

**MUSKOGEE COMMUNITY RECYCLING
AND DISPOSAL FACILITY
MUSKOGEE COUNTY, OKLAHOMA
ODEQ PERMIT NO. 3551020

TIER III PERMIT MODIFICATION
LANDFILL EXPANSION

VOLUME 2B OF 4**

Prepared for

Waste Management of Oklahoma, Inc.

October 2023



Prepared by

Weaver Consultants Group, LLC
CA 3804 PE 06/30/2025
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WCG Project No. 0086-364-11-19

**MUSKOGEE COMMUNITY RECYCLING
AND DISPOSAL FACILITY
MUSKOGEE COUNTY, OKLAHOMA
ODEQ PERMIT NO. 3551020**

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LANDFILL EXPANSION**

VOLUME 2B OF 4

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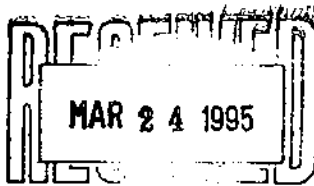
PERMITTED LANDFILL SUBSURFACE INVESTIGATION REPORTS

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RUST
RUST PHASE II HYDROGEOLOGICAL INVESTIGATION REPORT
(1994)



(94-106)

**PHASE II - HYDROGEOLOGICAL INVESTIGATION
FOR
MUSKOGEE LANDFILL AND RECYCLING CENTER
MUSKOGEE, OKLAHOMA**

Appendices

**Prepared For:
WASTE MANAGEMENT OF OKLAHOMA, INC.
MUSKOGEE, OKLAHOMA**

**Prepared By:
RUST ENVIRONMENT & INFRASTRUCTURE
100 Glenborough Dr., Suite 300
Houston, Texas 77067**

RUST E & I PROJECT NO. 86251

October, 1994

**QUALITY
♦
INTEGRITY
♦
CREATIVITY
♦
RESPONSIVENESS**

**RUST ENVIRONMENT &
INFRASTRUCTURE**



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**PHASE II - HYDROGEOLOGICAL INVESTIGATION
FOR
MUSKOGEE COMMUNITY LANDFILL AND RECYCLING CENTER
MUSKOGEE, OKLAHOMA**

APPENDICES

**Prepared For:
WASTE MANAGEMENT OF OKLAHOMA, INC.
MUSKOGEE, OKLAHOMA**

**Prepared By:
RUST ENVIRONMENT & INFRASTRUCTURE
100 GLENBOROUGH, SUITE 300
HOUSTON, TEXAS 77067**

PROJECT NO. 86251.150

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APPENDIX A
CLIMATOLOGICAL DATA

STATION (Climate only)

Muskogee

(River Station, if different)

Muskogee

MONTH

Jan

DAY

23

WS FORM B-91

(7-89)

U.S. DEPARTMENT OF COMMERCE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

NATIONAL WEATHER SERVICE

STATE

Oklahoma

COUNTY

Muskogee

RIVER

Arkansas

TIME (local) OF OBSERVATION

8:27 am

TEMP.

72

PRECIPITATION

0.00

STANDARD TIME IN USE

CST

TYPE OF RIVER GAGE

ELEVATION OF RIVER GAGE ZERO

FLOOD STAGE

NORMAL POOL STAGE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

TEMPERATURE F.				PRECIPITATION												WEATHER (Calendar Day)						RIVER STAGE		REMARKS (Special observations, etc.,)
24 HRS. ENDING AT OBSERVATION			AT OBSN.	24-HR AMOUNTS		A.M.	NOON	P.M.	Mark "X" for all types occurring each day.						GAGE READING AT	TENDENCY								
MAX.	MIN.			24-HR AMOUNTS	A.M.				NOON	P.M.	Pop	Ice Pellets	Glaze	Thunder			Hail	Damaging Winds						
DATE																								
1	31.4	20.3	31.4																					
2	42	31	42																					
3	65	41	55	.18																				
4	60	30	33																					
5	60	21.3	35																					
6	43	26	39																					
7	47	31	45	.04													lt. Mist							
8	46	37	37																					
9	39	36	38	.86																				
10	38	20	28														lt. Rain							
11	41	28	39	.05													lt. Mist							
12	44	37	39																					
13	39	19.2	29.4																					
14	34	25	34																					
15	46	31	44																					
16	51	39	49																					
17	49	29	45																					
18	49.6	32	32.7	.04													lt. Mist, F.R.							
19	33.9	30	35.9	1.03																				
20	41.8	30.5	38.6																					
21	47	37	44																					
22	57	29	55																					
23	52.9	29.4	48	T																				
24	47.8	27.5	44.4																					
25	48.2	22.2	46.4																					
26	54.8	25.8	48.3																					
27	63	29	59																					
28	59.3	39.9	53.6																					
29	52.6	28	38.8																					
30	53.6	20.3	47.1																					
31	64	28	63																					
SUN				2.14																				
CONDITION OF RIVER AT GAGE					CHECK BAR (For micro weights) NORMAL CR. BAR																			
					READING																			
					DATE																			
					OBSERVER																			
					SUPER																			

T = .01

STATION (Climatological)		(River Station, if different)		MONTH	YEAR	WS FORM 8-91 (7-89)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE	
STATE <u>Mississippi</u>		COUNTY <u>Mississippi</u>		RIVER <u>Arkansas</u>				
TIME (local) OF OBSERVATION <u>17-5pm</u>		TEMP. <u>2am</u>		STANDARD TIME IN USE <u>C.S.T.</u>				
TYPE OF RIVER GAGE		ELEVATION OF RIVER GAGE ZERO		FLOOD STAGE		NORMAL POOL STAGE		
TEMPERATURE F.		PRECIPITATION		WEATHER (Calendar Day)		RIVER STAGE		
24 HRS. ENDING AT OBSERVATION		24-HR. AMOUNTS		A.M. NOON P.M.		GAGE READING AT		
MAX. MIN. OBS.		Rain, in. (measured or estimated)		Snow, in. (measured or estimated)		TENDENCY		
DATE		A.M. NOON P.M.		Fog Ice Pellets Sleet Thunder Hail Drizzle		REMARKS		
1		64 28 59						
2		57.7 37.4 52.8		T				
3		52.8 42.2 45.1		T				
4		46.7 42 45		41				
5		49.8 41.5 46.2				Visibility 3 blocks		
6		55.5 36.8 54.3						
7		63.5 29.1 62.2						
8		69 33 66						
9		68 40.4 63.8						
10		64 48.5 51.4		.55				
11		53 43 43						
12		48.9 35.9 32.5						
13		48 28.3 48.3						
14		48 27 46		1.60 9.0		Heavy Wet Snow Began 10pm		
15		46.5 31.8 32.2		.03 T		Changed to Rain + Snow 4am, Snow till 11am		
16		33.2 18.5 21.7						
17		21.7 12.2 22.4						
18		19.6 9.1 23.7						
19		47.3 20.4 47.1						
20		66 33 64		M				
21		64.4 38.3 46.9		O				
22		46.7 25.7 37.9						
23		39 28 38						
24		38 26 30		1.50				
25		38.6 26.6 31.4						
26		34.8 21.5 33						
27		41.9 23.5 40.8						
28		44.9 34.1 43.8						
29								
30								
31								
SUM		4.09		CHECK BAR (For use with) NORMAL CK. BAR				
CONDITION OF RIVER AT GAGE		READING		DATE				
A. Obscured by rough ice.		B. Ice gauge below gage.		C. Upper surface of ice.		D. Ice gauge above		
E. Frozen, but open.		F. Shore ice.		G. Floating ice.		H. Pool stage.		
OBSERVER		SUPERVISOR		STATION INDEX NO.				
Mary J. Fuller				34-6130-6				
W30, TULSA, OKLAHOMA								

KEYED BY 17540

STATION (Climatological)		(River Station, if different)		MONTH	WS FORM B-91 (7-89)		U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE					
Muskogee				April	1993							
STATE	COUNTY	RIVER		RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS								
Oklahoma	Muskogee	Arkansas										
TIME (local) OF OBSERVATION	TEMP.	PRECIPITATION	STANDARD TIME IN USE									
7 am	7 am		CDT									
TYPE OF RIVER GAGE		ELEVATION OF RIVER GAGE ZERO	FLOOD STAGE	NORMAL POOL STAGE								
		Fl.	Fl.	Fl.								
TEMPERATURE F.			PRECIPITATION			WEATHER (Calendar Day)			RIVER STAGE			
24 HRS. ENDING AT OBSERVATION			24-HR. AMOUNTS			Mark 'X' for all types occurring each day.			GAGE READING AT			
AT OBSN.			A.M. NOON P.M.			Fog Ice Pellets Sleet Thunder Hail Drizzling Wind			TENDENCY			
DATE	MAX.	MIN.	OBSN.	1 2 3 4 5 6 7 8 9 10 11 12			1 2 3 4 5 6 7 8 9 10 11 12			A.M.		
1	52	39	42									
2	57.7	30.2	56.7									
3	56	44	50									
4	50.3	40.1	43.3									
5	47	38	47									
6	63.6	35	61									
7	65.6	39	65.1									
8	65.1	48	51									
9	72	39	71									
10	81.8	50.7	80.2									
11	80.2	49	79									
12	82	53	80									
13	79.7	46.9	67.6									
14	68	43	43									
15	50	39	50									
16	66	39	65									
17	66.3	39.2	51									
18	74	48	73									
19	80.4	48.9	73.9									
20	80.4	43.1	60.9									
21	63	37	62									
22	72	36	71									
23	75.9	54.3	72.3									
24	76.5	66.2	73.4									
25	74.7	53.2	72.6									
26	76.6	46.5	75.4									
27	76.8	54.5	75.3									
28	77.1	55.7	68.7									
29	71.2	58.4	71									
30	71	67.2	69.4									
31												
SUM			5.31	CHECK BAR (For stream-gage) NORMAL CR. BAR								
CONDITION OF RIVER AT GAGE			READING	DATE			OBSERVED			STATION INDEX NO.		
A. Obscured by rough ice.							Mary J. Fuller			84-6130-6		
B. Frozen, but open.												
C. Upper surface of ice.												
D. Ice gorge above gage.												
E. Ice gorge below gage.												
F. Shove ice.												
G. Floating ice.												
H. Pool stage.												

STATION (Climatological)		(River Station, if different)		MONTH	DAY	WS FORM 8-81 (7-89)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE	
Muskegoe				May	1993			
STATE Oklahoma		COUNTY Muskogee		RIVER Arkansas				
TIME (Local) OF OBSERVATION RIVER		TEMP. PRECIPITATION		STANDARD TIME IN USE				
5:00 am		50.2 am		CDT				
TYPE OF RIVER GAGE		ELEVATION OF RIVER GAGE ZERO		FLOOD STAGE		NORMAL POOL STAGE		
		Ft.		Ft.		Ft.		
TEMPERATURE F.			PRECIPITATION		WEATHER (Calendar Day)		RIVER STAGE	
24 HRS. ENDING AT OBSERVATION			24-HR AMOUNTS		Mark 'X' for all types occurring each day.		GAGE READING AT	
DATE	MAX.	MIN.	AT OBSN.	24-HR AMOUNTS	PRECIPITATION	WEATHER	CONDITION	TENDENCY
1	79.0	58.6	77.2					
2	78	60.5	68.5	.81				
3	68.5	55.9	61.3					
4	81.1	49.6	80					
5	82.4	64.2	75.7	.60				
6	80.9	64.4	72.5					
7	81.5	69.6	78.8					
8	78.9	67.4	67.8	.42				
9	67.8	57.5	57.9	5.33				
10	68.6	54.5	55.4	.21				
11	61.5	53.8	60.9	.39				
12	67	51.9	65					
13	71	53	68					
14	74.8	45.3	74.6					
15	84	56	82					
16	88.2	56.3	77					
17	84.5	62.9	83.1	.29				
18	83.1	60.8	68.7					
19	68.9	47.8	65.1					
20	69.4	50.5	66.9					
21	67	49	66	.26				
22	76	57	86					
23	77.9	65.1	67.4	.10				
24	81	61	80					
25	80.2	60	76.4					
26	78	53.7	77.5					
27	82	56.4	80.6					
28	82.4	63.3	80.7					
29	82.2	68.7	78.6					
30	86.8	66.5	84.9					
31	85.2	59.9	7.3					
SUM			8.40					
CONDITION OF RIVER AT GAGE			CHECK BAR (For with-weights) NORMAL CK. BAR		OBSERVER		STATION INDEX NO.	
			READING		DATE			
					Mary J. Fuller			
					SUPERVISOR			
					OFFICE			
					JULSA, OKLAHOMA			
					34-6130-6			

STATION (Climatological)		(River Station, if different)		MONTH	WS FORM B-91 (7-89)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE	
Muskegee				JUNE 1993			
STATE Oklahoma		COUNTY Muskogee		RIVER Arkansas			
TIME (Local) OF OBSERVATION		TEMP. 5:00 PM		PRECIPITATION 7.0 mm	STANDARD TIME IN USE CDT		
TYPE OF RIVER GAGE		ELEVATION OF RIVER GAGE LEAD		FLOOD STAGE	NORMAL POOL STAGE		
		Ft.		Ft.	Ft.		

DATE	TEMPERATURE F.			PRECIPITATION		WEATHER (Calendar Day)						RIVER STAGE		REMARKS (Special observations, etc.)	
	24 HRS. ENDING AT OBSERVATION		AT	24-HR AMOUNTS	At Gage	Mark 'X' for all types occurring each day.						GAGE READING AT	TENDENCY		
	MAX.	MIN.				Obsn.	A.M.	NOON	P.M.	Fog	Ice Pellets				Shrubs
1	76.7	52.8	75												
2	85	63	84												
3	87	69.6	94.5												
4	84.7	68	75.7												
5	78.6	55	77												
6	82.4	67.6	86.5												
7	87.6	74.3	80.9	.12											
8	80.9	66.2	72.1	.86											
9	82.3	64.7	61.1	.43											
10	78	62.6	76.4												
11	79	67	73												
12	85.1	56.6	84.5												
13	87	69.4	86.5												
14	87	63.9	73.5	.75											
15	87	70	77												
16	89.7	71.9	86.3												
17	87.6	69.2	78.6	.84											
18	87	72	79	.03											
19	84.7	71.4	76.1												
20	84	76	81	.15											
21	86	69	85	1.23											
22	86.7	71.2	85.9												
23	90.6	71	71.2	.16											
24	88	69	88												
25	88	67	74.4	.05											
26	82.9	67.6	81.6												
27	85	68	85												
28	87	73	89												
29	90	75	90												
30	90.8	78.2	89.4												
31															
SUM			411												

CONDITION OF RIVER AT GAGE		CHECK BAR (For wire-sight) NORMAL CK. BAR		OBSERVER		STATION INDEX NO.	
A. Obstructed by rough ice.	E. Ice gage below gage.	READING	DATE	Mary J. Fuller		34-6130	
B. Frozen, but open at gage.	F. Shore ice.			SUPERVISING OFFICER			
C. Surface of smooth ice.	G. Floating ice.			NEW 30, TULSA, OKLAHOMA			
D. Ice above gage.	H. Pool stage.						

[illegible]

KEYED BY J11128

STATION (Climatological)		(River Station, if different)		MONTH	WE FORM B-81 (7-89)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE	
STATE	COUNTY	RIVER	DATE	RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS			
TIME (Local) OF OBSERVATION	TEMP.	PRECIPITATION	STANDARD TIME IN USE				
TYPE OF RIVER GAGE	ELEVATION OF RIVER GAGE ZERO	FLOOD STAGE	NORMAL POOL STAGE				
Muskogee		Muskogee	Arkansas	Aug 1923			
Okla		Muskogee	Arkansas	Aug 1923			
7 am		7 am	C.D.T.				
TYPE OF RIVER GAGE		ELEVATION OF RIVER GAGE ZERO	FLOOD STAGE	NORMAL POOL STAGE			
TEMPERATURE P.		PRECIPITATION		WEATHER (Calendar Day)		RIVER STAGE	REMARKS (Special observations, etc.)
24 HRS. ENDING AT OBSERVATION		24-HR. AMOUNTS		Mark 'X' for all types occurring each day.		GAGE READING AT	
DATE	MAX.	MIN.	OBS.	A.M. NOON P.M.		CONDITION	
1	102.5	76	97				Thunder Sun. Afternoon - No Rain
2	99	74	94				
3	99.3	69.8	86.5				
4	88	70	85				
5	85	67	72				Began 8:15 am End 4 am
6	85.2	63.3	72.5				
7	86	58	83				
8	88.3	68.1	86.5				
9	92.4	75.9	84.8				
10	98	75	97				
11	98	77.1	95.7				
12	102.9	72.5	101.1				
13	100	73	100				
14	107	77.1	101.4				
15	101.4	75.9	98.9				
16	109	77	101				
17	101.8	78.3	101.3				
18	103	75	101.1				
19	103.4	75	101				
20	103.6	78	102.3				
21	104	75	102.3				
22	102.6	77	98.5				
23	105.6	77	93				
24	93	68.5	87.4				
25	88	75	83				
26	92.1	70.7	98.6				
27	92.4	73.8	94.6				
28	97.7	72.2	95.5				
29	97.5	75.9	94.8				
30	95	75	87				
31	89	67	72				
SUN		4.37		CHECK BAR (For micro-weight) NORMAL C.E. BAR			
CONDITION OF RIVER AT GAGE		READING		DATE			
A. Obscured by rough ice.		B. Ice gorge below gage.		C. Shown ice.		D. Floating ice.	
E. Ice above gage.		F. Pool stage.		G. Normal stage.		H. Pool stage.	
OBSERVER		SUPERVISING OFFICER		STATION INDEX NO.			
Mary J. Fuller		W30, TULSA, OKLAHOMA		34-6130			

[illegible]

[illegible]

[illegible]

[illegible]

KEYED BY 17540

STATION (Climatological)			(River Station, if different)			MONTH		YEAR		WS FORM B-91 (7-89)		U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE		
Muskogee			Muskogee			JAN		1994						
STATE			COUNTY			RIVER		STANDARD TIME IN USE						
Oklahoma			Muskogee			Arkansas		EST						
TIME (local) OF OBSERVATION			TEMP.			PRECIPITATION			STANDARD TIME IN USE					
5 PM			7 AM			EST								
TYPE OF RIVER GAGE			ELEVATION OF RIVER GAGE ZERO			FLOOD STAGE			NORMAL POOL STAGE					
			17 Ft.											
TEMPERATURE F.			PRECIPITATION			WEATHER (Calendar Day)			RIVER STAGE			REMARKS		
24 HRS. ENDING AT OBSERVATION			24-HR. AMOUNTS			A.M.			NOON			P.M.		
DATE			A.M.			NOON			P.M.			DATE		
MAR.			MIN.			OBSH.			MAR.			MIN.		
1			59 29 57			0			1			1		
2			51.8 27.6 43.8			.02			2			2		
3			46 27.3 31.4						3			3		
4			55.7 26.2 33						4			4		
5			55 26 31						5			5		
6			5.8 26 33						6			6		
7			38.6 12 22.2						7			7		
8			43.5 13.8 41.9						8			8		
9			51.9 27.3 48.9						9			9		
10			49 42 46						10			10		
11			49 42.2 47.1						11			11		
12			47 32 35						12			12		
13			55 31 49						13			13		
14			48.2 22.2 27.6						14			14		
15			31 21 29						15			15		
16			36.1 22.2 31.1			.46 M			16			16		
17			32 13 17			M			17			17		
18			19.5 12.3 16.5			M			18			18		
19			34 12 32			O			19			19		
20			44 31.3 34.3						20			20		
21			43.8 20.6 35.2						21			21		
22			45.5 31.1 43.1						22			22		
23			47.6 34 47.4			.13			23			23		
24			53.9 26.4 33						24			24		
25			67 47 58						25			25		
26			61.6 50.7 57			1.94			26			26		
27			57.2 33 37.7						27			27		
28			58 26 36						28			28		
29			46.8 22.1 40.4						29			29		
30			40.4 27.1 32.9						30			30		
31			32.9 15.4 26.1						31			31		
SUM			2.41			X			SUM			SUM		
CONDITION OF			AT GAGE			CHECK GAGE (For instrument) NORMAL CK. GAGE			READING			DATE		
A. Observed by			B. Ice gage below gage.			C. Frozen, but open at gage.			D. Upper surface of ice at gage.			E. Floating ice.		
A. Observed by			B. Ice gage below gage.			C. Frozen, but open at gage.			D. Upper surface of ice at gage.			E. Floating ice.		
A. Observed by			B. Ice gage below gage.			C. Frozen, but open at gage.			D. Upper surface of ice at gage.			E. Floating ice.		

STATION (Climatological)

STATE

TIME (local) OF OBSERVATION

TYPE OF RIVER GAGE

(River Station, if different)

COUNTY

TEMP.

ELEVATION OF RIVER GAGE ZERO

MONTH

RIVER

PRECIPITATION

STANDARD TIME IN USE

WS FORM B-81

(7-59)

U.S. DEPARTMENT OF COMMERCE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

TEMPERATURE F.			PRECIPITATION		WEATHER (Calendar Day)							RIVER STAGE		REMARKS (Special observations, etc.)	
24 HRS. ENDING AT OBSERVATION			16-HR. AMOUNTS	AT ON	Mark "X" for all types occurring each day.							GAGE READING AT	TENDENCY		
DATE	MAX.	MIN.	Obs.	16-Hr. amount (inches and hundredths)	16-Hr. amount (inches and hundredths)	Pay	Ice Pellets	Clouds	Thunder	Fog	Drifting Snow	Time of observation if different from above	CONDITION		A.M.
1	44	15	41												
2	47.1	15.9	46.4												
3	57	27	53												
4	53	41	51												
5	53.4	36.5	40.6	.15											
6	50.9	34.6	57.7												
7	57.7	53.4	46.7												
8	46.7	26.6	46.7												
9	47.1	10.4	17.2	.08											
10	37.8	14.8	35.2												
11	40.9	20.8	45.6												
12	44.4	26.6	44.4												
13	49.6	23	49.1												
14	57	30.5	55												
15	62.4	32.7	56.6												
16	65	30	60												
17	68.9	30.3	60												
18	69	48.3	65.3												
19	65.3	58	61	.61											
20	66	44	62	.65											
21	62.2	41.5	52.1												
22	56.1	46.4	41.9	T	T										
23	47.8	28	29												
24	54.8	19.9	53.7												
25	53.7	30.1	30.9												
26	39.9	17.4	35												
27	42.4	23.1	42.2												
28	44	39	40	.44											
29															
30															
31															

LOCATION OF RIVER AT GAGE

1.93 YR

CHECK BAR (Do not write at right) NORMAL CN. BAR

READING

DATE

SUPERVISING OFFICER

Mary J. Fuller

STATION NO. AND

94-6130-6

REMARKS

(Special observations, etc.)

11:15-8PM
 ht Rain 12pm/1m with 4-9pm High Rain
 ht " ACFT OF Night
 Spit 3 snow all day
 Rain Bgn 1pm - still Rainy
 3-10pm with Fog

KEYED BY 1753

99

STATION (Climatological)		(River Station, if different)		MONTH		WS FORM B-81 (7-89)		U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE	
Muskoogee		Muskoogee		March 94				RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS	
STATE Oklahoma		COUNTY Muskogee		RIVER Arkansas					
TIME (local) OF OBSERVATION 7:00 PM		TEMP. 78.0		PRECIPITATION 0.97		STANDARD TIME IN USE CST			
TYPE OF RIVER GAGE		ELEVATION OF RIVER GAGE ZERO (14)		FLOOD STAGE		NORMAL POOL STAGE			
TEMPERATURE F.			PRECIPITATION		WEATHER (Calendar Day)		RIVER STAGE		REMARKS (Special observations, etc.)
24 HRS. ENDING AT OBSERVATION			24-HR. AMOUNTS		Mark 'X' for all types occurring each day.		GAGE READING AT		
MAX.	MIN.	AT OMSN.	IN. (to 0.01)	IN. (to 0.01)	Ice Pellets	Sleet	Thunder	Lightning	
DATE									
1	41	34	34	0.00					
2	50	32	50	0.00					
3	71.2	28.8	69	0.00					
4	76.1	41.5	73.5	0.00					
5	76.1	41.5	74	0.00					
6	79.1	39.3	76.4	1.50					
7	76	49	50	1.01	7.20				
8	51	30	30	0.00					
9	39.3	29.6	37.7	0.00					
10	56	26	55	0.00					
11	64.9	35	58.1	0.00					
12	57.7	58.1	58.1	0.00					
13	63	47	63	0.00					
14	NIT			0.00					
15				0.00					
16	69.6	32.3	67.4	0.00					
17	79.1	38.3	77	0.00					
18	77	55	71	0.00					
19	82.7	42.8	80.6	0.00					
20	82.3	66	77.9	0.00					
21	78.4	44.9	68.5	0.00					
22	75.9	40.1	72.3	0.00					
23	82.7	57.7	80.7	0.00					
24	80.9	42	43	1.18					
25	63	34	57.7	0.00					
26	57.9	48.4	58.1	1.35					
27	53	45.3	52.3	0.00					
28	52.3	33.4	50.7	0.00					
29	60.6	33.4	52.7	0.00					
30	59.9	34.1	50	0.00					
31	66.2	31.8	65.3	0.00					
SUN			5.06	7.2	CHECK BAR (or pressure) NORMAL CK. BAR				
LOCATION OF RIVER AT GAGE			READING		DATE				
Observed by rough ice.			Observed by rough ice.		Observed by rough ice.				
Obs. by frozen, but open at 21st.			Obs. by frozen, but open at 21st.		Obs. by frozen, but open at 21st.				
Obs. by upper surface of smooth ice.			Obs. by upper surface of smooth ice.		Obs. by upper surface of smooth ice.				
Obs. by lower surface of smooth ice.			Obs. by lower surface of smooth ice.		Obs. by lower surface of smooth ice.				
Obs. by floating ice.			Obs. by floating ice.		Obs. by floating ice.				
Obs. by ice gauge below gage.			Obs. by ice gauge below gage.		Obs. by ice gauge below gage.				
Obs. by shore ice.			Obs. by shore ice.		Obs. by shore ice.				
Obs. by floating ice.			Obs. by floating ice.		Obs. by floating ice.				
Obs. by ice gauge below gage.			Obs. by ice gauge below gage.		Obs. by ice gauge below gage.				
Obs. by shore ice.			Obs. by shore ice.		Obs. by shore ice.				
Obs. by floating ice.			Obs. by floating ice.		Obs. by floating ice.				

