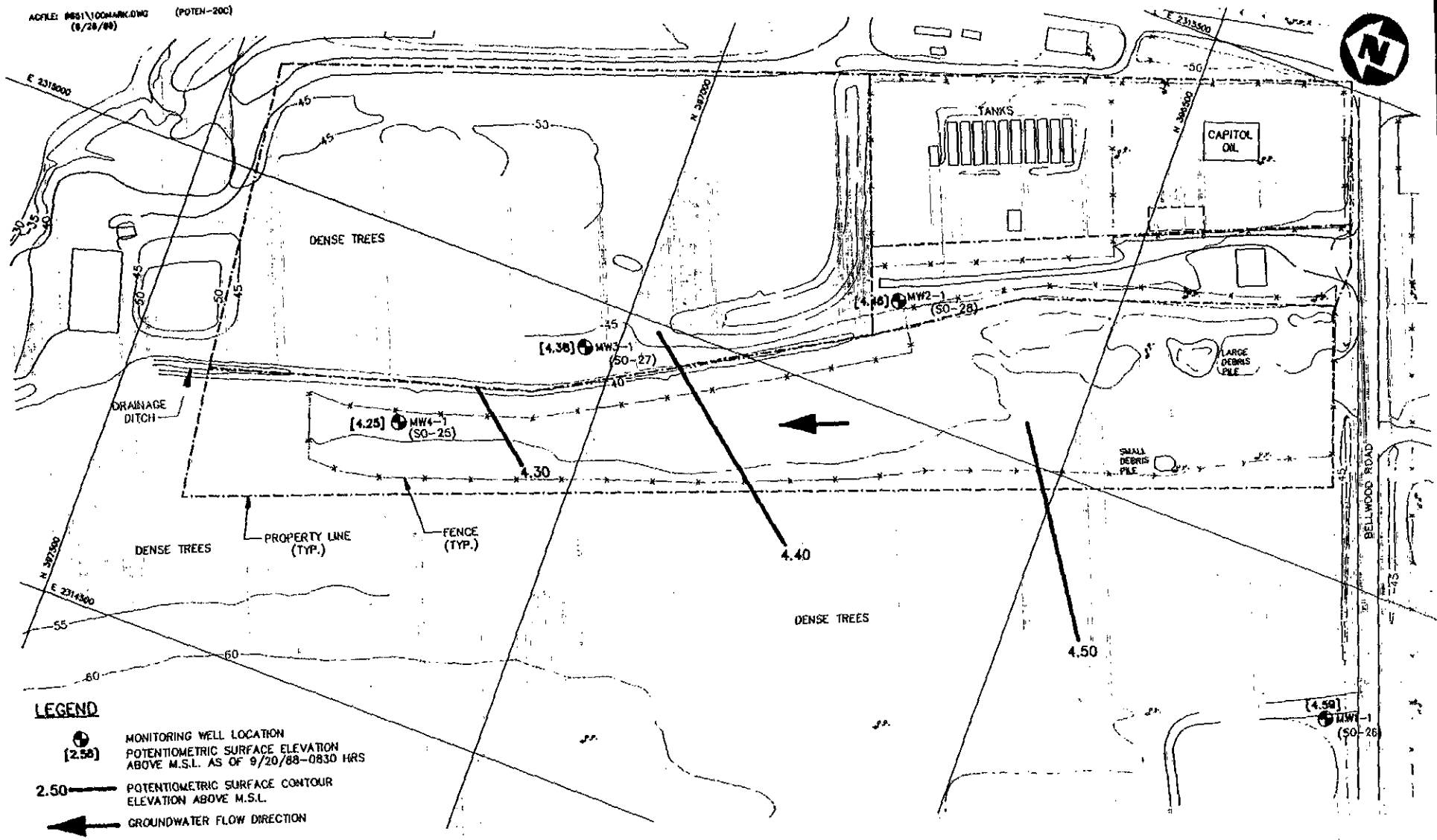


FIGURE C-5

POTENTIOMETRIC SURFACE CONTOUR MAP AS OF 9/20/88-0830 HRS
C & R BATTERY SITE, CHESTERFIELD CO., VIRGINIA

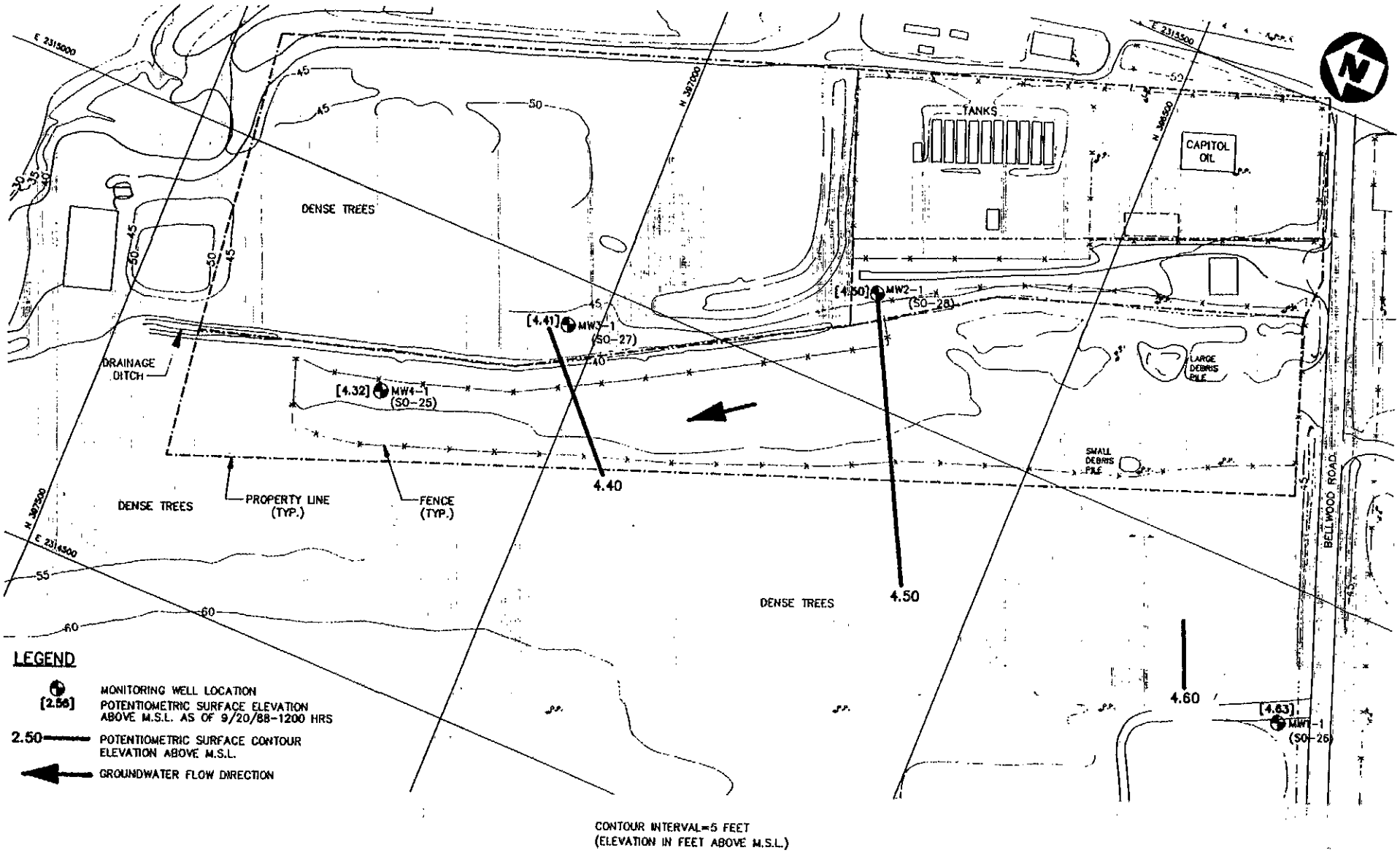


FIGURE C-6

POTENTIOMETRIC SURFACE CONTOUR MAP AS OF 9/20/88-1200 HRS
C & R BATTERY SITE, CHESTERFIELD CO., VIRGINIA

0 100 200
SCALE IN FEET

NUS CORPORATION

AR301777

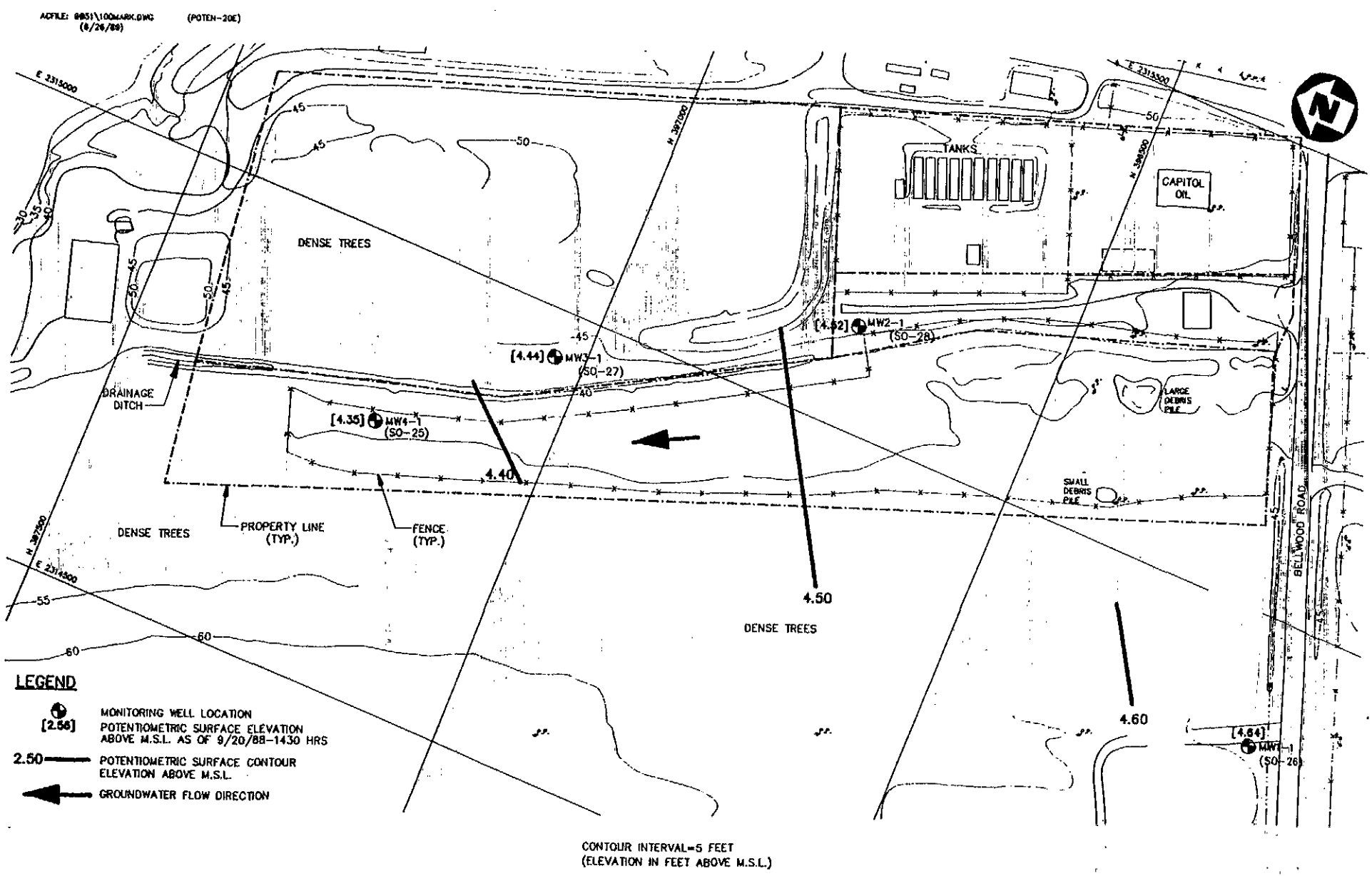


FIGURE C-7

POTENTIOMETRIC SURFACE CONTOUR MAP AS OF 9/20/88-1430 HRS
C & R BATTERY SITE, CHESTERFIELD CO., VIRGINIA

0 100 200
SCALE IN FEET

NUS CORPORATION

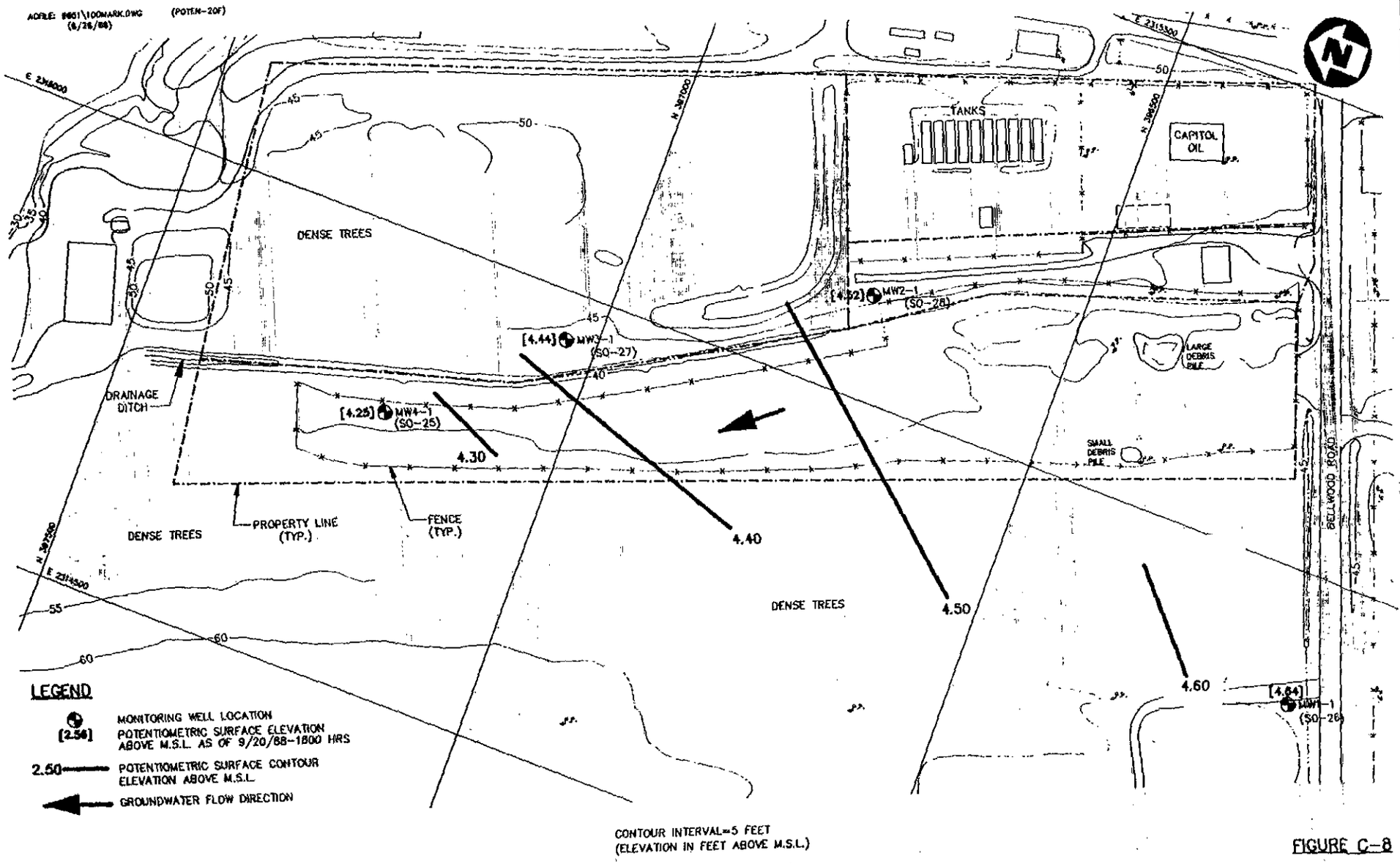


FIGURE C-8

POTENTIOMETRIC SURFACE CONTOUR MAP AS OF 9/20/88-1800 HRS
C & R BATTERY SITE, CHESTERFIELD CO., VIRGINIA

NUS CORPORATION

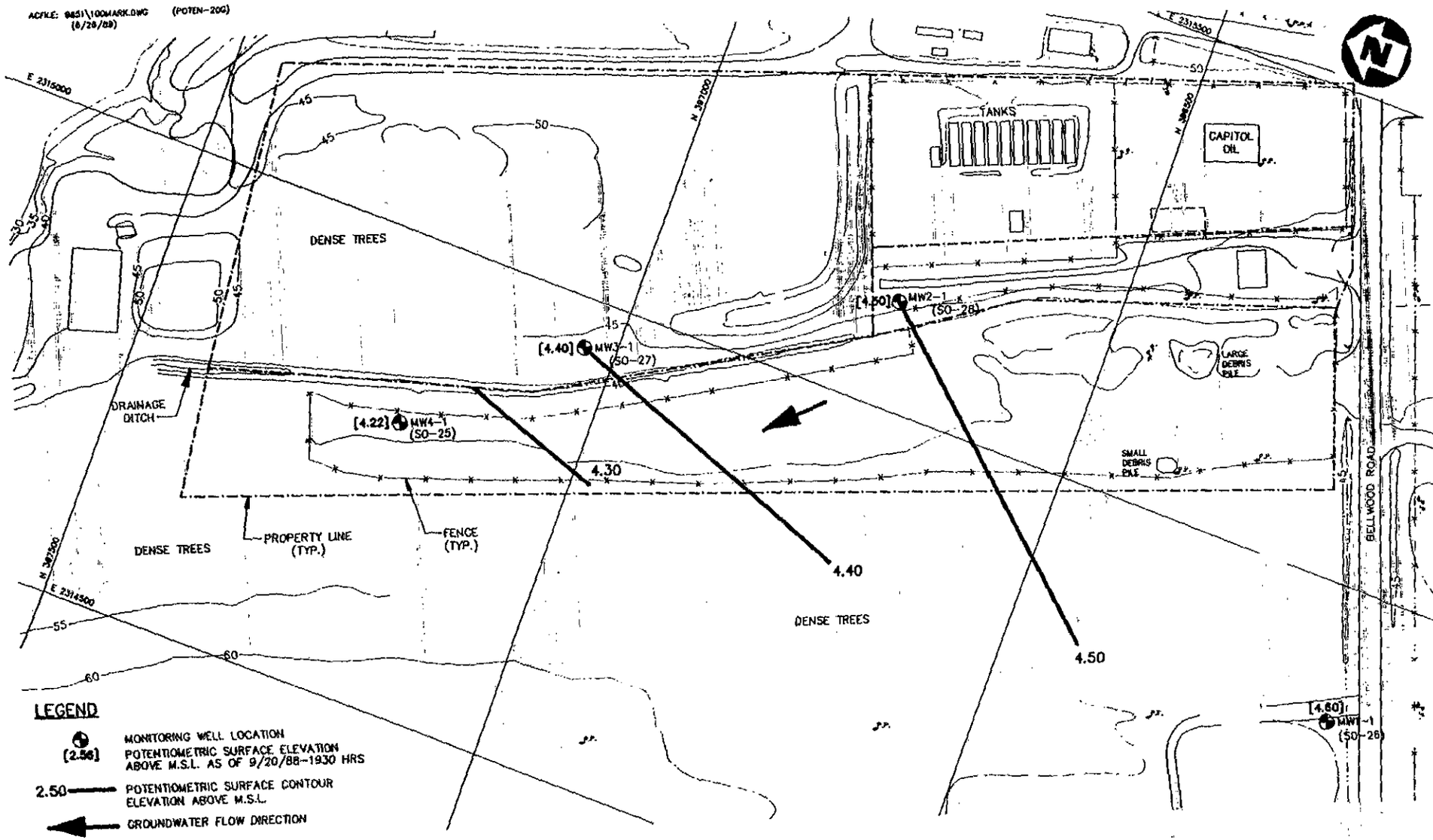


FIGURE C-9

POTENTIOMETRIC SURFACE CONTOUR MAP AS OF 9/20/88-1930 HRS
C & R BATTERY SITE, CHESTERFIELD CO., VIRGINIA

NUS CORPORATION

APPENDIX D

X-RAY FLUORESCENCE DATA AND LINEAR CORRELATION OF ANALYTICAL DATA

TABLE OF CONTENTS

APPENDIX D-1

XRF MOBILE LAB DATA OF SUBSURFACE SOIL AND SEDIMENT DURING ON SITE SCREENING

Paul,

Below are the triplicate analyses of the remaining samples that you sent to us to screen for site specific standards. Refer to Sheet H for the values of samples not included here.

Note that the sample values listed below were obtained from the X-MET whereas the sample values listed on Sheet H were obtained via a total digestion/ICP method at the EMSL-LV lab.

Bill

XRFS1	7.623	7.675	7.862
XRFS2	7.326	7.298	7.324
XRFS7	2.052	1.983	2.124
XRFS8	2.428	2.359	2.348
XRFS9	2.458	2.553	2.351
XRFS13	1.643	1.610	1.637
XRFS14	2.181	2.061	2.164
XRFS15	2.340	2.381	2.270
XRFS18	0.086	0.077	0.109
XRFS19	0.033	0.090	0.095
XRFS20	0.048	0.056	0.074
XRFS21	0.163	0.159	0.146
XRFS22	0.000	0.000	0.000
XRFS23	0.024	0.000	0.000

SITE SCREENING REPORT FOR C & R BATTERY SITE, CHESTERFIELD CO., VA

by

W. H. Cole, G. A. Raab, T. Hunt, R. Mc Claflin
and T. Nail
Lockheed Engineering & Sciences Company
1050 E. Flamingo, Suite 120
Las Vegas, Nevada 89119

Project Officers

P. H. Leonard
U.S. Environmental Protection Agency, Region III
Hazardous Waste Management Division
841 Chestnut Building
Philadelphia, PA 19107

and

L. A. Eccles
Advanced Monitoring Systems
Environmental Monitoring Systems Laboratory
Las Vegas, Nevada 89119

Technical Support through
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U. S. ENVIRONMENTAL PROTECTION LABORATORY
LAS VEGAS, NEVADA 89119

CONTENTS

Sheet A

Information and Regional Request

EPA Region: III Regional Project Manager: Leonard

Site Name: C & R Battery Location/address: Chesterfield Co, VA

Site Protection Level: A B C D E

Time Frame: from 8/29/88 to 9/30/88 .

PRPs: Fund-Lead

EPA on-site Contractors: NUS Corp.

Elements sought: Lead

Description of Work Requested: X-ray fluorescence screening of surface and subsurface soil samples to determine horizontal & vertical extent of contamination. Also to reduce the number of samples to be sent to the lab. Finally to receive a computer generated profile of the contamination at the site. Site area is equal to approximately 4 acres.