(Thunder & lightning)
Rain Aug 10. Snow 9:30am SNOW
Heavy T.A. 6:30pm. SNOW END 3:11

Observed by Mary J. Fuller
SUPERVISING OFFICER
NWSU, TULSA, OKLAHOMA

STATION INDEX NO. 34-6130-6

STATION (Climatological)			River Station, if different			MONTH		WS FORM B-81 (7-89)		U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE	
STATE			COUNTY			RIVER		STANDARD TIME IN USE		RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS	
TIME (Local) OF OBSERVATION			TEMP.			PRECIPITATION		NORMAL POOL STAGE			
TYPE OF RIVER GAGE			ELEVATION OF RIVER GAGE			FLOOD STAGE					
Muskogee			Muskogee			Arkansas		C.D.T.			
10:30 am			70.5			7.0		C.D.T.			
TEMPERATURE F			PRECIPITATION			WEATHER (Calendar Day)			RIVER STAGE		
24 HRS. ENDING AT OBSERVATION			24-HR AMOUNTS			Mark 'X' for all types occurring each day.			GAGE READING AT		
MAX MIN OCSN			Rain, melted snow, sleet, and rain (inches)			Fog Ice Pellets Sleet Thunder Hail Damaging Winds			CONDITION		
DATE			Snow, ice pellets, hail, ice on ground (inches)			Time of Abatement, if different from above			TENDENCY		
			A.M. NOON P.M.						REMARKS (Special observations, etc.)		
1			76.8 47.6 73.5						Hail 3/4 min Nickel Sized		
2			73.9 56.1 70								
3			75 70 56 145								
4			74 38 46.7								
5			66.7 39.7 40.1 105								
6			48.3 31.8 48.3								
7			40.8 33.5 40								
8			70 46 89						Hail Quarter Size		
9			69 38 65								
10			77.3 63.7 78.8 102								
11			78.8 57.3 57.3 1.73								
12			10.4 4A 58.6								
13			84.5 89.3 82.5								
14			82.7 63.5 79.7								
15			80.1 53.7 68.5								
16			77 39.3 76.4								
17			80.9 45.5 84								
18			80.9 45.2 77.5								
19			83 54 8A								
20			84 57 83								
21			83.8 68 82								
22			84.9 60.8 74.6								
23			75.9 58.6 74.4								
24			82.7 60 81						Tornado Watch		
25			81.6 63.3 69.9 T								
26			83.3 66.3 78.4 T								
27			78.4 53 68.4 HO						Sun. Thsta Watch		
28			63.1 50.1 59.7 1.21								
29			60.6 45.1 48.8 1.61								
30			52 45 51								
31											
SUN 3.47			CHECK BAR (For air-weight) NORMAL CG. BAR								
CONDITION OF WATER AT GAGE			READING			DATE					
A. Observed below gage.			B. Ice gage below gage.			C. Frozen, but not below gage.			D. Floating ice.		
E. Upper surface of current ice.			F. Lower surface of current ice.			G. Ice on bank.			H. Ice on bar.		
I. Ice on bar.			J. Ice on bar.			K. Ice on bar.			L. Ice on bar.		
M. Ice on bar.			N. Ice on bar.			O. Ice on bar.			P. Ice on bar.		
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U. Ice on bar.			V. Ice on bar.			W. Ice on bar.			X. Ice on bar.		
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CR. Ice on bar.			CS. Ice on bar.			CT. Ice on bar.			CU. Ice on bar.		
CS. Ice on bar.			CT. Ice on bar.			CU. Ice on bar.			CV		

STATION (Geographical)		(River Station, if different)		MONTH	W/S FORM 8-81 (7-59)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE								
Muskoys				May	74									
STATE Oklahoma		COUNTY Muskogee		RIVER Arkansas										
TIME (hour) OF OBSERVATION		TEMP. 5 PM 7 AM		STANDARD TIME IN USE C.D.T.										
TYPE OF RIVER GAGE		ELEVATION OF RIVER GAGE ZERO		FLOOD STAGE		NORMAL POOL STAGE								
TEMPERATURE				PRECIPITATION				WEATHER (Calendar Day)				RIVER STAGE		REMARKS (Special observations, etc.)
24 HRS. ENDING AT OBSERVATION				24 HRS. AMOUNTS				Mark 'X' for all types occurring each day				GAGE READING AT		
MAX	MIN	AT GAGE		Rain, melted snow, etc. (inc. and duration)	Snow, ice pellets, etc. (inc. and duration)	Snow, ice pellets, etc. (inc. and duration)		Thunder	Lightning	Wind	Clouds	CONCLOUD	AM	
60.9	42.4	60.9	1.03											
61.7	41.7	61.7	1.14											
67.4	45.3	66.9												
73.2	72.3	71.2												
78	50	77												
79.3	60	77.3												
77.5	57.3	76.6	46											
66.9	44	66	40											
73.3	57.2	70.3												
79	54	77												
79	59	76												
76.8	65.3	74.8	08											
78.4	63.3	78.2	34											
78.2	65.3	77.3	03											
78.7	60.4	78.1												
83.3	56.4	82.5												
83.9	64.7	80.6												
81.5	58.9	80.9												
81.6	55.7	79.5												
80	55	76												
79.7	53.5	78.6												
80.9	56.5	80.2												
83.4	56.8	81.5												
83.1	64.7	81	03											
86.3	64.7	85.1												
86.4	64	76.6	36											
78	57	74												
77.3	60.6	76.8												
78.6	60.6	76.8	54											
86.9	61.8	84.9												
89.8	64.7	82.7												
CONDITION OF "R" AT GAGE				CHECK BAR (For wire weight) NORMAL C.K. BAR				Log				STATION NUMBER		
A. Observed by gage				READING				DATE				STATION NUMBER		
B. Observed by gage														
C. Upper surface of smooth ice														
D. No gage above gage														
E. No gage below gage														
F. Short ice														
G. Floating ice														
H. Pool stage														

STATION (Name and location)		(River, Elevation, # of gages)		MONTH		WS FORM 8-91 (7-89)		U.S. DEPARTMENT OF COMMERCE NATIONAL TIDE AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE	
STATE		COUNTY		RIVER		STANDARD TIME		RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS	
TIME (Hour) OF OBSERVATION		TEMP		PRECIPITATION		STANDARD TIME			
TYPE OF RIVER GAGE		(ELEVATION OF RIVER GAGE-34TH)		FLOOD STAGE		NORMAL POOL STAGE			
Muskegee <td colspan="2">Muskegee <td colspan="2">Arkansas <td colspan="2">COT <td colspan="2"></td> </td></td></td>		Muskegee <td colspan="2">Arkansas <td colspan="2">COT <td colspan="2"></td> </td></td>		Arkansas <td colspan="2">COT <td colspan="2"></td> </td>		COT <td colspan="2"></td>			
7 pm <td colspan="2">7 am <td colspan="2">2 am <td colspan="2">COT <td colspan="2"></td> </td></td></td>		7 am <td colspan="2">2 am <td colspan="2">COT <td colspan="2"></td> </td></td>		2 am <td colspan="2">COT <td colspan="2"></td> </td>		COT <td colspan="2"></td>			
TEMPERATURE F. <td colspan="2">PRECIPITATION <td colspan="2">WEATHER (Calendar Day) <td colspan="2">RIVER STAGE <td colspan="2"></td> </td></td></td>		PRECIPITATION <td colspan="2">WEATHER (Calendar Day) <td colspan="2">RIVER STAGE <td colspan="2"></td> </td></td>		WEATHER (Calendar Day) <td colspan="2">RIVER STAGE <td colspan="2"></td> </td>		RIVER STAGE <td colspan="2"></td>			
24-HR. ENDING AT OBSERVATION <td colspan="2">24-HR. AMOUNTS <td colspan="2">At 10 <td colspan="2">Draw a straight line (—) through hours precipitation was observed, and a wavy line (~~~~) through hours precipitation probably occurred or unobserved <td colspan="2">Mark X for all (plus) occurring each day </td></td></td></td>		24-HR. AMOUNTS <td colspan="2">At 10 <td colspan="2">Draw a straight line (—) through hours precipitation was observed, and a wavy line (~~~~) through hours precipitation probably occurred or unobserved <td colspan="2">Mark X for all (plus) occurring each day </td></td></td>		At 10 <td colspan="2">Draw a straight line (—) through hours precipitation was observed, and a wavy line (~~~~) through hours precipitation probably occurred or unobserved <td colspan="2">Mark X for all (plus) occurring each day </td></td>		Draw a straight line (—) through hours precipitation was observed, and a wavy line (~~~~) through hours precipitation probably occurred or unobserved <td colspan="2">Mark X for all (plus) occurring each day </td>		Mark X for all (plus) occurring each day	
MAX. MIN. OBSH. <td colspan="2">Rain, melting snow, etc. (in. and hundredths) <td colspan="2">Snow, ice, sleet, etc. (in. and hundredths) <td colspan="2">Snow on ground (in.) <td colspan="2">Time of observation if different from above </td></td></td></td>		Rain, melting snow, etc. (in. and hundredths) <td colspan="2">Snow, ice, sleet, etc. (in. and hundredths) <td colspan="2">Snow on ground (in.) <td colspan="2">Time of observation if different from above </td></td></td>		Snow, ice, sleet, etc. (in. and hundredths) <td colspan="2">Snow on ground (in.) <td colspan="2">Time of observation if different from above </td></td>		Snow on ground (in.) <td colspan="2">Time of observation if different from above </td>		Time of observation if different from above	
DATE <td colspan="2">A.M. NOON P.M. <td colspan="2">Fog <td colspan="2">Ice <td colspan="2">Gage </td></td></td></td>		A.M. NOON P.M. <td colspan="2">Fog <td colspan="2">Ice <td colspan="2">Gage </td></td></td>		Fog <td colspan="2">Ice <td colspan="2">Gage </td></td>		Ice <td colspan="2">Gage </td>		Gage	
1		86 66 85							
2		88.7 66 86.1							
3		87 70 72							
4		87 68 76							
5		88.1 69.9 86							
6		87.4 66.2 85.6 1.07							
7		91.5 68.5 90.1							
8		91 73 89							
9		91.2 63.8 86.4 1.03							
10		91.2 63.8 86.6							
11		82 69 82							
12		89.6 69.2 83.3							
13		89.6 69.2 82.7							
14		88.9 65.3 82.9							
15		84.9 75.0 81.5 .07							
16		88.8 75 87.4							
17		90.1 70.9 88.0							
18		90.5 72.5 88.2							
19		91.4 70.3 88.4							
20		90.5 71.2 84 .18							
21		93.3 70.8 91.2							
22		93.2 70.3 86.1							
23		91.9 73.7 90.8							
24		91.7 66.7 86.9							
25		97.1 66.8 86							
26		96.9 78.2 93.5							
27		96.9 78.3 92.8							
28		98 70 96							
29		98.9 69.4 92.7							
30		98.9 71.4 93.1							
31									
SUM		2,37		CHECK BAR (For wire weight) NORMAL CK. BAR					
CONDITION OF R. GAGE		READING		DATE		Fog		Ice	
A. Obscured by ice		B. Frozen, but open		C. Upper surface of ice		D. Ice gage below gage		E. Shore ice	
F. Flooding ice		G. Flood stage		H. Pool stage		I. Ice gage below gage		J. Shore ice	
K. Ice gage below gage		L. Flood stage		M. Pool stage		N. Ice gage below gage		O. Shore ice	
P. Ice gage below gage		Q. Flood stage		R. Pool stage		S. Ice gage below gage		T. Shore ice	
U. Ice gage below gage		V. Flood stage		W. Pool stage		X. Ice gage below gage		Y. Shore ice	
Z. Ice gage below gage		AA. Flood stage		AB. Pool stage		AC. Ice gage below gage		AD. Shore ice	
AE. Ice gage below gage		AF. Flood stage		AG. Pool stage		AH. Ice gage below gage		AI. Shore ice	
AJ. Ice gage below gage		AK. Flood stage		AL. Pool stage		AM. Ice gage below gage		AN. Shore ice	
AO. Ice gage below gage		AP. Flood stage		AQ. Pool stage		AR. Ice gage below gage		AS. Shore ice	
AT. Ice gage below gage		AU. Flood stage		AV. Pool stage		AW. Ice gage below gage		AX. Shore ice	
AY. Ice gage below gage		AZ. Flood stage		BA. Pool stage		BB. Ice gage below gage		BC. Shore ice	
BD. Ice gage below gage		BE. Flood stage		BF. Pool stage		BG. Ice gage below gage		BH. Shore ice	
BI. Ice gage below gage		BJ. Flood stage		BK. Pool stage		BL. Ice gage below gage		BM. Shore ice	
BN. Ice gage below gage		BO. Flood stage		BP. Pool stage		BQ. Ice gage below gage		BR. Shore ice	
BS. Ice gage below gage		BT. Flood stage		BU. Pool stage		BV. Ice gage below gage		BW. Shore ice	
BX. Ice gage below gage		BY. Flood stage		BZ. Pool stage		CA. Ice gage below gage		CB. Shore ice	
CC. Ice gage below gage		CD. Flood stage		CE. Pool stage		CF. Ice gage below gage		CG. Shore ice	
CH. Ice gage below gage		CI. Flood stage		CJ. Pool stage		CK. Ice gage below gage		CL. Shore ice	
CM. Ice gage below gage		CN. Flood stage		CO. Pool stage		CP. Ice gage below gage		CQ. Shore ice	
CR. Ice gage below gage		CS. Flood stage		CT. Pool stage		CU. Ice gage below gage		CV. Shore ice	
CW. Ice gage below gage		CX. Flood stage		CY. Pool stage		CA. Ice gage below gage		CB. Shore ice	
CA. Ice gage below gage		CB. Flood stage		CC. Pool stage		CD. Ice gage below gage		CE. Shore ice	
CB. Ice gage below gage		CC. Flood stage		CD. Pool stage		CE. Ice gage below gage		CF. Shore ice	
CC. Ice gage below gage		CD. Flood stage		CE. Pool stage		CF. Ice gage below gage		CG. Shore ice	
CD. Ice gage below gage		CE. Flood stage		CF. Pool stage		CG. Ice gage below gage		CH. Shore ice	
CE. Ice gage below gage		CF. Flood stage		CG. Pool stage		CH. Ice gage below gage		CI. Shore ice	
CF. Ice gage below gage		CG. Flood stage		CH. Pool stage		CI. Ice gage below gage		CJ. Shore ice	
CG. Ice gage below gage		CH. Flood stage		CI. Pool stage		CJ. Ice gage below gage		CK. Shore ice	
CH. Ice gage below gage		CI. Flood stage		CJ. Pool stage		CK. Ice gage below gage		CL. Shore ice	
CI. Ice gage below gage		CJ. Flood stage		CK. Pool stage		CL. Ice gage below gage		CM. Shore ice	
CJ. Ice gage below gage		CK. Flood stage		CL. Pool stage		CM. Ice gage below gage		CN. Shore ice	
CK. Ice gage below gage		CL. Flood stage		CM. Pool stage		CN. Ice gage below gage		CO. Shore ice	
CL. Ice gage below gage		CM. Flood stage		CN. Pool stage		CO. Ice gage below gage		CP. Shore ice	
CM. Ice gage below gage		CN. Flood stage		CO. Pool stage		CP. Ice gage below gage		CQ. Shore ice	
CN. Ice gage below gage		CO. Flood stage		CP. Pool stage		CQ. Ice gage below gage		CR. Shore ice	
CO. Ice gage below gage		CP. Flood stage		CQ. Pool stage		CR. Ice gage below gage		CS. Shore ice	
CP. Ice gage below gage		CQ. Flood stage		CR. Pool stage		CS. Ice gage below gage		CT. Shore ice	
CQ. Ice gage below gage		CR. Flood stage		CS. Pool stage		CT. Ice gage below gage		CU. Shore ice	
CR. Ice gage below gage		CS. Flood stage		CT. Pool stage		CU. Ice gage below gage		CV. Shore ice	
CS. Ice gage below gage		CT. Flood stage		CU. Pool stage		CV. Ice gage below gage		CW. Shore ice	
CT. Ice gage below gage		CU. Flood stage		CV. Pool stage		CW. Ice gage below gage		CX. Shore ice	
CU. Ice gage below gage		CV. Flood stage		CW. Pool stage		CX. Ice gage below gage		CY. Shore ice	
CV. Ice gage below gage		CW. Flood stage		CX. Pool stage		CY. Ice gage below gage		CZ. Shore ice	
CW. Ice gage below gage		CX. Flood stage		CY. Pool stage		CZ. Ice gage below gage		DA. Shore ice	
CX. Ice gage below gage		CY. Flood stage		CZ. Pool stage		DA. Ice gage below gage		DB. Shore ice	
CY. Ice gage below gage		CZ. Flood stage		DA. Pool stage		DB. Ice gage below gage		DC. Shore ice	
CZ. Ice gage below gage		DA. Flood stage		DB. Pool stage		DC. Ice gage below gage		DD. Shore ice	
DA. Ice gage below gage		DB. Flood stage		DC. Pool stage		DD. Ice gage below gage		DE. Shore ice	
DB. Ice gage below gage		DC. Flood stage		DD. Pool stage		DE. Ice gage below gage		DF. Shore ice	
DC. Ice gage below gage		DD. Flood stage		DE. Pool stage		DF. Ice gage below gage		DG. Shore ice	
DD. Ice gage below gage		DE. Flood stage		DF. Pool stage		DG. Ice gage below gage		DH. Shore ice	
DE. Ice gage below gage		DF. Flood stage		DG. Pool stage		DH. Ice gage below gage		DI. Shore ice	
DF. Ice gage below gage		DG. Flood stage		DH. Pool stage		DI. Ice gage below gage		DJ. Shore ice	
DG. Ice gage below gage		DH. Flood stage		DI. Pool stage		DJ. Ice gage below gage		DK. Shore ice	
DH. Ice gage below gage		DI. Flood stage		DJ. Pool stage		DK. Ice gage below gage		DL. Shore ice	
DI. Ice gage below gage		DJ. Flood stage		DK. Pool stage		DL. Ice gage below gage		DM. Shore ice	
DJ. Ice gage below gage		DK. Flood stage		DL. Pool stage		DM. Ice gage below gage		DN. Shore ice	
DK. Ice gage below gage		DL. Flood stage		DM. Pool stage		DN. Ice gage below gage		DO. Shore ice	
DL. Ice gage below gage		DM. Flood stage		DN. Pool stage		DO. Ice gage below gage		DP. Shore ice	
DM. Ice gage below gage		DN. Flood stage		DO. Pool stage		DP. Ice gage below gage		DQ. Shore ice	
DN. Ice gage below gage		DO. Flood stage		DP. Pool stage		DQ. Ice gage below gage		DR. Shore ice	
DO. Ice gage below gage		DP. Flood stage		DQ. Pool stage		DR. Ice gage below gage		DS. Shore ice	
DP. Ice gage below gage		DQ. Flood stage		DR. Pool stage		DS. Ice gage below gage		DT. Shore ice	
DQ. Ice gage below gage		DR. Flood stage		DS. Pool stage		DT. Ice gage below gage		DU. Shore ice	
DR. Ice gage below gage		DS. Flood stage		DT. Pool stage		DU. Ice gage below gage		DV. Shore ice	
DS. Ice gage below gage		DT. Flood stage		DU. Pool stage		DV. Ice gage below gage		DW. Shore ice	
DT. Ice gage below gage		DU. Flood stage		DV. Pool stage		DW. Ice gage below gage		DX. Shore ice	
DU. Ice gage below gage		DV. Flood stage		DW. Pool stage		DX. Ice gage below gage		DY. Shore ice	
DV. Ice gage below gage		DW. Flood stage		DX. Pool stage		DY. Ice gage below gage		DZ. Shore ice	
DW. Ice gage below gage		DX. Flood stage		DY. Pool stage		DZ. Ice gage below gage		EA. Shore ice	
DX. Ice gage below gage		DY. Flood stage		DZ. Pool stage		EA. Ice gage below gage		EB. Shore ice	
DY. Ice gage below gage		DZ. Flood stage		EA. Pool stage		EB. Ice gage below gage		EC. Shore ice	
DZ. Ice gage below gage		EA. Flood stage		EB. Pool stage		EC. Ice gage below gage		ED. Shore ice	
EA. Ice gage below gage		EB. Flood stage		EC. Pool stage		ED. Ice gage below gage		EE. Shore ice	
EB. Ice gage below gage		EC. Flood stage		ED. Pool stage		EE. Ice gage below gage		EF. Shore ice	
EC. Ice gage below gage		ED. Flood stage		EE. Pool stage		EF. Ice gage below gage		EG. Shore ice	
ED. Ice gage below gage		EE. Flood stage		EF. Pool stage		EG. Ice gage below gage		EH. Shore ice	
EE. Ice gage below gage		EF. Flood stage		EG. Pool stage		EH. Ice gage below gage		EI. Shore ice	
EF. Ice gage below gage		EG. Flood stage		EH. Pool stage		EI. Ice gage below gage		EJ. Shore ice	
EG. Ice gage below gage		EH. Flood stage		EI. Pool stage		EJ. Ice gage below gage		EK. Shore ice	
EH. Ice gage below gage		EI. Flood stage		EJ. Pool stage		EK. Ice gage below gage		EL. Shore ice	
EI. Ice gage below gage		EJ. Flood stage		EK. Pool stage		EL. Ice gage below gage		EM. Shore ice	
EJ. Ice gage below gage		EK. Flood stage		EL. Pool stage		EM. Ice gage below gage		EN. Shore ice	
EK. Ice gage below gage		EL. Flood stage		EM. Pool stage		EN. Ice gage below gage		EO. Shore ice	
EL. Ice gage below gage		EM. Flood stage		EN. Pool stage		EO. Ice gage below gage		EP. Shore ice	
EM. Ice gage below gage		EN. Flood stage		EO. Pool stage		EP. Ice gage below gage		EQ. Shore ice	
EN. Ice gage below gage		EO. Flood stage		EP. Pool stage		EQ. Ice gage below gage		ER. Shore ice	
EO. Ice gage below gage		EP. Flood stage		EQ. Pool stage		ER. Ice gage below gage		ES. Shore ice	
EP. Ice gage below gage		EQ. Flood stage		ER. Pool stage		ES. Ice gage below gage		ET. Shore ice	
EQ. Ice gage below gage		ER. Flood stage		ES. Pool stage		ET. Ice gage below gage		EU. Shore ice	
ER. Ice gage below gage		ES. Flood stage		ET. Pool stage		EU. Ice gage below gage		EV. Shore ice	
ES. Ice gage below gage		ET. Flood stage		EU. Pool stage		EV. Ice gage below gage		EW. Shore ice	
ET. Ice gage below gage		EU. Flood stage		EV. Pool stage		EW. Ice gage below gage		EX. Shore ice	
EU. Ice gage below gage		EV. Flood stage		EW. Pool stage		EX. Ice gage below gage		EY. Shore ice	
EV. Ice gage below gage		EW. Flood stage		EX. Pool stage		EY. Ice gage below gage		EZ. Shore ice	
EW. Ice gage below gage		EX. Flood stage		EY. Pool stage		EZ. Ice gage below gage		FA. Shore ice	
EX. Ice gage below gage		EY. Flood stage		EZ. Pool stage		FA. Ice gage below gage		FB. Shore ice	
EY. Ice gage below gage		EZ. Flood stage		FA. Pool stage		FB. Ice gage below gage		FC. Shore ice	
EZ. Ice gage below gage		FA. Flood stage		FB. Pool stage		FC. Ice gage below gage		FD. Shore ice	
FA. Ice gage below gage		FB. Flood stage		FC. Pool stage		FD. Ice gage below gage		FE. Shore ice	
FB. Ice gage below gage		FC. Flood stage		FD. Pool stage		FE. Ice gage below gage		FF. Shore ice	
FC. Ice gage below gage		FD. Flood stage		FE. Pool stage		FF. Ice gage below gage		FG. Shore ice	
FD. Ice gage below gage		FE. Flood stage		FF. Pool stage		FG. Ice gage below gage		FH. Shore ice	
FE. Ice gage below gage		FF. Flood stage		FG. Pool stage		FH. Ice gage below gage		FI. Shore ice	
FF. Ice gage below gage		FG. Flood stage		FH. Pool stage		FI. Ice gage below gage		FJ. Shore ice	
FG. Ice gage below gage		FH. Flood stage		FI. Pool stage		FJ. Ice gage below gage		FK. Shore ice	
FH. Ice gage below gage		FI. Flood stage		FJ. Pool stage		FK. Ice gage below gage		FL. Shore ice	
FI. Ice gage below gage		FJ. Flood stage		FK. Pool stage		FL. Ice gage below gage		FM. Shore ice	
FJ. Ice gage below gage		FK. Flood stage		FL. Pool stage		FM. Ice gage below gage		FN. Shore ice	
FK. Ice gage below gage		FL. Flood stage		FM. Pool stage		FN. Ice gage below gage		FO. Shore ice	
FL. Ice gage below gage		FM. Flood stage		FN. Pool stage		FO. Ice gage below gage		FP. Shore ice	
FM. Ice gage below gage		FN. Flood stage		FO. Pool stage		FP. Ice gage below gage		FQ. Shore ice	
FN. Ice gage below gage		FO. Flood stage		FP. Pool stage		FQ. Ice gage below gage		FR. Shore ice	
FO. Ice gage below gage		FP. Flood stage		FQ. Pool stage		FR. Ice gage below gage		FS. Shore ice	
FP. Ice gage below gage		FQ. Flood stage		FR. Pool stage		FS. Ice gage below gage		FT. Shore ice	
FQ. Ice gage below gage		FR. Flood stage		FS. Pool stage		FT. Ice gage below gage		FU. Shore ice	
FR. Ice gage below gage		FS. Flood stage		FT. Pool stage		FU. Ice gage below gage		FV. Shore ice	
FS. Ice gage below gage		FT. Flood stage		FU. Pool stage</					

APPENDIX B
OIL AND GAS WELL INVENTORY

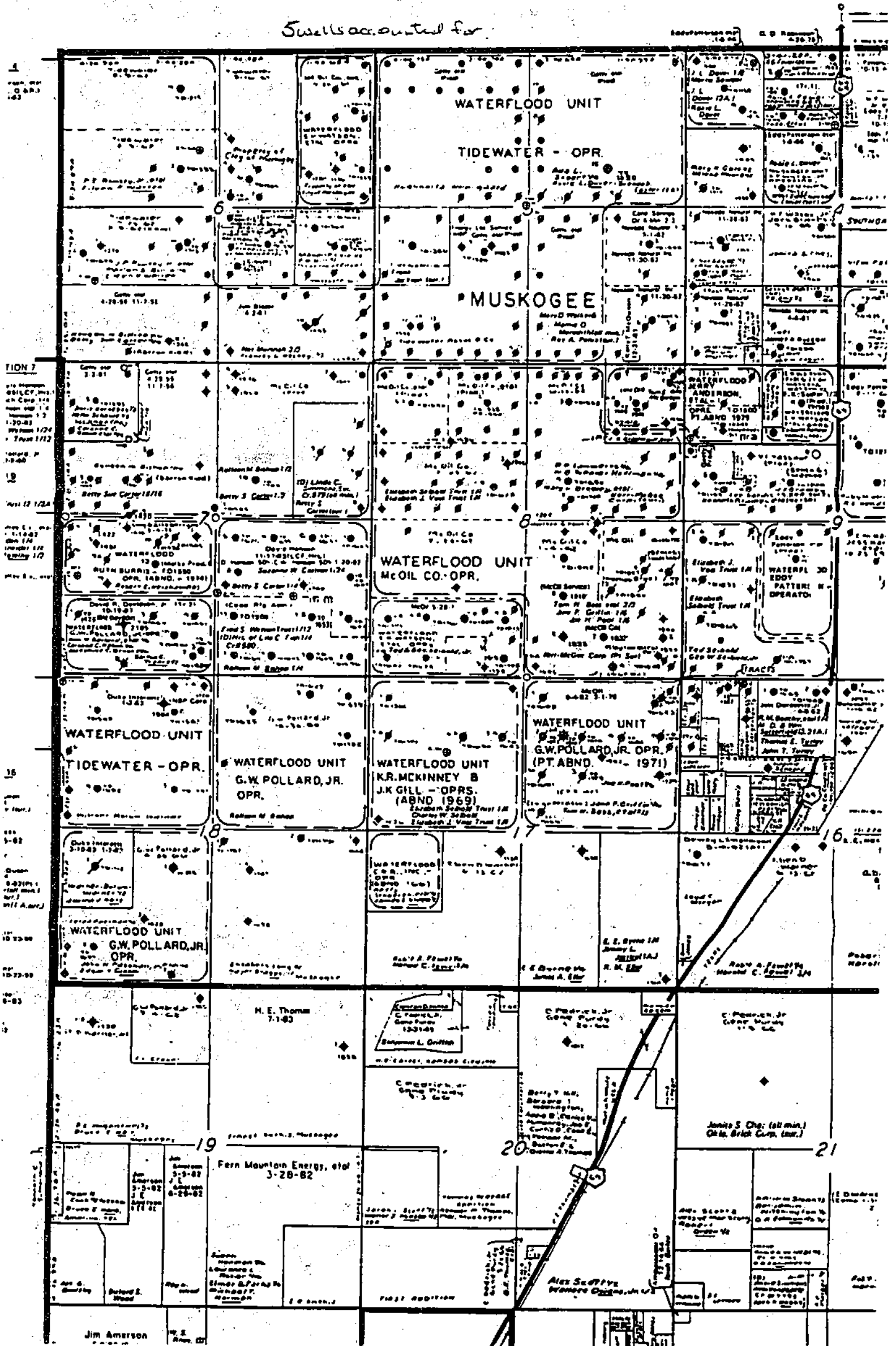
Muskogee\86251dp2.3rd

PETROLEUM INFORMATION

BB a subsidiary of
The Dun & Bradstreet Corporation

Midcontinent Map
#0801 7612
Denver, Colorado 80202

Swells accounted for



map prices become effective July 1, 1961.

MIDCONTINENT MAP COMPANY
205 Castle Bldg. Phone LU 4-7221
TULSA 3, OKLAHOMA

MIDCONTINENT MAP COMPANY

205 CASTLE BLDG. 114 W. 3RD. ST.
TULSA 3, OKLAHOMA
LUTHER 4-7221

LEGEND SHEET

- LOCATION
- RIG UP
- DRILLING WELL
- PRODUCING OIL WELL
- * PRODUCING GAS WELL
- ✧ COMBINATION OIL & GAS WELL
- ✧ GAS STORAGE WELL (ILL. ONLY)
- ✧ DRY HOLE
- INPUT WELL ● SUPPLY WELL
- ✧ WATER INPUT WELL (ILL. ONLY)
- ✧ "W" BEFORE WELL NO. DENOTES
CONVERSION TO INPUT WELL
- ✧ CONVERSION FROM OIL WELL
TO WATER INPUT WELL (ILL. ONLY)
- ✧ ABANDONED OIL WELL
- * ABANDONED GAS WELL
- ✧ ABANDONED COMBINATION WELL
- ✧ ABANDONED INPUT WELL
- ⊙ STORAGE TANK
- △ SALT WATER DISPOSAL WELL
- ◇ SALT WATER DISPOSAL WELL (ILL.)
- (TD) TAX DEED
- (LE) LIFE ESTATE
- (SD) SHERIFF'S DEED
- (D) RESTRICTED INDIAN LANDS
- (CP) CERTIFICATE OF PURCHASE
- (CD) CONTRACT FOR DEED OR
CONTRACT FOR SALE
- ←L→ LEASES GENERALLY ARE THE
SAME ON TRACTS JOINED BY
THIS SYMBOL
- ←M→ MINERALS GENERALLY ARE THE
SAME ON TRACTS JOINED BY
THIS SYMBOL
- ←LM→ LEASES AND MINERALS GENERALLY
ARE THE SAME ON TRACTS
JOINED BY THIS SYMBOL
- (NP) NON-PARTICIPATING MINERAL OR
ROYALTY INTERESTS HAVE BEEN
CONVEYED OR RESERVED UNDER
TRACTS BEARING THIS SYMBOL

(Mail to Corporation Commission, Oklahoma City, Oklahoma)
OKLAHOMA CORPORATION COMMISSION
 OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

COUNTY Muskogee SEC. 6 TWP. 14 N. RGE. 18 East

COMPANY OPERATING Beebe Oil Company

OFFICE ADDRESS Box 1631, Muskogee, Oklahoma

FARM NAME WATSON WELL NO. 1

DRILLING STARTED 8/19, 1961 DRILLING FINISHED 8/29, 1961

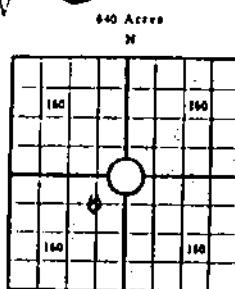
DATE OF FIRST PRODUCTION COMPLETED

WELL LOCATED C 1/4 NE 1/4 SW 1/4 1980 North of South

Line and 1980 ft. East of West Line of Quarter Section

Elevation (Relative to sea level) DERRICK FLOOR GROUND

CHARACTER OF WELL (Oil, gas or dryhole) Oil



Locate well correctly

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
1 Stray	1288	1265	4		
2 Muskogee	1279	1313	5		
3			6		

Perforating Record If Any

Formation	From	To	No. of Shots	Formation	From	To	Size of Shot

Shot Record

CASING RECORD

Amount Set						Amount Pulled		Packer Record	
Size	Wt.	Thds.	Make	Fl.	In.	Size	Length	Depth Set	Make
4 1/2"				1368					

Liner Record: Amount Kind Top Bottom

CEMENTING AND MUDDING

Size	Amount Set		Sacks Cement	Chemical		Method of Cementing	Amount	Mudding Method	Results (See Note)
	Fl.	In.		Gal.	Make				
4 1/2"	1368		50						

Note: What method was used to protect sands if outer strings were pulled?

NOTE: Were bottom hole plugs used? If so, state kind, depth set and results obtained

TOOLS USED

Rotary Tools were used from 0 feet to 1385 feet, and from 0 feet to 1385 feet, and from 0 feet to 1385 feet.

Type Rig Bucyrus-Erie 28-L

INITIAL PRODUCTION TEST

Describe initial test: whether by flow through tubing or casing or by pumping Pumping

Amount Oil Production 10 bbls. Size of choke, if any 24 hr. Length of test 24 hr.

Produ. 0 bbls. Gravity of oil 0 Type of Pump if pump is used, describe

Give detailed description and thickness of water, oil or gas.

9/16/61

NATIONAL OIL WELL INDEX
 OKLAHOMA CITY
 REF. NO. 490

Formation	Top	Bottom	Formation	Top	Bottom
Clay	0	20	Sand - Stray	238	1
Shale	20	132	Sandy Shale	265	1
Sand	132	145	Sand - Muskogee	279	1
Shale	145	177	Shale	313	1
Sandy Lime	177	189	Sand	316	1
Shale	189	222	Sandy Shale	330	1
Sand	222	240	Shale	335	1
Shale	240	320	Sand	350	1
Sand	320	337	Lime	360	1
Shale	337	548	Shale	373	1
Sand	548	565	Lime	379	1
Shale	565	712			
Lime - Broken	712	720			
Shale	720	775			
Lime - Broken	775	790			
Shale	790	805			
Lime	805	811			
Shale	811	865			
Lime	865	872			
Shale	872	907			
Sand	907	935			
Lime - Black	935	947			
Shale	947	960			
Lime - Hard	960	971			
Shale	971	994			
Lime	994	1005			
Shale	1005	1010			
Sand	1010	1025			
Shale	1025	1068			
Sand	1068	1075			
Shale	1075	1095			
Sand	1095	1105			
Shale	1105	1149			
Lime	1149	1156			
Shale	1156	1159			
Lime	1159	1168			
Sand	1168	1175			
Sand	1175	1180			
Shale	1180	1238			

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 CONSERVATION DEPT

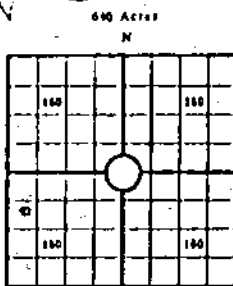
Sand, the undersigned, being first duly sworn upon oath, state that this well record is true, correct complete according to the records of this office and to the best of my knowledge and belief.

Jerry D. [Signature]
 Name and title of [Signature]
 relative of company

Subscribed and sworn to before me this 16 day of September, 1961

WELL NO. 2 COUNTY MUSKOGEE SEC. 6 TWP. 14 N. RGE. 18 E.

OKLAHOMA CORPORATION COMMISSION
OIL AND GAS CONSERVATION DEPARTMENT



Locate well correctly

Form 640 (Rev. 1-51)
COUNTY Muskogee SEC. 6 TWP. 14 N. RGE. 18 East
COMPANY OPERATING Reese Oil Company
OFFICE ADDRESS Box 1631, Muskogee, Oklahoma
FARM NAME Warren WELL NO. 2
DRILLING STARTED 9/15, 1961, DRILLING FINISHED 9/26, 1961
DATE OF FIRST PRODUCTION COMPLETED
WELL LOCATED S. 1/4 N. 1/4 SW 1/4 1270, North of South
Line and 330, East of West Line of Quarter Section
Elevation (Relative to sea level) DERRICK FLOOR GROUND.
CHARACTER OF WELL (Oil, gas or dryhole) Oil

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
1. Mud Hole	1115	1134	4. Timber Ridge	1250	1264
2. Stray	1182	1200			
3. Muskogee	1210	1240			

Perforating Record If Any

Formation	From	To	No. of Shots	Formation	From	To	Size of Shot
Shale	1350	1355	6				
Shale	1357	1360	4				

CASING RECORD

Amount Set								Amount Pulled		Packer Record	
Size	Wt.	Thds.	Make	Ft.	In.	Ft.	In.	Size	Length	Depth Set	Make
				405				6	405		
				1350							

Line Record; Amount Kind Top Bottom

CEMENTING AND MUDDING

Size	Amount Set		Sacks Cement	Chemical		Method of Cementing	Amount	Mudding Method	Results (See Note)
	Ft.	In.		Gal.	Make				
	1350		100						

Note: What method was used to protect sands if outer strings were pulled?

OTE: Were bottom hole plugs used? If so, state kind, depth set and results obtained

TOOLS USED

Hoisting Tools were used from feet to Cable tools were used from 0 feet to 1625 feet, and from feet to feet, and from feet to feet.
Type Rig Bucyrus-Erie 28 L

INITIAL PRODUCTION TEST

Describe initial test, whether by flow through tubing or casing or by pumping Pumping

Approx. Oil Production 12 bbls. Size of choke, if any Length of test 24 hr. Water Produced bbls. Gravity of oil Type of Pump or pump is used, describe

Give detailed description and thickness of water, oil or gas.

10/14/61

OKLAHOMA CORPORATION COMMISSION
OIL WELL INDEX CARD
REF. NO. 5437

Formation	Top	Bottom	Formation	Top
Clay	0	10	Brown Lime - broken	1254
Shale	10	85	Lime	1293
Sand	85	95	Shale	1325
Shale	95	115	Lime	1332
Sand	115	125	Shale & Shells	1335
Shale	125	180	Shale	1343
Sand	180	191	Shale & Shells	1367
Shale	191	297	Shale	1390
Sand	297	315	Lime	1400
Shale	315	390	Shelly Shale	1525
Sand	390	405	Shale	1580
Shale	405	532	Lime - Miss.	1600
Sand	532	567		
Shale	567	770		
Lime	770	783		
Shale	783	837		
Lime - broken	837	845		
Shale	845	860		
Sand	860	875		
Lime	875	907		
Shale	907	917		
Lime	917	931		
Shale	931	951		
Lime	951	964		
Shale	964	1025		
Lime	1025	1031		
Shale	1031	1045		
Lime	1045	1050		
Shale	1050	1099		
Lime	1099	1105		
Shale	1105	1110		
Lime	1110	1115		
Sand - Mud Hole	1115	1134		
Shale	1134	1182		
Sand	1182	1200		
Shale	1200	1205		
Sand	1205	1210		
Sand - Muskogee	1210	1240		
Shale	1240	1255		

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CONSERVATION DEPT

I, the undersigned, being first duly sworn upon oath, state that this well record is true, correct and complete according to the records of this office and to the best of my knowledge and belief.

C. C. Burch
Name and title of representative of company

Subscribed and sworn to before me this 10th day of October, 1961

$\mathbb{Z}_2$

540 ACFE

1

to date will correctly

WELL NO. 3

DATE OF FIRST PRODUCTION COMPLETED

Line and 1880 h. East of West Line of Quarter Section

CHARACTER OF WELL (Oil, gas or dryhole)..... Oil

Name	From	To	Name	From	To
111 Hole	1083	1107	4		
112 Masko'ee	1150	1220	5		
113 Timberline	1280	1285	6		

Paul Howard

Formation	From	To	No. of Shots	Formation	From	To	Size of Shot
Shoals Sand	113	118	30				
Interbedded	127	128	6 s				

Amount Set								Amount Pulled		Packer Record	
Size	Wt	Thda	Make	Fr	In.	Fr	In.	Size	Length	Depth Set	Make
				30							
				1335							

Year	Record	Amount	Kind	Top	Bottom
1911					
1912					
1913					
1914					
1915					
1916					
1917					
1918					
1919					
1920					
1921					
1922					
1923					
1924					
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2001					
2002					
2003					
2004					
2005					
2006					

Amount Set		Sacks Cement	Chemical		Method of Cementing	Amount	Mudding Method	Results (See Note)
Ft.	In.		Gal.	Parts				
50		10						
1555		100						

Q- What method was used to protect sands if outer strings were pulled?

Were bottom hole plugs used? If so, state kind, depth set and results obtained

Sounding Tools were used from _____ feet to _____ feet. Cable tools were used from 0 feet to 1335 feet, and from _____ feet to _____ feet, and from _____ feet to _____ feet.

Estimate initial test, whether by flow through tubing or casing or by pumping Pumping

Approximate Production 30 bbls. Size of choke, if any _____ Length of test 24 hr

Produced _____ bbls. Gravity of oil _____ Type of Pump if pump is used, describe _____

JAN 20 1962

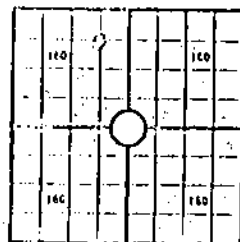
NATIONAL OIL WELL INDEX CO.
OKLAHOMA CITY
REP. NO. 1-0395

Formation	Top	Bottom
Clay	0	15
Shale	15	215
Sand	315	330
Shale	330	535
Sand	535	542
Shale	542	615
Lime	615	623
Shale	623	722
Lime - Broken	722	730
Shale	730	776
Lime - Broken	776	786
Shale	786	887
Lime	887	895
Shale	895	903
Sand	903	905
Sandy Lime	905	914
Shale	914	940
Sandy Lime	940	950
Shale	950	1004
Sand	1004	1009
Shale	1009	1025
Lime	1025	1032
Shale	1032	1085
Sand	1085	1107
Shale	1108	1160
Sand	1160	1220
Sand - Broken	1220	1240
Sandy Shale	1240	1260
Sandy Lime	1260	1266
Brown Lime-Broken	1266	1280
Sand	1280	1285
Brown Lime	1285	1335

I, the undersigned, being first duly sworn upon oath, state that this well record is true, correct complete according to the records of this office and to the best of my knowledge and belief.

Subscribed and sworn to before me this 15th day of June

WELL NO. 6 TWP. 14N RGE. 18E COUNTY: Muskogee SEC. 6



Locate well correctly

WELL RECORD
 COUNTY Muskogee, SEC. 6 TWP. 14N RGE. 18E
 COMPANY OPERATING Beebe Oil Company
 OFFICE ADDRESS Box 1631, Muskogee, Oklahoma
 FARM NAME Warren WELL NO. 4
 DRILLING STARTED 3/9, 1962 DRILLING FINISHED 3/16, 1962
 DATE OF FIRST PRODUCTION _____ COMPLETED _____
 WELL LOCATED C $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ 4620 North of South
 Line and 1980 H. East of West Line of Quarter Section
 Elevation (Relative to sea level) DERRICK FLOOR _____ GROUND _____
 CHARACTER OF WELL (Oil, gas or dryhole) Oil

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
Stray	1115	1125			
Muskogee	1125	1160			
Timberidge	1165	1180			

Perforating Record If Any

Formation	From	To	No. of Shots	Formation	From	To	Size of Shot

Shot Record

CASING RECORD

Amount Set							Amount Pulled		Packer Record	
Size	Th. Ht.	Rate	Ft.	In.	Ft.	In.	Size	Length	Depth Set	Marks
7"			1202							
10"			23							

Liner Record: Amount _____ Kind _____ Top _____ Bottom _____

CEMENTING AND MUDDING

Size	Amount Set	Sacks Cement	Chemical		Method of Cementing	Amount	Mudding Method	Results (See Note)
			Gal.	Rate				
7"	120	150						
10"	23	7						

Note: What method was used to protect sands if outer strings were pulled?

_____ If so, this kind, depth of seal and results obtained

TOOLS USED

Tools were used from _____ feet to _____ feet. Cable tools were used from 0 feet to 1215 feet, and from _____ feet to _____ feet, and from _____ feet to _____ feet.

_____ Bucyrus-Erie 20L

WATER PRODUCTION TEST

_____ by flow through tubing or casing or by pumping _____ Pumping

_____ bbls. Size of choke, if any _____ Length of test _____ Water _____ bbls. Gravity of oil _____ Type of Pump if pump is used, describe _____ not in production yet

Formation	Top	Bottom
Soil	0	
Clay	3	15
Shale	15	190
Sand	190	194
Shale	194	230
Sand	230	240
Shale	240	310
Sand	310	327
Shale	327	515
Sand	515	522
Shale	522	660
Lime	660	665
Shale	665	698
Lime	698	715
Shale	715	780
Sand	780	785
Shale	785	812
Lime	812	818
Shale	818	872
Sand	872	895
Lime	895	910
Shale	910	920
Lime - Black	920	932
Shale	932	979
Lime	979	984
Shale	984	998
Sand	998	1015
Shale	1015	1050
Sand	1050	1055
Sand - Bad Hole	1055	1077
Shale	1077	1115
Sand - Stray	1115	1145
Sandy Shale	1145	1160
Shale	1160	1165
Broken Sand	1165	1180
Sand	1180	1195
Lime - Brown	1195	1215

I, the undersigned, being first duly sworn upon oath, state that the well is being drilled, completed according to the records of this office and to the best of my knowledge.

Subscribed and sworn to before me this 21st day of 1962

62-1581

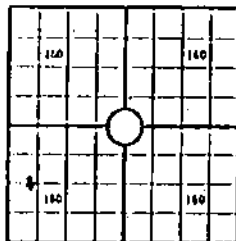
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 CONSERVATION DEPT.

RECEIVED
 CONSERVATION DEPARTMENT
 MAR 22 1962
 OKLAHOMA COMMISSION

WELL NO. 7 COUNTY, MUSKOGEE SEC. 6 TWP. 14N. RGE. 18E

FO 2A

840 ACRES
N



Locate well correctly

(Mail to Corporation Commission, Oklahoma City, Oklahoma)

OKLAHOMA CORPORATION COMMISSION

OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

COUNTY Muskogee SEC. 6 TWP. 14N RGE. 18E

COMPANY OPERATING Beebe Oil Company

OFFICE ADDRESS Box 1631, Muskogee, Oklahoma

FARM NAME Warren WELL NO. 7

DRILLING STARTED 5/10 1962 DRILLING FINISHED 5/16 1962

DATE OF FIRST PRODUCTION COMPLETED

WELL LOCATED N. 1/4 SW 1/4 SW 1/4 1320, North of South

Line and 550 ft. East of West Line of Quarter Section

Elevation (Relative to sea level) DERRICK FLOOR GROUND

CHARACTER OF WELL (Oil, gas or dryhole) Injection

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
1 Stray	1170	1190	4		
2			5		
3			6		

Perforating Record If Any

Formation	From	To	No. of Shots	Formation	From	To	Size of Shot

Shot Record

CASING RECORD

Amount Set								Amount Pulled		Packer Record	
Size	Wt.	Yds.	Make	Fl.	In.	Fl.	In.	Size	Length	Depth Set	Make
8"				25							
2 1/2"				1290							

Line Record: Amount Kind Top Bottom

CEMENTING AND MUDDING

Size	Amount Set		Sacks Cement	Chemical		Method of Cementing	Amount	Mudding Method	Results (See Note)
	Fl.	In.		Gal.	Make				
8"	25		10						
2 1/2"	290		150						

Note: What method was used to protect sands if outer strings were pulled?

OTE Were bottom hole plugs used? If so, state kind, depth set and results obtained

TOOLS USED

Rotary Tools were used from feet to feet Cable tools were used from 0 feet to 1290 feet, and from feet to feet, and from feet to feet

Type Rig Bucyrus-Erie 28L

INITIAL PRODUCTION TEST

Initial test whether by flow through tubing or casing or by pumping

Oil Production bbls. Gals. Size of choke, if any Length of test Water

Gravity of Type of Pump if pump is used, describe

Give detailed description and th water, oil or gas.

JUN 2 1962

NATIONAL OIL WELL INDEX
OKLAHOMA CITY
REF. NO. 267

Formation	Top	Bottom	Formation	Top
Soil	0	2		
Clay	2	15		
Shale	15	125		
Sandy Shale	125	150		
Shale	150	300		
Sand	300	315		
Shale	315	558		
Sand	558	570		
Shale	570	740		
Sime	740	745		
Shale	745	800		
Lime	800	810		
Shale	810	880		
Sand	880	913		
Shale	913	922		
Lime	922	931		
Shale	931	992		
Sand	992	996		
Shale	996	1012		
Lime	1012	1018		
Shale	1018	1037		
Lime	1037	1042		
Shale	1042	1102		
Sand	1102	1130		
Shale	1130	1170		
Sand - Stray	1170	1190		
Sand - Broken	1190	1200		
Shale & Shelly Lime	1200	1220		
Sand	1220	1239		
Sand - Broken	1239	1242		
Sand	1242	1255		
Limey Sand	1255	1275		
Brown Lime	1275	1290		

RECEIVED
CONSERVATION DEPARTMENT
MAY 31 1962
OKLAHOMA CORPORATION
COMMISSION

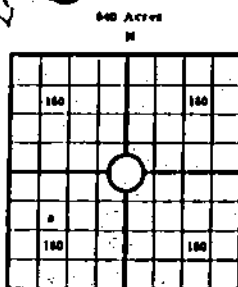
I, the undersigned, being first duly sworn upon oath, state that the well and its contents are complete according to the records of this office and to the best of my knowledge and belief.

Subscribed and sworn to before me this 29th day of May 1962.