Prepared and signed by: Paul Leonard Date: 8/16/88

Sheet B

Site Reconnaissance

Site Name: C & R Battery Region: III

Reconnaissance Team: Bill Cole and Tim Hunt (Safety Officer)

Is Site closed or still in operation? closed (circa 1985)

Limited Access? Site is surrounded by a chain link fence. Obtained key on reconnaissance.

Structures that might be Problems:

Buildings: No permanent structures. A trailer is located on the southwest corner of the property.

Discarded materials:(drums, scrap metal, concrete, rubbish, etc.): A debris pile is located on the southeast corner. The remnant of a concrete loading dock is located just north of the trailer on the west property line. The loading dock depression has been back filled with imported riprap material (gneissic/schistosic rock). Same riprap material is lining the drainage ditch along the eastern property line and is found scattered throughout the property.

Geological/Morphological: Property is flat. Drainage is to the north.

Vegetation: Short (0-4') grassy vegetation on the northeast section of the property.

Weather: Warm (78 - 80^{0}F), patchy clouds, possible rain.
Proximity to Commercial, Residential Areas, Schools, Parks, etc.: Capitol Oil Co. to the east, forested to the north and west, and a road is on the southern border.

Power Available? no Size of Site: approx. 4.5 acre

Availibility of prior reports and data? see Sheet D

History: Site was used for lead reclamation from spent batteries. Acids from batteries were dumped into holding ponds which have since been neutralized. Battery casings were shredded and scraps were distributed throughout the property.

Sheet C

Data Quality Objective Summary Form

1. Site: C & R Battery EPA Region: III

Location: Chesterfield Co, VA

Phase: RI1, RI2, ERA, FS, RD, RA

2. Media: soil, ground water, surface water, sediment, air, biological, other (specify)

3. Use: Site Charact., Risk Assess., Eval. Alts., Eng'g Design, Monitoring Remedial Action, other (specify):

4. Objective: Establish spatial distribution of lead contamination on site.

5. Site Information:
Area: approx. 4.5 acres
Depth to ground water: 26-38 ft.
Ground water use: Up gradient used as potable water supply.
Soil Types: River point bar and overbank deposits.

6. Data types:

A. Analytical Data			B. Physical Data	
pH	Pesticides	TOX	Permeability	Hydraulic head
conductivity	PCB	TOC	Porosity	Penetration test
VOA	Metals	BTX	Grain size	Hardness
ABN	Cyanide	COD	Bulk density	Moisture

7. Sampling Method to be Used: Surface grab samples; surface and subsurface, split tube spoon samples; and in situ specimen analysis

8. Analytical Levels (indicate level and equipment to be used):
Level 1, 2, 3, 4, or 5

9. Sampling procedures: NUS will drill a series of holes throughout the property. At various intervals, split tube spoon sampling will be done. The cores will be homogenized and split as necessary, one split being for on site X-ray screening analysis. Approximately 180 splits will be awaiting the X-ray team.

Contractor: LESC Prime Contractor: NUS
Site manager: Paul Leonard Date: 9/26 - 9/30/88

Sheet D

Sampling Grid

Prior Data on the Site available: Y N; If Y, list references:
1. NUS Corporation, June 1988, Work Plan for RI/FS, C&R Battery

2. NUS Corporation, February 1986, Site Inspection of C&R Battery

3. Sayer & Associates, December 1983, Geotechnical Study of C&R Battery Company

Enough data for semivariograms? Y N; If Y, show variograms, ranges, sills, and proposed sampling grid.
Completed by: Date:
NO GEOSTATISTICS TO BE USED

On-Site:

Does the proposed grid apply to the real-world situation on-site? Y, N; if N then answer questions below:

What affects the proposed sampling grid? Concrete pad (old zone of operation) forced adustment of the 50' x 50' grid pattern.

Comments: The data will be contoured using CPS-PC.

Sheet E

Sampling

Sample size: 40-80 grams Homogenized in situ: Y N

Distance between sample stations: ~ 50 ft

Appearance of soil: Wet or dry

Description of soil:

Paumunkey loam: typical overbank deposits and point bar sequences.

Containers:
glass jars, freezer zip-lock bags, polyethylene bottles, polycarbonate bottles

Sampling device:
Split spoon drive tube
Describe sampling: Samples run in the mobile lab were received (under sample custody) in 8 oz. glass jars which were one of several splits from split spoon core samples. The other splits will go to assigned CLP labs for RAS and SAS analyses.

Do the samples contain organics? Y N.
Are the samples going to be analyzed for organics? Y N.

Sheet F

Chain-of-Custody Check List

Site: C & R Battery, Chesterfield Co, VA Date: 9-26-88

Samplers: NUS crew under supervision of R. Bethel

Were sample bottles decontaminated? Y N

Have labels been filled out and dated? Y N

Have boxes of bottles been secured with Custody Seals? Y N

Who has samples in custody? Sample splits for X-Ray analysis were signed over to Lockheed (Tim Hunt). Sample splits for CLP analysis remained in the custody of NUS.

What analyses are scheduled for the samples? CLP-SAS and RAS analysis for the following parameters: TAL inorganics, alkalinity, acidity, TSS, TDS and sulfate.

Which laboratories are scheduled to receive the samples? CLP

A sample is under custody if:
1. **it is in your possession, or**
2. **it is in your view, after being in your possession**
3. **it was in your possession and you locked it up, or**
4. **it is in a designated secure area**

Sheet G

Instrument Specifications

The X-Met 840 is a field portable, energy dispersive X-Ray fluorescence spectrometer marketed by Columbia Scientific Industries Corporation, Austin, TX. The unit is self-contained, battery powered, microprocessor based and weighs 8.5 kg. The surface analysis probe is specifically designed for field use. The X-Met 840 is hermetically sealed and can be decontaminated with soap and water. The probe includes a radioisotope source of Curium-244, a proportional counter and the associated electronics. The source is protected by an NRC-approved safety shutter.

The electronic unit has eight calibration memories called 'models'. Each model can be independently calibrated for as many as six elements. These can be used to measure elements from silicon to uranium assuming the proper isotope source is available. The unknown sample intensities are regressed against the calibration curves to yield concentrations.

For the C & R Battery site, only lead was investigated. Two models were calibrated, Model #4 for lead concentrations up to approximately 1.5 percent and Model #1 for concentrations ranging from approximately 1.5 percent to 21.5 percent.

Detection Limits:

The American Chemical Society (ACS) defines a limit of detection as "...the lowest concentration level that can be determined to be statistically different from a blank"(1). This is further defined as three times the standard deviation of a series of blanks (3 sigma).

The ACS defines a quantitation limit as "...the level above which quantitative results may be obtained with a specified degree of confidence"(1). The recommended value for the quantitation limit is 10 sigma. This is said to correspond "...to an uncertainty of +30% in the measured value (10 sigma±3 sigma) at the 99% confidence level"(1).

Using the above definitions and the QCCS 0 sample as the series of blanks, we get the following:

Number of observations	= n	= 54	
Standard deviation	= sigma	= 0.004 wt%	
Detection Limit	= 3 sigma	= 0.012 wt%	= 120 mg/kg
Quantitation limit	= 10 sigma	= 0.040 wt%	= 400 mg/kg

A value falling below 3 sigma is considered to be "not detected"; this is not to be interpreted as a zero level of concentration but merely below the sensitivity of the instrument. Values between 3 sigma and 10 sigma are considered to be in the "region of less-

certain quantitation". Values greater than 10 sigma are considered to be in the region of quantitation. The ACS states quite emphatically that "...quantitative interpretation, decision making and regulatory actions should be limited to data at or above the limit of quantitation."

The above discussion is supplied as a source of information. More important, though, is that this program is designed to be a screening technique. In that light, the major emphasis should not be placed on individual samples but rather on the trend of analyte concentration over the area of interest.

(1) ACS Committee on Environmental Quality,"Principles of Environmental Analysis" Anal. Chem. 1983, 55, 2210-2218

Sheet H

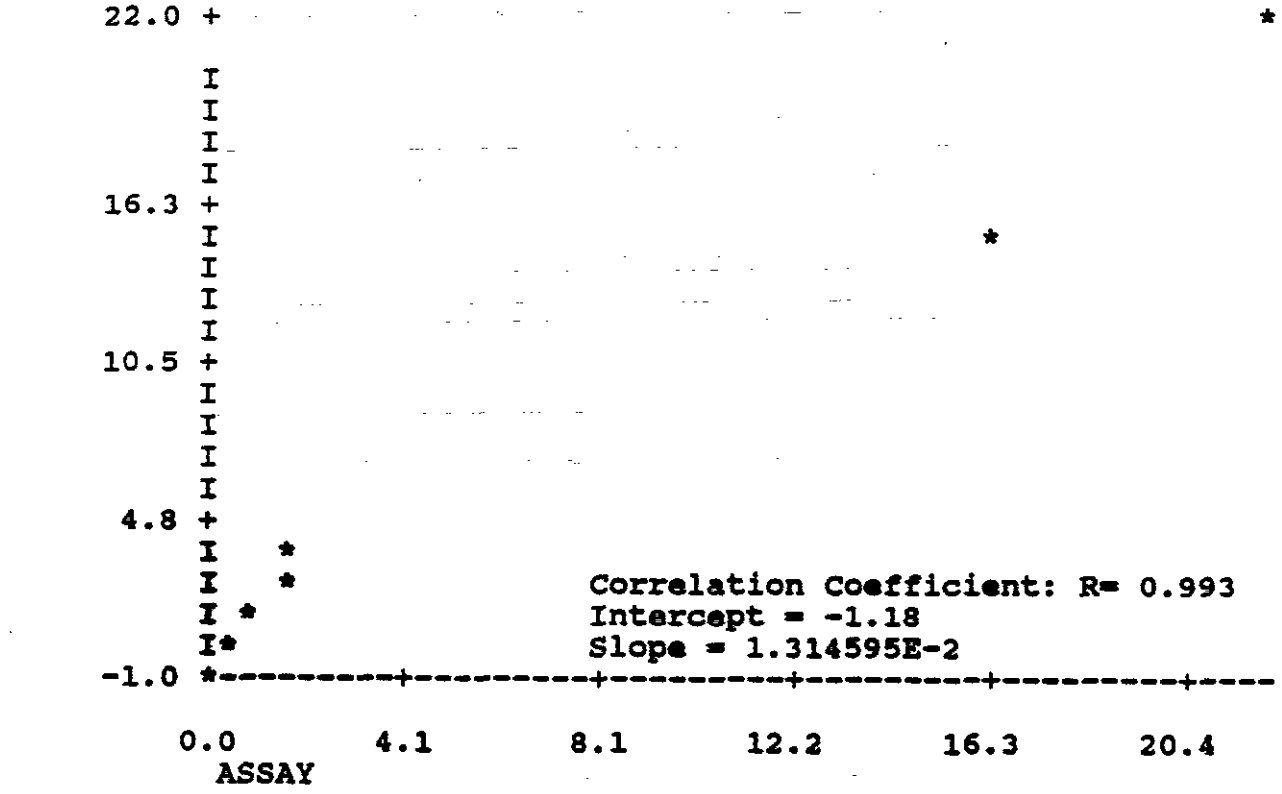
Instrument Calibration

CALIBRATION FOR MODEL #1
(Used for samples exceeding approximately 3.0 wt% Pb)

Standards were site specific samples characterized at EMSL-LV.

Elements:	Pb (all concentrations in wt%)	
1.	16.358	(S3)
2.	21.598	(S4)
3.	0.412	(S5)
4.	0.041	(S6)
5.	0.841	(S10)
6.	2.784	(S11)
7.	1.542	(S12)
8.	1.444	(S16)
9.	0.656	(S17)

CALIBRATION PLOT FOR MODEL #1



Instrument Calibration

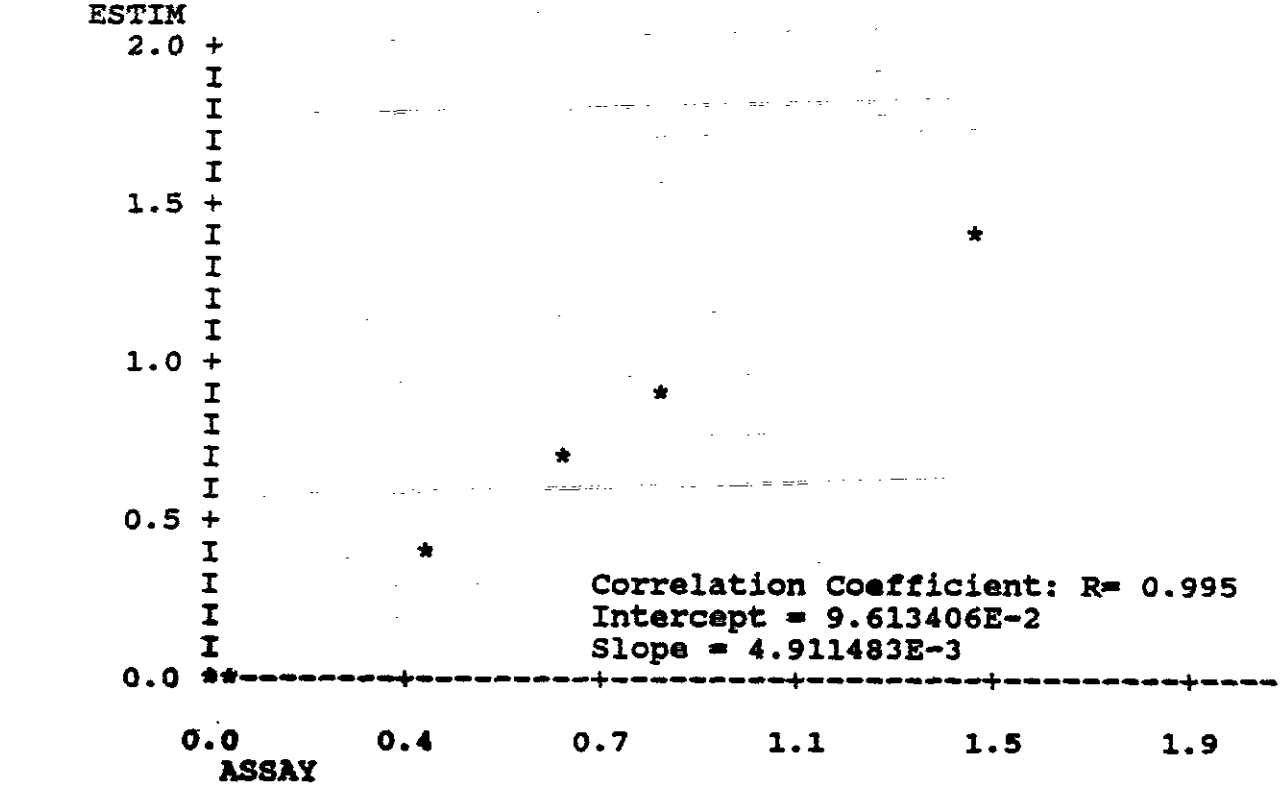
CALIBRATION FOR MODEL #4
(Used for sample range 0.0 - 3.0 wt%; all samples were first shot on this curve.)

Standards were site specific samples characterized at EMSL-LV.

Elements: Pb (all concentrations in wt%)

1.	0.000	(CSI std.)
2.	0.041	(S6)
3.	0.412	(S5)
4.	0.656	(S17)
5.	0.841	(S10)
6.	1.444	(S16)

CALIBRATION PLOT FOR MODEL #4



Sheet I
Mobile Laboratory Analysis
Blanks and Quality Control Check Samples (QCCS)

note: A blank sample (QCCS 0)and two QCCS (QCCS 5 & 17) were run in triplicate before the first routine sample, after every twelfth routine sample and after the last sample.

QCCS TYPE	TRUE VALUE	TRIPLICATES X1	X2	X3
QCCS 0	0.000	0.000	0.000	0.000
QCCS 0	0.000	0.000	0.000	0.036
QCCS 0	0.000	0.000	0.000	0.000
QCCS 0	0.000	0.000	0.000	0.000
QCCS 0	0.000	0.000	0.000	0.007
QCCS 0	0.000	0.023	0.000	0.000
QCCS 0	0.000	0.000	0.007	0.004
QCCS 0	0.000	0.000	0.000	0.000
QCCS 0	0.000	0.000	0.000	0.000
QCCS 0	0.000	0.000	0.000	0.003
QCCS 0	0.000	0.000	0.000	0.000
QCCS 0	0.000	0.003	0.000	0.000
QCCS 0	0.000	0.000	0.000	0.003
QCCS 0	0.000	0.005	0.000	0.000
QCCS 0	0.000	0.000	0.000	0.000
QCCS 0	0.000	0.000	0.000	0.000
QCCS 0	0.000	0.000	0.015	0.002
QCCS 0	0.000	0.000	0.000	0.017
QCCS S5	0.412	0.299	0.324	0.373
QCCS S5	0.412	0.437	0.390	0.393
QCCS S5	0.412	0.476	0.457	0.386
QCCS S5	0.412	0.404	0.390	0.397
QCCS S5	0.412	0.370	0.318	0.367
QCCS S5	0.412	0.397	0.340	0.396
QCCS S5	0.412	0.371	0.403	0.408
QCCS S5	0.412	0.298	0.400	0.423
QCCS S5	0.412	0.415	0.387	0.395
QCCS S5	0.412	0.364	0.436	0.400
QCCS S5	0.412	0.450	0.406	0.386
QCCS S5	0.412	0.369	0.378	0.396
QCCS S5	0.412	0.405	0.382	0.354
QCCS S5	0.412	0.363	0.321	0.402
QCCS S5	0.412	0.430	0.350	0.434
QCCS S5	0.412	0.383	0.423	0.394
QCCS S5	0.412	0.371	0.376	0.409
QCCS S5	0.412	0.395	0.398	0.397
QCCS S17	0.656	0.830	0.824	0.811
QCCS S17	0.656	0.866	0.881	0.903
QCCS S17	0.656	0.857	0.879	0.979
QCCS S17	0.656	0.877	0.830	0.825
QCCS S17	0.656	0.802	0.866	0.840

Sheet I (cont.)
Mobile Laboratory Analysis
Blanks and Quality Control Check Samples (QCCS)

QCCS TYPE	TRUE VALUE	TRIPLICATES X1	X2	X3
QCCS S17	0.656	0.888	0.902	
QCCS S17	0.656	0.770	0.765	0.733
QCCS S17	0.656	0.706	0.726	0.789
QCCS S17	0.656	0.862	0.835	0.881
QCCS S17	0.656	0.847	0.803	0.839
QCCS S17	0.656	0.872	0.760	0.901
QCCS S17	0.656	0.802	0.746	0.828
QCCS S17	0.656	0.756	0.842	0.854
QCCS S17	0.656	0.827	0.885	0.785
QCCS S17	0.656	0.831	0.791	0.753
QCCS S17	0.656	0.795	0.856	0.832

Sheet J
Mobile Laboratory Analysis
Routine Analysis Data
(all concentrations in wt% Pb)

SAMPNO	X1	X2	X3	X4	$\bar{X}$	SD
S001-00	0.341	0.137	0.211		0.230	0.103
S001-03	0.597	0.805	0.599		0.667	0.120
S001-06	0.000	0.000	0.000		0.000	
S001-09	0.000	0.000	0.000		0.000	
S001-13	0.000	0.000	0.020		0.000	
S002-00	1.049	0.930	1.109		1.029	0.091
S002-03	0.041	0.063	0.000	0.013	0.029	0.028
S002-06	0.016	0.357	0.000	0.013	0.124	0.202
S002-09	0.011	0.000	0.022	0.003	0.009	0.010
S002-13	0.000	0.000	0.000		0.000	
S003-00	0.086	0.026	0.082		0.065	0.034
S003-03	0.000	0.000	0.000		0.000	
S003-06	0.000	0.000	0.000		0.000	
S003-09	0.000	0.000	0.000		0.000	
S003-13	0.000	0.000	0.000		0.000	
S004-00	0.000	0.000	0.000		0.000	
S004-03	0.000	0.013	0.000		0.000	
S004-07	0.000	0.000	0.000		0.000	
S004-09	0.000	0.000	0.000		0.000	
S004-13	0.000	0.000	0.000		0.000	
S005-00	0.000	0.000	0.000		0.000	
S005-03	0.684	0.778	1.075		0.846	0.204
S005-03-D	0.688	0.690	0.357		0.578	0.192
S005-06	0.000	0.030	0.075		0.035	0.038
S005-09	0.000	0.000	0.000		0.000	
S005-13	0.000	0.000	0.000		0.000	
S005-20	0.000	0.000	0.000		0.000	
S005-25	0.000	0.007	0.020		0.009	0.010
S005-30	0.000	0.000	0.000		0.000	
S005-35	0.000	0.000	0.000		0.000	
S005-40	0.000	0.000	0.000		0.000	
S006-00	0.455	0.456	0.621		0.511	0.096
S006-03	0.076	0.042	0.072		0.063	0.019
S006-03-D	0.005	0.039	0.037		0.027	0.019
S006-06	0.000	0.000	0.000		0.000	
S006-09	0.000	0.000	0.000		0.000	
S006-13	0.000	0.000	0.000		0.000	

Sheet J (cont.)
Mobile Laboratory Analysis
Routine Analysis Data
(all concentrations in wt% Pb)

SAMPNO	X1	X2	X3	X4	$\bar{X}$	SD
S007-00	2.188	2.208			2.198	0.014
S007-03	0.098	0.050	0.056		0.068	0.026
S007-03-D	0.016	0.000	0.019		0.012	0.010
S007-06	0.154	0.000	0.000		0.051	0.089
S007-09	0.014	0.000	0.014		0.009	0.008
S007-13	0.000	0.000	0.000		0.000	
S008-00	7.619	7.662			7.641	0.030
S008-03	0.000	0.000	0.000		0.000	
S008-06	0.190	0.240	0.104		0.178	0.069
S008-09	0.015	0.132	0.030		0.059	0.064
S008-13	0.000	0.015	0.007		0.007	0.008
S009-00	0.367	0.170	0.151		0.229	0.120
S009-03	0.000	0.000	0.000		0.000	
S009-06	0.000	0.000	0.000		0.000	
S009-09	0.000	0.000	0.000		0.000	
S009-13	0.000	0.000	0.000		0.000	
S010-00	1.919	2.323	2.024		2.089	0.210
S010-03	1.598	1.908			1.753	0.219
S010-06	0.367	0.338	0.457		0.387	0.062
S010-09	0.040	0.102	0.137	0.052	0.083	0.045
S010-13	0.000	0.000	0.000		0.000	
S011-00	9.143	9.308			9.226	0.117
S011-03	2.391	1.740	2.069		2.067	0.326
S011-03-D	3.760	5.552	3.563		4.292	1.096
S011-06	1.445	1.620	1.591		1.552	0.094
S011-09	0.000	0.000	0.000		0.000	
S011-13	0.000	0.033	0.000	0.010	0.011	0.016
S012-00	0.886	0.482	0.815		0.728	0.216
S012-03	0.532	0.275	0.223		0.065	0.054
S012-06	0.055	0.123	0.017		0.065	0.054
S012-09	0.000	0.059	0.000	0.000	0.015	0.030
S012-13	0.000	0.000	0.000		0.000	