ARM NAME Warren WELL NO. 6 COUNTY Muskogee TWP. 14N RGE. 18E SEC. 3

(Mail to Corporation Commission, Oklahoma City, Oklahoma)
OKLAHOMA CORPORATION COMMISSION
 OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD



COUNTY Muskogee TWP. 14N RGE. 18E
 COMPANY OPERATING Beebe Oil Company
 OFFICE ADDRESS Box 1631, Muskogee, Oklahoma
 FARM NAME Warren WELL NO. 8
 DRILLING STARTED 8/20, 1962 DRILLING FINISHED 9/18, 1962
 DATE OF FIRST PRODUCTION COMPLETED
 WELL LOCATED SE 1/4 NW 1/4 1400 North of South
 Line and 1000 ft. East of West Line of Quarter Section
 Elevation (Relative to sea level) DERRICK FLOOR GROUND
 CHARACTER OF WELL (Oil, gas or dryhole) Oil

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
1			4		
2			5		
3			6		

Perforating Record If Any

Shot Record

Formation	From	To	No. of Shots	Formation	From	To	Size of Shot

CASING RECORD

Amount Set						Amount Pulled		Packer Record	
Size	Wt.	Thds.	Make	Ft.	In.	Size	Length	Depth Set	Make

Liner Record: Amount Kind Top Bottom

CEMENTING AND MUDDING

Size	Amount Set		Sacks Cement	Chemical		Method of Cementing	Amount	Mudding Method	Results (See Note)
	Ft.	In.		Gal.	Make				

Note: What method was used to protect sands if outer strings were pulled?

OPE: Were bottom hole plugs used? If no, state kind, depth set and results obtained

TOOLS USED

Rotary Tools were used from feet to feet Cable tools were used from feet to
feet, and from feet to feet, and from feet to feet
 Type Rig LUCYRUS-Erie 28L

INITIAL PRODUCTION TEST

Describe initial test: whether by flow through tubing or casing or by pumping
Pumping

Amo: Oil Production 7 bbls. Size of choke, if any Length of test 24 hr Water
 Proc Common working barrel

Give detailed description of water, oil or gas.

OCT 20 1962

NATIONAL OIL WELL INDEX
 OKLAHOMA CITY
 REF. NO. 2-5026

Formation	Top	Bottom	Formation	Top
This is an old hole on this lease which was cleaned out and put on pump.				
RECEIVED CONSERVATION DEPARTMENT OCT 16 1962 OKLAHOMA CORPORATION COMMISSION				
FILE COPY DO NOT REMOVE CONSERVATION DEPT				

I, the undersigned, being first duly sworn upon oath, state that this well record is true, so complete according to the records of this office and to the best of my knowledge and belief.

Name and Title of James Beebe representative of company

Subscribed and sworn to before me this 15th day of October 1962

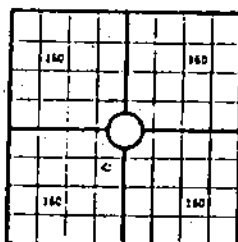
Form 1002-A
 SEC 6 TWP 14N RGE 18E
 COUNTY MUSKOGEE
 PAID NAME

Form 1002-A

OKLAHOMA CORPORATION COMMISSION

OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD



Locate well correctly

COUNTY Muskogee SEC 6 TWP 14N RGE 18E

COMPANY OPERATING Beebe Oil Company

OFFICE ADDRESS Box 1631, Muskogee, Oklahoma

FARM NAME Warren

WELL NO. 9

DRILLING STARTED 10/17, 1962 DRILLING FINISHED 10/26, 1962

DATE OF FIRST PRODUCTION

COMPLETED

WELL LOCATED NE SE NE 1/4 SW 1/4 1800, North of South

Line and 2310

M. East of West Line of Quarter Section

Elevation (Relative to sea level) DERRICK FLOOR GROUND

CHARACTER OF WELL (Oil, gas or dryhole) Oil

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
1 Bad Hole	1115	1142	4		
2 Muskogee	1226	1333	5		
3			6		

Perforating Record If Any

Formation	From	To	No. of Shots	Formation	From	To	Size of Shot
Shale	1302	1318	32				
Sand	1266	1276	20				
Sand	1238	1256	36				

Shot Record

CASING RECORD

Amount Set								Amount Pulled		Packer Record	
Size	Wt.	Thds.	Made	Fl.	In.	Fl.	In.	Size	Length	Depth Set	Make
10 3/4				27							
5 1/2				1340							

Line Record: Amount Kind Top Bottom

CEMENTING AND MUDDING

Size	Amount Set		Sacks Cement	Chemical		Method of Cementing	Amount	Mudding Method	Results (See Note)
	Fl.	In.		Gal.	Make				
10 3/4	27		5						
5 1/2	1340		100						

Note: What method was used to protect sands if outer strings were pulled?

If Were bottom hole plugs used? If so, state kind, depth set and results obtained

TOOLS USED

String Tools were used from feet to feet Cable tools were used from 0 feet to 1345

feet, and from feet to feet, and from feet to feet

Type Rig Bucyrus-Erie 28L

INITIAL PRODUCTION TEST

Produced by flow through tubing or casing or by pumping

Pumping

Amount of Oil Production 5 bbls. Size of choke, if any 24 Length of test Water

Prod bbls. Gravity of oil Type of Pump if pump is used, describe

Common working barrel

Give detailed description and the water, oil or gas.

DEC 15 1962

NATIONAL OIL WELL INDEX

OKLAHOMA CITY

REF. NO.

2-5901

Formation	Top	Bottom	Formation	Top
Soil	0	3		
Clay	3	15		
Shale	15	180		
Sand	180	192		
Shale	192	330		
Sand	330	348		
Shale	348	550		
Sand	550	565		
Shale	565	720		
Lime - Broken	720	730		
Shale	730	815		
Lime	815	820		
Shale	820	865		
Lime	865	875		
Shale	875	915		
Lime	915	942		
Shale	942	955		
Lime	955	965		
Shale	965	1000		
Sand	1000	1015		
Shale	1015	1026		
Lime	1026	1030		
Shale	1030	1055		
Sand	1055	1065		
Sand - Broken	1065	1075		
Shale	1075	1115		
Sand - Bad Hole	1115	1142		
Shale	1142	1198		
Sand	1198	1333		
Shale	1333	1340		
Lime	1340	1345		

FILE COPY
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 CONSERVATION DEPT

RECEIVED
 CONSERVATION DEPARTMENT
 DEC 11 1962
 OKLAHOMA CORPORATION
 COMMISSION

I, the undersigned, being first duly sworn upon oath, state that this well record is true, complete according to the records of this office and to the best of my knowledge and belief.

Name and title of representative of company

Subscribed and sworn to before me this 10/11 day of 1962
 My Commission expires

(Mail to Corporation Commissioner, Oklahoma City, Oklahoma)
OKLAHOMA CORPORATION COMMISSION
 OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

COUNTY Muskogee SEC. 6 TWP. 14N RGE. 18E

COMPANY OPERATING Beede Oil Company

OFFICE ADDRESS Box 1631, Muskogee, Oklahoma

FARM NAME Warren WELL NO. 10

DRILLING STARTED 9/18 1963 DRILLING FINISHED 9/27 1963

DATE OF FIRST PRODUCTION _____ COMPLETED _____

WELL LOCATED SW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ 1650, North of South

Line and 1375 ft. East of West Line of Quarter Section

Elevation (Relative to sea level) DERRICK FLOOR _____ GROUND _____

CHARACTER OF WELL (Oil, gas or dryhole) Oil

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
1 Bad Hole	1120	1147	4 Timerridge	1298	1312
2 Stray	1200	1228	5		
3 Muskogee	1228	1292	6		

Perforating Record if Any

Formation	From	To	No. of Shots	Formation	From	To	Size of Shot

CASING RECORD

Amount Set						Amount Pulled		Packer Record	
Size	WT.	Thk.	Mkts.	Fl.	In.	Fl.	In.	Size	Length
4 1/2"				1332					
8"				30					

Line Record: Amount _____ Kind _____ Top _____ Bottom _____

CEMENTING AND MUDDING

Size	Amount Set		Sacks Cement	Chemical		Method of Cementing	Amount	Mudding Method	Results (See Note)
	Fl.	In.		Gal.	Mkts.				
4 1/2"	1332		125						
8"	30		25						

Note: What method was used to protect sands if outer strings were pulled?

JTE: Were bottom hole plugs used? _____ If so, state kind, depth set and results obtained _____

TOOLS USED

Rotary Tools were used from _____ feet to _____ Cable tools were used from 0 feet to 1332 feet, and from _____ feet to _____ feet, and from _____ feet to _____ feet.

Type Rig Bucyrus Erie 28L

NOTAL PRODUCTION TEST

Describe initial test: whether by flow through tubing or casing or by pumping _____
Pumping

Amc. Oil Production 10 bbls. Size of choke, if any _____ Length of test 24hrs Water _____

Pro. _____ bbls. Gravity of oil _____ Type of Pump if pump is used, describe _____

40 gravity. Common working barrel pump

Give detailed description and this water, oil or gas.

NOV 16 1963

REF. NO. 3-5016

Formation		
Clay	0	12
Shale	12	540
Lime	540	545
Shale	545	880
Lime	880	890
Shale	890	900
Sandy Lime	900	925
Shale	925	935
Lime	935	945
Shale	945	965
Lime	965	970
Sand	970	980
Sandy Shale	980	990
Shale	990	1035
Lime	1035	1042
Shale	1042	1057
Sand	1057	1065
Shale	1065	1120
Sand - Bad Hole	1120	1147
Shale	1147	1200
Sand	1200	1228
Broken Sand	1228	1245
Sand	1245	1250
Sand	1250	1271
Broken Sand	1271	1280
Sand	1280	1292
Shale	1292	1298
Broken Sand	1298	1312
Brown Lime	1312	1332

FILE COPY
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 CONSERVATION DEPT.

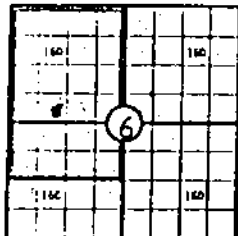
I, the undersigned, being first duly sworn upon oath, state that this well record is true, so complete according to the records of this office and to the best of my knowledge and belief.

Subscribed and sworn to before me this 16th day of Nov 1963

OKLAHOMA CORPORATION COMMISSION
OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

COUNTY Muskogee SEC 6 TWP. 14N RGE 16E
COMPANY OPERATING Tidewater Oil Company
OFFICE ADDRESS Box 752, Drumright, Okla.
FARM NAME Warren WELL NO. W-17
DRILLING STARTED 6-2-65 DRILLING FINISHED 6-11-65
DATE OF FIRST PRODUCTION - COMPLETED 7-17-65
WELL LOCATED SE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ 50' North of South
Line and 1023' N. East of West Line of Quarter Section
Elevation (Relative to sea level) DERRICK FLOOR 640 GROUND 636
CHARACTER OF WELL (Oil, gas or dryhole) Injection Well



Locate well correctly

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
Muskogee	1198	1248			
Shale	1251	1253			

Perforating Record If Any

Formation	From	To	No. of Shots	Formation	From	To	Size of Shot
Shale	1174	1178	2 (Sand Out)				
Muskogee	1202	1245	10 (")				
Shale	1251.5	1253	1 (")				

CASING RECORD

Amount Set				Amount Pulled		Packer Record	
This	Make	Fi	In	Fi	In	Size	Length
158		154					
1275		1275					
						1224	Shaw

Record As Kind Top Bottom

CEMENTING AND MUDDING

Amount Set	Soils	Disposal	Method of	Amount	Mudding	Results
Fe	Cement	Go.	Notes	Cementing	Method	(See Note)
158	100			Dovell		
1275	188					

What method was used to protect sands if outer strings were pulled?

Are bottom hole plugs used? If so, state kind, depth set and results obtained

TOOLS USED

Tools were used from _____ feet to _____ feet. Cable tools were used from 0 feet to 1275 feet, and from _____ feet to _____ feet, and from _____ feet to _____ feet.

Type Rig _____

INITIAL PRODUCTION TEST

Describe initial test whether by flow through tubing or casing or by pumping _____

Amount of Oil Production _____ bbls. Size of choke, if any _____ Length of test _____ Water

Production _____ bbls. Gravity of oil _____ Type of Pump if pump is used, describe _____

Give detailed description and thickness of water, oil or gas.

OCT 16 1965

NATIONAL OIL WELL INDEX C
OKLAHOMA CITY

REF. NO. 7188

Formation	Top	Bottom	Formation	Top	Bottom
Soil	0	5			
Clay	5	15			
Shale	15	45			
Shale	45	330			
Sand	330	345			
Shale	345	348			
Sand	348	355			
Shale	355	545			
Sand	545	551			
Shale	551	725			
Lime	725	731			
Shale	731	869			
Sand	869	880			
Sandy Lime	880	890			
Lime	890	903			
Shale	903	913			
Lime	913	924			
Shale	924	945			
Sand	945	954			
Shale	954	1012			
Lime	1012	1015			
Shale	1015	1029			
Sand	1029	1035			
Sand	1035	1042			
Shale	1042	1100			
Sand	1100	1124			
Shale	1124	1165			
Sand, Str.	1165	1185			
Shale	1185	1190			
Sand, Musk.	1190	1195			
Sand	1195	1240			
Shale	1240	1243			
Shale	1243	1251			
Sand, TR	1251	1260			
Shale	1260	1265			
Hole Caving	1265	1275			

RECEIVED
OCT 12 1965
OKLAHOMA CORPORATION
COMMISSION

O.C. C. ✓
W.L. Boone
H. P. Shackelford
File

I, the undersigned, being first duly sworn upon oath, state that this well record is true, correct and complete according to the records in this office and to the best of my knowledge and belief.

W.H. McPhail

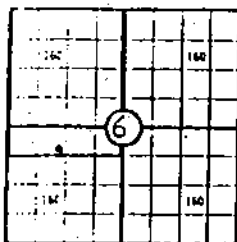
Area Supt
Name and title of representative of company

Subscribed and sworn to before me this 8th day of October 1965
My Commission expires 7-16-66

OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

COUNTY Muskogee SEC. 6 TWP. 14N. RGE. 16E.
 COMPANY OPERATING Tidewater Oil Company
 OFFICE ADDRESS Box 752, Drumright, Okla.
 FARM NAME Warren WELL NO. W-22
 DRILLING STARTED 8-9-65 DRILLING FINISHED 8-17-65
 DATE OF FIRST PRODUCTION - COMPLETED 9-7-65
 WELL LOCATED NE 1/4 NW 1/4 SW 1/4 13201 North of South
 Line and 12881 N. East of West Line of Quarter Section
 Elevation (Relative to sea level) DERRICK FLOOR 623.3 GROUND 619.3
 CHARACTER OF WELL (Oil, gas or dryhole) Injection Well



Locate well correctly

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
Stray	1238	1249			
	1280	1293			
Clasher Ridge	1303	1325			

Perforating Record If Any

Formation	From	To	No. of Shots	Formation	From	To	Size of Shot
Stray	1241	1245	2 (Hydra-Jet)				
Muskogee	1285	1289	2 "				
Clasher Ridge	1305	1323	3 "				

CASING RECORD

Amount Set						Amount Pulled				Packer Record	
Size	Wt.	Thds.	Mkts.	ft.	In.	Size	Length	Depth Set	Mkts.		
10-3/4	25	53		153							
10-1/2	25	53		1391							
								1296	Shaw		

CEMENTING AND MUDDING

Amount Set				Chemical		Method of Cementing		Mudding Method		Results (See Note)	
Size	Wt.	Thds.	Mkts.	Gal.	Mkts.						
10-3/4	157		125			Dowell					
10-1/2	1584		188								

What method was used to protect sands if outer strings were pulled?

Were bottom hole plugs used? If so, state kind, depth set and results obtained

TOOLS USED

What tools were used from _____ feet to _____ Cable tools were used from 0 feet to 1385 feet, and from _____ feet to _____ feet, and from _____ feet to _____ feet

INITIAL PRODUCTION TEST

Describe initial test, whether by flow through tubing or casing or by pumping
 Amount of Oil Produced _____ bbls. Size of choke, if any _____ Length of test _____ Water
 Production _____ bbls. Gravity of oil _____ Type of Pump if pump is used, describe _____

Give detailed description and thickness of water, oil or gas.

OCT 16 1965

OKLAHOMA OIL WELL INDEX
 ANADARKO CITY
 REF. NO. - 4189

Formation	Top	Bottom	Formation	Top	Bottom
Soil	0	2	Sand	1275	1325
Clay	2	4	Shale	1325	1330
Shale	4	125	Sand	1330	1334
Sand	125	143	Shale	1334	1340
Shale	143	312	Brown Lime	1340	1360
Lime	312	330	Lime	1360	1385
Shale	330	345			
Shale Shell	345	415			
Shale	415	430			
Sandy Lime	430	442			
Shale	442	546			
Lime	546	557			
Shale	557	620			
Lime	620	626			
Shale	626	710			
Lime	710	715			
Sandy Shale	715	745			
Shale	745	795			
Lime	795	800			
Shale	800	895			
Sand	895	932			
Blk. Lime	932	940			
Shale	940	956			
Lime	956	967			
Shale	967	1004			
Sand	1004	1014			
Shale	1014	1068			
Sand	1068	1074			
Shale	1074	1093			
Sand	1093	1102			
Shale	1102	1142			
Sand	1142	1148			
Shale	1148	1156			
Sand	1156	1178			
Shale	1178	1233			
Sand, Str.	1233	1248			
Shale	1248	1275			

OCT 12 1965

OCT 12 1965

OKLAHOMA OIL WELL INDEX

COMMISSION

OKLAHOMA OIL WELL INDEX

COMMISSION

OKLAHOMA OIL WELL INDEX

COMMISSION

OKLAHOMA OIL WELL INDEX

COMMISSION

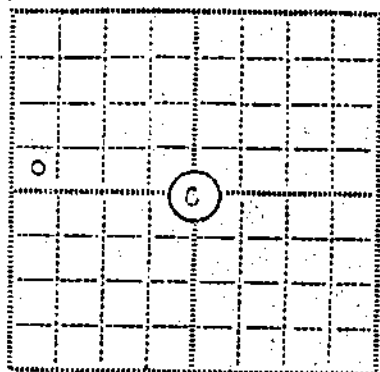
I, the undersigned, being first duly sworn upon oath, state that this well record is true, correct and complete according to the records of the office and to the best of my knowledge and belief.

W.H. McPhail Area Supt.
 Name and title of representative of company

Subscribed and sworn to before me this 11th day of October
 My Commission expires 7-16-66

CORPORATION COMMISSION
OIL AND GAS CONSERVATION DEPT
OKLAHOMA CITY, OKLAHOMA

MUSKOGEE COUNTY



COMPANY— T.P. McADAMS
FARM— Rooney #1
LOCATION— SW C SW NW
COUNTY— Muskogee
TOTAL DEPTH— 922'
PRODUCTION— OIL
ROCK PRESSURE—
ELEVATION—
DRILLING COMMENCED— 8-10-49
DRILLING COMPLETED— 8-21-49

SFC.
0
TWP.
1N
RGE.
10E

This record received by Corporation T. F. McAdams
Commission Sept. 15, 1949. Bristow, Oklahoma

OIL OR GAS SANDS OR ZONES
Wainwright sand 885' to 922'

CASING RECORD
10" - Amount Set 127'
6 5/8" " " 837'

Cable Tools from 0 to 922'
Type Rig: Spudder
Ant. Oil Production: 25 bbls.

FORMATION RECORD	TOP	BOTTOM
Soil & clay	0	20
Shale	20	40
Line	40	49
Shale & slate	49	235
Sand	235	245
Shells	245	265
Shale	265	308
Line	308	310
Shale	310	505
Line	505	510
Shale	510	545
Line	545	550
Shale	550	640
Line	640	642
Shale	642	745
Line	745	750
Shale	750	755
Sand	755	765
Shale	765	820
Line	820	835
Shale	835	850
Line	850	860
Shale	860	870
Line	870	885
Sand (Oil & 905')	885	992

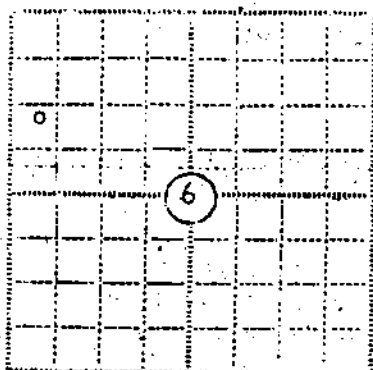
TOTAL DEPTH: 992'

SIGNED: T.F.M (Owner)

STENCILED: 11-17-49 ni

CORPORATION COMMISSION
OIL AND GAS CONSERVATION DEPT
OKLAHOMA CITY, OKLAHOMA

Muskogee County



COMPANY— William H. Pine
FARM— hooney # 2
LOCATION— NW SW NW
COUNTY— Muskogee
TOTAL DEPTH— 2082'
PRODUCTION— OIL
ROCK PRESSURE—
ELEVATION— Derrick 653' Ground 652'
DRILLING COMMENCED— 11-20-49
DRILLING COMPLETED— 11-27-49

SEC. 6
TWP. 14N
RGE. 18E

This record received by the Corporation
Commission Dec. 12, 1949.

William H. Pine
Okmulgee, Oklahoma.

NW SW NW OF SEC. 6-14N-18E- 990' North
of South Line and 275' East of West Line
of Quarter Section.
Date of first Production 11-20-49
Completed 11-26-49. OIL

NOTE: All above measurements are taken
from Lane Wells Logs which are off from
plus 3 1/2' at 750 to minus 7' at 2082.

OIL OR GAS SANDS OR ZONES:

Sand - Sho oil	752	756
Wapanucka-Sho O&G	1240	1252
Simpson Dolo. Wtr.	1776	1789
Sandy Lime, stain	1970	1982
Sand- Sho Oil & wtr.	2018	2025
Sand- Sho oil	2033	2035

The shows in the Burgen below 2018 prob.
justify drilling out to 2082 T.D. running
string 5 1/2" & cementing above Simpson.
Re- run Gamma Ray & Neutron & Perf. off
same line. If Production is obtained rip
off pipe above Simpson & produce all
three zones.

This well drilled to 2021' by McAdams
& Wallace, Bristow, and taken over at
2021 by Williams H. Pine.

TEMPERATURE RECORD:

	No. Shots	FORMATION	TOP	BOTTOM
Burgen 2042 2047	10 holes	Clay, yellow		8
Burgen 2031 2038	14 holes	Shale	5	45
Burgen 2011 2018	14 holes	Sand	45	65
Burgen 1976 1989	26 holes	Shale	65	237
Burgen 1976 1989	500 Gals.	Sand	237	250
		Shale	250	298

SHOT RECORD:

	Size shot	Lime, broken		
Simpson Dolo. 1785 1794	17 holes	Shale	298	301
Simpson Dolo. 1785 1794	500 Gall	Lime	301	425
Wapanucka 1244 1254	34 holes	Shale	425	437
Wapanucka 1239 1244	17 holes	Sand, sho, Gas	437	498
Wapanucka 1239 1254	1000 Gal	Shale	498	506
Simpson Dolo 1785 1794	17 holes	Sand, wtr. 3 blr./hr.	506	510
Simpson Dolo. 1785 1794	500 gal.	Shale	510	524
Wapanucka 1244 1254	34 holes	Lime	524	635
Wapanucka 1239 1244	17 holes	Shale	635	645
Wapanucka 1239 1254	1000 gal	Sand, so	645	752
Wapanucka 1239 1254	4000 gal	Shale	752	756
	777	1 hole	756	756
Block 7534 7541	10 holes	Lime	756	811
Block 7534 7541	Hydrafrac		811	996

CONT. PAGE # 2. Wm. H. Pine

Page # 2. William H. Pine

Okmulgee, Oklahoma.

NW SW NW OF SEC. 6-14N-18E

Muskogee County.

FARM NAME: Rooney # 2.

FORMATION	TOP	BOTTOM
Sand HFW	996	1013
Sandy lime	1013	1022
Sand	1022	1045
Shale	1045	1059
Lime	1059	1076
Shale	1076	1082
Lime	1082	1086
Shale	1086	1111
Lime	1111	1126
Shale	1126	1184
Sand, no sho	1184	1206
Shale	1206	1215
Sand	1215	1222
Shale	1222	1228
Lime	1228	1233
Shale	1233	1236
Lime, blk	1236	1240
Wapanucka, 30	1240	1265
Shale	1265	1301
Lime	1301	1316
Shale	1316	1329
Lime	1329	1339
Shale	1339	1344
Lime	1344	1439
Shale	1439	1544
Lime	1544	1636
Shale	1636	1796
Hunton Lmr	1696	1702
Shale	1702	1750
Viola Lime	1750	1765
Dense	1765	1776
Dolomite	1776	1789
Sandy Dolo.	1789	1796
Wilcox wtr. 2 blrs. /hr.	1796	1805
Green Sandy shale	1805	1859
Sand, hd.	1859	1874
Gr en sandy shale	1874	1970
Sandy lime, stain.	1970	1983
Lime	1983	2006
Sand	2006	2018
Sand, oil & wtr.	2018	2025
Sand, So 2033 1/2 wtr. 2041	2025	2044
Lime	2044	2052
Sandy lime, wtr.	2052	2079
Sand	2079	2082
TOTAL DEPTH		2082'

Filled to top with rotary mud. Filled

8 5/8" casing- Ran Schlumberger. Ran 7"

Casing and cemented.

Bailed hole dry & ran Gamma Ray & Neutron Logs.

PERFORATING, PLUG BACK, ACIDIZING AND HYDRAFRACING RECORD

FORMATION	No.	OR	Size	Results
Burgen	2035	2040	10 holes	HF SW
Burgen	2024	2031	14 "	Nothing shn
Burgen	2011	2018	14 "	Nothing shwn

Lane Wells Bridging Plug 1993' Leaking
Lane-Wells " " " 1987 Shut off.

Burgen 1989 1982 26" holes N. Shwn
Burgen 1969 1982 500 gal. N. Coming
in

Lane-Wells Bridging Plug 1823 Shut Off
Dolomite 1778 1787 17 holes Nothing
shown

Dolomite 1778 1787 500 gals. Est.
30 bbls. SW/day

Lane Wells Bridging Plug 1271 Shut off

Wapanucka 1239 1254 51 holes Sho-
gas- est. 1 gal. oil/day.

Wapanucka 1239 1254 1000 Gals.
Inc. in gas.

Wapanucka 1239 1254 4000 Gals.
200 M. Gas, 2 bbls. oil

HONCO Bridging Plug 794' shut off

Booch 757 758 10 holes- est.
1 bbl.- oil/day

Booch 757 758 Hydrafrac
very little increase

Drilled out plug at 790' & producing from
both Booch & Wapanucka.