Sheet J (cont.)
Mobile Laboratory Analysis
Routine Analysis Data
(all concentrations in wt% Pb)

SAMPNO	X1	X2	X3	X4	$\bar{X}$	SD
S013-00	12.68	13.76	11.71		12.71	1.025
S013-03	2.247	1.640	2.222		2.036	0.343
S013-06	0.109	0.198	0.100		0.136	0.054
S013-06-D	0.146	0.084	0.054		0.095	0.047
S013-09	0.000	0.000	0.000		0.000	
S013-13	0.000	0.000	0.000		0.000	
S013-20	0.000	0.000	0.000		0.000	
S013-25	0.024	0.000	0.000	0.000	0.000	
S013-30	0.000	0.000	0.000		0.000	
S013-35	0.000	0.000	0.000		0.000	
S013-40	0.000	0.000	0.000		0.000	
S014-00	13.15	13.76	13.44		13.45	0.305
S014-03	2.269	1.023	1.869		1.720	0.636
S014-06	0.095	0.141	0.054		0.097	0.044
S014-09	0.091	0.100	0.081		0.091	0.010
S014-13	0.147	0.071	0.054		0.091	0.050
S015-00	1.857	2.457	2.443		2.252	0.420
S015-03	0.150	0.179	0.144		0.158	0.019
S015-06	0.912	0.565	0.572		0.683	0.198
S015-09	0.000	0.000	0.000		0.000	
S015-13	0.000	0.000	0.000		0.000	
S016-00	13.23	11.69	11.19		12.04	1.03
S016-03	3.328	2.168	1.797	2.145	2.360	0.668
S016-06	1.431	1.191	1.481		1.368	0.155
S016-09	0.055	0.086	0.000		0.047	0.044
S016-13	0.000	0.000	0.000		0.000	
S017-00	0.757	0.383	0.318		0.486	0.237
S017-03	0.000	0.000	0.000		0.000	
S017-06	0.000	0.002	0.000		0.000	
S017-09	0.000	0.000	0.000		0.000	
S017-09-D	0.000	0.000	0.000		0.000	
S017-13	0.000	0.000	0.000		0.000	
S017-20	0.000	0.000	0.000		0.000	
S017-25	0.000	0.008	0.017		0.008	0.008
S017-30	0.000	0.000	0.000		0.000	
S017-35	0.000	0.000	0.000		0.000	
S017-40	0.000	0.000	0.000		0.000	

Sheet J (cont.)
Mobile Laboratory Analysis
Routine Analysis Data
(all concentrations in wt% Pb)

SAMPNO	X1	X2	X3	X4	$\bar{X}$	SD
S018-00	1.430	1.579	1.450		1.486	0.081
S018-03	0.115	0.041	0.066	0.036	0.064	0.036
S018-06	0.062	0.022	0.085		0.056	0.032
S018-09	0.000	0.000	0.000		0.000	
S018-13	0.000	0.000	0.000		0.000	
S019-00	1.849	1.278	1.150		1.426	
S019-00-D	0.932	0.986	1.426		1.115	0.271
S019-03	0.001	0.000	0.031	0.000	0.000	
S019-06	0.000	0.000	0.000		0.000	
S019-09	0.000	0.000	0.000		0.000	
S019-13	0.000	0.000	0.000		0.000	
S020-00	0.114	0.077	0.069		0.087	0.024
S020-03	0.000	0.000	0.000		0.000	
S020-06	0.018	0.000	0.006		0.008	0.009
S020-09	0.000	0.018	0.000		0.006	0.010
S020-13	0.000	0.000	0.000		0.000	
S021-00	0.042	0.050	0.012		0.035	0.020
S021-03	0.000	0.000	0.000		0.000	
S021-06	0.000	0.000	0.000		0.000	
S021-09	0.000	0.000	0.000		0.000	
S021-13	0.000	0.000	0.000		0.000	
S022-00	2.110	1.655	2.539		2.101	0.442
S022-03	0.765	0.851	0.498		0.705	0.184
S022-06	0.000	0.000	0.000		0.000	
S022-09	0.000	0.000	0.000		0.000	
S022-13	0.000	0.000	0.000		0.000	
S022-13-D	0.000	0.000	0.003		0.000	
S022-20	0.000	0.000	0.000		0.000	
S022-30	0.000	0.000	0.000		0.000	
S022-35	0.000	0.000	0.000		0.000	
S022-40	0.000	0.000	0.000		0.000	
S023-00	0.000	0.000	0.000		0.000	
S023-03	0.000	0.000	0.000		0.000	
S023-06	0.000	0.000	0.000		0.000	
S023-09	0.000	0.000	0.000		0.000	
S023-13	0.000	0.000	0.000		0.000	

Sheet J (cont.)
Mobile Laboratory Analysis
Routine Analysis Data
(all concentrations in wt% Pb)

SAMPNO	X1	X2	X3	X4	$\bar{X}$	SD
S024-00	0.000	0.000	0.000		0.000	
S024-00-D	0.000	0.000	0.000		0.000	
S024-03	0.000	0.000	0.000		0.000	
S024-06	0.000	0.000	0.000		0.000	
S024-09	0.000	0.000	0.000		0.000	
S024-13	0.000	0.000	0.000		0.000	
S025-00	0.322	0.380	0.463		0.388	0.071
S025-03	0.288	0.506	0.161		0.318	0.174
S025-06	0.000	0.007	0.000		0.000	
S025-09	0.000	0.000	0.000		0.000	
S025-09	0.000	0.000	0.000		0.000	
S025-13	0.000	0.000	0.000		0.000	
S025-20	0.000	0.021	0.068		0.030	0.035
S025-25	0.000	0.020	0.000		0.000	
S025-30	0.033	0.035	0.030		0.033	0.002
S025-35	0.000	0.000	0.000		0.000	
S025-40	0.000	0.000	0.000		0.000	
S026-00	0.000	0.000	0.000		0.000	
S026-03	0.000	0.000	0.000		0.000	
S026-06	0.000	0.000	0.000		0.000	
S026-09	0.000	0.000	0.000		0.000	
S026-14	0.000	0.000	0.000		0.000	
S026-20	0.000	0.000	0.000		0.000	
S026-25	0.001	0.045	0.006		0.017	0.024
S026-30	0.006	0.000			0.000	
S026-35	0.000	0.026	0.012		0.013	0.013
S026-40	0.000	0.006	0.000		0.000	
S028-00	0.241	0.148	0.136		0.175	0.057
S028-03	0.075	0.140	0.050		0.088	0.046
S028-06	0.000	0.000	0.000		0.000	
S028-09	0.000	0.000	0.000		0.000	
S028-13	0.000	0.000	0.000		0.000	
S028-20	0.000	0.000	0.000		0.000	
S028-26	0.000	0.000	0.025		0.008	0.014
S028-30	0.000	0.000	0.000		0.000	
S028-35	0.000	0.000	0.000		0.000	
S028-40	0.000	0.000	0.000		0.000	
S029-00	0.000	0.000	0.000		0.000	
S030-00	0.000	0.000	0.000		0.000	

Sheet J (cont.)
Mobile Laboratory Analysis
Routine Analysis Data
(all concentrations in wt% Pb)

SAMPNO	X1	X2	X3	X4	$\bar{X}$	SD
SD01-01	0.299	0.275	0.260		0.278	0.020
SD02-01	1.283	1.264	1.241		1.263	0.021
SD03-01	0.003	0.066	0.079		0.049	0.041
SD03-01-D	0.082	0.068	0.033		0.061	0.025
SD04-01	0.000	0.000	0.000		0.000	
SD05-01	0.000	0.000	0.000		0.000	
SD06-01	0.000	0.000	0.000		0.000	
SD07-01	0.000	0.000	0.000		0.000	
SD09-01	0.366	0.297	0.310		0.324	0.037
SD08-01	0.000	0.000	0.000		0.000	

Sheet K

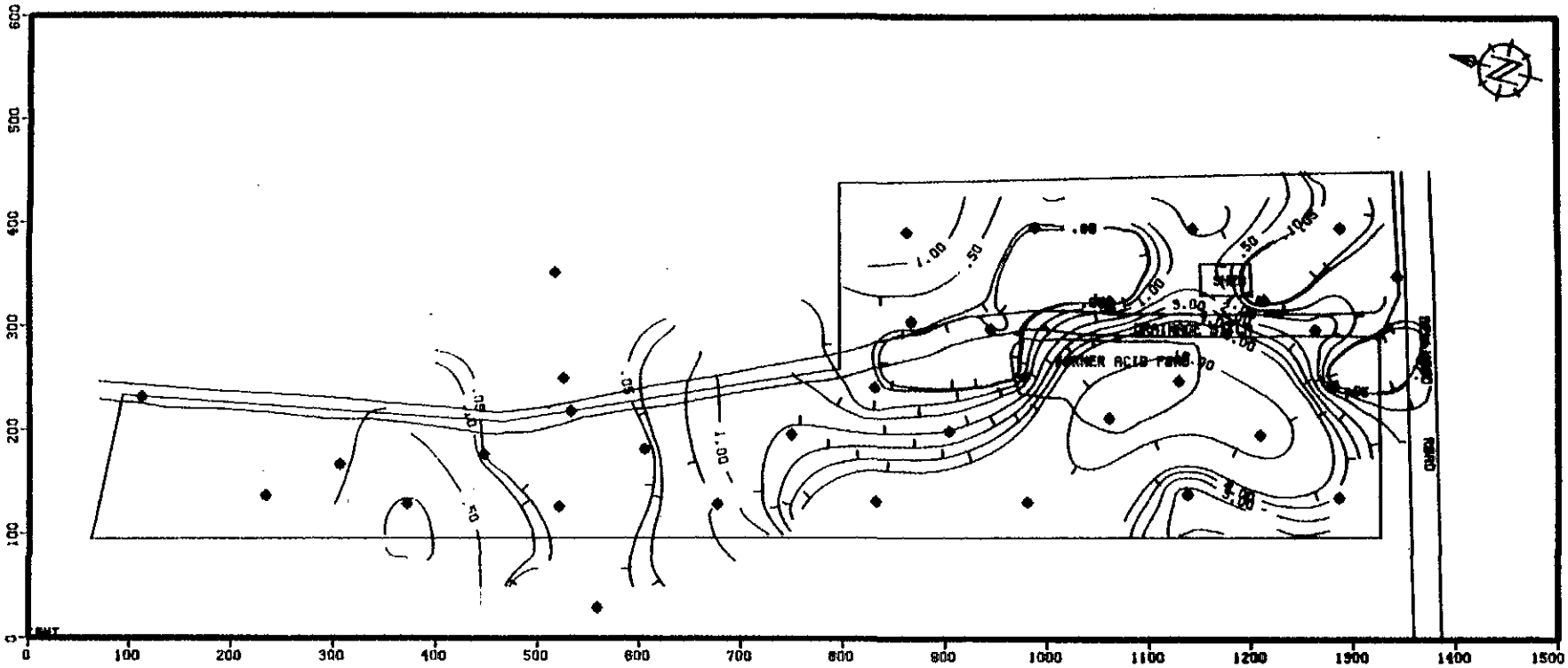
Concentration Isopleth Contouring

Concentration Isopleth Contours - Unkrigged

Software used: CPS-PC, Radian Corp.

List of elements mapped:
Lead

ISOPLETH MAPS FOLLOW THIS SHEET



LEGEND

S SURFACE ØR BØRE HØLE SØIL SAMPLES

SD SEDIMENT SAMPLE

LEAD ISØPLETH MAP - SURFACE ELEVATIØN
C AND R BATTERY SITE, CHESTERFIELD CØ., VA

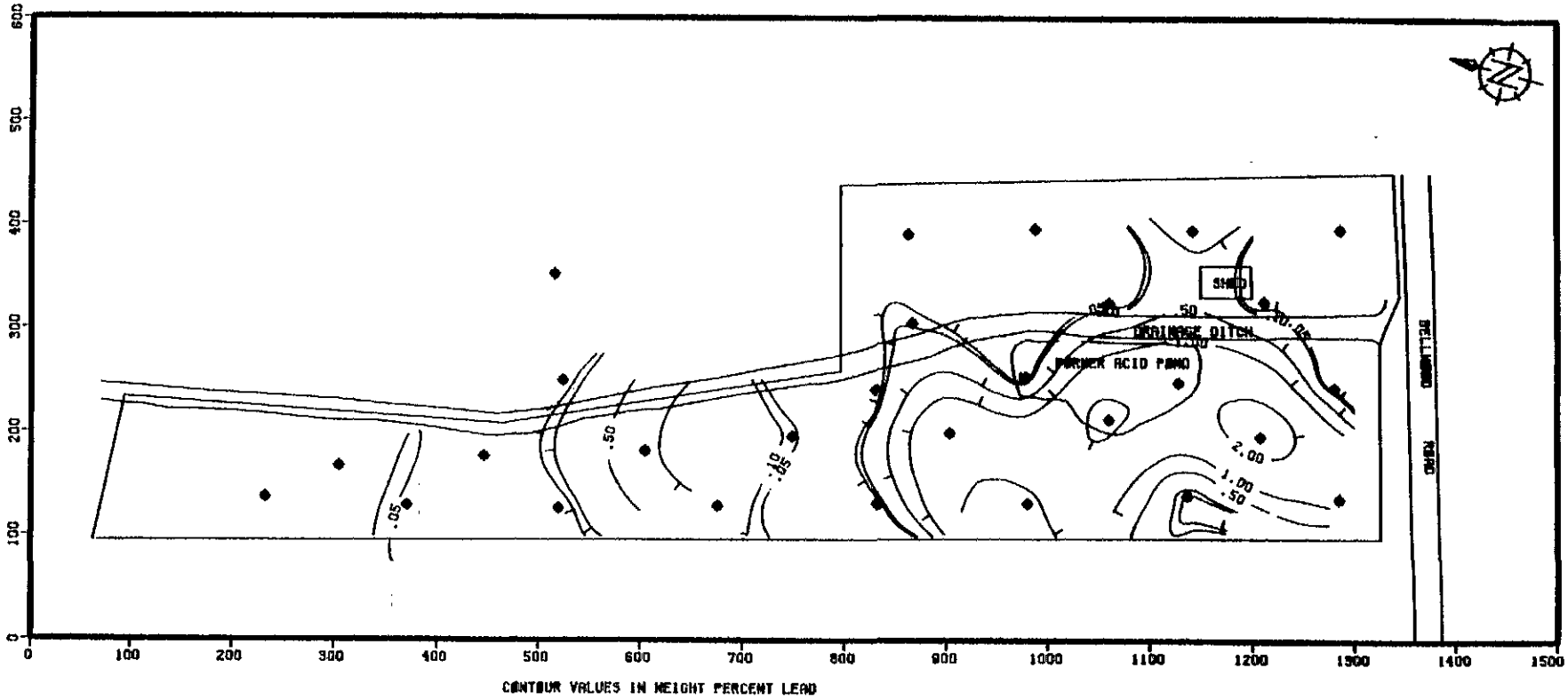
0 100 200

SCALE IN FEET

LØCKHEED ESC
R. EMMALL/B. CØLE

AR301806

AR301806



CONTOUR VALUES IN WEIGHT PERCENT LEAD

LEGEND

S SURFACE OR BORE HOLE SOIL SAMPLES

SD SEDIMENT SAMPLE

LEAD ISOPLETH MAP - 3 FOOT DEPTH
C AND R BATTERY SITE, CHESTERFIELD CO., VA

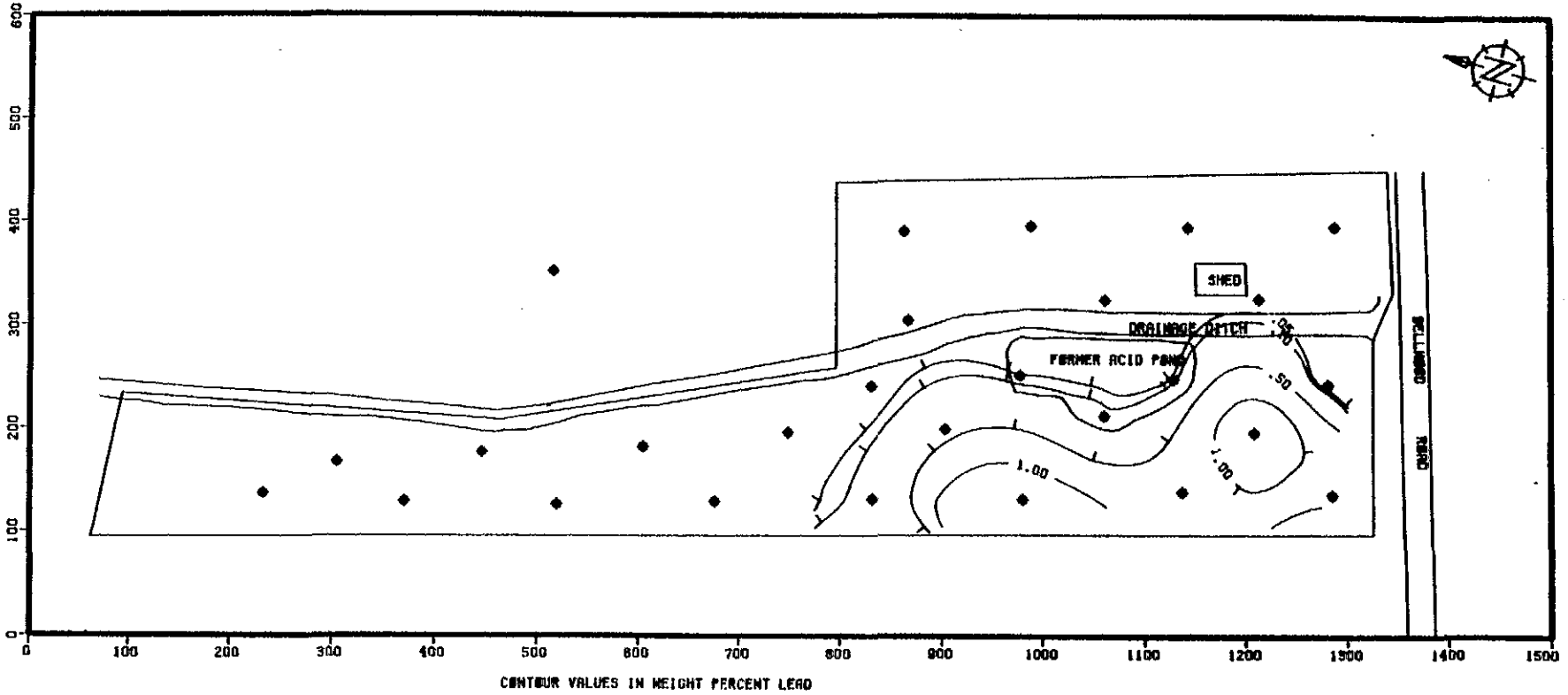
0 100 200

SCALE IN FEET

LOCKHEED ESC
R. EMMALL/B. COLE

AR301807

*



LEGEND

S SURFACE OR BORE HOLE SOIL SAMPLES

SD SEDIMENT SAMPLE

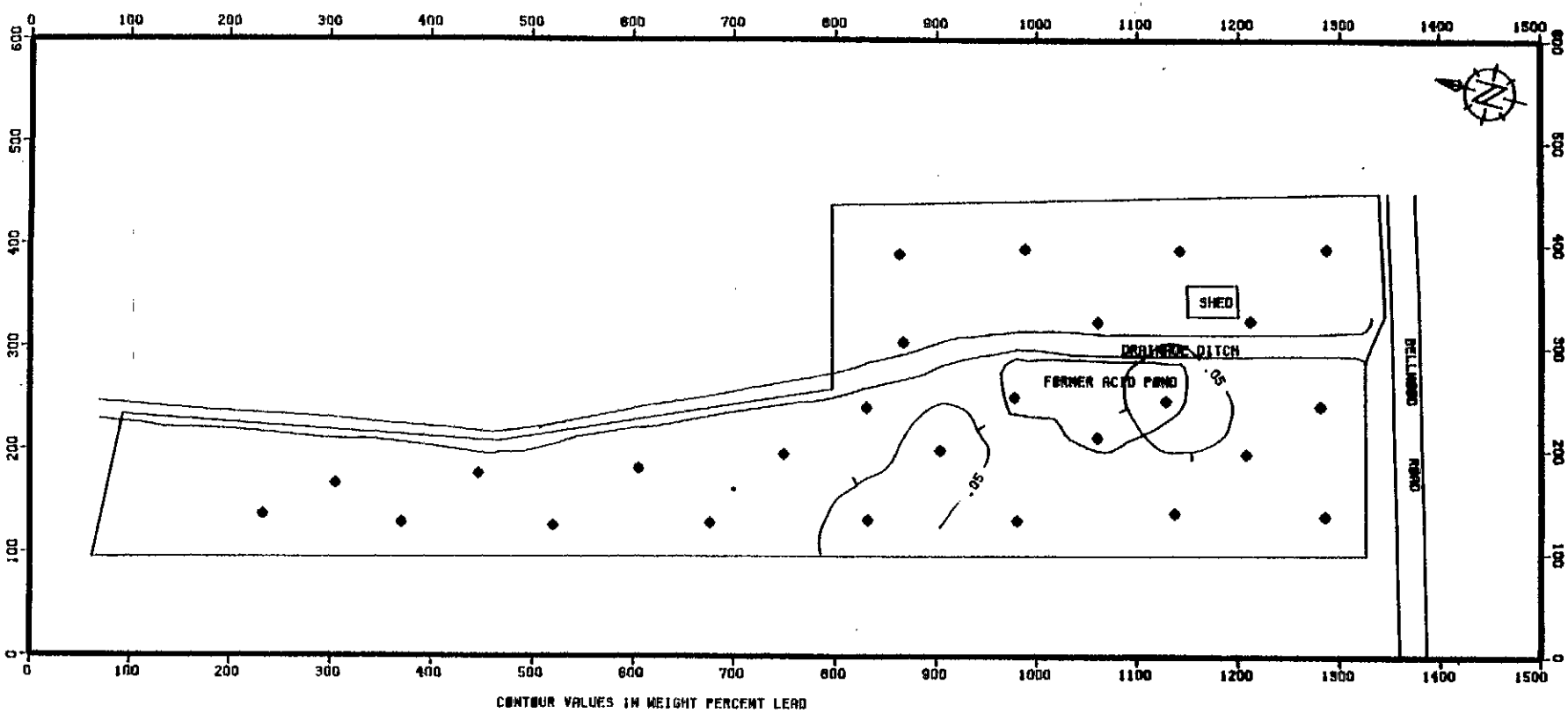
LEAD ISØPLETH MAP - 6 FØØT DEPTH
C AND R BATTERY SITE, CHESTERFIELD CØ., VA

0 100 200

SCALE IN FEET

LØCKHEED ESC
R. EMHALL/B. COLE

AR301808 *



CONTOUR VALUES IN WEIGHT PERCENT LEAD

LEGEND

S SURFACE OR BORE HOLE SOIL SAMPLES

SD SEDIMENT SAMPLE

LEAD ISOPLETH MAP - 9 FOOT DEPTH
C AND R BATTERY SITE, CHESTERFIELD CO., VA

0 100 200

SCALE IN FEET

LOCKHEED ESC
R. ENNALL/B. LOLE

AR301809

APPENDIX D-2

XRF FIELD DATA OF SURFACE SOIL

NUS CORPORATION AND SUBSIDIARIES — STANDARD CALCULATION SHEET

CLIENT: EPA: C+R BATTERY	FILE NO.: 9851	BY: R. Bethel	PAGE OF
SUBJECT: FIELD XRF MEAS. FOR LEAD CONC. IN SURFACE SOIL		CHECKED BY:	DATE: 2-16-89

LOCATION COORDINATE/ DESCRIPTION	LEAD CONCENTRATION VALUES IN % WEIGHT (BELOW GROUND SURFACE) SURFACE	2"	3"	COMMENTS
0'N 0'E	0.135, 0.190, 0.192 } 0.172	0.229		Coordinates from SE corner of fence.
0'N 50'E	0.329	0.407		
100'N 25'E	0.565, 0.571 } 0.568		0.000	
Ground floor of shed	1.080			Center of shed
200'N 0'E	1.093	1.196	0.778 (4")	Battery casing fragments observed.
200'N 50'E	0.411	0.136		
300'N 25'E	0.388	0.334		
400'N 0'E	0.550		1.133	Battery casing fragments observed
400'N 40'E	0.481		0.068	
500'N 25'E	0.017			Center of road
600'N + center of embankment	0.028		0.072	Center of embankment
600'N, 50E of last sply. pt.	0.089	0.003		
700'N + center of embankment	0.048	0.079		Battery casing fragments observed
700'N, 50'E of last sply. pt	0.018	0.000		
800'N + center of Bonded Rd.	0.000			Near MW03-1
800'N + 50'E of last sply. pt.	.042, .149, .158 } 0.116		0.000	Line 800N was S. bound of E. wood lot
900'N + on cut road	0.058	0.000		
900'N + 50E, of last spl. pt.	.055, .063, .082 } 0.0669		0.000	
1000'N + Center of road	0.000			
1000'N + 50'E of last spl.	.184, .042, 0.000 } 0.075		0.013, 0.000 } 0.006	
1100'N + Edge of road	0.178		0.000	
1100'N + 50'E of last spl. pt.	0.050, 0.000, 0.000 } 0.017	0.024	0.000	

AR301811

NUS 155A REVISED 0285

NUS CORPORATION AND SUBSIDIARIES — **STANDARD CALCULATION SHEET**

CLIENT:	FILE NO.:	BY:	PAGE OF
EPA: C+R BATT.	9851	RDB	
SUBJECT: FIELD XRF MEASUREMENTS FOR Pb CONC. IN SURF. SOIL		CHECKED BY:	DATE: 7-16-89

LOCATION COORDINATE	SURFACE LEAD CONC. (XRF)				COMMENTS
	1"	2"	3"	AVERAGE	
0'N/0'W	0.354	0.357		0.356	Coordinates reference from SW fence corner
0'N / 50'W	2.308			2.308	
0'N / 100'W	1.168			1.168	
100'N / 25'W	1.022			1.022	
100'N / 75'W	1.654			1.654	
200'N / 0'W	4.250			4.250	
200'N / 50'W	0.171			0.171	
4000 STANDARD	0.437			0.437	
300'N / 25'W	4.423			4.423	
300'N / 75'W	0.0			0.000	
400'N / 0'W	0.233			0.233	
400'N / 50'W	1.007	0.789		0.898	
500'N / 25'W	0.404			0.404	
500'N / 75'W	0.078			0.078	
600'N / 0'W	2.386	1.984		2.185	
8000 STANDARD	.842			0.842	
0 "	.000			0.000	
600'N / 50'W	0.257			0.257	
700'N / 25'W	0.024			0.024	
700'N / 75'W	0.041			0.041	
800'N / 0'W	0.827			0.827	
800'N / 50'W	0.189			0.189	
900'N / 25'W	0.276			0.276	
900'N / 75'W	0.000			0.000	
4000 STANDARD	0.414			0.414	
0 STANDARD	.005	.019	.000	0.008	
1000'N / 0'W	1.845			1.845	
1000'N / 50'W	.000			0.000	
1100'N / 25'W	0.087			0.087	
1100'N / 75'W	.000			0.000	

LEAD

ALL CONCENTRATION VALUES ARE EXPRESSED IN % WEIGHT

AR301812

NUS 155A REVISED 0285

NUS CORPORATION AND SUBSIDIARIES — STANDARD CALCULATION SHEET

CLIENT:	FILE NO.:	BY:	PAGE OF
EPA : C+R BATT.	9851	RDB	
SUBJECT: FIELD XRF MEASUREMENTS FOR Pb CONC. IN SURFACE SOIL		CHECKED BY:	DATE: 2-16-89

LOCATION COORDINATE	SURFACE LEAD CONC. (XRF) 2"	3"	4"	Comments
0'N / 0'W				
0'N / 50'W			0.751	Coordinates referenced to
0'N / 100'W			0.088	SW corner of fence
100'N / 25'W			0.261	
100'N / 75'W			0.057	
200'N / 0'W			0.477	
200'N / 50'W	0.000			
4000 STANDARD	0.437			
300'N / 25'W		0.000		
300'N / 75'W				
400'N / 0'W		0.303		
400'N / 50'W	0.004			
500'N / 25'W			0.013	
500'N / 75'W	0.000			
600'N / 0'W	1.459			Discovered buried battery fragments; trimmed path thru fence
8000 STANDARD	0.842			
0 STANDARD	0.000			
600'N / 50'W	0.000			
700'N / 25'W			0.000	
700'N / 75'W		0.005		
800'N / 0'W	0.113			
800'N / 50'W		0.000		
900'N / 25'W	0.008/0.031			Average: 0.020
900'N / 75'W				
4000 STANDARD	0.414			
0 STANDARD	.005/.019/.000			
1000'N / 0'W		0.174		
1000'N / 50'W				
1100'N / 25'W		.000		
1100'N / 75'W				

AR301813

APPENDIX D-3

XRF FIELD DATA OF SUBSURFACE SOIL FROM TEST PITS

NUS CORPORATION AND SUBSIDIARIES — STANDARD CALCULATION SHEET

CLIENT: EPA: C+R BATTERY	FILE NO.: 9851	BY: RDB	PAGE OF
SUBJECT: FIELD XRF MEASUREMENTS FOR Pb IN SOIL conc.*		CHECKED BY:	DATE: 2-16-89

	LOCATION COORDINATE	LEAD CONC. AT 1 FOOT DEPTH (XRF) 1	2	3	AVERAGE	COMMENTS
P-1	0'N / 25'E	0.706	0.710		0.708	Coordinates Referenced to SW corner of fence
P-2	0'N / 75'E	1.025	1.203	1.205	1.144	
P-3	0'N / 125'E	1.821	1.793	1.802	1.805	
P-4	100'N / 0'E	0.387	0.405	0.375	0.389	
P-5	100'N / 50'E	2.296	2.297	2.312	2.302	
P-6	100'N / 100'E	1.405	1.375	1.340	1.373	
P-7	200'N / 25'E	0.228	0.331	0.327	0.295	
P-8	200'N / 75'E	1.076	1.117	1.106	1.100	
	200'N / 125'E				—	could not penetrate below concrete pad
	300'N / 0'E				—	Did not excavate; back hoe missed
	300'N / 50'E				—	Could not penetrate below concrete pad
	300'N / 100'E				—	"
P-9	300'N / 150'E	3.078	3.059	3.097	3.078	
P-10	400'N / 25'E	0.526	0.611	0.536	0.558	
P-11	400'N / 75'E	1.685	1.624	1.591	1.633	
P-12	400'N / 125'E	3.296	2.281	2.154	2.577	
P-13	500'N / 0'E	1.211	1.198	1.193	1.201	
P-14	500'N / 50'E	0.684	0.646	0.568	0.633	
P-15	500'N / 100'E	0.365	0.400	1.056	0.607	
P-16	600'N / 25'E	0.057	0.007	0.008	0.024	
P-17	600'N / 75'E	2.740	2.855	2.887	2.827	
P-18	700'N / 0'E	0.161	0.159	0.128	0.149	
P-19	700'N / 50'E	1.036	1.013	1.009	1.019	
P-20	800'N / 25'E	0.000	0.000	0.000	0.000	
P-21	800'N / 75'E	0.346	0.319	0.303	0.323	
P-22	900'N / 0'E	3.401	3.599	3.606	3.353	
P-23	900'N / 50'E	1.681	1.679	1.722	1.694	
P-24	1000'N / 25'E	0.280	0.262	0.259	0.267	
P-25	1000'N / 75'E	1.774	1.808	1.778	1.787	
P-26	1100'N / 0'E	0.000	0.000	0.000	0.000	
P-27	1100'N / 50'E	1.177	1.283	1.180	1.213	

*LEAD

NUS 155A REVISED 0285 ALL CONC. VALUES ARE EXPRESSED IN % WEIGHT

NUS CORPORATION AND SUBSIDIARIES — **STANDARD CALCULATION SHEET**

CLIENT: EPA: C+R BATTERY	FILE NO.: 9851	BY: RDR	PAGE OF
SUBJECT: FIELD XRF MEASUREMENTS FOR PB CONC. IN SOIL	CHECKED BY:		DATE: 2-16-89

	LOCATION COORDINATE	LEAD CONC. AT 2 FOOT DEPTH (XRF) 1	2	3	Average	Comments
P-1	0'N / 25'E	0.451	0.522	0.520	0.498	Coordinates Referenced to SW corner of fence.
P-2	0'N / 75'E	0.000	0.004	0.000	0.001	
P-3	0'N / 125'E	0.000	0.000	0.000	0.000	
P-4	100'N / 0'E	0.430	0.331	0.318	0.360	
P-5	100'N / 50'E	0.018	0.048	0.064	0.043	
P-6	100'N / 100'E	1.637	1.670	—	1.654	
P-7	200'N / 25'E	0.413	0.449	0.457	0.440	
P-8	200'N / 75'E	2.699	2.685	2.707	2.697	
	200'N / 125'E	--			—	concrete pad
	300'N / 0'E				—	" "
	300'N / 50'E				—	" "
	300'N / 100'E				—	" "
	300'N / 150'E				—	" "
P-10	400'N / 25'E	0.343	0.385	0.364	0.364	
P-11	400'N / 75'E	0.658	0.568	0.545	0.590	
P-12	400'N / 125'E	1.925	1.695	1.620	1.747	
P-13	500'N / 0'E	0.000	0.000	0.000	0.000	
P-14	500'N / 50'E	0.086	0.142	0.062	0.097	
P-15	500'N / 100'E	2.910	2.978	3.013	2.967	
P-16	600'N / 25'E	0.079	0.095	0.113	0.096	
P-17	600'N / 75'E	0.087	0.102	0.097	0.095	
P-18	700'N / 0'E	0.000	0.000	0.000	0.000	
P-19	700'N / 50'E	0.676	0.640	0.595	0.637	
P-20	800'N / 25'E	0.000	0.000	0.004	0.001	
P-21	800'N / 75'E	0.000	0.000	0.000	0.000	
P-22	900'N / 0'E	0.000	0.000	0.000	0.000	
P-23	900'N / 50'E	0.000	0.000	0.000	0.000	
P-24	1000'N / 25'E	0.003	0.003	0.031	0.012	
P-25	1000'N / 75'E	0.879	0.795	0.804	0.826	
P-26	1100'N / 0'E	0.000	0.000	0.000	0.000	
P-27	1100'N / 50'E	0.000	0.000	0.000	0.000	

AR301816

NUS CORPORATION AND SUBSIDIARIES — **STANDARD CALCULATION SHEET**

CLIENT: EPA: C+R BATTERY	FILE NO.: 9851	BY: RDR	PAGE OF
SUBJECT: FIELD XRF MEASUREMENTS FOR PB CONC. IN SOIL		CHECKED BY:	DATE: 2-16-89

	LOCATION COORDINATE	LEAD CONC. AT 3 FOOT DEPTH (XRF) 1	2	3	Average	Comments
P-1	0'N / 25'E	0.000	0.000	0.000	0.000	Coordinates Referenced to
P-2	0'N / 75'E	0.000	0.021	0.000	0.007	SW corner of fence
P-3	0'N / 125'E	0.000	0.000	0.000	0.000	
P-4	100'N / 0'E	0.000	0.000	0.000	0.000	
P-5	100'N / 50'E	0.004	0.005	0.006	0.005	
P-6	100'N / 100'E	0.392	0.354	0.385	0.377	
P-7	200'N / 25'E	—	—	—	—	
P-8	200'N / 75'E	0.658	0.989	1.085	0.911	
	200'N / 125'E	—			—	concrete pad
	300'N / 0'E				—	" "
	300'N / 50'E				—	" "
	300'N / 100'E				—	" "
P-9	300'N / 150'E				—	" "
P-10	400'N / 25'E	0.062	0.039	0.034	0.045	
P-11	400'N / 75'E	0.000	0.000	0.000	0.000	
P-12	400'N / 125'E	0.000	0.000	0.000	0.000	
P-13	500'N / 0'E	0.014	0.027	0.000	0.014	
P-14	500'N / 50'E	0.434	0.411	0.379	0.408	
P-15	500'N / 100'E	0.834	0.843	0.829	0.835	
P-16	600'N / 25'E	0.067	0.114	0.084	0.088	
P-17	600'N / 75'E	0.050	0.000	0.000	0.017	
P-18	700'N / 0'E	0.009	0.063	0.066	0.046	
P-19	700'N / 50'E	0.043	0.044	0.064	0.050	
P-20	800'N / 25'E	0.001	0.009	0.020	0.010	
P-21	900'N / 75'E	0.000	0.000	0.000	0.000	
P-22	900'N / 0'E	0.010	0.000	0.000	0.003	
P-23	900'N / 50'E	0.000	0.000	0.000	0.000	
P-24	1000'N / 25'E	0.000	0.000	0.000	0.000	
P-25	1000'N / 75'E	0.015	0.000	0.000	0.005	
P-26	1100'N / 0'E				—	
P-27	1100'N / 50'E	0.000	0.000	0.000	0.000	
	0 STANDARD	0.000	0.000	—	0.000	
	400 "	0.047	0.042	0.021	0.037	
	4000 "	0.340	0.404	0.356	0.367	

AR301817

NUS 155A REVISED 0285

ALL LEAD CONCENTRATION VALUES ARE EXPRESSED IN % WEIGHT

APPENDIX D-4

XRF FIELD DATA OF SEDIMENT

NUS CORPORATION AND SUBSIDIARIES — STANDARD CALCULATION SHEET

CLIENT: EPA: C+R BATTERY	FILE NO.: 9851	BY: RDB	PAGE OF
SUBJECT: FIELD XRF MEAS. FOR LEAD CONC. IN SED.		CHECKED BY:	DATE: 2-16-89

	LOCATION COORDINATE / LOCATION DESCRIPTION	DEPTH BELOW SURFACE IN INCHES	LEAD CONCENTRATION VALUES IN % WEIGHT 1	2	3	AVERAGE	COMMENTS
F-1	STARTING POINT @ SD02-01	SURFACE	1.372	—	—	1.372	Coordinates reference from S. fence line along the drainage ditch
		2"	0.470	—	—	0.470	
		6"	0.163	—	—	0.163	
		12"	0.036	—	—	0.036	
F-2	+50'	SURFACE	0.146	—	—	0.146	
		6"	0.000	0.010	0.000	0.003	
F-3	1+00	SURFACE	0.000	0.000	—	0.000	
F-4	1+50'	SURFACE	0.201	—	—	0.201	
		4"	0.004	0.018	0.013	0.012	
		6"	0.023	0.008	0.000	0.010	
F-5	2+00	SURFACE	0.076	0.159	0.128	0.121	
		4"	0.000	0.042	0.000	0.014	
F-6	2+50	SURFACE	0.000	0.054	0.012	0.022	
		4"	0.029	0.055	0.034	0.039	
		5"	0.000	0.000	0.000	0.000	
F-7	3+00	SURFACE	0.029	0.060	0.057	0.049	
		6"	0.010	0.000	0.000	0.003	
F-8	3+50	SURFACE	0.136	0.096	0.157	0.130	
		6"	0.000	0.013	0.000	0.004	
		3"	0.019	0.002	0.030	0.017	
	0 STANDARD		0.000	0.000	0.012	0.004	
X	400 ppm		0.029	0.000	0.049	0.026	
	4000 "		0.393	0.411	0.365	0.390	
F-9	4+00 NEXT TO SD03-01	SURFACE	0.204	0.166	0.171	0.180	
		3"	0.039	0.000	0.000	0.013	
		4"	0.000	0.000	0.000	0.000	
F-10	4+55' @ fence intersection	surface on slope of ditch	0.000	0.000	0.000	0.000	
		surface in ditch	0.304	0.315	0.261	0.293	
		6"	0.066	0.121	0.066	0.084	
		12"	0.000	0.000	0.000	0.000	
F-11	5+00' inbound	surface along ditch slope	0.000	0.000	0.000	0.000	
		ditch surface	0.183	0.234	0.182	0.200	
		6"	0.325	0.285	0.265	0.292	
		8"	0.000	0.000	0.000	0.000	

NUS CORPORATION AND SUBSIDIARIES — STANDARD CALCULATION SHEET

CLIENT: EPA : GR BATTERY	FILE NO.: 9851	BY: RDB	PAGE OF
SUBJECT: FIELD XRF MEAS. FOR LEAD CONC. IN SED.		CHECKED BY:	DATE:

	LOCATION COORDINATE/ DESCRIPTION	DEPTH BELOW SURFACE IN INCHES	LEAD CONCENTRATION, VALUES IN % WEIGHT 1	2	3	AVERAGE	COMMENTS
F-12	5+50	SURFACE	0.159	0.122	0.103	0.128	coordinates referenced all staked line along drainage ditch
		6"	0.202	0.208	0.192	0.201	
		12"	0.000	0.007	0.016	0.008	CANNOT GO DEEPER DUE TO WATER
F-13	6+00	DITCH SURFACE	0.246	0.260	0.260	0.255	" " "
		SLOPE SURFACE	0.027	0.015	0.028	0.023	
		4"	0.012	0.030	0.014	0.019	
		12"	0.000	0.000	0.000	0.000	
F-14	6+50 (SOUTH OF RIP RAP DAM)	SURFACE	0.268	0.227	0.224	0.240	
		6"	0.240	0.242	0.192	0.225	
		12"	0.000	0.030	0.027	0.019	WATER SATURATED BELOW 12"
F-15	7+00	DITCH SURFACE	0.002	0.000	0.000	0.001	
F-16	7+50	DITCH SURFACE	0.032	0.067	0.048	0.049	
		12"	0.039	0.066	0.064	0.056	
		13"	0.000	0.000	0.022	0.007	
F-17	8+00	SURFACE	0.127	0.115	0.149	0.130	
		8"	0.000	0.000	0.000	0.000	
	0 STANDARD		0.000	0.000	0.007	0.002	
X	400 "		0.020 0.041	0.000, 0.028	0.019, 0.017	0.021	
	8000 "		0.857	0.842	0.829	0.843	
F-18	8+50	SURFACE	0.011	0.000	0.012	0.008	
F-19	9+00	SURFACE	0.000	0.000	0.000	0.000	
F-20	9+50	SURFACE	0.050	0.063	0.050	0.054	
		4"	0.000	0.000	0.000	0.000	
F-21	10+00	SURFACE	0.000	0.026	0.013	0.013	WATER SATURATED BELOW SURFACE
F-22	10+50	—	—	—	—	—	STANDING WATER
F-23	11+00	SURFACE	0.000	0.000	0.000	0.000	
F-24	11+50	"	0.000	0.000	0.000	0.000	
F-25	12+00	"	0.003	0.000	0.002	0.002	
	8000 STANDARD	0.801/ 0.807	0.812/ 0.811	0.807/ 0.821	0.858	0.825	
	400		0.027/ 0.075	0.068	0.049/ 0.046	0.264	
	0		0.000	0.000	0.000	0.000	

AR301820

NUS 155A REVISED 0285

APPENDIX D-5

LINEAR CORRELATION FOR LEAD CONCENTRATION IN SOIL: XRF DATA VS. CLP DATA

Soil Boring Without any XRF <120

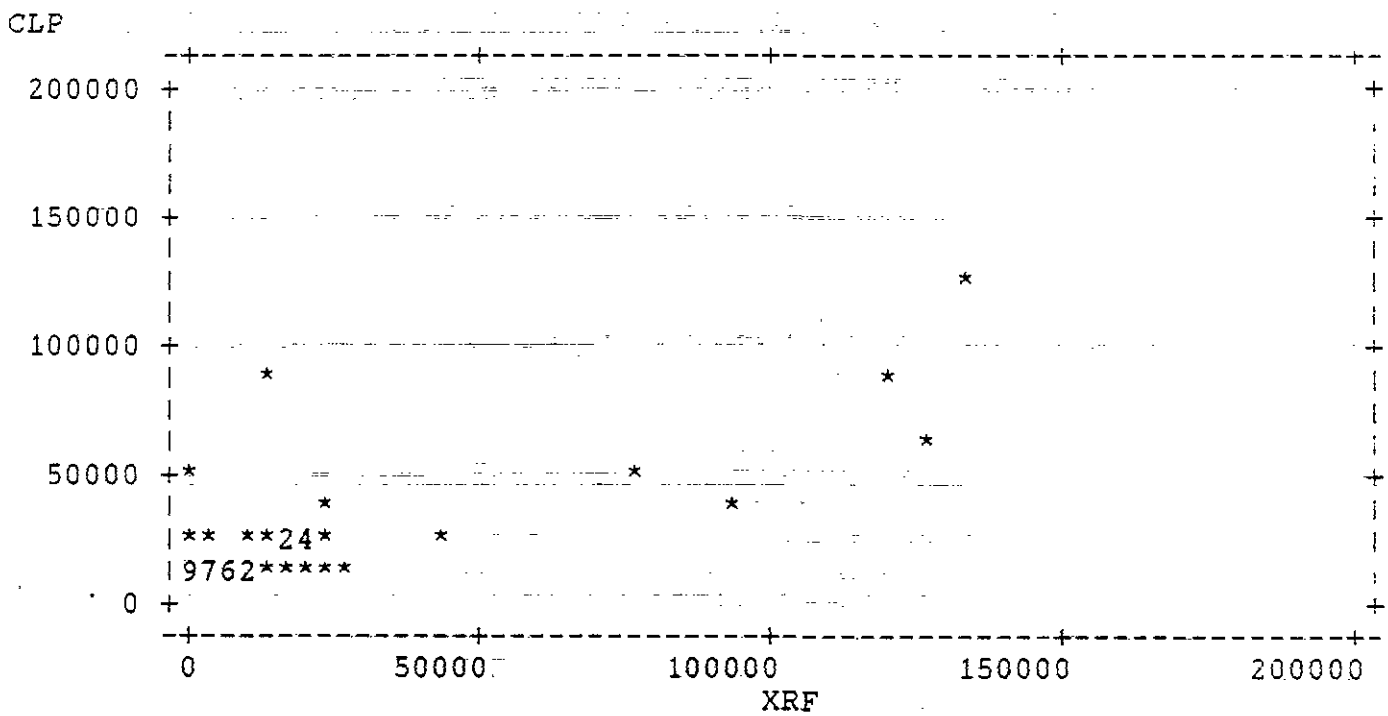
TOTAL OBSERVATIONS: 119

	CLP	XRF	DIFF
N OF CASES	[redacted]	[redacted]	77
MINIMUM	43.600	60.000	-76900.000
MAXIMUM	122000.000	134500.000	65720.000
MEAN	10663.735	12951.429	-2287.694
STANDARD DEV	20334.061	27752.453	16500.974