CASING RECORD:

10-3/4" 40# 8 Used	At. Set	
	70	N.P.
8 5/8" 32# 8 Used	1071	All P
7" 17# 10 Used	2082	N.P.

LINER RECORD: NONE.

CEMENTING AND MUDDING.

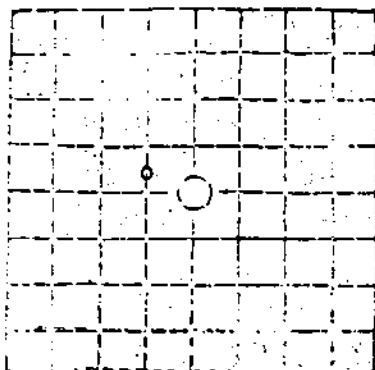
7" Amt. set 2082' max- cem 300 HONCO
Cemented to abt. 700 ft. top.

Cont. Page # 3. Wm. H. Pine

CORPORATION COMMISSION

WELL LOG DIVISION

OKLAHOMA CITY, OKLAHOMA



COMPANY—Tidal Oil Company

FARM—Sallie Sango

LOCATION—C S $\frac{1}{2}$ SE NW

COUNTY—Muskogee

TOTAL DEPTH—

PRODUCTION—

ROCK PRESSURE—

ELEVATION—

DRILLING COMMENCED—

DRILLING COMPLETED—

Muskogee

NO. 8

SEC.

6

TWP.

14N

RGE.

18E

2046'

Well is pumping water.

9-25-26

11-19-26

ADDRESS CORRESPONDENCE REGARDING THIS WELL TO—
REMARKS:

Tidal Oil Co.,
Box 2046,
Tulsa, Okla.

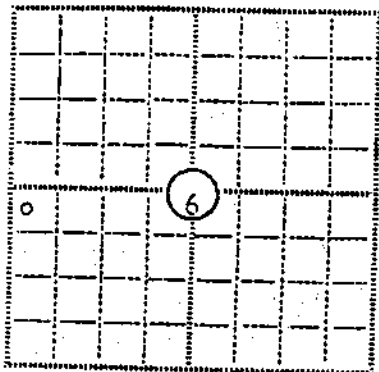
SE SE $\frac{1}{4}$ of South
line and 660' West of East Line.

10" 24 $\frac{1}{2}$ 29'
8 $\frac{1}{2}$ " 20 $\frac{1}{2}$ 135'
6 5/8" 17 $\frac{1}{2}$ 1162'

FORMATION	TOP	BOTTOM	FORMATION	TOP	BOTTOM
Clay		27	Black shale		1196
black shale		28	timber ridge sand		1218 -
black shale		45	Slight show.		
gray lime		60	sand		1225
shale		90	black shale		1241
lime & water		96	brown lime		1250
shale		127	gray & brown lime		1580
lime		135	brown shale		1610
shale		200	gray lime		1630
brown lime		220	black shale		1644
dark shale		260	brown lime		1685
slate		295	black shale		1760
brown shale		360	brown lime		1785
light shale		420	buttermilk lime		1830
light shale		540	lime		2021
dark shale		600	Wilcox sand		2041
brown lime		610	Wilcox sand - water		2046
light shale		775			
black shale		810	Plugged back to 1235'		
brown shale		890			
brown lime		905	Total Depth		2046'
gray lime		935			
shale		1040	3-30-27 G		
sand-and hole		1063			
shale		1077			
gas sand		1105			
shale		1162			
Muskogee sand		1187	- fair show oil		

**CORPORATION COMMISSION
OIL AND GAS CONSERVATION DEPT
OKLAHOMA CITY, OKLAHOMA**

Muskogee County



COMPANY—	McAdams Drilling Company	SEC.
FARM—	Allen # 1	
LOCATION—	NW NW SW	6
COUNTY—	Muskogee	
TOTAL DEPTH—	1252'	TWP.
PRODUCTION—	Dry Hole	14N
ROCK PRESSURE—		
ELEVATION—		
DRILLING COMMENCED—	12-8-49	RGE.
DRILLING COMPLETED—	12-31-49	18E

This record received by the Corporation Commission Jan. 3, 1950.

McAdams Drilling Company
Box 996
Bethany, Oklahoma.

NW NW SW OF SEC. 6-14N-18E- DRY HOLE

Oil or gas sands or zones:
NONE.

CASING RECORD:
NONE.

CEMENTING AND MUDDING: NONE.
Cable tools from 0 to T.D.

INITIAL PRODUCTION TEST: NOT GIVEN.

FORMATION	TOF	BOTTOM
Soil & Clay	0	20
Set Shale		
10 3/4"	20	95
Casing @		
91' Shale	95	227
Sand	227	237
Shale	237	280
Lime	280	282
Shale	282	383
Lime Broken	383	396
Shale	396	550
Lime	550	555
Shale	555	628
Lime	628	630
Shale	630	639
Lime	639	641
Shale	641	730
Lime	730	735
Shale	735	795
Lime	795	801
Shale	801	815
Lime	815	819
Shale	819	870
Sand	870	902
Lime	902	908

FORMATION	TOF	BOTTOM
Shale	908	913
Lime	913	927
Shale	927	968
Sandy Lime	948	953
Sand small gas	953	967
Shale	967	1014
Sand	1014	1021
Shale	1021	1030
Sand	1030	1048
Shale	1048	1101
Lime	1101	1121
Shale	1121	1152
Lime- Brown	1152	1155
Shale	1155	1174
White Lime	1174	1176
Reduced @ 1174		
Sand	1176	1190
Shale	1190	1205
Sand Timber Hedge	1205	1214
Lime- Brown	1214	1221
Shale	1221	1230
Lime Broken	1230	1243
Shale- T.D.	1243	1252

TOTAL DEPTH 1252'

Signed: No Signature

Stenciled: 1-27-50.p.c.

Form 1003A

OKLAHOMA CORPORATION COMMISSION
OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

COUNTY Muskogee SEC. 6 Twp. 14 N. RGE. 18 E.

COMPANY OPERATING Tidewater Oil Company

OFFICE ADDRESS P. O. Box 752, Drumright, Okla.

FARM NAME Muskogee Royalty Unit NO. Tr. 1 No. 11

DRILLING STARTED 5-10-1966 DRILLING FINISHED 5-28-1966

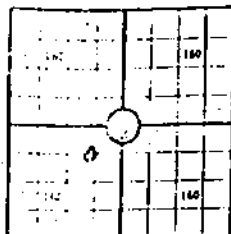
DATE OF FIRST PRODUCTION 8-19-66 COMPLETED 8-1-66

WELL LOCATED 1/4 NE 1/4 SW 1/4 1980' North of South

Line and 1858' N. East of West Line of Quarter Section

Elevation (Relative to sea level) DERRICK FLOOR 630.9 GROUND 629.4

CHARACTER OF WELL (Oil, gas or dryhole) Oil Well



Drawn well correctly

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
Stray	1213	1229	4		
Muskogee	1231	1274	5		
Timber Ridge	1278	1298	6		

Penetrating Record If Any

Shot Record

Name	To	No. of Shots	Formation	From	To	Size of Shot
Stray	1213		Sand			
Muskogee	1248		Cuts			
Timber Ridge	1282					

CASING RECORD

Amount Set						Amount Pulled		Packer Record	
Top	Base	Feet	In.	Feet	In.	Size	Length	Depth Set	Make
1213	SH	127							
1278	SH	1387							

Amount Kind Top Bottom

CEMENTING AND MUDDING

Date	Amount Set	Sacks Cement	Chemical		Method of Cementing	Amount	Mudding Method	Results (See Note)
			Gal	Make				
10-3-1966	155	100	3%	Cacl	Dowell			
5-1-2-1966	1316	175		34.37	Dowell			

What method was used to protect sands if outer strings were pulled?

Were bottom hole plugs used? If so, state kind, depth set and results obtained.

TOOLS USED

Tools were used from 1297 feet to 1350. Cables tools were used from 0 feet to 1297 feet, and from feet to feet, and from feet to feet.

Rotary & Cable Tools

INITIAL PRODUCTION TEST

Test whether by flow through tubing or casing or by pumping

Pumping

Production 0 bbls. Size of choke, if any Length of test 24 hr. Water production 220 bbls. Gravity of oil Type of Pump or pump is used, describe

Tubing Pump

Give detailed description and thickness of water, oil or gas.

SEP 24 1966

NATIONAL OIL INDEX CO.

REF. NO.

66-2720

Formation	Top	Bottom
Soil & Clay	0	12
Shale	12	124
Lime	124	130
Shale	130	172
Lime	172	177
Shale	177	192
Sand	192	196
Shale	196	320
Sand	320	326
Shale	326	530
Limey Sand	530	535
Shale	535	565
Sandy Shale	565	610
Shale	610	894
Limey Sand	894	900
Sand	900	910
Lime	910	926
Shale	926	942
Lime	942	952
Shale	952	984
Sand	984	991
Shale	991	1068
Limey Sand	1068	1075
Shale	1075	1123
Lime	1123	1127
Shale	1127	1130
Sand	1130	1155
Shale	1155	1211
Sand	1211	1215
Limey Sand	1215	1227
Sand	1227	1270
Shale	1270	1275
Sand	1275	1290
Lime	1290	1315
Shale	1315	1331
Lime	1331	1350
Total Depth	1350	

RECEIVED
CONSERVATION DEPARTMENT
SEP 21 1966
OKLAHOMA CORPORATION
COMMISSION

OCO-
Boone
Shackelford
File

I, the undersigned, being first duly sworn upon oath, state that this well record is true, correct and complete according to the records of this office and to the best of my knowledge and belief.

W. H. Smith
Name and title of representative of company

Subscribed and sworn to before me this 20th day of September 1966
My Commission expires 11-22-60

OKLAHOMA CORPORATION COMMISSION
OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

COUNTY Muskogee SEC 6 TWP 14 N RGE 18 East

COMPANY OPERATING Tidewater Oil Company

OFFICE ADDRESS PO Box 752, Drumright, Oklahoma

FARM NAME Muskogee Royalty Undd. No. Tr. 1 No. 1

DRILLING STARTED 11-4-66 DRILLING FINISHED 11-13-1966

DATE OF FIRST PRODUCTION 12-4-66 COMPLETED 12-4-66

WELL LOCATED 1/4 NW 1/4 SE 1/4 1980' North of South

Line and 579' II. East of West Line of Quarter Section

Elevation (Relative to sea level) DERRICK FLOOR GROUND 624.6

CHARACTER OF WELL (Oil, gas or dryhole) Oil Well

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
Stras	1170	1187			
Muskogee	1192	1226			
Timber Ridge	1240	1248			

Perforating Record If Any

Formation	From	To	No. of Shots	Formation	From	To	Size of Shot
Stras	1174	1185		Sand			
Muskogee	1195	1223		Cuts			
Timber Ridge	1241	1246					

CASING RECORD

Amount Set										Amount Pulled		Packer Record	
Size	Wt.	Ends	Make	Fi	In	Fi	In	Size	Length	Depth Set	Make		
10 3/4	32	8r	SH	154									
12 1/2	17	8r	N	2301									

CEMENTING AND MUDDING

Cement Set	Spuds	Chemical		Method of Cementing	Amount	Mudding Method	Results (See Note)
		Gal.	Make				
158	100	3%	CaCl	Dowell			
229	200	10%	Salt	Dowell			

Method used to protect sands if outer strings were pulled?

Bottom hole plugs used? If so, state kind, depth set and results obtained

TOOLS USED

Tools were used from feet to feet Cable tools were used from 0 feet to 1280 feet, and from feet to feet, and from feet to feet

Cable Tools

INITIAL PRODUCTION TEST

Test whether by flow through tubing or casing or by pumping

Flowing

Initial Oil Production 10 bbls. Size of choke, if any Length of test 24 Water

Gravity of oil Type of Pump if pump is used, describe

Give detailed description and thickness of water, oil or gas

DEC 17 1966

NATIONAL OIL WELL INDEX CO. OKLAHOMA CITY

REF. NO. 6

Formation	Top	Bottom	Formation	Top	Bottom
Sand	0	15			
Shale	15	90			
Sandy Shale	90	100			
Shale	100	185			
Sandy Shale	185	205			
Shale	205	300			
Sand	300	317			
Shale	317	535			
Lime	535	543			
Shale	543	590			
Shale and Shells	590	620			
Lime	620	625			
Shale	625	760			
Lime	760	765			
Shale	765	850			
Sand	850	903			
Shale	903	912			
Lime	912	925			
Shale	925	955			
Sand	955	965			
Shale	965	1015			
Lime	1015	1075			
Shale	1075	1080			
Sand	1080	1090			
Sandy Shale	1090	1092			
Shale	1092	1100			
Sand	1100	1103			
Shale	1103	1125			
Sand	1125	1173			
Shale	1173	1183			
Sand	1183	1187			
Shale	1187	1230			
Lime	1230	1244			
Shale	1244	1260			
Lime	1260	1265			
Total Depth	1265	1280			

OKLAHOMA CORPORATION COMMISSION
DEC 15 1966
CONSERVATION DEPARTMENT
RECEIVED

OCC
Boone
Shackelford
File

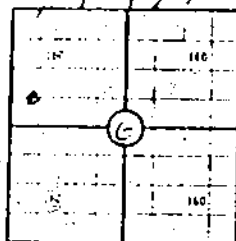
I, the undersigned, being first duly sworn upon oath, state that this well record is true, correct and complete according to the records of this office and to the best of my knowledge and belief.

W. H. H. H. Area Supt.
Name and title of representative of company

Subscribed and sworn to before me this 12 th day of December 1966
My Commission expires 11-22-60

SEC 6 TWP 14 N RGE 18 E

CASE NAME North Muskogee Royalty Unit No. 13



OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

COUNTY Muskogee SEC 6 TWP 14 N RGE 18 E
 COMPANY OPERATING TIDEWATER OIL COMPANY
 OFFICE ADDRESS P. O. Box 752, Drumright, Okla.
 FARM NAME N. Muskogee Royalty Unit No. 1. No. 13
 DRILLING STARTED 5-4-67 DRILLING FINISHED 5-9-1967
 DATE OF FIRST PRODUCTION 6-7-67 COMPLETED 6-7-67
 WELL LOCATED 1/4 SW 1/4 3300' North of South
 Line and 579' 1/2 East of West Line of Quarter Section
 Elevation (Relative to sea level) DERRICK FLOOR GROUND 645.3
 CHARACTER OF WELL (oil, gas or dryhole) Oil Well

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
Stray	1134	1160			
Muskogee	1167	1215			
	1218	1220			

Name	From	To	Name	From	To
Stray	1198	1202	Sand Cuts		
Muskogee					

CASING RECORD

Date	Wt.	Amount Set				Amount Pulled				Packer Record	
		Thds	Make	Fr	In	Fr	In	Size	Length	Depth Set	Make
8/5/67	24	8r	SH	150							
5/1/67	15	8r	SH	1249							

Line Number Amount Kind Top Bottom

CEMENTING AND MUDDING

Date	Amount	Sacks	Chemical		Method of Cementing	Amount	Mudding Method	Results (See Note)
			Gal	Make				
8/5/67	152	100	3 1/2	HA-5	Halliburton			
5/1/67	1260	200	10 1/2	Salt	Halliburton			

Method was used to protect sands if outer strings were pulled?

See bottom hole plugs used? If so, state kind, depth set and results obtained

TOOLS USED

Tools were used from 0 feet to 1261 feet
 Cable tools were used from feet to feet
 and from feet to feet, and from feet to feet
 Rotary

INITIAL PRODUCTION TEST

Test whether by flow through tubing or casing or by pumping

Pumping

Produced 17 bbls. Size of choke, if any Length of test 24 hrs. Water
 11.6 bbls. Gravity of oil Type of Pump, if pump is used, describe

Tubing Pump

Give detailed description of water, oil or gas

JUN 24 1967

OKLAHOMA CITY

Formation	Top	Bottom	Formation	Top	Bottom
Sand & Shale	0	127			
Shale	127	153			
Shale & Lime	153	370			
Shale	370	780			
Sand	780	795			
Shale & Sand	795	831			
Sand	831	878			
Shale & Lime	878	892			
Lime	892	910			
Shale & Lime	910	960			
Lime & Shale	960	964			
Sand & Shale	964	1071			
Shale & Lime	1071	1126			
Sand	1126	1143			
Sand & Shale	1143	1158			
Core No. 1	1158	1214			
Core No. 2	1214	1228			
Shale & Lime	1228	1242			
Lime & Shale	1242	1261			
Total Depth		1261			

OCC
 SHACKELFORD
 BOONE
 FILE

FILE COPY
 DO NOT REMOVE
 CONSERVATION DEPT.

RECEIVED
 OIL AND GAS CONSERVATION DEPARTMENT
 JUN 19 1967
 OKLAHOMA CORPORATION
 COMMISSION

I, the undersigned, being first duly sworn upon oath, state that this well record is true, correct and complete according to the records of this office and to the best of my knowledge and belief.

Area Supt
 Name and title of representative of company

Subscribed and sworn to before me this day of
 My Commission expires 11-23-69

FAIRM NAME No. Muskogee Royalty (WILL. NO. 100) COUNTY Muskogee SEC. 6 TWP. 14 N. RGE. 18 E.

OKLAHOMA CORPORATION COMMISSION
OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

COUNTY Muskogee SEC. 6 TWP. 14 N. RGE. 18 E.

COMPANY OPERATING Tidewater Oil Co.

OFFICE ADDRESS P. O. Box 752, Drumright, Okla.

FARM NAME No. Muskogee Royalty W-26 Tr. 1

DRILLING STARTED 1-14-1966 DRILLING FINISHED 1-23-1966

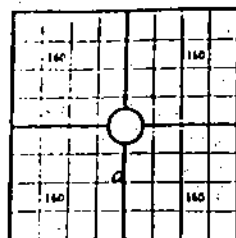
DATE OF FIRST PRODUCTION - COMPLETED 3-8-66

WELL LOCATED SESE 1/4 NE 1/4 SW 1/4 13701 North of South

Line and 26151 h. East of West Line of Quarter Section

Elevation (Relative to sea level) DERRICK FLOOR GROUND

CHARACTER OF WELL (Oil, gas or dryhole) Inj. Well



Locate well correctly

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
1 Stray	1275	1297	4		
2 Muskogee	1311	1336	5		
3 Timber Ridge	1350	1362	6		

Performing Record If Any

Shot Record

Formation	From	To	No. of Shots	Formation	From	To	Size of Shot
Stray	1280	1293					
Muskogee	1317	1335					
Timber Ridge	1353	1362					

CASING RECORD

Amount Set						Amount Pulled				Packer Record	
Size	Wt.	Thk.	Make	Fr.	In.	Fr.	In.	Size	Length	Depth Set	Make
10 3/4	32	8ml		152							
4 1/2	9.5	2nd		1398							

Enter Record Amount Kind Top Bottom

CEMENTING AND MUDDING

Size	Amount Set		Sacks Cement	Chemical		Method of Cementing	Amount	Mudding Method	Results (See Note)
	Fr.	In.		Gal.	Make				
10 3/4	1158		100	3%	CaCl	Dowell			
4 1/2	2139		150		FL 37	Dowell			

Note: What method was used to protect sands if outer strings were pulled?

NOTE: Were bottom hole plugs used? If so, state kind, depth set and results obtained

TOOLS USED

Rotary Tools were used from 1300 feet to 1397 Cable tools were used from 0 feet to 1300

feet, and from feet to feet, and from feet to feet

Type Rig Rotary and cable tools

INITIAL PRODUCTION TEST

Describe initial test: whether by flow through tubing or casing or by pumping

Amount of Oil Production bbls. Size of choke, if any Length of test Water

Production bbls. Gravity of oil Type of Pump if pump is used, describe

Water Injection Well

Give detailed description and thickness of water, oil or gas

MAR 19 1966

NATIONAL OIL WELL INDEX CO.

REF. NO.

1222

Formation	Top	Bottom	Formation	Top	Bottom
Soil	0	5			
Clay	5	10			
Shale	10	180			
Sand	180	194			
Shale	194	432			
Sand	432	440			
Shale	440	560			
Lime	560	570			
Shale	570	730			
Lime	730	735			
Shale	735	918			
Lime & Sandy Lime	918	945			
Lime	945	955			
Shale	955	965			
Lime	965	978			
Shale	978	1010			
Sand	1010	1085			
Sand	1085	1100			
Shale	1100	1110			
Sand	1110	1116			
Shale	1116	1150			
Lime	1150	1156			
Shale	1156	1195			
Sand	1195	1220			
Shale	1220	1278			
Sand	1278	1306			
Shale	1306	1320			

O.C.C.
Boone
Shalkelford
File

I, the undersigned, being first duly sworn upon oath, state that this well record is true, correct and complete according to the records of this office and to the best of my knowledge and belief

Area Supt.

Name and title of representative of company

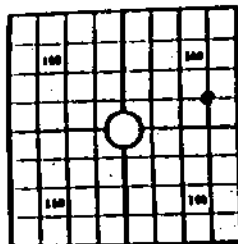
Subscribed and sworn to before me this 14 th day of March 1966

My Commission expires 11-23-69

Form 1002A

(Mail to Corporation Commission, Oklahoma City, Oklahoma)
OKLAHOMA CORPORATION COMMISSION
 OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

COUNTY MUSKOGEE, SEC. 6, TWP. 14-N., RGE. 18 EastCOMPANY OPERATING Watson & WatsonOFFICE ADDRESS Morris, OklahomaFARM NAME Wrigley WELL NO. 8DRILLING STARTED 7-23, 1965 DRILLING FINISHED 8-27, 1965DATE OF FIRST PRODUCTION 8-27-65 COMPLETED 8-27-65WELL LOCATED CL. 1/4, SE 1/4, NE 1/4, 660' North of SouthLine and 660' East of West Line of Quarter SectionElevation (Relative to sea level) DEBRICK FLOOR GROUNDCHARACTER OF WELL (Oil, gas or dryhole) Oil

Locate well correctly

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
1 Stray	1175	1190	4		
2 Muskogee	1206	1218	5		
3 Timberidge	1246	1250	6		

Perforating Record If Any

Formation	From	To	No. of Shots	Formation	From	To	Size of Shot
				Muskogee	1206	1226	40 gts

CASING RECORD

Amount Set								Amount Pulled		Packer Record	
Size	Wt.	Thdn.	Make	Fl.	In.	Fl.	In.	Size	Length	Depth Set	Make
8 5/8	28	8	LN	508							
10	50	8	SS	60							
6 1/2	17	10	LN	1200							

Liner Record: Amount Kind Top Bottom

CEMENTING AND MUDDING

Size	Amount Set		Sacks Cement	Chemical		Method of Cementing	Amount	Mudding Method	Results (See Note)
	Fl.	In.		Gal.	Make				
6 1/2	1200		100			Haliburton			

Note: What method was used to protect sands if outer strings were pulled? CementingNOTE: Were bottom hole plugs used? NO If so, state kind, depth set and results obtained.

TOOLS USED

Rotary Tools were used from foot to foot Cable tools were used from 0 foot to 1272foot, and from foot to foot, and from foot to footType Rig Spudger

DETAIL PRODUCTION TEST

Give detailed description and thickness of water, oil or gas.

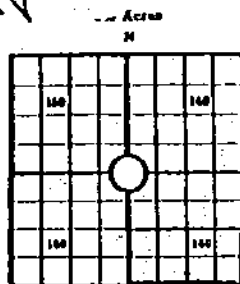
OCT 23 1965

 MAY 65 OIL 42 INDE 79
 OKLAHOMA CITY
 REF. NO.

Formation	Top	Bottom	Formation	Top	Bottom
Surface	0	25	Sandy Lime	1218	1225
Clay	25	33	Sand with Shale	1225	1236
Blue Shale	33	49	Shale	1236	1246
Water Sand	49	63	Sandy Lime	1246	1250
Shale	63	60	Show of oil		
Limey Shale	60	75	Shale	1250	1268
Shale	75	108	Lime	1268	1272
Sand	108	145			
Sandy Shale	145	176			
Shale	176	395			
Shale	395	472			
Sand	472	478			
Shale	478	494			
Sand	494	606			
Shale	606	578			
Sandy Shale	578	596			
Shale	596	685			
Lime	685	678			
Shale	678	770			
Lime	770	775			
Limey Shale	775	800			
Shale	800	851			
Lime and Shale	851	900			
Lime	900	910			
Shale	910	938			
Sand	938	966			
Shale	966	1030			
Sandy Lime	1030	1040			
Shale	1040	1098			
Sand	1098	1118			
Shale	1118	1140			
Shale	1140	1175			
Stray Sand	1175	1182			
Sand	1182	1190			
Limey Sand	1190	1192			
Shale	1192	1200			
Sand	1200	1218			

I, the undersigned, being first duly sworn upon oath, state that this well record is true, correct and complete according to the records of this office and to the best of my knowledge and belief.