EARSON CORRELATION MATRIX

	CLP	XRF	DIFF
CLP	1.000		
XRF	[redacted]	1.000	
DIFF	-0.126	=0.687	1.000

NUMBER OF OBSERVATIONS: 77



42 CASES WITH MISSING VALUES EXCLUDED FROM PLOT

42 CASES DELETED DUE TO MISSING DATA.

DEP VAR: CLP N: 77 MULTIPLE R: .808 SQUARED MULTIPLE R: .652
ADJUSTED SQUARED MULTIPLE R: .647 STANDARD ERROR OF ESTIMATE: 12073.763

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	[redacted]	1520.174	0.000	.	1.974	0.052
XRF	[redacted]	0.050	0.808	.100E+01	11.856	0.000

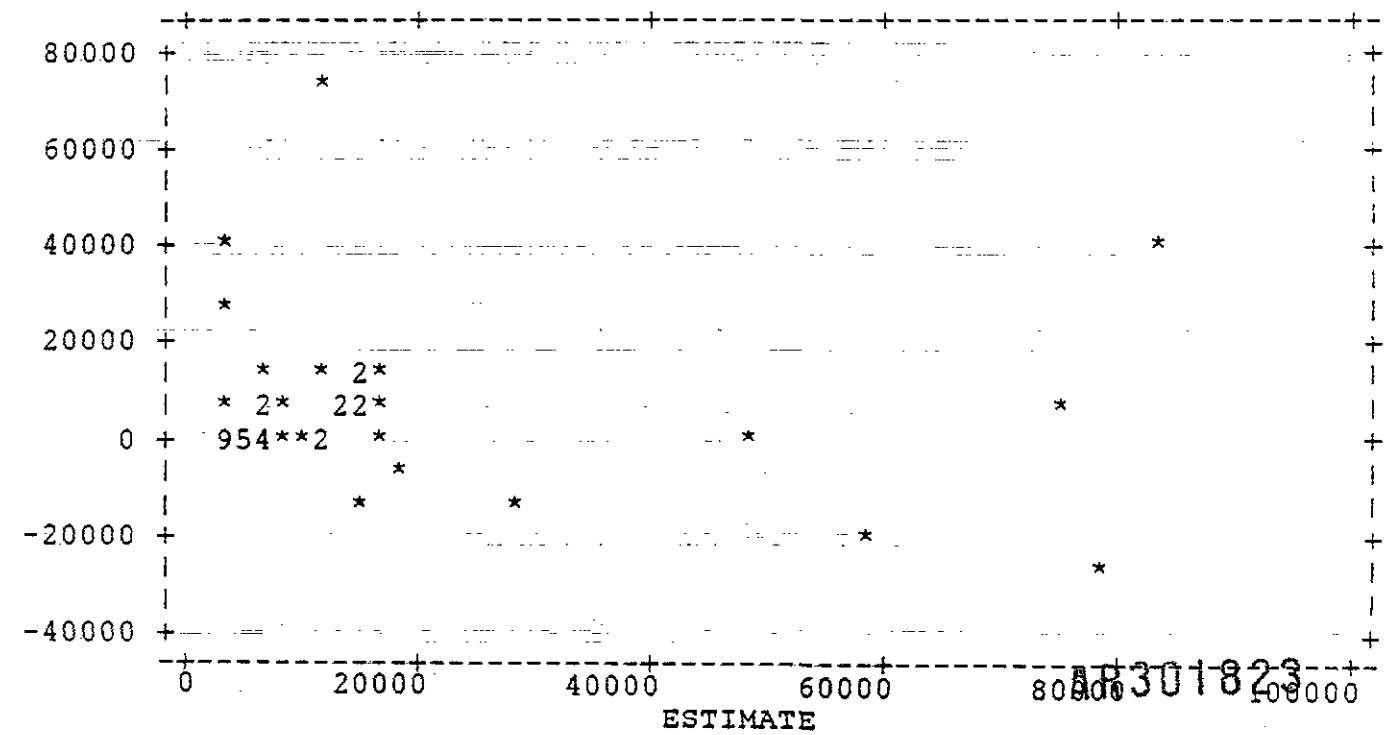
ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	.204908E+11	1	.204908E+11	140.564	0.000
RESIDUAL	.109332E+11	75	.145776E+09		

WARNING: CASE 29 HAS UNDUE INFLUENCE (LEVERAGE = .082)
WARNING: CASE 41 HAS UNDUE INFLUENCE (LEVERAGE = .120)
WARNING: CASE 52 HAS UNDUE INFLUENCE (LEVERAGE = .236)
WARNING: CASE 59 HAS UNDUE INFLUENCE (LEVERAGE = .265)
WARNING: [redacted] (STUDENTIZED RESIDUAL = 4.213)
WARNING: CASE 68 HAS UNDUE INFLUENCE (LEVERAGE = .210)
WARNING: [redacted] (STUDENTIZED RESIDUAL = 7.508)
WARNING: [redacted] (STUDENTIZED RESIDUAL = 3.374)

DURBIN-WATSON D STATISTIC 2.113
FIRST ORDER AUTOCORRELATION -.057

RESIDUALS HAVE BEEN SAVED
RESIDUAL



Removed 3 outliers

TOTAL OBSERVATIONS: 119

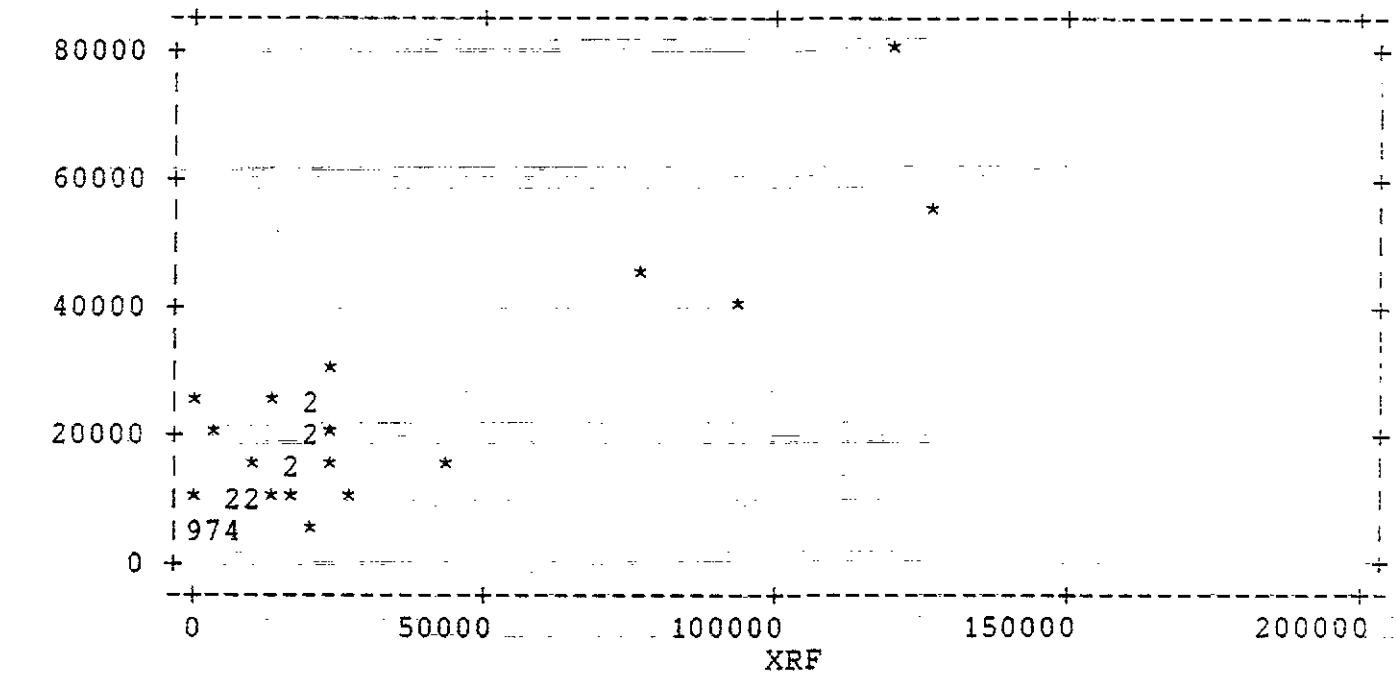
	CLP	XRF	DIFF
N OF CASES	74	[redacted]	74
MINIMUM	43.600	60.000	-76900.000
MAXIMUM	75100.000	127100.000	22960.000
MEAN	7814.968	11462.162	-3647.195
STANDARD DEV	13220.121	24397.020	13845.941

EARSON CORRELATION MATRIX

	CLP	XRF	DIFF
CLP	1.000		
XRF	[redacted]	1.000	
DIFF	-0.625	-0.906	1.000

NUMBER OF OBSERVATIONS: 74

CLP = 2246.981 + 0.486 * XRF



45 CASES WITH MISSING VALUES EXCLUDED FROM PLOT

45 CASES DELETED DUE TO MISSING DATA.

DEP VAR: CLP N: 74 MULTIPLE R: .896 SQUARED MULTIPLE R: .804
ADJUSTED SQUARED MULTIPLE R: .801 STANDARD ERROR OF ESTIMATE: 5898.585

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	[redacted]	758.541	0.000	.	2.962	0.004
XRF	[redacted]	0.028	0.896	.100E+01	17.167	0.000

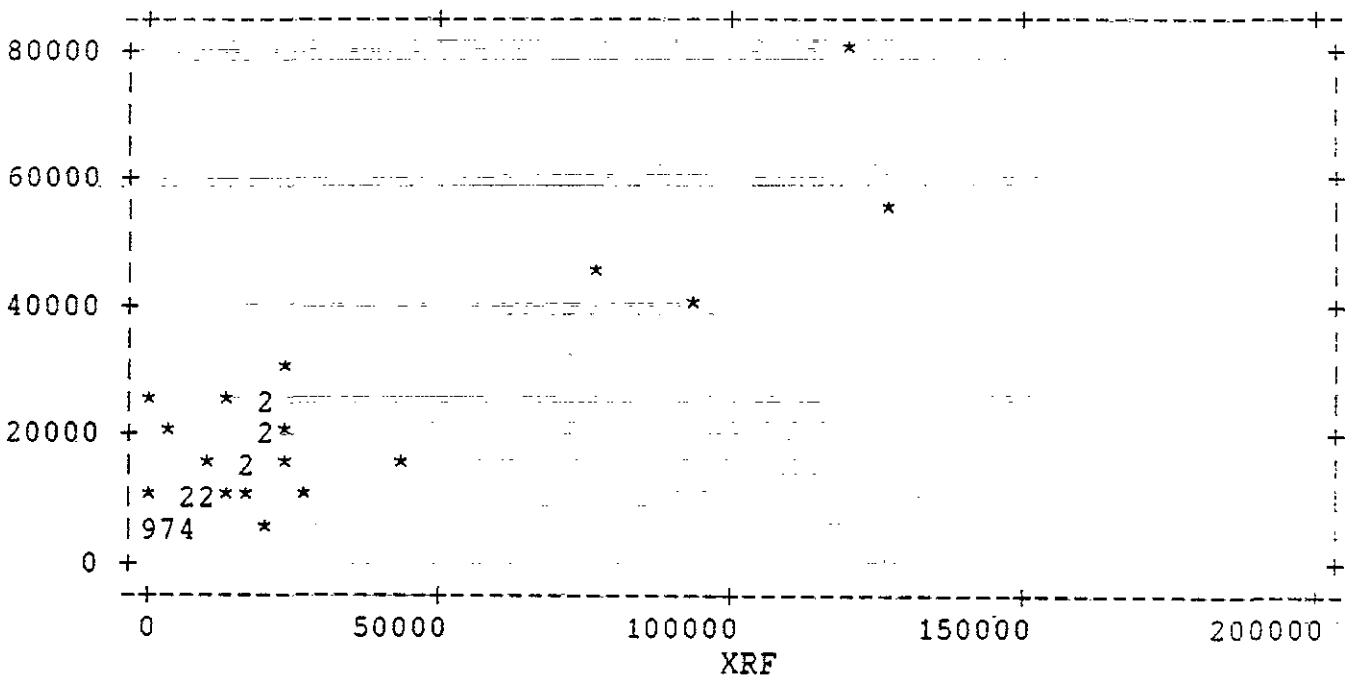
ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	.102532E+11	1	.102532E+11	294.689	0.000
RESIDUAL	.250512E+10	72	.347933E+08		

WARNING: CASE 29 HAS UNDUE INFLUENCE (LEVERAGE = .111)
WARNING: CASE 41 HAS UNDUE INFLUENCE (LEVERAGE = .164)
WARNING: CASE 52 HAS UNDUE INFLUENCE (LEVERAGE = .321)
WARNING: CASE 68 HAS UNDUE INFLUENCE (LEVERAGE = .287)
WARNING: CASE 68 IS AN OUTLIER (STUDENTIZED RESIDUAL = 3.045)
WARNING: CASE 79 IS AN OUTLIER (STUDENTIZED RESIDUAL = 3.943)

DURBIN-WATSON D STATISTIC 2.008
FIRST ORDER AUTOCORRELATION -.006

RESIDUALS HAVE BEEN SAVED



45 CASES WITH MISSING VALUES EXCLUDED FROM PLOT

APPENDIX D-6

LINEAR CORRELATION BETWEEN CLP LEAD CONCENTRATION AND EP TOXICITY FOR SOIL

Soil Data <Without SO-13-02>

MYSTAT Editor

Case	SAMPLEID$	PB	EPTOX
1	SO-05-02	320.000	4.900
2	SO-05-35	7200.000	.050
3	SO-13-02	.	.
4	SO-17-02	17400.000	5.600
5	SO-17-35	43.000	.900
6	SO-22-35	3700.000	25.400
7	SO-22-68	26.000	.050
8	SO-25-02	2620.000	19.700
9	SO-25-35	4220.000	5.800
10			
11			
12			
13			
14			
15			

>

TOTAL OBSERVATIONS: 9

	PB	EPTOX
N OF CASES	8	8
MINIMUM	26.000	0.050
MAXIMUM	17400.000	25.400
MEAN	4441.125	7.800
STANDARD DEV	5797.524	9.535

EARSON CORRELATION MATRIX

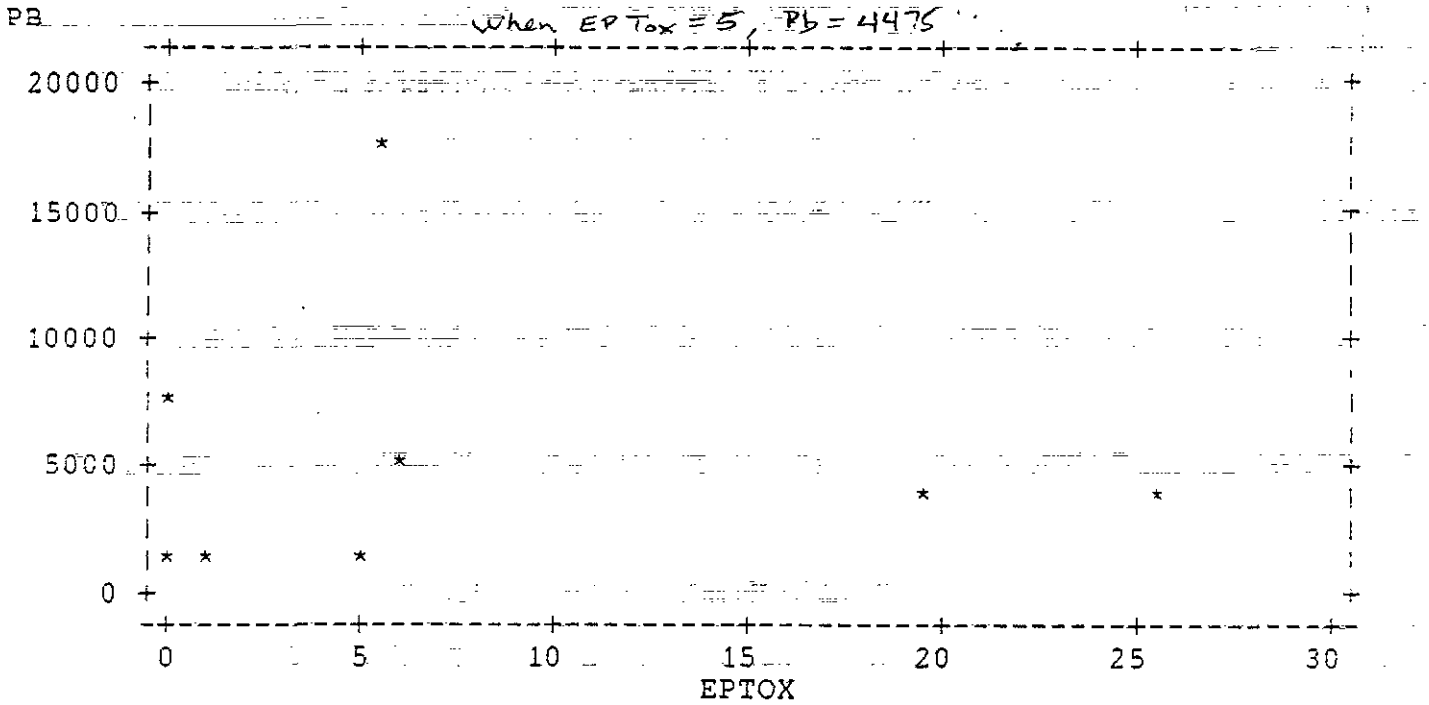
	PB	EPTOX
PB	1.000	
EPTOX	[redacted]	1.000

NUMBER OF OBSERVATIONS: 8

AR301827

PB = 4534.271 − 12.019 * EPTox

When EPTox = 5, PB = 4475



1 CASES WITH MISSING VALUES EXCLUDED FROM PLOT

1 CASES DELETED DUE TO MISSING DATA.

DEP VAR: PB N: 8 MULTIPLE R: .020 SQUARED MULTIPLE R: .000
ADJUSTED SQUARED MULTIPLE R: .000 STANDARD ERROR OF ESTIMATE: 6260.813

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	[redacted]	2940.633	0.000	.	1.542	0.174
EPTOX	-12.019	248.188	-0.020	.100E+01	-0.048	0.963

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	91921.904	1	91921.904	0.002	0.963
RESIDUAL	.235187E+09	6	.391978E+08		

WARNING: [redacted] STUDENTIZED RESIDUAL = 4.770)

DURBIN-WATSON D STATISTIC 2.112
FIRST ORDER AUTOCORRELATION -.093

RESIDUALS HAVE BEEN SAVED

<without SO-13-02 and SO-17-02>

MYSTAT Editor

Case	SAMPLEID$	PB	EPTOX
1	SO-05-02	320.000	4.900
2	SO-05-35	7200.000	.050
3	SO-13-02	.	.
4	SO-17-02	.	.
5	SO-17-35	43.000	.900
6	SO-22-35	3700.000	25.400
7	SO-22-68	26.000	.050
8	SO-25-02	2620.000	19.700
9	SO-25-35	4220.000	5.800
10			
11			
12			
13			
14			
15			

TOTAL OBSERVATIONS: 9

	PB	EPTOX
N OF CASES	7	7
MINIMUM	26.000	0.050
MAXIMUM	7200.000	25.400
MEAN	2589.857	8.114
STANDARD DEV	2688.128	10.254

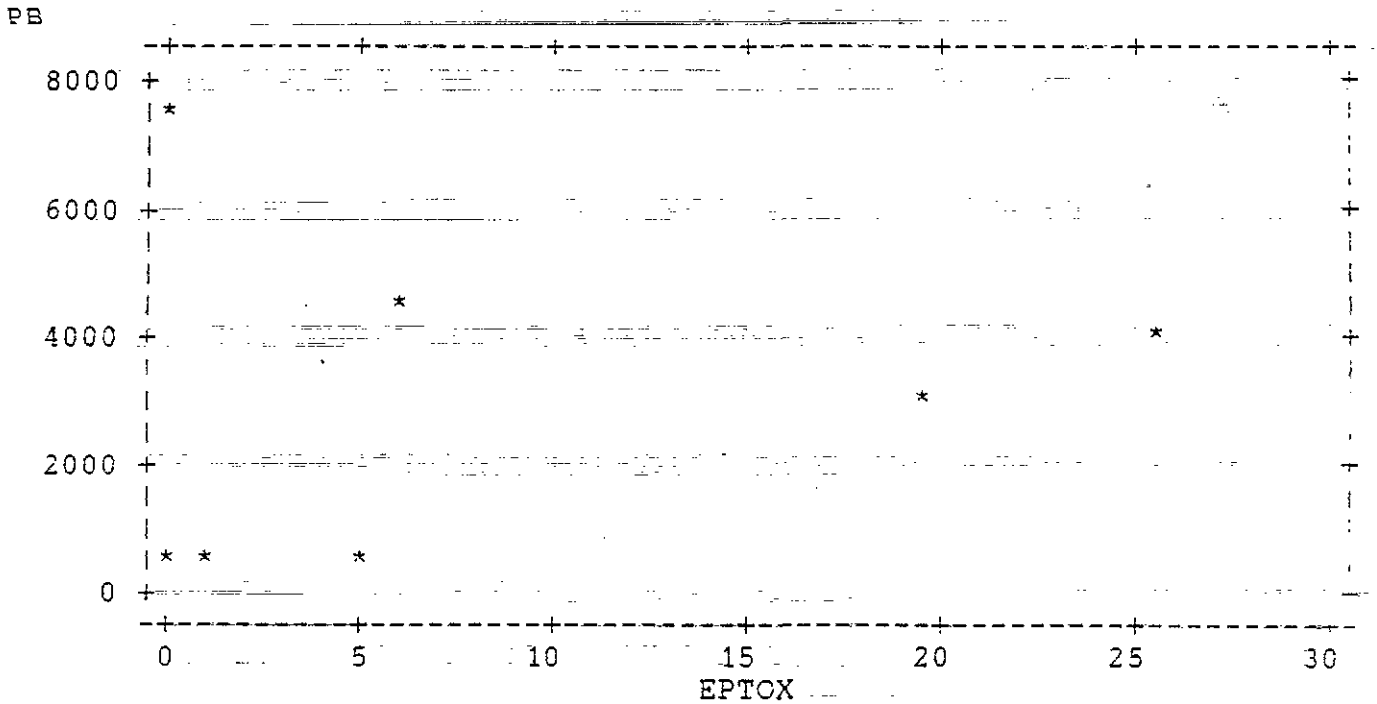
EARSON CORRELATION MATRIX

	PB	EPTOX
PB	1.000	
EPTOX	[redacted]	1.000

NUMBER OF OBSERVATIONS: 7

AR301829

PB = 2269.130 + 39.526 * EPTox



2 CASES WITH MISSING VALUES EXCLUDED FROM PLOT

2 CASES DELETED DUE TO MISSING DATA.

DEP VAR: PB N: 7 MULTIPLE R: .151 SQUARED MULTIPLE R: .023
ADJUSTED SQUARED MULTIPLE R: .000 STANDARD ERROR OF ESTIMATE: 2911.036