271943

ARM NAME Kitty Roberts WELL NO. W-8 COUNTY Muskogee SEC. 6 TWP. 14N RGE. 18E

Locate well correctly

OKLAHOMA CONSERVATION COMMISSION OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

COUNTY Muskogee SEC. 6 TWP. 14N RGE. 18ECOMPANY OPERATING Tidewater Oil CompanyOFFICE ADDRESS Box 752, Drumright, OklahomaFARM NAME Kitty Roberts WELL NO. W-8DRILLING STARTED 6-20-62 DRILLING FINISHED 7-8-62DATE OF FIRST PRODUCTION - COMPLETED 7-19-62WELL LOCATED SE 1/4 SW 1/4 SE 1/4 10 North of SouthLine and 3960 ft. East of West Line of Quarter Section LineElevation (Relative to sea level) DERRICK FLOOR GROUND 799.5CHARACTER OF WELL (Oil, gas or dryhole) water injection

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
1 <u>Dutcher Series</u>			4		
2 <u>Stray</u>	1527	1554	5		
3 <u>Muskogee</u>	1572	1598	6		

Perforating Record If Any

Shot Record

Formation	From	To	No. of Shots	Formation	From	To	Size of Shot
<u>Stray</u>	1532	1547	30	<u>Tornado Jets, squeezed w/</u>			<u>50 sks.</u>
<u>Muskogee</u>	1584	1592	32	<u>Tornado Jets</u>			
<u>Stray</u>	1536	38-42-44		<u>Sand perf. w/ Howco 3-way tool.</u>			

CASING RECORD

Amount Set						Amount Pulled				Packer Record	
Size	Wt.	Thds.	Make	Fl.	In.	Fl.	In.	Size	Length	Depth Set	Make
10 3/4	32#		154								
4 1/2	9.5		1633								

Liner Record: Amount Kind Top Bottom

CEMENTING AND MUDDING

Size	Amount Set		Sacks Cement	Chemical		Method of Cementing	Amount	Mudding Method	Results (See Note)
	Fl. @	In.		Gal.	Make				
10 3/4	153	1	100			HA-5			
4 1/2	1606	450				Pozmix			

Note: What method was used to protect sands if outer strings were pulled?

NOTE: Were bottom hole plugs used? If so, state kind, depth set and results obtained

TOOLS USED

Rotary Tools were used from feet to feet to Cable tools were used from feet to feet to and from feet to feet to and from feet to feet toType Rig

INITIAL PRODUCTION TEST

Describe initial test: whether by flow through tubing or casing or by pumping

Water injection wellAmount of Oil Production bbbls. Size of choke, if any Length of test WaterProduction bbbls. Gravity of oil Type of Pump or pump is used, describe

Give detailed description and thickness of water, oil or gas.

SEP 8 1962

REF. NO.

-730-

Formation	Top	Bottom	Formation	Top	Bottom
Soil	0	1			
Sand - Rock	1	20			
Shale	20	72			
Sand	72	78			
Shale	78	272			
Sand	272	295			
Shale	295	375			
Sand	375	420			
Shale	420	537			
Sand	537	555			
Shale	555	785			
Sand	785	795			
Shale	795	975			
Lime - Blk	975	987			
Shale	987	1170			
Lime - Blk	1170	1200			
Lime	1200	1215			
Shale	1215	1227			
Lime - Blk	1227	1237			
Shale	1237	1270			
Sand - Blk	1270	1290			
Shale	1290	1340			
Lime	1340	1347			
Shale	1347	1425			
Sand	1425	1435			
Shale	1435	1442			
Sand	1442	1465			
Shale	1465	1529			
Sand	1529	1562			
Sand - Blk	1562	1571			
Sand	1571	1601			
Shale	1601	1611			
Sandy - Lime	1611	1613			
Shale - Lime	1613	1625			
	TD	1625			
	PSTD	1601			

RECEIVED
OIL AND GAS CONSERVATION DEPARTMENT
AUG 31 1962
OKLAHOMA CORPORATION
COMMISSION

I, the undersigned, being first duly sworn upon oath, state that this well record is true, complete according to the records of this office and to the best of my knowledge and belief.

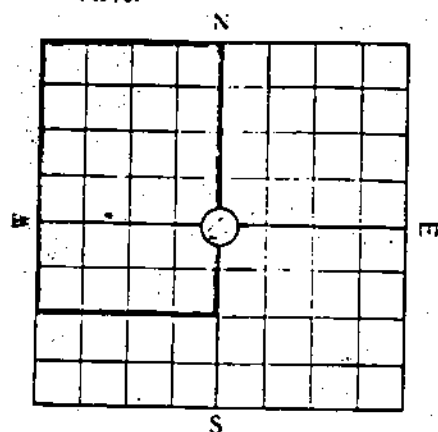
Wm H. W. W. W. Area Supt.
Name and title of representative of company

6th August

Subscribed and sworn to before me this

day of

(1970) O.G. Acres

Locate Well Correctly
and Outline Lease

PLUGGING RECORD

OKLAHOMA CORPORATION COMMISSION
Oil and Gas Conservation Division
Oklahoma City, OklahomaNOTICE: All questions on this form must be satisfactorily answered
and mailed to District Office in duplicate. Within 15 days
after plugging is completed.

Company Operating GETTY OIL COMPANY
Office Address P. O. BOX 752, DEERBORN, OKLAHOMA 74030
County Westmoreland Sec. 36 Twp. 12N Range 15E
Location in Section 36 $\frac{1}{4}$ Sec. 36 $\frac{1}{4}$ Twp. 12N $\frac{1}{4}$ Range 15E
Farm Name No. 1001, Sec. 36, Twp. 12N, Range 15E Well No. 1174 Field Deerborn
Character of Well (whether oil, gas or dry) Oil well

Commenced Plugging 4-21-72 Finished 4-26-72 Total Depth 1775

Was permission obtained from the Corporation Commission or its agents before plugging was commenced Yes

Signature of District Manager B. J. McNally Original Signature B. J. McNally Perforations: 1174 - 1231

Name of Field Supervisor J. H. DeWitt

Name of producing sand Dutchman Series Depth top 1165 Bottom 1231

Show depth and thickness of all fresh water, oil and gas formations. Oklahoma Tax Commission Assigned Lease No. _____

SAND OR ZONE RECORDS

CASING RECORDS

Formation	Content	From	To	Size	Put In	Pulled Out
<u>Dutchman Series</u>	<u>1174</u>	<u>1231</u>	<u>1231</u>	<u>4 1/2</u>	<u>1231</u>	<u>0</u>

Describe in detail the manner in which the well was plugged, indicating where the mud fluid was placed and the methods used in introducing into the hole. If cement or other plugs were used, state the character of same and depth placed:

Plugged 75 sacks of cement down 4 1/2 casing to 3650 cu. feet per between 4 1/2 and 6 1/2 casing and cemented with 125 sacks of cement. Put casing up 3' below 6 1/2 casing and tested bottom.

Does the above conform strictly to the oil and gas regulations? Yes

The Law requires that adjacent lease, and land-owners be notified; give their names with their addresses below:

Not Required

REMARKS: Why plugged? Prod. Loss If abandoned oil or gas well, state amount and date of last production Production

Plugging Contractor's Name _____ Address: _____

Correspondence regarding this well should be addressed to GETTY OIL COMPANY

P. O. BOX 752

DEERBORN, OKLAHOMA 74030

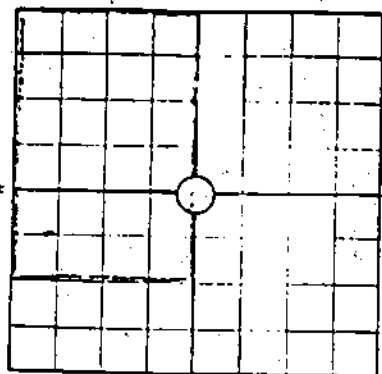
Address _____

I, the undersigned, being duly sworn upon oath, state that this well record is true, correct and complete according to the reports of this office and to the best of my knowledge and belief.

Subscribed and sworn to before me this 11 day of May

Name and title of representative of company

(1970) 16-11 April



Locate Well Correctly and Outline Lease

PLUGGING RECORD
OKLAHOMA CORPORATION COMMISSION
Oil and Gas Conservation Division
Oklahoma City, Oklahoma

NOTICE: All questions on this form must be satisfactorily answered and mailed to District Office in duplicate. Within 15 days after plugging is completed.

Company Operating THE OIL COMPANY
Office Address Washington, D. C.
County Washington Sec. 6 Twp. 17N Range 3E
Location in Section 14
Farm Name Mr. B. J. Fingersh Well No. 11412 Field 1
Character of Well (whether oil, gas or dry) oil well

Commenced Blugging 4-21-72 Finished 4-26-72 Total Depth 1253

Was permission obtained from the Corporation Commission or its agents before plugging was commenced yes

Signature of District Manager B. J. H. 114 Perforations: 114 - 1746

Name of Field Supervisor L. D. Bennett

Name of producing sand Duck-lake Series Depth top 1114 Bottom 1146

Show depth and thickness of all fresh water, oil and gas formations. Oklahoma Tax Commission Assigned Lease No. _____

SAND OR ZONE RECORDS

CASING RECORDS

Formation	Content	From	To	Size	Put In	Pulled Out
Dutchess Series	6146342	11 10	12 48	10 94	155	—
				576	1677	—

Describe in detail the manner in which the well was plugged, indicating where the mud fluid was placed and the methods used in introducing into the hole. If cement or other plugs were used, state the character of same and depth placed:

Pumped out water & regular cement and connected to 100' well and out. Pressure
gauge indicated 34' casing at 250'-252' with 4 holes per foot. Pumped 100 sacks
regular cement into well and circulated cement to surface. Capped casing
2' below G.L. and installed 100' well.

Does the above conform strictly to the oil and gas regulations? *yes*

The Law requires that adjacent lease, and land-owners be notified; give their names with their addresses below:

Not Reported

REMARKS: Why plugged? 4961 If abandoned oil or gas well, state amount and date of last production: 1079

Plugging Contractor's Name: _____ Address: _____ **ALOMA CORPORATION**

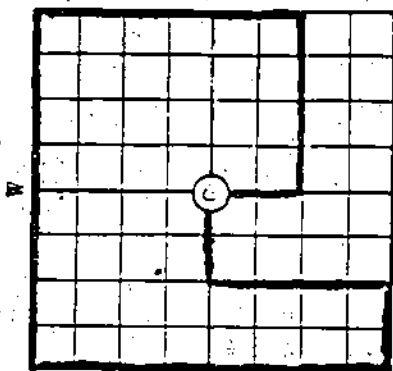
Correspondence regarding this well should be addressed to _____ GETTY OIL COMPANY 5310

Address _____

the undersigned, being duly sworn upon oath, state that this well record is true, correct and complete according to the records of this office and to the best of my knowledge and belief.

Subscribed and sworn to before me this day of May 1964

Commission expires 11/23/15



PLUGGING RECORD

OKLAHOMA CORPORATION COMMISSION
Oil and Gas Conservation Division
Oklahoma City, Oklahoma

NOTICE: All questions on this form must be satisfactorily answered and mailed to District Office in duplicate. Within 15 days after plugging is completed.

Company Operating GLUTY OIL COMPANY
Office Address PO BOX 752
SPRINGTOWN, OKLAHOMA - 74031
County Pushmataha Sec. 6 Twp. 12N Range 11E
Location in Section SW 1/4 NE 1/4 SW 1/4 NE 1/4
Farm Name No Pasture Property Well No. - Field East of
Character of Well (whether oil, gas or dry) Oil 11/16

Commenced Plugging 5-14-72 Finished 5-19-72 Total Depth 4126' 0"

Was permission obtained from the Corporation Commission or its agents before plugging was commenced Y.C.S.

Signature of District Manager, _____ Perforations: _____

Name of Field Supervisor T.W. Deane

Name of producing sand Unknown Depth top Unknown Bottom Unknown

Show depth and thickness of all fresh water, oil and gas formations. Oklahoma Tax Commission Assigned Lease No. _____

SAND OR ZONE RECORDS

CASING RECORDS

[illegible]

Describe in detail the manner in which the well was plugged, indicating where the mud fluid was placed and the methods used in introducing into the hole. If cement or other plugs were used, state the character of same and depth placed:

Pressure changed on 5-12-66 with 6.55 sacks of regular cement and circulating cement to surface. Pressured to 600 psi and pumped in 20 additional sacks of cement.

Does the above conform strictly to the oil and gas regulations? Yes

The Law requires that adjacent lease, and land-owners be notified; give their names with their addresses below:

Not Registered

REMARKS: Why plugged: 2-7-61 It abandoned oil or gas well, state amount and date of last production _____

Plugging Contractor's Name: _____ Address: _____

Correspondence regarding this well should be addressed to _____ GETTY OIL COMPANY

P. O. BOX 752

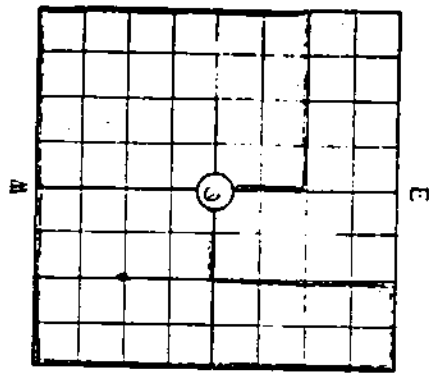
~~CONFIDENTIAL~~ UNCLASSIFIED - 73030

Address _____

the undersigned, being duly sworn upon oath, state that this well record is true, correct and complete according to the records of this office and to the best of my knowledge and belief.

Subscribed and sworn to before me this the 30 day of August 19 73

Name and title of representative of company



Locate Well Correctly
and Outline Lease

PLUGGING RECORD OKLAHOMA CORPORATION COMMISSION Oil and Gas Conservation Division Oklahoma City, Oklahoma

NOTICE: All questions on this form must be satisfactorily answered and mailed to District Office in duplicate, within 15 days after plugging is completed.

GETTY OIL COMPANY

Company Operating P. O. BOX 752
Office Address DRUMRIGHT, OKLAHOMA - 74030
County Pushkappa Sec. 6 Twp. 14N Range 13E
Location in Section 6-2 SW 1/4 1288 EWL
Farm Name Pushkappa Well No. 22 Field Pushkappa
Character of Well (whether oil, gas or dry) Oil Well

Commenced Plugging 1-19-71 Finished 1-19-71 Total Depth 1385

Was permission obtained from the Corporation Commission or its agents before plugging was commenced YES

Signature of District Manager _____ Perforations: 1241' - 1323'

Name of Field Supervisor T. H. Dumas

Name of producing sand Dutchman Series Depth top 1238 Bottom 1385

Show depth and thickness of all fresh water, oil and gas formations. Oklahoma Tax Commission Assigned Lease No. _____

SAND OR ZONE RECORDS

CASING RECORDS

Formation	Content	From	To	Size	Put In	Pulled Out
<u>Dutchman Series</u>	<u>Oil & Water</u>	<u>1238</u>	<u>1325</u>	<u>10 3/4"</u>	<u>153'</u>	<u>6</u>
				<u>4 1/2"</u>	<u>1391</u>	<u>2</u>

Describe in detail the manner in which the well was plugged, indicating where the mud fluid was placed and the methods used in introducing into the hole. If cement or other plugs were used, state the character of same and depth placed:

Cleaned out to 320' Cement was pumped down the 2 1/8" tubing and circulated to the surface in the surface casing. Closed 2" outlet and squeezed with 50 sacks of cement. Total cement used was 175 sacks. Cut casing 3' below cement level, capped well and leveled location.

Does the above conform strictly to the oil and gas regulations? YES

The Law requires that adjacent lease, and land-owners be notified; give their names with their addresses below:

Not Required

RECEIVED

REMARKS: The plugged 22 lease. If abandoned oil or gas well, state amount and date of last production Oil Well

Plugging Contractor's Name: _____ Address: _____

Correspondence regarding this well should be addressed to GETTY OIL COMPANY

P. O. BOX 752

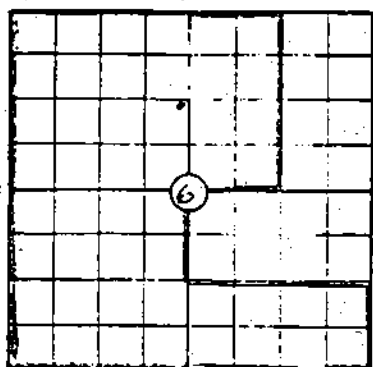
DRUMRIGHT, OKLAHOMA - 74030

Address _____

The undersigned, being duly sworn upon oath, state that this well record is true, correct and complete according to the records of this office and to the best of my knowledge and belief.

Subscribed and sworn to before me this _____ day of _____

[Signature]

Locate Well Correctly
and Outline Lease

PLUGGING RECORD

OKLAHOMA CORPORATION COMMISSION
Oil and Gas Conservation Division
Oklahoma City, OklahomaNOTICE: All questions on this form must be satisfactorily answered
and mailed to District Office in duplicate. Within 15 days
after plugging is completed.

GETTY OIL COMPANY

Company Operating GETTY OIL COMPANYOffice Address P. O. BOX 752County Muskogee Sec. 6 Twp. 14N Range 15ELocation in Section N6 1 30 1 NW 1 244 CLCFarm Name the Muskogee County Farm Well No. 27 Field MuskogeeCharacter of Well (whether oil, gas or dry) Oil Gas WaterCommenced Plugging 1-14-11 Finished 1-14-11 Total Depth 1232Was permission obtained from the Corporation Commission or its agents before plugging was commenced yesSignature of District Manager [Signature] Perforations: 121 113Name of Field Supervisor E. H. DumasetteName of producing sand Dutchman Series Depth top 1118 Bottom 1154

Show depth and thickness of all fresh water, oil and gas formations. Oklahoma Tax Commission Assigned Lease No. _____

SAND OR ZONE RECORDS

CASING RECORDS

Formation	Content	From	To	Size	Put In	Pulled Out
<u>Dutchman Series</u>	<u>Oil & Water</u>	<u>1118</u>	<u>1154</u>	<u>10 3/4</u>	<u>156</u>	<u>2</u>
				<u>4 1/2</u>	<u>1251</u>	<u>2</u>

Describe in detail the manner in which the well was plugged, indicating where the mud fluid was placed and the methods used in introducing into the hole. If cement or other plugs were used, state the character of same and depth placed:

Chased out 2 1/2" tubing to 320'. Put tubing off and pulled 300' Chased out and perforated casing with 8 holes at 300'. Pumped cement down 4 1/2" casing and circulated to the surface outside the casing using 160 sacks of cement. Capped casing cut off 3' below ground level and marked location.

Does the above conform strictly to the oil and gas regulations? yes

The Law requires that adjacent lease, and land-owners be notified: give their names with their addresses below:

Not Required

RECEIVED

REMARKS: Why plugged? Oil Lease If abandoned oil or gas well, state amount and date of last production _____Injection Well

Plugging Contractor's Name _____ Address: _____

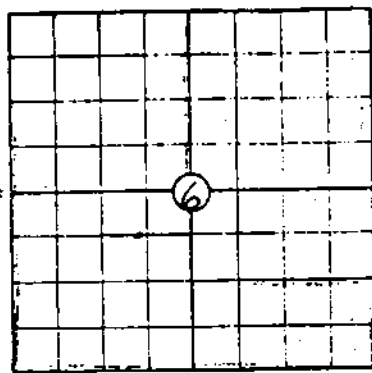
Correspondence regarding this well should be addressed to GETTY OIL COMPANYP. O. BOX 752DRUMRIGHT, OKLAHOMA - 74030

Address _____

I, the undersigned, being duly sworn upon oath, state that this well record is true, correct and complete according to the records of this office and to the best of my knowledge and belief.

[Signature]
Name and title of representative of company

Subscribed and sworn to before me this 28 day of January 1911

Locate Well Correctly
and Outline Lease

PLUGGING RECORD

OKLAHOMA CORPORATION COMMISSION

Oil and Gas Conservation Division
Oklahoma City, Oklahoma

NOTICE: All questions on this form must be satisfactorily answered and mailed to District Office in duplicate, within 15 days after plugging is completed.

Company Operating OKLAHOMA OIL & GAS
Office Address 2415 N. Lincoln Blvd. Oklahoma City, OK 73104
County Nowata Sec. 6 Twp. 14N Range 18E
Location in Section C-1 NE 1/4 1/2 1/2
Farm Name Alva Oil Well No. 11 Field Alva Oil
Character of Well (whether oil, gas or dry) Oil

Commenced Plugging 1/6/71 Finished 1/11/71 Total Depth 1230

Was permission obtained from the Corporation Commission or its agents before plugging was commenced Yes

Signature of District Manager [Signature] Perforations: 1218 - 1230

Name of Field Supervisor Bill Dismore

Name of producing sand Dutcher Series Depth top 1213 Bottom 1270

Show depth and thickness of all fresh water, oil and gas formations. Oklahoma Tax Commission Assigned Lease No. _____

SAND OR ZONE RECORDS

CASING RECORDS

Formation	Content	From	To	Size	Put In	Pulled Out
<u>Dutcher Series</u>	<u>Wellbore</u>	<u>1213</u>	<u>1273</u>	<u>10 3/4</u>	<u>155</u>	<u>-</u>
				<u>5 1/2</u>	<u>1349</u>	<u>-</u>

Describe in detail the manner in which the well was plugged, indicating where the mud fluid was placed and the methods used in introducing into the hole. If cement or other plugs were used, state the character of same and depth placed:

Pumped 100 sacks of cement and displaced to 1050 with 20 bbls of mud and 25 sacks of cement top plug. Put tubing between casing and surface pipe to 100' Circulate cement to surface using 60 sacks of cement. Put casing off 2' below G.C. cap well and isolated location.

Does the above conform strictly to the oil and gas regulations? Yes

The Law requires that adjacent lease, and land-owners be notified; give their names with their addresses below:

Alva Oil

REMARKS: Why plugged Per lease If abandoned oil or gas well, state amount and date of last production _____

Plugging Contractor's Name _____ Address _____

Correspondence regarding this well should be addressed to _____

Address _____

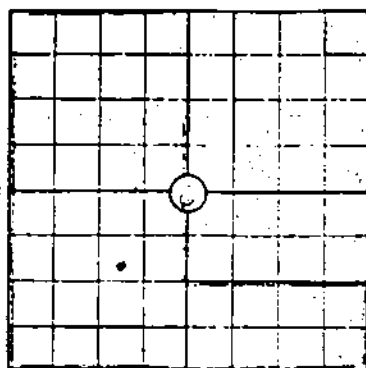
I, the undersigned, being duly sworn upon oath, state that this well record is true, correct and complete, as submitted to the records of this office and to the best of my knowledge and belief.

Subscribed and sworn to before me this 25 day of January, 1971.

(1970)

(6-1) Acres

N

Locate Well Correctly
and Outline Lease

PLUGGING RECORD

OKLAHOMA CORPORATION COMMISSION

Oil and Gas Conservation Division

Oklahoma City, Oklahoma

NOTICE: All questions on this form must be satisfactorily answered and mailed to District Office in duplicate. Within 15 days after plugging is completed.

Company Operating _____

Office Address _____

County Mustang Sec. 6 Twp. 14N Range 12ELocation in Section Sec 6 N 1/2 1375Farm Name H. H. & R. R. Co. Well No. 4 Field 11442000Character of Well (whether oil, gas or dry) Oil 1144Commenced Plugging 1-5-71 Finished 1-5-71 Total Depth 1332Was permission obtained from the Corporation Commission or its agents before plugging was commenced yesSignature of District Manager _____ Perforations: 1211-1212Name of Field Supervisor T. H. DuncansonName of producing sand Dutcher Series Depth top 1200 Bottom 1312

Show depth and thickness of all fresh water, oil and gas formations. Oklahoma Tax Commission Assigned Lease No. _____

SAND OR ZONE RECORDS

CASING RECORDS

Formation	Content	From	To	Size	Put In	Pulled Out
<u>Dutcher Series</u>	<u>Oil & water</u>	<u>1200</u>	<u>1312</u>	<u>3</u>	<u>30</u>	<u>6</u>
				<u>4 1/2</u>	<u>1332</u>	<u>0</u>

Describe in detail the manner in which the well was plugged, indicating where the mud fluid was placed and the methods used in introducing into the hole. If cement or other plugs were used, state the character of same and depth placed:

Pumped 100 sacks of regular cement and displaced to 1000 with 11 bbls. of mud and 25 sa
cement surface plug. Well previously cemented from 1000 to surface outside the
casing. Set up casing 2' below G.L. capped well and located location.

Does the above conform strictly to the oil and gas regulations? yes

The Law requires that adjacent lease, and land-owners be notified: give their names with their addresses below:

Let us billREMARKS: Why plugged? Oil Lease If abandoned oil or gas well, state amount and date of last production _____

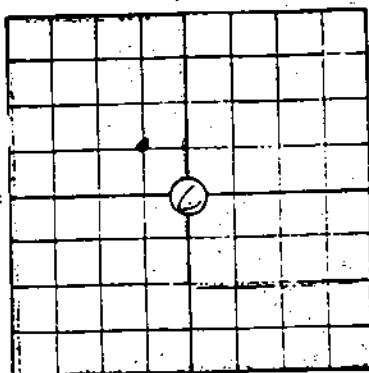
Plugging Contractor's Name: _____ Address: _____

Correspondence regarding this well should be addressed to _____

Address _____

I, the undersigned, being duly sworn upon oath, state that this well record is true, correct and complete according to the records of the well and to the best of my knowledge and belief.

Subscribed and sworn to before me this 15 day of January 1971



Locate Well Correctly
and Outline Lease

PLUGGING RECORD

OKLAHOMA CORPORATION COMMISSION
Oil and Gas Conservation Division
Oklahoma City, Oklahoma

NOTICE: All questions on this form must be satisfactorily answered and mailed to District Office in duplicate. Within 15 days after plugging is completed.

Company Operating NETTY OIL COMPANY

Company Address 1111 N. 10th St., Oklahoma City, Oklahoma 73103

Office Address 1111 N. 10th St., Oklahoma City, Oklahoma 73103

County Nowata Sec. 6 Twp. 14N Range 13E

Location in Section C SE NW 3200' NSE

Farm Name Nowata Well No. 3 Field Nowata

Character of Well (whether oil, gas or dry) Oil

Commenced Plugging 1-3-71 Finished 1-7-71 Total Depth 1266

Was permission obtained from the Corporation Commission or its agents before plugging was commenced Yes

Signature of District Manager [Signature] Perforations: 1174 1175

Name of Field Supervisor [Signature] Depth top 1174 Bottom 1175

Name of producing sand Detoken Series

Show depth and thickness of all fresh water, oil and gas formations. Oklahoma Tax Commission Assigned Lease No.