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	[redacted]	1447.436	0.000	.	1.568	0.178
EPTOX	[redacted]	115.903	0.151	.100E+01	0.341	0.747

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	985552.987	1	985552.987	0.116	0.747
RESIDUAL	.423707E+08	5	8474130.374		

Soil without any PB > 4000

MYSTAT Editor

Case	SAMPLEID$	PB	EPTOX
1	SO-05-02	320.000	4.900
2	SO-05-35	.	.
3	SO-13-02	.	.
4	SO-17-02	.	.
5	SO-17-35	43.000	.900
6	SO-22-35	3700.000	25.400
7	SO-22-68	26.000	.050
8	SO-25-02	2620.000	19.700
9	SO-25-35	.	.
10			
11			
12			
13			
14			
15			

TOTAL OBSERVATIONS: 9

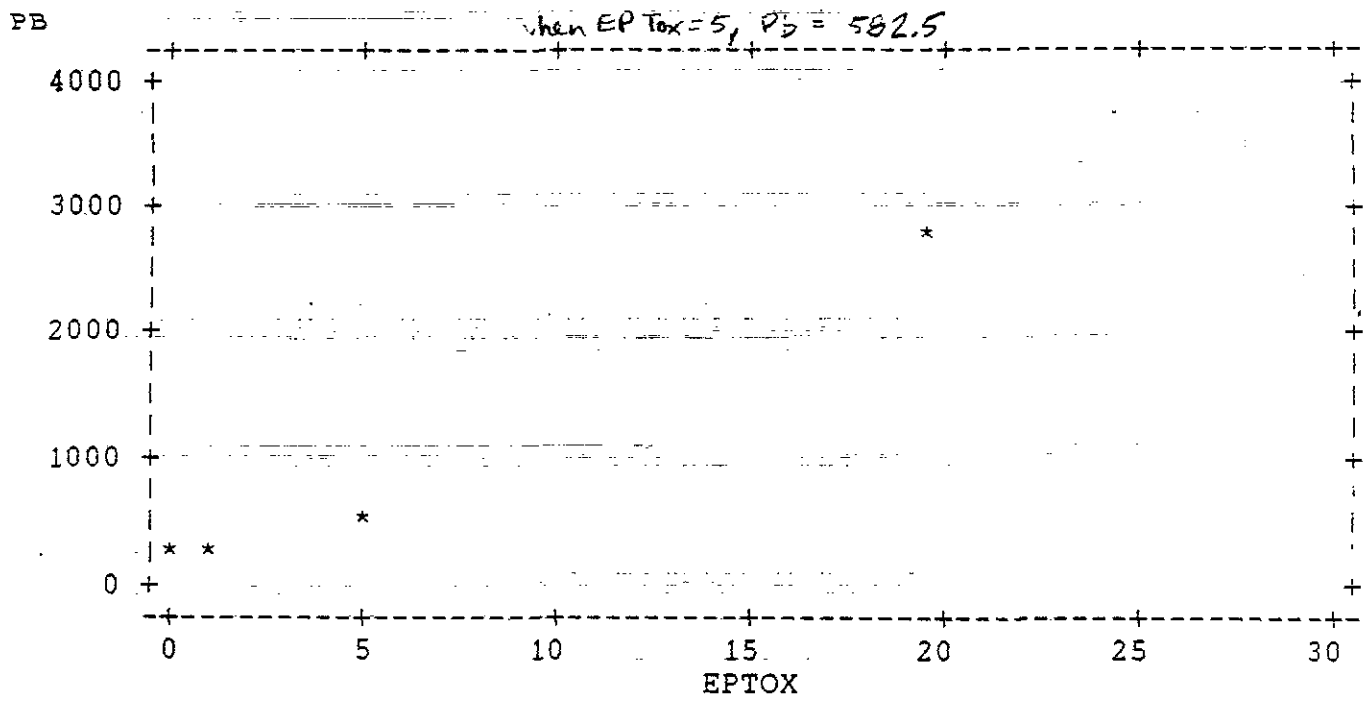
	PB	EPTOX
N OF CASES	[redacted]	[redacted]
MINIMUM	26.000	0.050
MAXIMUM	3700.000	25.400
MEAN	1341.800	10.190
STANDARD DEV	1707.131	11.607

EARSON CORRELATION MATRIX

	PB	EPTOX
PB	1.000	
EPTOX	[redacted]	1.000

NUMBER OF OBSERVATIONS: 5

PB = −148.948 + 146.295 * EPTox



4 CASES WITH MISSING VALUES EXCLUDED FROM PLOT

4 CASES DELETED DUE TO MISSING DATA.

DEP VAR: PB N: 5 MULTIPLE R: .995 SQUARED MULTIPLE R: .989
ADJUSTED SQUARED MULTIPLE R: .986 STANDARD ERROR OF ESTIMATE: 203.039

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	[redacted]	127.234	0.000	.	-1.171	0.326
EPTOX	[redacted]	8.746	0.995	.100E+01	16.726	0.000

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	.115335E+08	1	.115335E+08	279.770	0.000
RESIDUAL	123675.045	3	41225.015		

DURBIN-WATSON D STATISTIC 1.458
FIRST ORDER AUTOCORRELATION -.029

RESIDUALS HAVE BEEN SAVED

APPENDIX D-7

LINEAR CORRELATION BETWEEN CLP LEAD CONCENTRATION AND EP TOXICITY FOR SEDIMENT

Sediment Data Only

OK
RDB

MYSTAT Editor

Case	SAMPLEID$	PB	EPTOX
1	SD-03	1060.000	1.700
2	SD-03D	1250.000	2.400
3	SD-05	238.000	.400
4	SD-08	18.100	.050
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

>

TOTAL OBSERVATIONS: 4

	PB	EPTOX
N OF CASES	4	4
MINIMUM	18.100	0.050
MAXIMUM	1250.000	2.400
MEAN	641.525	1.138
STANDARD DEV	604.664	1.101

EARSON CORRELATION MATRIX

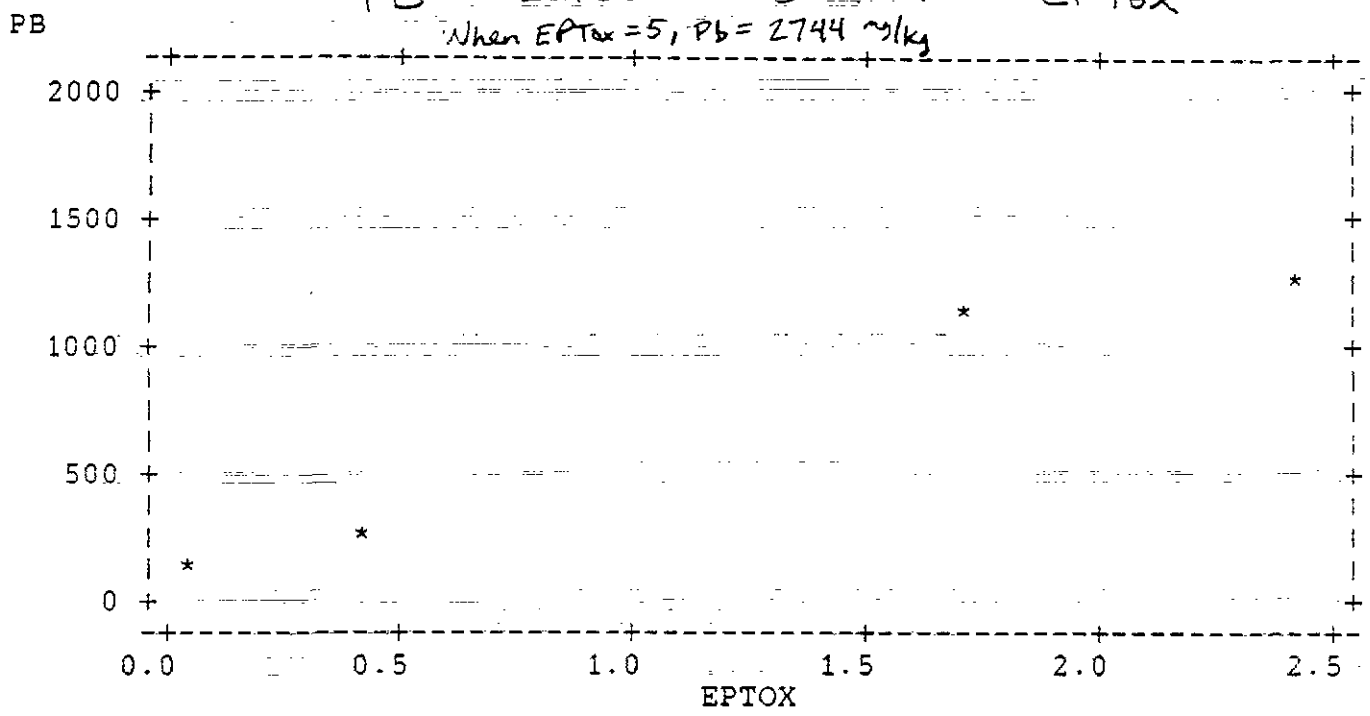
	PB	EPTOX
PB	1.000	
EPTOX	[redacted]	1.000

NUMBER OF OBSERVATIONS: 4

AR301834

PB = 22.504 + 544.194 * EPTox

When EPTox = 5, Pb = 2744 mg/kg



DEP VAR: PB N: 4 MULTIPLE R: .991 SQUARED MULTIPLE R: .982
ADJUSTED SQUARED MULTIPLE R: .973 STANDARD ERROR OF ESTIMATE: 99.508

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	[redacted]	77.448	0.000	.	0.291	0.799
EPTOX	[redacted]	52.179	0.991	.100E+01	10.429	0.009

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	1077050.777	1	1077050.777	108.774	0.009
RESIDUAL	19803.530	2	9901.765		

WARNING: CASE 1 IS AN OUTLIER (STUDENTIZED RESIDUAL = 5.007)
WARNING: CASE 2 IS AN OUTLIER (STUDENTIZED RESIDUAL = -163.757)

DURBIN-WATSON D STATISTIC 2.179
FIRST ORDER AUTOCORRELATION -.434

[redacted]ESIDUALS HAVE BEEN SAVED

APPENDIX E

ENVIRONMENTAL SURVEY DATA

TABLE OF CONTENTS

TABLES

LETTERS

TABLE E-1

PLANTS (TO GENUS) OCCURRING IN CHESTERFIELD COUNTY, VIRGINIA

TABLE E-1

PLANTS (TO GENUS) OCCURRING IN CHESTERFIELD COUNTY, VIRGINIA

PTERIDOPHYTA (FERNS AND FERN-ALLIES); 6 families
1. EQUISETACEAE (HORSETAIL FAMILY); 1 Genus, 2 Species; Equisetum
2. LYCOPODIACEAE (CLUB MOSS FAMILY); 1 Genus, 5 Species; Lycopodium
3. SELAGINELLANCAE (SPIKE-MOSS FAMILY); 1 Genus, 2 Species; Selaginella
4. OPHIOGLOSSACEAE (ADDER'S-TONGUE FAMILY); 2 Genera, 4 Species; Botrychium (3) and Ophioglossum
5. OSMUNDACEAE (ROYAL FERN FAMILY); 1 Genus, 2 Species; Osmunda
6. POLYPODIACEAE (FERN FAMILY); 13 Genera, 17 Species; Adiantum, Anchister, Asplenium, Athyrium, Dryopteris (4), Lorinseria, Onoclea, Phegopteris, Polypodium (2), Polystichum, Pteridium, Thelypteris, and Woodsia.

SPERMATOPHYTA (SEED BEARING PLANTS); 116 Families GYMNOSPERMAE (SEEDS NAKED); 2 Families
1. CUPRESSACEAE (CEDAR FAMILY); 1 Genus, 1 Species; Juniperus
2. PINACEAE (PINE FAMILY); 1 Genus, 3 Species; Pinus

TABLE E-1
PLANTS (TO GENUS) OCCURRING IN CHESTERFIELD COUNTY, VIRGINIA
PAGE TWO

SPERMATOPHYTA (continued) ANGIOSPERMAE (SEEDS ENCLOSED); 114 Families MONOCOTYLEDONS; 18 Families
1. ALISMATACEAE (WATER-PLANTAIN FAMILY); 3 Genera, 3 Species; Alisma, Echinodorus, and Sagittaria
2. AMARYLLIDACEAE (AMARYLLIS FAMILY); 2 Genera, 2 Species; Hypoxis and Zephyranthes
3. ARACEAE (ARUM FAMILY); 5 Genera, 6 Species: Acorus, Arisaema (2), Orontium, Peltandra, and Symplocarpus
4. COMMELINACEAE (SPIDERWORT FAMILY); 3 Genera, 5 Species; Commelina (3), Murdannia, and Tradescantia
5. CYPERACEAE (SEDGE FAMILY); 8 Genus, 68 Species; Bulbostylis, Carex (35), Cyperus (16), Dulichium, Eleocharis (3), Fimbristylis, Rhynchospora (7), and Scirpus (4)
6. DIOSCOREACEAE (YAM FAMILY); 1 Genus, 1 Species; Dioscorea
7. HYDROCHARITACEAE (WATER WEED FAMILY); 1 Genus, 1 Species; Elodea
8. IRIDACEAE (IRIS FAMILY); 4 Genera, 7 Species; Belamcanda, Gladiolus, Iris (3), and Sisyrinchium (2)
9. JUNCACEAE (RUSH FAMILY); 2 Genera, 13 Species; Juncus (9) and Luzula (4)
10. LEMNACEAE (DUCKWEED FAMILY); 1 Genus, 1 Species; Lemna
11. LILIACEAE (LILY FAMILY); 16 Genera, 22 Species; Aletris, Allium, Amianthium, Asparacus, Convallaria, Erythronium (2), Hemerocallis, Lilium, Medeola, Ornithogalum, Polygonatum, Smilacina, Smilax (5), Trillium, Uvularia (2), and Zigadenus
12. ORCHIDACEAC (ORCHID FAMILY); 11 Genera, 18 Species; Aplectrum, Calopogon, Cleistes, Cypripedium (2), Goodyera, Habenaria (4), Isotria, Liparis, Orchis, Spiranthes (4), and Tipularia
13. POACEAE (GRASS FAMILY); 52 Genera, 101 Species: Agrostic (3), Aira (2), Alopecurus, Andropogon (5), Anthoxanthum, Aristida (2), Arrhenatherum, Arthraxon, Arundinaria, Avena, Brachyelytrum, Bromus (3), Calamagrostis, Cenchrus, Cinna, Cynodon, Dactylis, Danthonia (2),Dichanthelium (9), Digitaria, Echinochloa, Eleusine, Elymus, Eragrostis (7), Erianthus (2), Festuca (4), Glyceria (2), Holcus, Hordeum, Hystrix, Leersia (2), Lolium, Melica, Microstegium, Miscanthus, Muhlenbergia, Panicum (6), Paspalum (6), Phleum, Phragmites, Phyllostachys, Poa (4), Setaria (3), Sorghastrum (2), Sorghum, Sphenopholis (2), Sporobolus, Stipa, Tridens, Tripsacum, Uniola (2), and Zizania
14. PONTEDERIACEAE (PICKEREL-WEED FAMILY); 2 Genera, 2 Species; Heteranthera and Pontederia
15. POTAMOGETONACEAE (POND WEED FAMILY); 1 Genus, 1 Species; Potamogeton
16. SPARGANIACEAE (BUR-REED FAMILY); 1 Genus, 1 Species; Sparganium
17. TYPHACEAE (CAT-TAIL FAMILY); 1 Genus, 2 Species; Typha
18. XYRIDACEAE (YELLOW-EYED GRASS FAMILY); 1 Genus, 3 Species; Xyris

TABLE E-1
PLANTS (TO GENUS) OCCURRING IN CHESTERFIELD COUNTY, VIRGINIA
PAGE THREE

ANGIOSPERMAE (continued) DICOTYLEDONES; 96 Families
1. ACANTHACEAE (ACANTHUS FAMILY); 3 Genera, 3 Species; Diclipterа, Justicia, and Ruellia
2. ACERACEAE (MAPLE FAMILY); 1 Genus, 3 Species; Acer
3. AIZOACEAE (CARPET-WEED FAMILY) Mollugo
4. AMARANTHACEAE (AMARANTH FAMILY); 2 Genera, 6 Species; Amaranthus (5), and Froelichia
5. ANACARDIACEAE (CASHEW FAMILY); 1 Genus, 4 Species; Rhus
6. ANNONACEAE (CUSTARD-APPLE FAMILY); 1 Genus, 1 Species; Asimina
7. APIACEAE (CARROT FAMILY); 14 Genera, 19 Species; Angelica, Chaerophyllum (2), Cicuta, Conium, Cryptotaenia, Daucus, Eryngium (2), Foeniculum, Hydrocotyle, Osmorhiza (2), Oxypolis, Sanicula (2), Thaspium (2), and Zizia
8. APOCYNACEAE (DOGBANE FAMILY); 4 Genera, 6 Species; Amsonia, Apocynum (2), Trachelospermum, and Vinca (2)
9. AQUIFOLIACEAE (HOLLY FAMILY); 1 Genus, 3 Species; Ilex
10. ARALIACEAE (GINSENG FAMILY); 2 Genera, 2 Species: Aralia and Hedera
11. ARISTOLOCHIACEAE (WILD-GINGER FAMILY); 2 Genera, 3 Species; Asarum and Hexastylis (2)
12. ASCLEPIADACEAE (MILKWEED FAMILY) 3 Genera, 9 Species; Asclepias (6), Cynanchum, and Matelea (2)
13. ASTERACEAE (ASTER FAMILY); 49 Genera, 112 Species: Achillea, Ageratina (2), Ambrosia (2), Antennaria, Anthemis, Arnica, Artemisia (2), Aster (6), Baccharis, Bidens (3); Boltonia, Centaurea (2), Chrysanthemum, Chrysogonum, Cichorium, Cirsium, Conoclinium, Coreopsis (3), Crepis, Elephantopus (2), Erechtites, Erigeron (3), Eupatoriadelphus, Eupatorium (12), Galinsoga, Gnaphalium (2), Helenium (2), Helianthus (6), Heterotheca (4), Hieracium (4), Hypochoeris, Krigia (2), Lactuca (4), Liatris (3), Mikania, Parthenium, Pluchea, Polymnia, Prenanthes, Pyrrhopappus, Rudeckia (3), Senecio (2), Sericocarpus (3), Solidago (10), Sonchus (2), Taraxacum, Verbesina (2), Vernonia (2), and Xanthium
14. BALSAMINACEAE (JEWEL-WEED FAMILY); 1 Genus, 1 Species; Impatiens
15. BERBERIADACEAE (BARBERRY FAMILY); 2 Genera, 2 Species; Berberis and Podophyllum
16. BETULACEAE (BIRCH FAMILY); 5 Genera, 5 Species; Alnus, Betula, Carpinus, Corylus, and Ostrya
17. BIGNONIACEAE (BIGNONIA FAMILY); 3 Genera, 3 Species; Bignona, Campsis, and Catalpa
18. BORAGINACEAE (BORAGE FAMILY); 3 Genera, 6 Species; Echium, Lithospermum, and Myosotis (4)
19. BRASSICACEAE (MUSTARD FAMILY); 16 Genera, 20 Species; Alliaria, Arabidopsis, Arabis, Barbarea, Brassica (2), Camelina, Capsella, Cardamine (2), Denteria (2), Draba, Hesperis, Lepidium (2), Raphanus, Sisymbrium, Teesdalia, and Thlaspi