SAND OR ZONE RECORDS

CASING RECORDS

Formation	Content	From	To	Size	Put In	Pulled Out
<u>Detoken Series</u>	<u>Wellbore</u>	<u>1174</u>	<u>1179</u>	<u>8 1/4</u>	<u>30</u>	<u>0</u>
				<u>4 1/2</u>	<u>1335</u>	<u>0</u>

Describe in detail the manner in which the well was plugged, indicating where the mud fluid was placed and the methods used in introducing into the hole. If cement or other plugs were used, state the character of same and depth placed:

Pumped 100 sacks cement and displaced to 1050' with 12 bbls of mud and 5 bbls of water. 48 hours. Perforated casing at 250'-252'. Run 1" tubing outside casing to 120'. Pumped 50 sacks of cement down casing. Pumped 100 sacks down 1" tubing and circulated cement to surface outside casing. Cut casing at 2' below G.L., capped well and marked location.

Does the above conform strictly to the oil and gas regulations? Yes

The Law requires that adjacent lease, and land-owners be notified: give their names with their addresses below:

B. E. Davis

REMARKS: Why plugged? Abandoned If abandoned oil or gas well, state amount and date of last production

1 50% 2 10 5 14-20

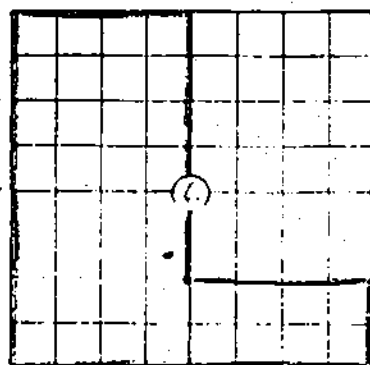
Plugging Contractor's Name Address

Correspondence regarding this well should be addressed to

I, the undersigned, being duly sworn upon oath, state that this well record is true, correct and complete according to the records of this office and to the best of my knowledge and belief.

[Signature] [Signature]

Subscribed and sworn to before me this 12 day of January



Locate Well Correctly
and Outline Lease

PLUGGING RECORD

OKLAHOMA CORPORATION COMMISSION
Oil and Gas Conservation Division
Oklahoma City, Oklahoma

NOTICE: All questions on this form must be satisfactorily answered and mailed to District Office in duplicate. Within 15 days after plugging is completed.

Company/Operator: PLUG OIL COMPANY
Office Address: 1211 E. 10TH ST. OKLAHOMA CITY, OKLAHOMA 73101
County: LeFlore Sec. 8 Twp. 26N Range 10E
Location in Section: 34
Farm Name: Blackhawk Well Well No. 2 Field Blackhawk
Character of Well (whether oil, gas or dry): Oil

Commenced Plugging: 1-5-71 Finished: 1-5-71 Total Depth: 1326'

Was permission obtained from the Corporation Commission or its agents before plugging was commenced: yes

Signature of District Manager: [Signature] Perforations: 1226' - 1259'

Name of Field Supervisor: T. H. Duncanson

Name of producing sand: Dutchman Series Depth top: 1276' Bottom: 1259'

Show depth and thickness of all fresh water, oil and gas formations. Oklahoma Tax Commission Assigned Lease No. _____

SAND OR ZONE RECORDS

CASING RECORDS

Formation	Content	From	To	Size	Pur In	Pulled Out
<u>Dutchman Series</u>	<u>oil & water</u>	<u>1276</u>	<u>1254</u>	<u>10 3/4</u>	<u>2'</u>	<u>2'</u>
				<u>5 1/2</u>	<u>1340</u>	<u>2'</u>

Describe in detail the manner in which the well was plugged, indicating where the mud fluid was placed and the methods used in introducing into the hole. If cement or other plugs were used, state the character of same and depth placed:

Pumped 100 sacks of regular cement and shipped to 100' with 12 bbls of mud and 25 sacks of cement. Casing previously cemented on the outside. Cut casing off 2' below G.L., cased well and leveled location.

Does the above conform strictly to the oil and gas regulations? yes

The law requires that adjacent lease, and land-owners be notified; give their names with their addresses below:

Netra Oil

REMARKS: Why plugged? Per Lease If abandoned oil or gas well, state amount and date of last production _____

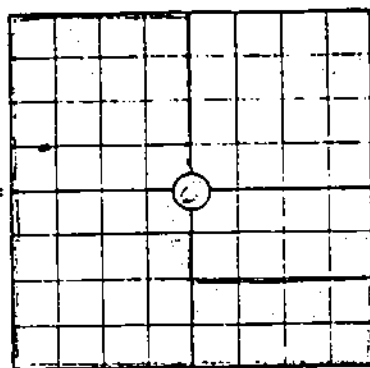
Plugging Contractor's Name: _____ Address: _____

Correspondence regarding this well should be addressed to: _____

Address: _____

I, the undersigned, having duly sworn upon oath, state that this well record is true, correct, and complete according to the records of the well, and to the best of my knowledge and belief.

Subscribed and sworn to before me this 15 day of Jan, 1971.



Locate Well Correctly
and Outline Lease

PLUGGING RECORD OKLAHOMA CORPORATION COMMISSION Oil and Gas Conservation Division Oklahoma City, Oklahoma

NOTICE: All questions on this form must be satisfactorily answered and mailed to District Office in duplicate. Within 15 days after plugging is completed.

Company Operating GLITY OIL COMPANY
Office Address P.O. Box 752
DRUMRIGHT, OKLAHOMA 73030
County Muskogee Sec. 36 Twp. 22N Range 10E
Location in Section 1, S10, 1, N10, 1, 33, 1, N10
Farm Name No. 13 Well No. 13 Field 1, 13, 1, 13
Character of Well (whether oil, gas or dry) oil

Commenced Plugging 12-31-70 Finished 12-31-70 Total Depth 1220

Was permission obtained from the Corporation Commission or its agents before plugging was commenced? yes

Signature of District Manager _____ Perforations: 1134

Name of Field Supervisor L. D. Dumas

Name of producing sand Dutcher Series Depth top 1134 Bottom 1220

Show depth and thickness of all fresh water, oil and gas formations. Oklahoma Tax Commission Assigned Lease No. _____

SAND OR ZONE RECORDS

CASING RECORDS

Formation	Content	From	To	Size	Put In	Pulled Out
<u>Dutcher Series</u>	<u>oil & water</u>	<u>1134</u>	<u>1220</u>	<u>3 7/8</u>	<u>132</u>	<u>15</u>
				<u>5 1/2</u>	<u>1220</u>	<u>4</u>

Describe in detail the manner in which the well was plugged, indicating where the mud fluid was placed and the methods used in introducing into the hole. If cement or other plugs were used, state the character of same and depth placed:

Pumped 100 sacks of regular cement and displaced to 1134' with 18 bbl. of mud and 25 sacks of cement. Top plug. Top of cement outside casing at 150'. Cement taking to 130' outside casing. Circulated cement to surface using 50 sacks pulled 11' tubing. Cost was \$2' below E.L. cement well was plugged location.
Does the above conform strictly to the oil and gas regulations? yes

The law requires that adjacent lease, and land-owners be notified; give their names with their addresses below:

Not NA

REMARKS: Why plugged? PLUG If abandoned oil or gas well, state amount and date of last production _____

Plugging Contractor's Name: _____ Address: _____

Correspondence regarding this well should be addressed to _____

Witness

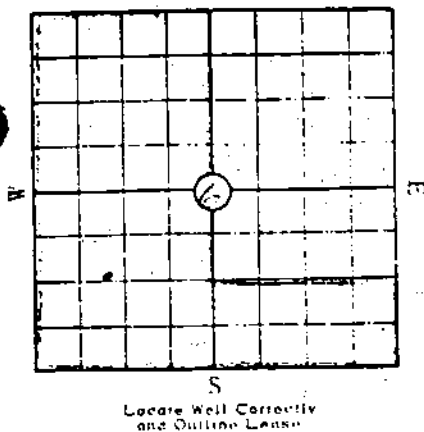
I, the undersigned, being duly sworn upon oath, state that this well record is true, correct, and complete according to the records of the office and to the best of my knowledge and belief.

Subscribed and sworn to before me this _____ day of _____

PLUGGING RECORD

OKLAHOMA CORPORATION COMMISSION
Oil and Gas Conservation Division
Oklahoma City, Oklahoma

NOTICE: All questions on this form must be satisfactorily answered and mailed to District Office in duplicate, within 15 days after plugging is completed.



Company Operating OKLAHOMA OIL COMPANY
Office Address DEPT. OF REVENUE, 74030
County Muskogee Sec. 6 Twp. 14N Range 18E
Location in Section SE
Farm Name McKoy's Well No. 1 Field McKoy's
Character of Well (whether oil, gas or dry) Oil

Commenced Plugging 1/3/71 Finished 1/17/71 Total Depth 1266'

Was permission obtained from the Corporation Commission or its agents before plugging was commenced? Yes

Signature of District Manager L. H. DAVIS Perforations: Open 14-16'
Name of Field Supervisor L. H. DAVIS
Name of producing sand Dutchman Series Depth top 1266' Bottom 1266'

Show depth and thickness of all fresh water, oil and gas formations. Oklahoma Tax Commission Assigned Lease No. _____

SAND/ZONE RECORDS

CASING RECORDS

Formation	Content	From	To	Size	Put In	Pulled Out
<u>Dutchman Series</u>	<u>oil & gas</u>	<u>1216</u>	<u>1266</u>	<u>7</u>	<u>1144</u>	<u>0</u>

Describe in detail the manner in which the well was plugged, indicating where the mud fluid was placed and the methods used in introducing into the hole. If cement or other plugs were used, state the character of same and depth placed:

Pumped 100 sacks of cement and displaced to 1000' with 28 bbls. mud and 12 bbls. water. While 48 hrs. restricted casing at 250'-252'. Pumped 100 sacks of cement down casing and circulated to the surface outside the casing. Cut casing off 2' below G.C., Chopped well & moved location.

Does the above conform strictly to the oil and gas regulations? Yes

The Law requires that adjacent lease, and land-owners be notified; give their names with their addresses below

Not Required

REMARKS: Why plugged? Abandoned If abandoned oil or gas well, state amount and date of last production

13000 22 BOPD 4-3-61

Plugging Contractor's Name: _____ Address: _____

Correspondence regarding this well should be addressed to _____

Address: _____

I, the undersigned, being duly sworn, depose and say that the well record is true, correct, and complete, and that the same is true and correct to the best of my knowledge and belief.

Name and title of person executing this record

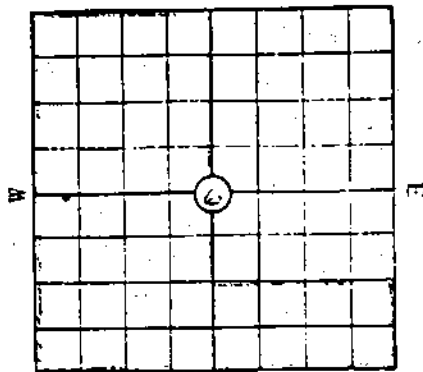
Notary Public for Oklahoma

Witnessed and sworn to before me this _____ day of _____, 1971.

Notary Public for Oklahoma

PLUGGING RECORD

OKLAHOMA CORPORATION COMMISSION
Oil and Gas Conservation Division
Oklahoma City, Oklahoma



Locate Well Correctly
and Outline Lease

NOTICE: All questions on this form must be satisfactorily answered and mailed to District Office in duplicate. Within 15 days after plugging is completed.

GETTY OIL COMPANY

Company Operating P. C. BOK 700
Office Address DRUMRIGHT, OKLAHOMA - 74030
County Washita Sec. 6 Twp. 19N Range 18E
Location in Section N6 1 N6 1 S6 1 E20 N20
Farm Name N. Washita Leppell Well No. 7 Field Washita
Character of Well (whether oil, gas or dry) Washita

Commenced Plugging 12-31-70 Finished 12-31-70 Total Depth 1275'

Was permission obtained from the Corporation Commission or its agents before plugging was commenced yes

Signature of District Manager _____ Perforations: _____

Name of Field Supervisor J. H. Dumas

Name of producing sand DUTCHER SERIES Depth top 1170' Bottom 1275'

Show depth and thickness of all fresh water, oil and gas formations. Oklahoma Tax Commission Assigned Lease No. _____

SAND OR ZONE RECORDS

CASING RECORDS

Formation	Content	From	To	Size	Put In	Pulled Out
<u>DUTCHER SERIES</u>	<u>DIFFERENT</u>	<u>1170'</u>	<u>1275'</u>	<u>8"</u>	<u>25'</u>	<u>6'</u>
				<u>2 1/2"</u>	<u>1270'</u>	<u>6'</u>

Describe in detail the manner in which the well was plugged, indicating where the mud fluid was placed and the methods used in introducing into the hole. If cement or other plugs were used, state the character of same and depth placed:

Pumped 100 sacks of cement and left 24" casing full cement down tubing between surface pipe and 24" casing to a depth of 750' and circulated cement from this depth. The surface pullout tubing was filled annular with cement. Total cement used 200 sacks. The casing was 150 sacks. Cut casing off 2" well G.C., changed well and tested.

Does the above conform strictly to the oil and gas regulations? yes

The Law requires that adjacent lease, and land-owners be notified; give their names with their addresses below:

Not Required

REMARKS: The plugged well is If abandoned oil or gas well, state amount and date of last production

Abandoned

Plugging Contractor's Name _____ Address: _____

Correspondence regarding this well should be addressed to _____

GETTY
P. C. BOK
DRUMRIGHT, OKLAHOMA - 74030

Address _____

I, the undersigned, being duly sworn upon oath, state that this well record is true, correct and complete according to the record of this office and to the best of my knowledge and belief.

Subscribed and sworn to before me this _____ day of _____

J. H. Dumas District Manager

1970)

(c) Agree

2



London Well University
and London University

OKLAHOMA CORPORATION COMMISSION

Oil and Gas Conservation Division
Oklahoma City, Oklahoma

NOTICE: All questions on this form must be satisfactorily answered and mailed to District Office in duplicate. Within 15 days after plugging is completed.

GETTY OIL COMPANY
Company Operating P. O. BOX 112
Office Address DRUMRIGHT, OKLAHOMA 73117
County Mustang Sec. 6 Twp. 14N Range 18E
Location in Section SW 1/4
Farm Name Mustang Well No. 2 Field Mustang
Character of Well (whether oil, gas or hot) Oil

Commenced Pugging 1-27 Finished 1-6 Total Depth 1550

Was permission obtained from the Corporation Commission or its agents before plugging was commenced - Yes

Signature of District Manager _____ Perforations: Black and Red

Name of Field Supervisor J. M. Dumas

Name of producing sand Dutchman River Depth top _____ Bottom _____

Show depth and thickness of all fresh water, oil and gas formations. Oklahoma Tax Commission, Assigned Lease No. _____

SAND OR ZONE RECORDS

CASING RECORDS

Formation	Content	From	To	Size	Put In	Pulled Out
Detroit Lenses	Cl. & L. sh.	10' 0" down		8 1/4	21	4
				4 1/2	1350	1

Describe in detail the manner in which the well was plugged, indicating where the mud fluid was placed and the methods used in introducing it into the hole. If cement or other plugs were used, state the character of same and depth placed:

Pumped 100 sacks of cement and displaced to 1500' with 11 bbls of mud and 5 bbls of water.
W.P.C. 48 hrs. Perforated casing at 250'-252'. Pumped 185 sacks of cement and circulated
cement to the surface outside the casing and left casing full of cement. Cut
casing off 2' below G.L. cropped well and located location.
Does the above conform strictly to the oil and gas regulations? yes

The Law requires that adjacent lease, and land-owners be notified: give their names with their addresses below:

Not Required

REMARKS: Why plugged NTG LA 2 If abandoned oil or gas well, state amount and date of last production

یا توبہ نہ کرے۔۔۔۔۔ نہ توبہ نہ کرے نہ

Plugging Contractor's Name: _____ Address: _____

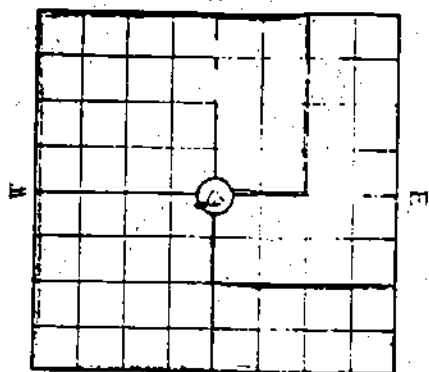
Correspondence regarding this well should be addressed to: Mr. J. J. [redacted] 1000 [redacted] 1000 [redacted]

References

I, the undersigned, being duly sworn upon oath, state that this well known is true, correct and complete according to the records of this office and to the best of my knowledge and belief.

Subsequently, and as we noted above, the $1/\Delta$ day set

Sec 1003
(1970) 640 Acres



Locate Well Correctly
and Outline Ledge

PLUGGING RECORD

OKLAHOMA CORPORATION COMMISSION

Oil and Gas Conservation Division
Oklahoma City, Oklahoma

NOTICE: All questions on this form must be satisfactorily answered and mailed to District Office in duplicate, within 15 days after plugging is completed.

GETTY OIL COMPANY

Company Operating GETTY OIL COMPANY
Office Address P. O. BOX 752
DRUMRIGHT, OKLAHOMA - 74030
County Nowata Sec. 6 Twp. 14N Range 13E
Location in Section 6-14 5-2 26-2 W-2
Farm Name McPherson Well No. 6-14 Field Nowata
Character of Well (whether oil, gas or dry) 2 1/2 inch well

Commenced Plugging 1-19-71 Finished 1-19-71 Total Depth 1306'

Was permission obtained from the Corporation Commission or its agents before plugging was commenced? yes

Signature of District Manager T. H. Dicussette Perforations 1213' - 1257'

Name of Field Supervisor T. H. Dicussette

Name of producing sand Dutcher Series Depth top 1204 Bottom 1262

Show depth and thickness of all fresh water, oil and gas formations. Oklahoma Tax Commission Assigned Lease No. _____

SAND OR ZONE RECORDS

CASING RECORDS

Formation	Content	From	To	Size	Put In	Pulled Out
<u>Dutcher Series</u>	<u>Oil & Water</u>	<u>1204</u>	<u>1262</u>	<u>8 5/8</u>	<u>145</u>	<u>6</u>
				<u>4 1/2</u>	<u>1333</u>	<u>2</u>

Describe in detail the manner in which the well was plugged, indicating where the mud fluid was placed and the methods used in introducing into the hole. If cement or other plugs were used, state the character of same and depth placed:

Previously cemented with 20 sacks of cement between casing & surface pipe in 1966. Cemented to 520'. Bore tubing at 300'. Pumped 20 sacks of cement down tubing and circulated cement to isolate between tubing & casing. Grouted with 10 sacks of cement at 2500 psi. Put casing off 3' below 66' capped casing and leveled hole.

Does the above conform strictly to the oil and gas regulations? yes

The Law requires that adjacent lease, and land-owners be notified: give their names with their addresses below

Not required

REMARKS: Why plugged? Not line If abandoned oil or gas well, state amount and date of last production

Plugging Contractor's Name _____ Address _____

Correspondence regarding this well should be addressed to

GETTY OIL COMPANY
P. O. BOX 752
DRUMRIGHT, OKLAHOMA 74030

I, the undersigned, being duly sworn upon oath, state that this well record is true, correct and complete according to the records of this office and to the best of my knowledge and belief.

Walter Phair
Name and title of representative of company

Subscribed and sworn to before me on this 18 day of February

APPENDIX C
WATER WELL INVENTORY

**WELL RECORDS
HANCOCK RD. AND 51ST ST.
MUSKOGEE COUNTY**

Hand not well lettered

IX

N

Permit No:

E-8-67

Appendix D

APPENDIX D

FIELD EXPLORATION PROGRAM

The field exploration program was designed to fill the data gaps necessary to refine a hydrogeologic conceptual model for WMO based on sound engineering and geologic practices, and to meet ODEQ requirements. Based on ODEQ 252:510-11, a minimum of 19 soil borings were required per ODEQ site characterization standards. RUST E&I proposed a total of 30 boreholes to be drilled at the designated locations as shown on Figure 6-1. Fifteen borings were drilled strictly for geotechnical testing, six borings for piezometers and geotechnical testing and nine borings for piezometers. The field exploration program was conducted in September, October, and November of 1993.

The purposes of the field exploration program were to explore the subsurface conditions of Tract A, determine the thickness of any U.S. Drinking Water aquifer underlying the facility, if any, and determine the uppermost saturated zone to be monitored. In addition, soil and rock samples were taken during drilling and tested for physical and engineering properties for landfill design purposes. The information obtained was used to prepare this Phase II final report and a site-specific ground-water monitoring plan. The program was based on the assumption that the deepest proposed excavation will be the top of the weathered shale, not taking the depth to ground water into account. A buffer zone 50-feet wide is along the southern and western property boundaries, and 75-feet wide along the northern and eastern boundaries.

The borings were drilled with hollow-stem auger until refusal, then air rotary methods were used. The driller could not obtain core samples in borings B-4, 10, 11, 16, 17, and 18 without drilling with potable water. The core bit turned the soft formation into powder. Excessive ground water from the fractured and weathered bedrock entered the borehole, mixed with the powder, and plugged the core bits. The driller ascertained it was impossible to continue these borings without wet rotary operations. Rust agreed. The borings were logged and sampled using visual classification techniques, paying particular attention to the presence of shallow ground water.

Soil samples for geotechnical analyses were collected from the borings. Lithologic sample logs were made of each borehole and include the following items:

- Drilling data such as drilling method and type of rig used;
- Description of all soil and rock layers encountered using ASTM 2487 methods including:
 - Name, color, texture, thickness, structure and amount of moisture present in each layer,
 - Approximate soil classifications,
 - Rock classification as defined in the Dictionary of Geological Terms,
 - Secondary features such as slickensides, fossils, fractures, seams, calcite healing, organic debris, ferrous nodules or staining;
- The depths at which ground water, if any was encountered. Ground water was anticipated to be at or above the top of the weathered bedrock. Typically the rate of drilling exceeded the rate of infiltration of ground water into the borehole. This created a lag period from which ground water was encountered to the time and depth ground water was noted on the sampler or when the sampler penetrated a more permeable zone and water was seen in the sample. Due to the lag period, the depths of the encountered ground water noted on the boring logs may not be accurate. Often times, evidence of ground water was not seen on the sampler or in the sample while drilling with hollow-stem augers. However, once coring operations commenced, damp or wet conditions of the core were noted.
- Stabilized ground water elevations. Typically, since ground water infiltration into the boreholes was so slow, the borehole was completed prior to measuring stabilized ground water. After the boreholes were drilled, 18 to 24 plus hours was considered sufficient time to allow for stabilization. Upon, stabilization, a reading was taken, except for those locations adjacent to piezometers or monitoring wells.

Table D-1 defines the boring/piezometer location number, the topographic elevation where the boring was located, and the depth or zone of all piezometric/geotechnical borings.

When rock conditions were encountered, the rock name, color, bedding, weathering, structure, and any other applicable descriptors were recorded on the field log for each borehole. Percent recovery of the rock core and the Rock Quality Designation (RQD) were calculated for every core. The RQD is a modified core recovery measurement used to characterize the quality of the

rock mass. To calculate RQD, all pieces of a core over six inches in length were added together and divided by the total length of the core run, and expressed as a percentage. Listed below is a table showing the relationship of RQD and rock quality.

<u>RQD%</u>	<u>Description of Rock Quality</u>
0 - 25	Very Poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

The detailed logs in the field were recorded on Waste Management forms presented behind this narrative. These logs represent conditions and classifications as recorded by the field geologists. Geotechnical laboratory results are presented where applicable, as well as the laboratory classification. In general, the residual soils consisted of silty clays, with the United Soil Classification symbol of "CL."

The boreholes were grouted from the bottom up using a cement-bentonite or bentonite grout to the surface. Rock cores were stored in waxed cardboard boxes, appropriately labelled, and turned over to Waste Management for storage.