TABLE E-1
PLANTS (TO GENUS) OCCURRING IN CHESTERFIELD COUNTY, VIRGINIA
PAGE FOUR

DICOTYLEDONES (continued)
20. CACTACEAE (GACTUS FAMILY); 1 Genus, 1 Species; Opuntia
21. CALLITRICHACEAE (WATER-STAR FAMILY); 1 Genus, 1 Species, Callitriche
22. CAMPANULACEAE (BELLFLOWER FAMILY); 2 Genera, 7 Species; Lobelia (6) and Triodanis
23. CANNABACEAE (HEMP FAMILY); 1 Genus, 1 Species; Humulus
24. CAPRIFOLIACEAE (HONEYSUCKLE FAMILY); 4 Genera, 9 Species; Lonicera (2), Sambucus, Symphoricarpos, and Viburnum (5)
25. CARYOPHYLLACEAE (PINK FAMILY); 11 Genera, 18 Species; Arenaria (2), Cerastium (2), Dianthus, Holosteum, Lychnis, Sagina, Saponaria, Scleranthus, Silene (5), Spergula, and Stellaria (2)
26. CELASTRACEAE (BITTER-SWEET FAMILY); 2 Genera, 2 Species; Celastrus and Scandens
27. CHENOPODIACEAE (GOOSEFOOT FAMILY); 1 Genus, 2 Species; Chenopodium
28. CISTACEAE (ROCKROSE FAMILY); 1 Genus, 3 Species; Lechea
29. CLETHRACEAE (SUMMER-SWEET FAMILY); 1 Genus, 1 Species; Clethra
30. CONVOLVULACEAE (MORNING-GLORY FAMILY); 3 Genera, 10 Species; Calystegia, Cuscuta (4), and Ipomoea (5)
31. CORNACEAE (DOGWOOD FAMILY) 1 Genus, 3 Species; Cornus
32. CRASSULACEAE (STONE-CROP FAMILY); 2 Genera, 2 Species; Penthorum and Sedum
33. CUCURBITACEAE (GOURD FAMILY); 2 Genera, 2 Species; Melothria and Sicyos
34. EBENACEAE (EBONY FAMILY); 1 Genus, 1 Species; Diospyros
35. ELAEAGNACEAE (OLEASTER FAMILY); 1 Genus, 1 Species; Elaeagnus
36. ERICACEAE (HEATH FAMILY); 10 Genera, 19 Species; Chimaphia (2), Epigaea, Gaylussacia (2), Kalmia, Leucothoe, Lyonia (2), Monotropa (2), Oxydendrum, Rhododendron (3), and Vaccinium (4).
37. EUPHORBIACEAE (SPURGE FAMILY); 4 Genera, 11 Species; Acalypha(2), Croton, Crotonopsis, and Euphorbia (7)
38. FABACEAE (PEA FAMILY); 26 Genera, 57 Species; Apios, Baptisia, Cassia (3), Centrosema, Cercis, Clitoria, Coronilla, Crotalaria (2), Cytisus, Desmodium (6), Glenditsia, Lathyrus (2), Lespedeza (9), Lupinus, Medicago, Melilotus (2), Psoralea, Pueraria, Rhynchosia, Robinia, Strophastyles (2),Stylosanthes, Tephrosia (2), Trifolium (7), Vicia (5), and Wisteria
39. FAGACEAE (BEECH FAMILY); 3 Genera, 16 Species; Castanea (2), Fagus, and Quercus (13)
40. FUMARIACEAE (FUMEROOT FAMILY); 2 Genera, 3 Species; Corydalis and Dicentra (2)

TABLE E-1
PLANTS (TO GENUS) OCCURRING IN CHESTERFIELD COUNTY, VIRGINIA
PAGE FOUR

DICOTYLEDONES (continued)
41. GENTIANACEAE (GENTIAN FAMILY); 4 Genera, 7 Species; Bartonia, Gentiana (3), Obolaria, and Sabatia (2)
42. GERANIACEAE (GERANIUM FAMILY); 2 Genera, 3 Species; Erodium and Geranium (2)
43. HALORAGACEAE (WATER-MILFOIL FAMILY); 2 Genera, 2 Species; Myriophllum and Proserpinaca
44. HYDROPHYLLACEAE (WATER-LEAF FAMILY); 4 Genera, 4 Species; Hydrolea, Hydrophyllum, Nemophila, and Phacelia
45. HYPERICACEAE (ST. JOHN'S-WORT FAMILY); 1 Genus, 10 Species; Hypericum
46. JUGLANDACEAE (WALNUT FAMILY); 1 Genus, 3 Species; Carya
47. LAMIACEAE (MINT FAMILY); 11 Genera, 16 Species; Glecoma, Lamium (2), Lycopus (2), Monarda, Perilla, Prunella, Pycnanthermum (2), Salvia, Satureja, Scutellaria (3), and Trichostema
48. LAURACEAE (LAUREL FAMILY); 2 Genera, 2 Species; Lindera and Sassafras
49. LENTIBULARIACEAE (BLADDER-WORT FAMILY); 1 Genus, 4 Species; Utricularia
50. LIMNANTHACEAE (FALSE-MERMAID FAMILY); 1 Genus, 1 Species; Linum
51. LOGANIACEAE (LOGANIA FAMILY); 1 Genus, 1 Species; Polypremum
52. LORANTHACEAE (MISTLETOE FAMILY), 1 Genus, 1 Species; Phoradendron
53. LYTHRACEAE (LOOSESTRIFE FAMILY); 3 Genera, 3 Species; Ammannia, Peplis, and Rotala
54. MANGOLIACEAE (MAGNOLIA FAMILY); 2 Genera, 2 Species; Liriodendron and Magnolia
55. MALVACEAE (MALLOW FAMILY); 5 Genera, 6 Species; Abutilon, Hibiscus (2), Kosteletzkya, Malva, and Sida
56. MELASTOMATACEAE (MEADOW-BEAUTY FAMILY); 1 Genus, 3 Species; Rhexia
57. MELIACEAE (MAHOGANY FAMILY); 1 Genus, 1 Species; Melia
58. MORACEAE (MULBERRY FAMILY); 3 Genera, 4 Species; Broussonetia, Maclura, and Morus (2)
59. MYRICACEAE (BAYBERRY FAMILY); 2 Genera, 2 Species; Comptonia and Myrica
60. NYMPHAEACEAE (WATERLILY FAMILY); 2 Genera, 2 Species; Nuphar and Nymphaea
61. NYSSACEAE (SOUR-GUM FAMILY); 1 Genus, 1 Species; Nyssa
62. OLEACEAE (OLIVE FAMILY), 3 Genera, 4 Species; Chionanthus, Fraxinus (2), and Ligustrum
63. ONAGRACEAE (EVENING-PRIMROSE FAMILY); 4 Genera, 13 Species; Circaea, Gaura, Ludwigia (6), and Oenothera (5)
64. OROBANCHACEAE (BROOM-RAPE FAMILY); 3 Genera, 3 Species; Conopholis, Epifagus, and Orobanche

TABLE E-1
PLANTS (TO GENUS) OCCURRING IN CHESTERFIELD COUNTY, VIRGINIA
PAGE FIVE

DICOTYLEDONES (continued)
65. OXALIDACEAE (WOOD-SORREL FAMILY); 1 Genus, 4 Species; Oxalis
66. PAPAVERACEAE (POPPY FAMILY); 2 Genera, 2 Species; Papaver and Sanguinaria
67. PASSIFLORACEAE (PASSION-FLOWER FAMILY); 1 Genus, 2 Species; Passiflora
68. PHRYMACEAE (LOPSEED FAMILY); 1 Genus, 1 Species; Phryma
69. PHYTOLACCACEAE (POKE-WEED FAMILY); 1 Genus, 1 Species; Phytolacca americana
70. PLANTAGINACEAE (PLANTAIN FAMILY); 1 Genus, 4 Species; Plantago
71. PLATANACEAE (PLANE TREE FAMILY); 1 Genus, 1 Species; Platanus
72. POLEMONIACEAE (PHLOX FAMILY); 2 Genera, 4 Species; Phlox (3) and Polemonium
73. POLYGALACEAE (CANDY-ROOT FAMILY); 1 Genus, 6 Species; Polygala
74. POLYGONACEAE (BUCKWHEAT FAMILY); 2 Genera, 14 Species; Polygonum (12) and Rumex (2)
75. PORTULACACEAE (PURSLANE FAMILY); 3 Genera, 3 Species; Claytonia, Portulaca, and Talinum
76. PRIMULACEAE (PRIMROSE FAMILY); 2 Genera, 5 Species; Anagallis and Lysimachia (4)
77. RANUNCULACEAE (BUTTERCUP FAMILY); 9 Genera, 19 Species; Anemone, Aquilegia, Cimicifuga, Clematis (3), Delphinium, Hepatica, Ranunculus (8), Thalictrum (2), and Xanthorhiza
78. RHAMNACEAE (BUCKTHORN FAMILY); 1 Genus, 1 Species; Ceanothus
79. ROSACEAE (ROSE FAMILY); 13 Genera, 20 Species; Amelanchier (2), Aronio, Aruncus, Crataegus, Fragaria, Geum, Gillenia, Malus, Potentilla (2), Prunus (3), Rosa, Rubus (4), and Spiraea
80. RUBIACEAE (MADDER FAMILY); 7 Genera, 14 Species; Cephalanthus, Diodia (2), Galium (4), Houstonia (3), Mitchella, Oldenlandia, and Richardia (2)
81. SALICACEAE (WILLOW FAMILY); 2 Genera, 5 Species; Populus (3) and Salix (2)
82. SANTALACEAE (SANDALWOOD FAMILY); 1 Genus, 1 Species; Comandra
83. SARRACENIACEAE (PITCHER-PLANT FAMILY); 1 Genus, 1 Species; Sorracenia
84. SAURURACEAE (LIZARD'S TAIL FAMILY); 1 Genus, 1 Species; Saururus
85. SAXIFRAGACEAE (SAXIFRAGE FAMILY); 5 Genera, 5 Species; Heuchera, Hydrangea, Itea, Saxifraga, and Tiarella

TABLE E-1
PLANTS (TO GENUS) OCCURRING IN CHESTERFIELD COUNTY, VIRGINIA
PAGE SIX

DICOTYLEDONES (continued)
86. SCROPHULARIACEAE (FIGWORT FAMILY); 15 Genera; 27 Species; Agalinis (2), Aureolaria (2), Chelone (2), Gratiola (2), Kickxia, Linaria, Lindernia, Mecardonia, Mimulus (2), Paulownia, Pedicularis (2), Penstemon (2), Scrophularia, Verbascum (2), and Veronica (5)
87. SIMAROUBACEAE (QUASSIA FAMILY); 1 Genus, 1 Species; Ailanthus
88. SOLANACEAE (NIGHTSHADE FAMILY); 4 Genera, 6 Species; Datura, Lycium, Physalis (2), and Solanum (2)
89. STAPHYLEACEAE (BLADDER - POD FAMILY); 1 Genus, 1 Species; Staphylea
90. SYMPLOCACEAE (SWEET-LEAF FAMILY); 1 Genus, 1 Species; Symplocos
91. ULMACEAE (ELM FAMILY); 2 Genera, 5 Species; Celtis (2) and Ulmus (3)
92. URTICACEAE (NETTLE FAMILY); 4 Genera, 4 Species; Boehmeria, Laportea, Pilea, and Urtica
93. VALERIANACEAE (VALERIAN FAMILY) 1 Genus, 3 Species; Valerianella
94. VERBENACEAE (VERBENA FAMILY); 2 Genera, 3 Species; Lippia and Verbena (2)
95. VIOLACEAE (VIOLET FAMILY); 2 Genera, 12 Species; Hybanthus and Viola (11)
96. VITACEAE (GRAPE FAMILY); 2 Genera, 6 Species; Parthenocissus and Vitis (5)

Source: Harrill et al., 1986

TABLE E-2

LIST OF WILDLIFE SPECIES OF CHESTERFIELD COUNTY, DREWRYS BLUFF QUAD, VIRGINIA

TABLE E-2

LIST OF WILDLIFE SPECIES OF CHESTERFIELD COUNTY, DREWRYS BLUFF QUAD, VIRGINIA

FISH

NAME	SCIENTIFIC NAME	T.STATUS
Alewife	Alosa pseudoharengus	Sport Fish
Bass, largemouth	Micropterus salmoides	Sport Fish
		Sensitive
Bass, smallmouth	Micropterus dolomieui	Sport Fish
		See Comments
Bass, striped	Morone saxatilis	Sport Fish
		Commercial
Bluegill	Lepomis macrochirus	Sport Fish
		See Comments
Bowfin	Amia calva	Unclassified
Bullhead, brown	Ameirus nebulosus	Sport Fish
		See Comments
Bullhead, yellow	Ameirus natalis	Unclassified
Carp, common	Cyprinus carpio	Biological Indicator
		Commercial
		Pest/Nuisance
		See Comments
Carpsucker, river	Carpiodes cyprinus	Unclassified
Catfish, channel	Ictalurus punctatus	Sport Fish
		Commercial
		See Comments
Catfish, white	Ameirus catus	Sport Fish
		Commercial
		See Comments
Chub, bluehead	Nocomis leptocephalus leptocephalus	Unclassified
Chub, creek	Semotilus atromaculatus	Biological Indicator
		See Comments
Chub, river	Nocomis micropogon	Unclassified
Chubsucker, creek	Erimyzon oblongus	Unclassified
		See Comments
Crappie, black	Pomoxis nigromaculatus	Sport Fish
		See Comments
Dace, blacknose	Rhinichthys atratulus	Biological Indicator
		Commercial
		See Comments
Dace, longnose	Rhinichthys cataractae cataractae	Unclassified
		See Comments
Dace, mountain redbelly	Phoxinus oreas	Unclassified
Darter, fantail	Etheostoma flabellare	Unclassified
		See Comments
Darter, glassy	Etheostoma vitreum	Unclassified
		See Comments
Darter, johnny	Etheostoma nigrum	Unclassified
		See Comments
Darter, shield	Percina peltata	Unclassified
		See Comments
Darter, stripeback	Percina notogramma	Unclassified
Fallfish	Semotilus corporalis	Unclassified
		See Comments
Goldfish	Carassius auratus	EPA Indicator
		Biological Indicator
		See Comments
Herring, blueback	Alosa aestivalis	Commercial
		See Comments
Hogsucker, northern	Hypentelium nigricans	Unclassified
		See Comments
Killifish, banded	Fundulus diaphanus	Unclassified
		Heritage G5 - Demonstrably secure g
		Heritage S3 - Rare or uncommon in s

TABLE E-2

LIST OF WILDLIFE SPECIES OF CHESTERFIELD COUNTY, DREWRYS BLUFF QUAD, VIRGINIA

NAME	SCIENTIFIC NAME	T.STATUS
Madtom, margined	Noturus insignis	Commercial
		See Comments
Mosquitofish	Gambusia affinis	Unclassified
Mudminnow, eastern	Umbra pygmaea	Unclassified
Perch, girate	Aphredoderus sayanus sayanus	Unclassified
Perch, white	Morone americana	Sport Fish
		Commercial
		See Comments
Perch, yellow	Perca flavescens	Sport Fish
		Commercial
		See Comments
Pickerel, chain	Esox niger	Unclassified
Pickerel, redfin	Esox americanus americanus	Unclassified
		See Comments
Pumpkinseed	Lepomis gibbosus	Sport Fish
		See Comments
Shad, gizzard	Dorosoma cepedianum	Unclassified
Shiner, bridle	Notropis bifrenatus	Unclassified
Shiner, comely	Notropis amoenus	Unclassified
Shiner, common	Notropis cornutus chrysocephalus	Biological Indicator
		Commercial
		See Comments
Shiner, golden	Notemigonus crysoleucas	Biological Indicator
		Commercial
		See Comments
Shiner, rosyface	Notropis rubellus	Unclassified
Shiner, satinfin	Notropis analostomus	Unclassified
Shiner, spottail	Notropis hudsonius	Commercial
		See Comments
Shiner, swallowtail	Notropis procne	Unclassified
		See Comments
Sturgeon, shortnose	Acipenser brevirostrum	Federal Endangered
Sucker, torrent	Moxostoma rhothoecum	Unclassified
Sucker, white	Catostomus commersoni	Sport Fish
		See Comments
Sunfish, banded	Enneacanthus obesus	Sport Fish
Sunfish, bluespotted	Enneacanthus gloriosus	Sport Fish
		See Comments
Sunfish, green	Lepomis cyanellus	Sport Fish
		See Comments
Sunfish, redbreast	Lepomis auritus	Sport Fish
		See Comments
Warmouth	Lepomis gulosus	Sport Fish
		See Comments

FISH

AMPHIBIANS & REPTILES

Bullfrog	Rana catesbeiana	Nongame-Protected
Frog, Brimley's chorus	Pseudacris brimleyi	Nongame-Protected
Frog, little grass	Limnaoedus ocularis	Unclassified
		Heritage G5 - Demonstrably secure g
		Heritage S3 - Rare or uncommon in s
Frog, pickerel	Rana palustris	Nongame-Protected
Frog, southern leopard	Rana utricularia	Nongame-Protected
Frog, upland chorus	Pseudacris triseriata feriarum	Nongame-Protected
Newt, red-spotted	Notophthalmus viridescens viridescens	Nongame-Protected
Peeper, northern spring	Hyla crucifer crucifer	Nongame-Protected
Salamander, Mabee's	Ambystoma mabeei	Unclassified
		Heritage G4 - Apparently secure glo
		Heritage S2 - Imperiled in state be
Salamander, eastern mud	Pseudotriton montanus montanus	Nongame-Protected
Salamander, eastern tiger	Ambystoma tigrinum tigrinum	State Endangered

TABLE E-2

LIST OF WILDLIFE SPECIES OF CHESTERFIELD COUNTY, DREWRYS BLUFF QUAD, VIRGINIA

NAME	SCIENTIFIC NAME	T.STATUS
		Heritage G5 - Demonstrably secure g
		Heritage S1 - Critically imperiled
Salamander, four-toed	Hemidactylium scutatum	Nongame-Protected
Salamander, marbled	Ambystoma opacum	Nongame-Protected
Salamander, northern dusk	Desmognathus fuscus fuscus	Nongame-Protected
Salamander, northern two-	Eurycea bislineata bislineata	Nongame-Protected
Salamander, redback	Plethodon cinereus	Nongame-Protected
Salamander, slimy	Plethodon glutinosus glutinosus	Nongame-Protected
Salamander, spotted	Ambystoma maculatum	Nongame-Protected
Salamander, three-lined	Eurycea longicauda guttolineata	Nongame-Protected
Spadefoot, eastern	Scaphiopus holbrooki holbrooki	Nongame-Protected
Toad, American	Bufo americanus	Nongame-Protected
Toad, Fowler's	Bufo woodhousii fowleri	Nongame-Protected
Toad, eastern narrowmouth	Gastrophryne carolinensis	Nongame-Protected
Toad, oak	Bufo quercicus	Unclassified
		Heritage G5 - Demonstrably secure g
		Heritage SU - Status uncertain in s
Treefrog, Cope's gray	Hyla chrysoscelis	Nongame-Protected
Treefrog, barking	Hyla gratiosa	Unclassified
		Heritage G5 - Demonstrably secure g
		Heritage S3 - Rare or uncommon in s
Treefrog, gray	Hyla versicolor	Nongame-Protected
Treefrog, green	Hyla cinerea	Nongame-Protected
Treefrog, pine woods	Hyla femoralis	Nongame-Protected
Copperhead, northern	Agkistrodon contortrix mokason	Nongame-Protected
Cottonmouth, eastern	Agkistrodon piscivorus piscivorus	Nongame-Protected
Kingsnake, eastern	Lampropeltis getulus getulus	Unclassified
		Heritage G5 - Demonstrably secure g
		Heritage S2 - Imperiled in state be
Lizard, eastern slender g	Ophisaurus attenuatus longicaudus	Nongame-Protected
Lizard, northern fence	Sceloporus undulatus	Nongame-Protected
Racer, northern black	Coluber constrictor constrictor	Nongame-Protected
Racerunner, six-lined	Cnemidophorous sexlineatus	Nongame-Protected
Rattlesnake, canebrake	Crotalus horridus atricaudatus	Nongame-Protected
		See Comments
Skink, broadhead	Eumeces laticeps	Nongame-Protected
Skink, five-lined	Eumeces fasciatus	Nongame-Protected
Skink, ground	Scincella lateralis	Nongame-Protected
Skink, southeastern five-	Eumeces inexpectatus	Nongame-Protected
Snake, black rat	Elaphe obsoleta obsoleta	Nongame-Protected
Snake, corn	Elaphe guttata guttata	Unclassified
Snake, eastern garter	Thamnophis sirtalis sirtalis	Nongame-Protected
Snake, eastern hognose	Heterodon platyrhinos	Nongame-Protected
Snake, eastern worm	Carphophis amoenus amoenus	Nongame-Protected
Snake, northern brown	Storeria dekayi dekayi	Nongame-Protected
Snake, northern water	Nerodia sipedon sipedon	Nongame-Protected
Snake, queen	Regina septemvittata septemvittata	Nongame-Protected
Stinkpot	Sternotherus odoratus	Nongame-Protected
Turtle, common snapping	Chelydra serpentina serpentina	Game (Consumptive Recreational)
		See Comments
Turtle, eastern box	Terrapene carolina carolina	Nongame-Protected
Turtle, eastern mud	Kinosternon subrubrum subrubrum	Nongame-Protected
Turtle, eastern painted	Chrysemys picta picta	Nongame-Protected

AMPHIBIANS & REPTILES

BIRDS

Blackbird, red-winged	Agelaius phoeniceus	Federal Migratory
		Nongame-Protected
Bluebird, eastern	Sialia sialis	Federal Migratory
		Nongame-Protected
Bobwhite, northern	Colinus virginianus	Game (Consumptive Recreational)
Bufflehead	Bucephala albeola	Game (Consumptive Recreational)

LIST OF WILDLIFE SPECIES OF CHESTERFIELD COUNTY, DREWRYS BLUFF QUAD, VIRGINIA

NAME	SCIENTIFIC NAME	T.STATUS
		Federal Migratory
Bunting, indigo	Passerina cyanea	Nongame-Protected
		Federal Migratory
Bunting, snow	Plectrophenax nivalis nivalis	Federal Migratory
		Nongame-Protected
Canvasback	Aythya valisineria	Federal Migratory
		Game (Consumptive Recreational)
Cardinal, northern	Cardinalis cardinalis	Federal Migratory
		Nongame-Protected
Catbird, gray	Dumetella carolinensis	Federal Migratory
Chat, yellow-breasted	Icteria virens virens	Federal Migratory
		Nongame-Protected
Chickadee, Carolina	Parus carolinensis	Federal Migratory
Chuck-will's-widow	Caprimulgus carolinensis	Federal Migratory
		Nongame-Protected
Cowbird, brown-headed	Molothrus ater	Federal Migratory
		Nongame-Protected
Crow, American	Corvus brachyrhynchos	Federal Migratory
		Nongame-Protected
		Pest/Crops
		See Comments
Crow, fish	Corvus ossifragus	Unclassified
Cuckoo, yellow-billed	Coccyzus americanus	Federal Migratory
		Nongame-Protected
Dove, mourning	Zenaida macroura	Federal Migratory
		Game (Consumptive Recreational)
		See Comments
Dove, rock	Columba livia	Game (Consumptive Recreational)
		Federal Migratory
Duck, American black	Anas rubripes	Game (Consumptive Recreational)
		Federal Migratory
		See Comments
Duck, ring-necked	Aythya collaris	Federal Migratory
		Game (Consumptive Recreational)
Duck, ruddy	Oxyura jamaicensis	Federal Migratory
Duck, wood	Aix sponsa	Federal Migratory
		Game (Consumptive Recreational)
Eagle, bald	Haliaeetus leucocephalis leucocephalis	Federal Endangered
		Plan approved by Director
		Federal Migratory
		Nongame-Protected
		See Comments
Egret, cattle	Bubulcus ibis	Federal Migratory
		Nongame-Protected
		See Comments
Finch, house	Carpodacus mexicanus	Federal Migratory
		Nongame-Protected
		See Comments
Finch, purple	Carpodacus purpureus	Nongame-Protected
		Federal Migratory
		Heritage G5 - Demonstrably secure g
		Heritage S2 - Imperiled in state be
Flicker, northern	Colaptes auratus	Federal Migratory
		Nongame-Protected
Flycatcher, acadian	Empidonax virescens	Federal Migratory
		Nongame-Protected
Flycatcher, great crested	Myiarchus crinitus	Federal Migratory
		Nongame-Protected
		See Comments

LIST OF WILDLIFE SPECIES OF CHESTERFIELD COUNTY, DREWRYS BLUFF QUAD, VIRGINIA

NAME	SCIENTIFIC NAME	T.STATUS
Gadwall	Anas strepera	Federal Migratory
		Game (Consumptive Recreational)
Gnatcatcher, blue-gray	Polioptila caerulea	Federal Migratory
		Nongame-Protected
Goldfinch, American	Carduelis tristis	Federal Migratory
		Nongame-Protected
Goose, Canada	Branta canadensis	Game (Consumptive Recreational)
		Federal Migratory
		See Comments
Grackle, common	Quiscalus quiscula	Federal Migratory
		Nongame-Protected
		Pest/Crops
Grebe, pied-billed	Podilymbus podiceps	Federal Migratory
		Nongame-Protected
		Heritage G5 - Demonstrably secure g
		Heritage S2 - Imperiled in state be
Grosbeak, black-headed	Pheucticus melanocephalus	Federal Migratory
		Nongame-Protected
		Pest/Crops
		Accidental
Grosbeak, blue	Guiraca caerulea caerulea	Federal Migratory
		Nongame-Protected
Grosbeak, evening	Coccothaustes vespertinus	Federal Migratory
		Nongame-Protected
		See Comments
Gull, laughing	Larus atricilla	Federal Migratory
		Nongame-Protected
		See Comments
		Heritage G5 - Demonstrably secure g
		Heritage S2 - Imperiled in state be
Hawk, broad-winged	Buteo platypterus	Federal Migratory
		Nongame-Protected
		See Comments
Hawk, red-shouldered	Buteo lineatus lineatus	Federal Migratory
		Sensitive
		Nongame-Protected
Hawk, red-tailed	Buteo jamaicensis	Federal Migratory
		Nongame-Protected
Hawk, sharp-shinned	Accipiter striatus velox	Federal Migratory
		Sensitive
		See Comments
Heron, great blue	Ardea herodias herodias	Sensitive
		See Comments
		Federal Migratory
		Nongame-Protected
Heron, green	Butorides virescens virescens	Federal Migratory
		Nongame-Protected
		See Comments
		Heritage G2 - Imperiled globally be
		Heritage S1 - Critically imperiled
Hummingbird, ruby-throate	Archilochus colubris	Federal Migratory
		Nongame-Protected
Jay, blue	Cyanocitta cristata	Federal Migratory
		Nongame-Protected
		See Comments
Junco, dark-eyed	Junco hyemalis	Federal Migratory
		Nongame-Protected
Kestrel, American	Falco sparverius sparverius	Federal Migratory
		Nongame-Protected

LIST OF WILDLIFE SPECIES OF CHESTERFIELD COUNTY, DREWRYS BLUFF QUAD, VIRGINIA

NAME	SCIENTIFIC NAME	T.STATUS
		Sensitive
		See Comments
Killdeer	Charadrius vociferus	Federal Migratory
		Nongame-Protected
Kingbird, eastern	Tyrannus tyrannus	Federal Migratory
		Nongame-Protected
Kingfisher, belted	Ceryle alcyon	Federal Migratory
		Nongame-Protected
Mallard	Anas platyrhynchos	Federal Migratory
		Game (Consumptive Recreational)
Martin, purple	Progne subis	Federal Migratory
		Nongame-Protected
Meadowlark, eastern	Sturnella magna	Nongame-Protected
		Federal Migratory
		See Comments
Merganser, hooded	Lophodytes cucullatus	Federal Migratory
		Game (Consumptive Recreational)
		See Comments
Mockingbird, northern	Mimus polyglottos	Federal Migratory
		Nongame-Protected
Night-heron, black-crowne	Nycticorax nycticorax hoactii	Federal Migratory
		Nongame-Protected
		Sensitive
		See Comments
Nighthawk, common	Chordeiles minor	Federal Migratory
		Nongame-Protected
Oriole, orchard	Icterus spurius	Federal Migratory
		Nongame-Protected
Osprey	Pandion haliaetus carolinensis	Federal Migratory
		Nongame-Protected
		Sensitive
Ovenbird	Seiurus aurocapillus	Federal Migratory
		Nongame-Protected
Owl, barred	Strix varia	Federal Migratory
		Nongame-Protected
		See Comments
Owl, common barn	Tyto alba pratincola	Nongame-Protected
		Federal Migratory
Owl, great horned	Bubo virginianus	Federal Migratory
		Nongame-Protected
Owl, long-eared	Asio otus	Federal Migratory
		Nongame-Protected
		See Comments
Pewee, eastern wood	Contopus virens	Federal Migratory
		Nongame-Protected
Phoebe, eastern	Sayornis phoebe	Federal Migratory
Pintail, northern	Anas acuta acuta	Federal Migratory
		Game (Consumptive Recreational)
Rail, king	Rallus elegans	Game (Consumptive Recreational)
		Federal Migratory
		Sensitive
		See Comments
		Heritage G4 - Apparently secure glo
		Heritage S3 - Rare or uncommon in s
Redhead	Aythya americana	Game (Consumptive Recreational)
		Federal Migratory
Robin, American	Turdus migratorius	Federal Migratory
		Nongame-Protected
		See Comments

LIST OF WILDLIFE SPECIES OF CHESTERFIELD COUNTY, DREWRYS BLUFF QUAD, VIRGINIA

NAME	SCIENTIFIC NAME	T.STATUS
Sandpiper, least	Calidris minutilla	Federal Migratory Nongame-Protected
Sandpiper, spotted	Actitis macularia	Federal Migratory Nongame-Protected Heritage G5 - Demonstrably secure g Heritage S3 - Rare or uncommon in s
Scaup, lesser	Aythya affinis	Federal Migratory Game (Consumptive Recreational)
Screech-owl, eastern	Otus asio	Federal Migratory Nongame-Protected
Shrike, loggerhead	Lanius ludovicianus ludovicianus	Federal Migratory State Endangered Heritage G4 - Apparently secure glo Heritage S1 - Critically imperiled
Snipe, common	Capella gallinago	Game (Consumptive Recreational) Federal Migratory
Sparrow, chipping	Spizella passerina	Federal Migratory Nongame-Protected
Sparrow, field	Spizella pusilla	
Sparrow, house	Passer domesticus	Unclassified
Sparrow, song	Melospiza melodia	Federal Migratory Nongame-Protected
Starling, European	Sturnus vulgaris	Unclassified
Swallow, bank	Riparia riparia	Federal Migratory Nongame-Protected Heritage G5 - Demonstrably secure g Heritage S3 - Rare or uncommon in s
Swallow, barn	Hirundo rustica	Federal Migratory Nongame-Protected
Swallow, northern rough-w	Stelgidopteryx serripennis	Federal Migratory Nongame-Protected
Swift, chimney	Chaetura pelagica	Federal Migratory Nongame-Protected
Tanager, scarlet	Piranga olivacea	Federal Migratory Nongame-Protected
Tanager, summer	Piranga rubra	Federal Migratory Nongame-Protected
Teal, blue-winged	Anas discors orphna	Federal Migratory Game (Consumptive Recreational)
Teal, green-winged	Anas crecca carolinensis	Federal Migratory Game (Consumptive Recreational)
Thrasher, brown	Toxostoma rufum	Federal Migratory
Thrush, wood	Hylocichla mustelina	Federal Migratory Nongame-Protected
Titmouse, tufted	Parus bicolor	Federal Migratory Nongame-Protected
Towhee, rufous-sided	Pipilo erythrophthalmus	Federal Migratory Nongame-Protected
Turkey, wild	Meleagris gallopavo silvestris	Game (Consumptive Recreational)
Vireo, red-eyed	Vireo olivaceus	Federal Migratory Nongame-Protected
Vireo, white-eyed	Vireo griseus	Federal Migratory Nongame-Protected
Vireo, yellow-throated	Vireo flavifrons	Federal Migratory Nongame-Protected
Vulture, turkey	Cathartes aura	Federal Migratory Nongame-Protected
Warbler, Kentucky	Oporornis formosus	Federal Migratory Nongame-Protected

LIST OF WILDLIFE SPECIES OF CHESTERFIELD COUNTY, DREWRYS BLUFF QUAD, VIRGINIA

NAME	SCIENTIFIC NAME	T.STATUS
Warbler, black-and-white	Mniotilta varia	Federal Migratory Nongame-Protected
Warbler, black-throated b	Dendroica caerulescens	Federal Migratory Nongame-Protected
Warbler, blackburnian	Dendroica fusca	Federal Migratory Nongame-Protected
Warbler, cerulean	Dendroica cerulea	Federal Migratory Nongame-Protected
Warbler, chestnut-sided	Dendroica pensylvanica	Federal Migratory Nongame-Protected
Warbler, hooded	Wilsonia citrina	Federal Migratory Nongame-Protected
Warbler, magnolia	Dendroica magnolia	Federal Migratory Nongame-Protected Heritage G5 - Demonstrably secure g Heritage S2 - Imperiled in state be
Warbler, northern parula	Parula americana	Federal Migratory Nongame-Protected
Warbler, palm	Dendroica palmarum	Federal Migratory Nongame-Protected
Warbler, pine	Dendroica pinus	Nongame-Protected Federal Migratory
Warbler, prairie	Dendroica discolor	Federal Migratory Nongame-Protected
Warbler, prothonotary	Protonotaria citrea	Federal Migratory Nongame-Protected
Warbler, worm-eating	Helmitheros vermivorus	Nongame-Protected Federal Migratory
Warbler, yellow	Dendroica petechia	Federal Migratory Nongame-Protected
Warbler, yellow-rumped	Dendroica coronata cornata	Federal Migratory Nongame-Protected See Comments
Warbler, yellow-throated	Dendroica dominica	Federal Migratory Nongame-Protected
Waterthrush, Louisiana	Seiurus motacilla	Federal Migratory Nongame-Protected
Waxwing, cedar	Bombycilla cedrorum	Federal Migratory Nongame-Protected
Whip-poor-will	Caprimulgus vociferus	Federal Migratory Nongame-Protected
Wigeon, American	Anas americana	Federal Migratory Game (Consumptive Recreational)
Woodpecker, downy	Picoides pubescens medianus	Federal Migratory Nongame-Protected
Woodpecker, hairy	Picoides villosus	Federal Migratory Nongame-Protected
Woodpecker, pileated	Dryocopus pileatus	Nongame-Protected Federal Migratory
Woodpecker, red-bellied	Centurus carolinus	Federal Migratory Nongame-Protected
Woodpecker, red-headed	Melanerpes erythrocephalus	Federal Migratory Nongame-Protected Heritage G5 - Demonstrably secure g Heritage S3 - Rare or uncommon in s
Wren, Carolina	Thryothorus ludovicianus	Federal Migratory
Wren, house	Troglodytes aedon	Federal Migratory Nongame-Protected See Comments

LIST OF WILDLIFE SPECIES OF CHESTERFIELD COUNTY, DREWRYS BLUFF QUAD, VIRGINIA

NAME	SCIENTIFIC NAME	T.STATUS
Yellowthroat, common	Geothlypis trichas brachidactylus	Federal Migratory Nongame-Protected
		BIRDS
Bat, big brown	Eptesicus fuscus fuscus	Sensitive
		See Comments
		MAMMALS
Bat, evening	Nycticeius humeralis humeralis	Sensitive
		See Comments
Bat, hoary	Lasiurus cinereus cinereus	Nongame-Protected
		See Comments
Bat, northern red	Lasiurus borealis borealis	Unclassified
		See Comments
		Heritage G5 - Demonstrably secure g
		Heritage SU - Status uncertain in s
Bat, seminole	Lasiurus seminolus	Nongame-Protected
Bat, silver-haired	Lasionycteris noctivagans	Sensitive
		See Comments
		Heritage G5 - Demonstrably secure g
		Heritage S3 - Rare or uncommon in s
Beaver, Canadian	Castor canadensis canadensis	Game (Consumptive Recreational)
		Furbearer
		Commercial
Chipmunk, Fisher's easter	Tamias striatus fisheri	Pest/Nuisance
		See Comments
Cottontail, eastern	Sylvilagus floridanus mallurus	Game (Consumptive Recreational)
		Commercial
		Furbearer
		Pest/Crops
		See Comments
Deer, white-tailed	Odocoileus virginianus	Game (Consumptive Recreational)
		Pest/Crops
		See Comments
Fox, eastern gray	Urocyon cinereoargenteus cinereoargenteu	Game (Consumptive Recreational)
		Commercial
		Furbearer
		See Comments
Fox, red	Vulpes vulpes fulva	Game (Consumptive Recreational)
Mink, common	Mustela vison mink	Furbearer
		Sensitive
		Commercial
		See Comments
Mole, eastern	Scalopus aquaticus aquaticus	Nongame-Protected
Mole, small star-nosed	Condylura cristata parva	Nongame-Protected
		See Comments
Mouse, common golden	Ochrotomys nuttalli nuttalli	Nongame-Protected
Mouse, common white-foote	Peromyscus leucopus leucopus	Pest/Nuisance
Mouse, eastern harvest	Reithrodontomys humulis virginianus	Nongame-Protected
		See Comments
Mouse, house	Mus musculus	Pest/Nuisance
		See Comments
Mouse, meadow jumping	Zapus hudsonius americanus	Pest/Crops
		See Comments
Mouse, northern white-foo	Peromyscus leucopus noveboracensis	Pest/Nuisance
		See Comments
Muskrat, large-toothed	Ondatra zibethicus macrodon	Game (Consumptive Recreational)
		Commercial
		Furbearer
		See Comments
Myotis, Keen's	Myotis keenii septentrionalis	Unclassified
		See Comments
		Heritage G4 - Apparently secure gl

LIST OF WILDLIFE SPECIES OF CHESTERFIELD COUNTY, DREWRYS BLUFF QUAD, VIRGINIA

NAME	SCIENTIFIC NAME	STATUS
		Heritage S3 - Rare or uncommon in s
Myotis, little brown	Myotis lucifugus lucifugus	Sensitive
		See Comments
Opossum, Virginia	Didelphis virginiana virginiana	Game (Consumptive Recreational)
		Commercial
		Furbearer
Otter, river	Lutra canadensis lataxina	Sensitive
		See Comments
Pipistrelle, eastern	Pipistrellus subflavus subflavus	Nongame-Protected
		See Comments
Raccoon	Procyon lotor lotor	Game (Consumptive Recreational)
		Commercial
		Furbearer
		See Comments
Rat, hispid cotton	Sigmodon hispidus virginianus	Pest/Crops
Rat, marsh rice	Oryzomys palustris palustris	Nongame-Protected
Rat, norway	Rattus norvegicus	Pest/Nuisance
		See Comments
Shrew, least	Cryptotis parva parva	Nongame-Protected
Shrew, southeastern	Sorex longirostris longirostris	Nongame-Protected
		See Comments
Shrew, southern short-tai	Blarina brevicauda carolinensis	Unclassified
		See Comments
		Heritage G5 - Demonstrably secure g
		Heritage S3 - Rare or uncommon in s
Skunk, striped	Mephitis mephitis nigra	Furbearer
		Sensitive
		Commercial
		See Comments
Squirrel, black fox	Sciurus niger niger	Game (Consumptive Recreational)
		Pest/Crops
		See Comments
Squirrel, fox	Sciurus niger vulpinus	Game (Consumptive Recreational)
		Pest/Crops
Squirrel, northern gray	Sciurus carolinensis pennsylvanicus	Game (Consumptive Recreational)
		Pest/Nuisance
		Pest/Crops
		See Comments
Squirrel, southern flying	Glaucomys volans volans	Pest/Nuisance
		See Comments
Squirrel, talkative red	Tamiasciurus hudsonicus loquax	Nongame-Protected
		See Comments
Vole, meadow	Microtus pennsylvanicus pennsylvanicus	Pest/Crops
		See Comments
Vole, pine	Microtus pinetorum scalapsoides	Nongame-Protected
		Pest/Nuisance
		See Comments
Weasel, long-tailed	Mustela frenata noveboracensis	Furbearer
		Commercial
		See Comments
Woodchuck	Marmota monax monax	Game (Consumptive Recreational)
		Pest/Crops

MAMMALS

Mussel	Leptodea fluviatilis	Unclassified
Mussel, Eastern elliptio	Elliptio complanata	Unclassified
Crayfish	Cambarus robustus	Unclassified
Crayfish	Cambarus longulus	Unclassified
Crayfish	Cambarus acuminatus	Unclassified
Crayfish	Cambarus diogenes diogenes	Unclassified
Crayfish	Orconectes immunis	Unclassified

MUSSELS & CRAYFISH

LIST OF WILDLIFE SPECIES OF CHESTERFIELD COUNTY, DREWRYS BLUFF QUAD, VIRGINIA

NAME	SCIENTIFIC NAME	T.STATUS
Crayfish	Orconectes limosus	Unclassified
Crayfish	Fallicambarus uhleri	Unclassified
Crayfish	Cambarus bartonii bartonii	Unclassified

SOURCE : DGIF (1989)

TABLE E-3

ENDANGERED SPECIES OF THE COMMONWEALTH OF VIRGINIA

TABLE E-3

ENDANGERED SPECIES OF THE COMMONWEALTH OF VIRGINIA

VR 325-01, &13. **Endangered Species.**

A. Hereby adopt the Federal Endangered and Threatened Species List, Endangered Species Act, December 1973 [16 U.S.C. 1531-1543, as amended], and declare all species listed thereon endangered or threatened in the Commonwealth.

B. In addition to the previous species, the following species are declared endangered in this Commonwealth, and are afforded the protection provided by Article 6, Chapter 5, Title 29.1 of the Code of Virginia:

Fish:	
Blackbanded sunfish	Enneacanthus chaetodon
Sharphead darter	Etheostoma acuticeps
Carolina darter	Etheostoma collis
Blueside darter	Etheostoma jessiae
Tippecanoe darter	Etheostoma tippecanoe
Amphibians:	
Eastern tiger salamander	Ambystoma tigrinum
Shenandoah salamander	Plethodon shenandoah
Reptiles:	
Bog turtle	Clemmys muhlenbergii
Chicken turtle	Deirochelys reticularia
Birds:	
Wilson's plover	Charadrius wilsonia
Bewick's wren	Thryomanes bewickii
Loggerhead shrike	Lanius ludovicianus
Mammals:	
Water shrew	Sorex palustris
Fisher	Martes pennanti
Rafinesque's big-eared bat	Plecotus rafinesquii
Molluscs:	
James River spiny mussel	Pleurobema collina
Cumberland combshell	Epioblasma brevidens
Oyster pearly mussel	Epioblasma capsaeformis
Snuffbox pearly mussel	Epioblasma triquetra
Little-wing pearly mussel	Pegias fabula

C. It shall be unlawful to take, transport, process, sell or offer for sale, within the Commonwealth, any threatened or endangered species. Regulation effective October 1, 1987.

SOURCE: DGIF (1989)

TABLE E-4

FEDERAL THREATENED AND ENDANGERED SPECIES LIST FOR VIRGINIA FAUNA

TABLE E-4

FEDERAL THREATENED AND ENDANGERED SPECIES LIST FOR VIRGINIA FAUNA

COMMON NAME	SCIENTIFIC NAME
Birds:	
Bald Eagle	Haliaeetus leucocephalus
Piping Plover	Charadrius melodus
Peregrine Falcon	Falco peregrinus
Red-cockaded Woodpecker	Dendrocopos borealis
Bachman's Warbler	Vermivora bachmanii
Mammals:	
Gray Bat	Myotis grisescens
Indiana Bat	Myotis sodalis
Virginia Big-eared Bat	Plecotus townsendii virginianus
Delmarva Fox Squirrel	Sciurus niger cinereus
Northern Flying Squirrel	Glaucomys sabrinus
Dismal Swamp Shrew	Sorex longirostris fisheri
Eastern Cougar	Felis concolor couguar
Marine Mammals:	
Finback Whale	Balaenoptera physalus
Sei Whale	Balaenoptera borealis
Humpback Whale	Megaptera novaeangliae
Right Whale	Balaena glacialis
Sperm Whale	Physeter catodon
Florida Manatee	Trichechus manatus
Reptiles:	
Kemp's Ridley Sea Turtle	Lepidochelys kempi
Hawksbill Sea Turtle	Eretmochelys imbricata
Leatherback Sea Turtle	Dermochelys coriacea
Loggerhead Sea Turtle	Caretta caretta
Green Sea Turtle	Chelonia mydas
Fish:	
Shortnose Sturgeon	Acipenser brevirostrum
Yellowfin Madtom	Noturus flavipinnis
Spotfin Chub	Hybopsis monacha
Slender Chub	Hybopsis cahni
Molluscs:	
Tan Riffle Shell Mussel	Epioblasma walkeri
Appalachian Monkeyface	Quadrula sparsa
Birdwing Pearly Mussel	Conradilla caelata
Cumberland Monkeyface	Quadrula intermedia
Dromedary Pearly Mussel	Dromus dromus
Fine-rayed Pearly Mussel	Fusconaia cuneolus
Green Blossom Pearly Mussel	Epioblasma torulosa gubernaculum
Rough Pigtoe Pearly Mussel	Pleurobema plenum
Shiny Pigtoe Pearly Mussel	Fusconaia edgariana
Virginia Fringed Mountain Snail	Polygriscus virginianus
Arthropods:	
Madison Cave Isopod	Antrolana lira

SOURCE : DGIF (1989)

AR301861

* Virginia Commission of Game and Inland Fisheries Nongame Program *

LETTER E-1

B. C. LEYNES, JR.
Director

DIVISIONS
ADMINISTRATION
HISTORIC LANDMARKS
PARKS AND RECREATION
SOIL AND WATER CONSERVATION

COMMONWEALTH of VIRGINIA

DEPARTMENT OF CONSERVATION AND HISTORIC RESOURCES
VIRGINIA NATURAL HERITAGE PROGRAM
203 GOVERNOR STREET, SUITE 402
RICHMOND, VIRGINIA 23219
(804) 786-7951

March 1, 1989

Richard M. Ninesteel
NUS Corporation
Park West Two
Cliff Mine Road
Pittsburgh, PA 15275-1071

Dear Richard:

In response to your request, I have searched the database of the Virginia Natural Heritage Program for rare flora of the Drewrys Bluff, Virginia USGS quadrangle.

Currently, only one rare plant location has been reported from that quadrangle. This location is for Chelone cuthbertii (Cuthbert turtlehead). The information was obtained from herbarium label information and has not recently been verified by staff scientists. The location, however, is not in the vicinity of the C&R Battery Site.

If I can be of further assistance, please contact me.

Thank you for your interest.

Sincerely,

Katie Perry

Katie Perry
Environmental Programs Specialist