TABLE D-1

BOREHOLE DEPTHS

MUSKOGEE COMMUNITY LANDFILL AND RECYCLING CENTER, OKLAHOMA

BORING	30 FEET BELOW DEEPEST PLANNED EXCAVATION ¹ (NGVD)	SURFACE ELEVATION OF BORING, FT	TARGET DEPTH OF BORINGS, FT	ACTUAL DEPTH OF BORING, FT	ACTUAL COMPLETION ELEVATIONS OF BORING, FT (NGVD)
B-1	583	622.9	40	45	577.9
B-2	582	624.5	43	49	575.5
B-3	582	625.5	44	48	577.5
B-4	582	627.9	46	48	579.9
P-1/B-5	586	629.5	44	133 (Zone D)	496.5
P-2/B-6	586	629.7	44	70 (Zone C)	559.7
B-7	586	623 ³	5,647	45	578.0
B-8	587	629.5 ⁴	43	45	584.5
B-9	588	625.1	37	53	572.1
B-10	588	631.0	43	47	584.0
B-11	589	627.0 ⁴	38	45	582.0
B-12	587	627.9	41	45	582.9
B-13A	587	628 ³	5,696	20	608
P-4/B13B	587	630.8	44	128 (Zone D)	502.8
P-5/B-14	587	630.5	44	67.5 (Zone C)	563.0
B-15	588	632.5 ⁴	45	45	587.5

TABLE D-1 (continued)

BORING	30 FEET BELOW DEEPEST PLANNED EXCAVATION ¹ (NGVD)	SURFACE ELEVATION OF BORING, FT	TARGET DEPTH OF BORINGS, FT	ACTUAL DEPTH OF BORING, FT	ACTUAL COMPLETION ELEVATIONS OF BORING, FT (NGVD)
B-16	590	630.5 ⁴	41	47	583.5
B-17	588	633.4	45	45	588.4
B-18	589	628.9	40	45	583.9
B-19	589	638.6	50	61	577.6
B-20A	589	632.4	43	28.5	603.9
P-8/B-20	589	641.5	53	171.0 (Zone D)	470.5
P-9/B-21	589	642.3	53	85.1 (Zone C)	557.2
P-3	586	629.2	⁴³	13.50 (Zone A)	615.7
P-6	587	630.3	⁴³	23 (Zone B)	607.3
P-7	587	630.2	⁴³	8.1 (Zone A)	622.1
P-10	589	641.8	⁵³	25.5 (Zone A)	616.3
P-11	589	627.0	³⁸	21.6 (Zone B)	605.4
P-12	588	627.9	⁴⁰	22.7 (Zone B)	605.2
P-13	588	625.3	³⁷	19.3 (Zone B)	606.0
P-14	587	629.7	⁴³	24.7 (Zone B)	605.0
P-15	583	624.4	⁴¹	27.2 (Zone B)	597.2

- 1 The deepest planned excavation is defined at the elevation where top of weathered shale is encountered per previous boring data at the site.
2 This boring is strictly for a piezometer; no geotechnical testing will be performed.
3 Pit dug to remove saturated surface soils. Estimated elevation.
4 Boring slightly offset to drill on level ground or other circumstance. Approximate elevation.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION Muskogee Landfill Muskogee, Oklahoma N272500.8 DATUM E2731415.1 ELEVATION 627.7 ft				DRILLING METHOD: <u>Hollow-stem augers.</u>				BORING NO. B-1			
				3-1/2-inch x 7-inch O.D.				SHEET 1 of 1			
				SAMPLING METHOD:				DRILLING			
				24-inch split spoon on 5-foot centers				START	FINISH		
				WATER LEVEL				TIME	TIME		
				TIME				14:30	15:30		
DATE				DATE	DATE						
CASING DEPTH				11/18/92 11/18/92							
DRILL RIG <u>CME 75</u>				SURFACE CONDITIONS <u>Dozer removed 3 to 4 feet of wet,</u>							
ANGLE <u>Vertical</u> BEARING				<u>loose soils so drilling rig could set up over</u>							
SAMPLE HAMMER TORQUE FT.-LBS				<u>boring location</u>							
DEPTH IN FEET (ELEVATION)	BLOWS/ MIN ON SAMPLER (RECOVERY)	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	TEST RESULTS				
							WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	OTHER TESTS
2			CLAY (CH), tan, homogeneous structure, ferrous nodules, ferrous staining								
4											
6	2,4,7										
8											
10	5,7,10										
12											
14			- interbedded silty clay @ 14.5 feet								
16	21,26, 26		- H ₂ O within interbedded silty clay @ 16 feet, ferrous staining, fossilized plant and animal detritus								
18											
20	33,34 50		- interbedded shale with ferrous staining and weak cementation @ 20 feet, fossilized plant and animal detritus								
22			SHALE, black and gray, weathered, fissile, silt partings, dry								
24											
26	24,50		- gray @ 25 feet								
28											
			TOTAL DEPTH @27.5 feet BOTTOM ELEVATION @ 601.2 feet								
Note: Added fill soil from elevation 627.7 to 630.2 ft prior to completion of MWQIR concrete pad.											

DRILLING CONTR

LOGGED BY Greg Hassett

SOIL BOREHOLE LOG

SITE NAME AND LOCATION Muskogee Landfill Muskogee, Oklahoma N271744.8 DATUM E2731158.9 ELEVATION 632.2 ft				DRILLING METHOD: Hollow-stem Augers, 3 1/2-inch I.D. x 7-inch O.D.				BORING NO. B-2			
				SAMPLING METHOD: 24-inch split spoons on five-foot centers				SHEET 1 OF 2			
								DRILLING START TIME FINISH TIME			
				WATER LEVEL 18.1 17.3 9.82 9.25 TIME 10:25 10:50 12:45 13:30 DATE 11/18 11/18 11/18 11/18				09:00 10:00 11/18/92 11/18/92			
DRILL RIG CME 75				SURFACE CONDITIONS Level and flat on fill pad							
SAMPLE HAMMER TORQUE FT.-LBS											
DEPTH IN FEET (ELEVATION)	BLOWS/ 4 IN. ON SAMPLER (RECOVERY)	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	OTHER TESTS
2			FILL, silty clay, tan								
4	push		- dark brown @ 2 ft								
6			- silty sand intermixed with clay @ 3 ft								
8			- silty clay @ 6 ft								
10	3,4,4		CLAY (CH), tan, homogeneous structure, ferrous nodules								
12											
14											
16	5,5,7		- black @ 17 ft								
18											
20	5,7,20		- H ₂ O within 1-inch claystone layer @ 20 ft, silt partings, ferrous staining								
22											
24											
26	7,12,15										
28			SHALE, blue gray, weathered, fissile, dry								

Printed on recycled paper.



SOIL BOREHOLE LOG

SITE NAME AND LOCATION Muskogee Landfill Muskogee, Oklahoma				DRILLING METHOD: Hollow-stem augers, 3½-inch I.D. x 7-inch O.D.				BORING NO. B-2			
				SAMPLING METHOD: 24-inch split spoons on 5-foot centers				SHEET 2 of 2			
				WATER LEVEL				START		FINISH	
				TIME				TIME		TIME	
				DATE				DATE		DATE	
				CASING DEPTH				DATE		DATE	
DATUM		ELEVATION		TIME		TIME		DATE			
DRILL RIG		SURFACE CONDITIONS		DATE		DATE		DATE			
ANGLE		BEARING		DATE		DATE		DATE			
SAMPLE HAMMER TORQUE		FT.-LBS		DATE		DATE		DATE			
DEPTH IN FEET (ELEVATION)	BLOWS/ A B ON SAMPLER (RECOVERY)	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL		SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	TEST RESULTS			
								WATER CONTENT %	LIQUID LIMIT %		
								PLASTIC LIMIT %	SPECIFIC GRAVITY		
								OTHER TESTS			
32	21,50		SHALE, blue gray, silty, weathered, fissile, dry								
34			TOTAL DEPTH @ 31 feet BOTTOM ELEVATION @ 601.2 feet								

DRILLING CONTR Terracon Environmental, Inc.

LOGGED BY Greg Hassett

0 11707



SOIL BOREHOLE LOG

SITE NAME AND LOCATION Muskogee Landfill Muskogee, Oklahoma N272179.4 DATUM E2730189.7 ELEVATION 641.5 ft				DRILLING METHOD: Hollowstem Augers, 3 1/2-inch I.D. x 7-in O.D.				BORING NO. B-3			
				SAMPLING METHOD: 24-inch split spoons on 5-foot centers				SHEET 1 OF 2			
				WATER LEVEL 14.5 TIME 10:04 DATE 11/19				DRILLING START TIME 0900 FINISH TIME 1035			
				CASING DEPTH n/a				DATE 11/19/92			
DRILL RIG CME 75				SURFACE CONDITIONS Wet and muddy				DRILLING CONTR Terracon Environmental Inc.			
ANGLE Vertical BEARING SAMPLE HAMMER TORQUE FT.-LBS											
DEPTH IN FEET (ELEVATION)	BLOWS/ 4 IN ON SAMPLER (RECOVERY)	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	TEST RESULTS				
							WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	OTHER TESTS
2			Fill, silty clay, brown								
4			CLAY (CH), tan and gray mottling, roots, homogeneous structure, ferrous nodules								
6	4,4,5										
8											
10	3,4,6										
12											
14											
16	4,5,4										
18											
20	6,9,12		- Slickensided cleavage planes @ 20 feet								
22											
24											
26	5,8, 12		- Soils are slightly more consolidated @ 25 feet								
28											

Printed on recycled paper.



SOIL BOREHOLE LOG

SITE NAME AND LOCATION Muskogee Landfill Muskogee, Oklahoma				DRILLING METHOD: <u>Hollowstem Augers,</u> <u>3 1/2-inch I.D. x 7-inch O.D.</u>				BORING NO. B-3			
				SAMPLING METHOD: <u>24-inch split spoons</u> <u>on 5-foot centers</u>				SHEET 2 of 2			
				WATER LEVEL <u>14.5</u>				DRILLING START TIME <u>09:00</u> FINISH TIME <u>10:35</u>			
				TIME <u>10:04</u>				DATE <u>11/19/92</u>			
				DATE <u>11/19</u>				DATE <u>11/19/92</u>			
				CASING DEPTH <u>N/A</u>				DATE <u>11/19/92</u>			
DATUM		ELEVATION		SURFACE CONDITIONS							
DRILL RIG		BEARING		Wet and Muddy							
SAMPLE HAMMER TORQUE		FT.-LBS									
DEPTH IN FEET (ELEVATION)	BLOWS/ MIN ON SAMPLER (RECOVERY)	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	TEST RESULTS				
							WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	OTHER TESTS
32	7,9, 16		CLAY (CH) - H ₂ O within 1-inch coal seam @ 30 feet - Coal seams, 32 to 35 feet								
34											
36	21,50		SHALE, blue gray, weathered, fissile, dry								
38											
40	50										
42											
			TOTAL DEPTH @ 39.5 feet BOTTOM ELEVATION @ 602.00 feet								

DRILLING CONTR Terracon Environmental, Inc.

LOGGED BY Greg Hassett

11/19/92

11/19/92



SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Hollow Stem Auger
with 3.25" ID x 7.25" OD augers.

BORING NUMBER:

B-1

SAMPLING METHOD: 1.5" dia. Split-spoon (SS) and
3" dia. Shelby tube (ST)

Sheet 1 of 1

DRILLING

WATER LEVEL

TIME

DATE

CAVE DEPTH

START FINISH

TIME TIME
17:30 18:45

DATE DATE

9/27/83 9/27/83

DATUM: ft. MSL

ELEVATION: 622.85

DRILL RIG: Mobil Drill B-81

SURFACE CONDITIONS: clay, flat, moist ground. Boring relocated

ANGLE: Vertical

BEARING: ---

Inside property boundary

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 271199.00 E = 2731378.00

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LAB CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-) 200 SEIVE
1/1/2	100			Brown SANDY SILT (ML); silty clay interbeds, damp	SS			20.2				
2/2/2	100			Brown SANDY CLAY (CL); damp, homogeneous structure, iron nodules	SS		P	21.8			3.14	
TWS					ST							
TWS	5			Tan & gray CLAY sandy clay interbed @ 5.0 to 5.2 ft	ST							
				- very stiff w/ root structures, slickensided cleavage planes; blocky structure @ 8 to 10 ft.	ST		P	19.6			4.50	
C=3.0	85							15.3	41	27		
				- abundant root structures, slickensided cleavage planes @ 13 to 14.5 ft	SS		P	18.9				
2/4/7												
				- remnant bedding plane @ 18 to 19 ft	SS		P	17.3	52	27		
5/10/14				Tan severely weathered CLAY-SHALE dry, weak calcareous cement, thin bedding planes (<0.03 ft), flat bedded oxidation in bedding planes, intermixed w/ residual soils Discontinue hollow-stem augering - resume w/ rotary operations @ 20 ft								

DRILLING CONTRACTOR A. M. Pool
Clinton, Ok.

LOGGED BY G. Hassell
DATE 09/27/93
CHECKED BY

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 88251

DRILLING METHOD: Air Rotary

BORING NUMBER:

B-1

SAMPLING METHOD: 5.25" OD x 3" ID Core Barrel

Sheet 1 of 1

DRILLING

START FINISH

TIME TIME
17:15 10:15

DATE DATE

9/28/93 9/28/93

DATUM: F.L. MSL

ELEVATION: 822.85

DRILL RIG: Failing 1500

SURFACE CONDITIONS: N = 274298.94, E = 2731347.59

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES				SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS		
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RQD							DEPTH IN FEET	PERMEABILITY CM/SEC	
													FROM	TO	
25			1	3>6"	77	32	Tan severely weathered CLAY-SHALE with interbedded LIMESTONE		Damp, well sorted, thin bedding with iron oxide staining, iron nodules interbedded LS @ 21.5 - 22'; 23.9 - 24.9 (shaley LS) shale interbeds have calcite crystallization 45' fracture w/ iron staining @ 25 - 25.5'						
30							Gray unweathered SHALEY LIMESTONE		Damp fine grained argillaceous matrix weak calcite cement, fossilifer- ous						
35			2	0>8"	85	0	Dark gray unweathered LIMEY-SHALE		Damp, well sorted, weak calcite cement, highly weathered zone @ 31.9 - 36.1						
40							COAL		high grade coal						
							CLAYSTONE								
							LIMEY-SHALE								
45			3	2>8"	100	45	Gray SHALEY-LIMESTONE		light gray, damp, well sorted, massive bedding weathered zone 41.2 - 42.6 fossiliferous @ 42.7 - 43.1						
							LIMEY-SHALE		gray, dry, well sorted, calcitic cement						
50							TO @ 45 feet		TO @ 45 ft.						
55															

DRILLING CONTRACTOR A. M. Pool
Clinton, Oklahoma

LOGGED BY D. Smith
DATE 09/29/93
CHECKED BY G. Hassett

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, OK
RUST Project # 86251

DRILLING METHOD: Hollow Stem Auger
with 3.25"ID x 7.25"OD augers.

BORING NUMBER:

B-2

Sheet 1 of 1

SAMPLING METHOD: 1.5" Split-spoon (SS)
and Shelby tube (ST)

DRILLING

START FINISH

WATER LEVEL DRY 15.0

TIME TIME

TIME 15:30 07:45

11:45 14:30

DATE 9/15/93 9/18/93

DATE DATE

CAVE DEPTH 17.0 17

9/15/93 9/15/93

DATUM: ft. MSL

ELEVATION: 824.54

DRILL RIG: Mobil Drill B-81

SURFACE CONDITIONS: clay, flat, along temp. roadway on east side

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 273771.17 E = 2731320.00

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE
41/11	100			Brown and tan CLAY (CL), damp, homogeneous structure, iron nodules, roots	SS			19.3				
2/2/2	100			- firm, brown, tan, and gray @ 2 - 4 ft.	SS			18.8	47	31		
C=4.0	50			Brown, tan & gray CLAY (CH) damp, homogeneous, blocky structure, slickensided cleavage planes, iron nodules, black oxidized surfaces at 4 to 8 ft.	ST			17.8				
C=2.25	85			tan & gray w/ sand streaks (<2mm) & root structures below 8 ft.	ST			18.5	48	32		
TWS					TWS							
C=4.5+	75			Tan severely weathered CLAYEY-SHALE (CL); dry, weak quartzitic cement, thin bedding planes (<10 mm), w/ oxidized surfaces, iron nodules; intermixed & interbedded w/ residual silty clay soils, small vertical fractures (<1mm) w/ oxidized surfaces	ST			18.8			8.70	
				hard below 18 ft.	SS			14.7	44	21		
	100			wet at 24 ft.	SS			10.9				
				Discontinue Hollow-stem augering @ 24, continue w/ rotary @ 24 ft								

DRILLING CONTRACTOR
A. M. Pool
Clinton, Ok.

LOGGED BY G. Hasselt
DATE 09/15/93
CHECKED BY

ROCK BOREHOLE LOG

SITE NAME AND LOCATION: Muskogee Community Landfill 2801 S. 54 Street W., Muskogee, Ok RUST Project # 88251	DRILLING METHOD: air Rotary				BORING NUMBER: B-2	
	SAMPLING METHOD: air coring w/ 5.25" OD X 3" ID core barrel				Sheet 1 of 1	
					DRILLING	
					START	FINISH
	WATER LEVEL				TIME	TIME
	TIME				07:45	11:30
DATE				DATE	DATE	
CASING DEPTH				9/18/93	9/18/93	

DATUM: FL MSL	ELEVATION: 824.54
DRILL RIG: Falling 1500	SURFACE CONDITIONS:
ANGLE: 0	BEARING: -
SAMPLE HAMMER TORQUE: ft.-lbs.	N = 273771.17 E = 2731320.00

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	CORES				SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS			
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	ROD							DEPTH IN FEET		PERMEABILITY CM/SEC	
													FROM	TO		
25			1	110+ < 8"	100	0	Tan severely weathered CLAY-SHALE		Damp, fine-grained, well sorted, weak quartzitic cement, thin bedding planes (< 0.03 ") w/ oxidized surfaces, small vertical fracture							
30			2	4>8"	100	93	Gray unweathered CLAY-SHALE		Damp, fine-grained, well sorted, weak quartzitic cement, thin bedding planes (< 0.03 ") flat bedded							
35			3	3<6"	25	0			poor recovery on run # 3 harder rock @ 36 ft - change core bit							
40			4	3>6"	77	43	Gray SHALEY-LIMESTONE		Dry, finely crystalline argillaceous matrix, firm calcareous cement medium bedding (0.2 - 0.5 ft) flat bedded, glauconitic shale interbeds (2 @ 0.05 & 0.4 ft) abundant shell hash (brinaves)							
45			5	2>6"	94	40	LIMEY-SHALE		Damp, fine grained, well sorted, firm calcareous cement, thin bedding planes (< 0.03 ") inclined, bedding @ 30°, ripple laminated flat bedding w/ ripple laminae @ 44- 49 ft							
50							TD @ 49 feet									
55																

DRILLING CONTRACTOR **A. N. Pool**
Clinton, Oklahoma

LOGGED BY **G. Hasselt**
DATE **09/18/93**

CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Hollow Stem Auger

with 3.25"ID x 7.25"OD augers.

air coring

SAMPLING METHOD: 1.5" dia. split-spoon (SS)

and 3" dia. Shelby tube (ST)

BORING NUMBER:

B-3

Sheet 1 of 1

DRILLING

START FINISH

TIME TIME
14:45 17:15

DATE DATE
9/15/93 8/15/93

DATUM: ft. MSL

ELEVATION: 825.45

DRILL RIG: Mobil Drill B-81

SURFACE CONDITIONS: clay

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 273305.18 E = 2731342.99

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE)
4/4/4				Tan and brown CLAY (CL) damp, homogeneous structure, iron nodules roots	SS			21.7 19.1	38	20		93.5
c=3.0	85			Tan and brown and gray CLAY (CH) damp homogeneous, blocky structure, slicken-sided cleavage planes, iron nodules	ST			21.1				
TWS					TWS			21.2				
c=2.25	75				ST			17.5	38	23		
c=4.5	75			Tan CLAY w/ sand (CL) damp, homogeneous structure, slicken-sided cleavage planes concentration of iron nodules	TWS			19.1				
4/4/8				- sandy clay pockets @ 10.5 ft	SS			18.9	44	20		
				Tan severely weathered CLAY-SHALE; dry, fine grained, well sorted, weak quartzitic cement, thin bedding planes w/ oxidized surfaces (<10 mm) iron nodules; interbedded & intermixed w/ residual clay soils	ST	NONE		17.7	43	19		
				- moderate weathering; vertical fractures (0.03ft) w/ oxidized surfaces	SS			11.8				
				- moderate weathering								
1/50-4"					SS							
50-5"					SS							
				discontinue hollowstem augering @ 24, move 4' South, continue w/ rotary Begin air coring @ 20 ft.								

DRILLING CONTRACTOR A. M. Pood
Chilton, Ok.

LOGGED BY G. Hasselt
DATE 09/15/93
CHECKED BY

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 88251

DRILLING METHOD: air Rotary

BORING NUMBER:

B-3

SAMPLING METHOD: air coring w/ 5.25" OD X 3" ID core barrel

Sheet 1 of 1

DRILLING

START FINISH

WATER LEVEL

TIME

DATE

CASING DEPTH

TIME

DATE

9/18/93 9/18/93

DATUM: Ft. MSL

ELEVATION: 825.45

DRILL RIG: Failing 1500

SURFACE CONDITIONS:

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 273305.18 E = 2731342.99

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	CORES			SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS	
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RCD						DEPTH IN FEET	PERMEABILITY CM/SEC
FROM	TO												
25			1	1 > 8"	100	10		Tan severely weathered CLAY-SHALE					
			2	1 > 8"	58	10							
30													
			3	2 > 6"	100	28		Gray unweathered CLAY-SHALE					
35													
			4	3 > 6"	100	60							
40													
			5	3 > 6"	83	38		Gray SHALEY-LIMESTONE					
45													
			6	2 > 6"	100	35							
50													
55													

DRILLING CONTRACTOR A. N. Pool
Clinton, Oklahoma

LOGGED BY G. Hasselt
DATE 12/9/93

CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Hollow Stem Auger

with 3.25"ID x 7.25"OD augers.

wet rotary coring, 20 to 48 ft.

SAMPLING METHOD: Spill-spoon (SS) with

2' drives and Shelby tube (ST)

BORING NUMBER:

B-4

Sheet 1 of 1

DRILLING

START FINISH

TIME TIME

17:20 18:45

DATE DATE

9/15/93 9/15/93

DATUM: ft. MSL

ELEVATION: 827.88

DRILL RIG: Mobil Drill B-81

SURFACE CONDITIONS: clay

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272924.18 E = 2731350.25

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE
4/7/77				Tan CLAY (CL), damp, homogeneous structure, roots, iron nodules	SS		Q	19.1			22	
c=3.0	100			Tan and Black CLAY (CH) damp, homogeneous, blocky structure, slicken-sided cleavage planes, iron nodules	ST		Q	15.8	42	25		
c=3.0	100				ST		Q	21.4	40	25		
TWS				Tan & gray CLAY (CL) damp, homogeneous blocky structure, slicken-sided cleavage planes, iron nodules - poor sample recovery @ 6 - 8 FT.	TWS		Q	22.2				
c=4.5	95				ST		Q					
10						NONE	Q					
c=4.25	77			Bivalve fossil @ 0.5 inch @ 14 ft.	ST		Q	18.8			5.00	
15							Q					
				Tan severely weathered CLAY-SHALE; dry, fine grained, well sorted, weak quartzitic cement, thin bedding planes (<0.03FT) flat bedded oxidized bedding plane surfaces, iron nodules; intermixed & interbedded residual clay soils; small vertical fractures (<1mm) w/ oxidized surfaces	SS		Q	14.7	44	20		
4/34/50												
20				end hollowstem augering @ 19.5 ft, wet rotary from 20 to 48 ft								
25												
30												

DRILLING CONTRACTOR A. M. Pool
Clinton, Ok.

LOGGED BY G. Hasselt
DATE 12/17/93
CHECKED BY

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Wet Rotary Coring, 20 to 48 ft.

BORING NUMBER:

B-4

SAMPLING METHOD: coring w/ 5.25" OD X 3" ID core barrel

Sheet 1 of 1

DRILLING

START FINISH

WATER LEVEL dry

TIME TIME

TIME 17:30

17:30 09:00

DATE 9/18/93

DATE DATE

CASING DEPTH (cave) 213.0

9/18/93 9/17/93

DATUM: Ft. MSL

ELEVATION: 627.86

DRILL RIG: Falling 1500

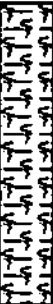
SURFACE CONDITIONS: clay

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272924.18 E = 2731350.25

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	CORES				SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS			
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	ROD							DEPTH IN FEET		PERMEABILITY CM/SEC	
													FROM	TO		
25			1	1 > 8"	78	18	Gray moderately weathered CLAY-SHALE		Damp, fine-grained, well sorted, weak quartzitic cement, thin bedding planes (0.03") w/ oxidized surfaces; abundant fractures (<0.01") filled w/ oxidized minerals from 30" to 70" from horizontal 0.25" - transmissive zone w/ severe weathering and bedrock intermixed w/ residual soil @ 30.6 to 32 ft.							
30			2	1 > 8"	100	10										
35			3	1 > 8"	85	20	Gray unweathered CLAY-SHALE		Damp, fine-grained, well sorted, firm quartzitic cement, thin bedding planes, (<0.03 ft) flat bedded							
40			4	3 > 8"	100	83			fine grained massive stratification, minor fractures (80" to vertical)							
45			5	2 > 8"	100	95			- transmissive zone w/ severe weathering and bedrock intermixed w/ residual soil @ 38.0 to 38.8 ft. & 41.1 to 41.3 ft.							
50			6	3 > 8"	100	81	Gray SHALEY-LIMESTONE		coal seam @ 45.7 to 45.8 ft.							
							Gray LIMY-SHALE		Dry, finely crystalline argillaceous and fossiliferous matrix, firm calcareous cement, massive bedding; abundant shell hash-bivalves							
55							TD @ 48 feet		damp, fine-grained, good sorting, firm calcareous cement, thin bedding planes (<0.03 ft) flat-bedded, glauconitic clay-shale interbeds							

DRILLING CONTRACTOR A. M. Pool
Clinton, Oklahoma

LOGGED BY G. Hasselt
DATE 09/15/93
CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Hollow Stem Auger
with 3.25"ID x 7.25"OD augers.

BORING NUMBER:

P-1/B-5

Sheet 1 of 1

SAMPLING METHOD: 1.5" dia. Split spoon (SS) and
3" dia. Shelby tube (ST)

DRILLING

START FINISH

WATER LEVEL

TIME TIME

TIME

08:00 09:10

DATE

DATE DATE

CAVE DEPTH

10/21/93 10/21/93

DATUM: ft. MSL

ELEVATION: 629.50

DRILL RIG: Mobil Drill B-61

SURFACE CONDITIONS: clay

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272591.38 E = 2731409.77

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE
	c=1.5	37.5		Tan CLAY; damp, homogeneous structure, sandy pockets	ST		P	23.5				
	c=2.5	82		- iron nodules @ 4 ft.	ST		P					
	c=3.0	75		- tan & gray color, mottled appearance, blocky structure, black oxidized nodules @ 8 ft.	ST		CL	20.6	47	29		
	c=3.5	77			ST		P					
	c=3.0	75			ST			19.1			3.63	88.0
10				- slickensided cleavage planes @ 13 ft.		NONE						
	c=4.25				ST							
15												
	37/50-5"			Tan severely weathered CLAY-SHALE; dry, homogeneous structure, reflect bedding planes, weak quartzitic cement, minor bivalve fossil content	SS			11.6				
20				discontinue hollowstem augering @ 19.5; continue w/ rotary @ 20 ft								
25												
30												

DRILLING CONTRACTOR: A. M. Pool
Clinton, Ok.

LOGGED BY: D. Smith
DATE: 12/21/93
CHECKED BY:

ROCK BOREHOLE LOG

SITE NAME AND LOCATION: Muskogee Community Landfill 2801 S. 54 Street W., Muskogee, Ok RUST Project # 86251	DRILLING METHOD: <u>air-Rotary</u>				BORING NUMBER: P-1/B-5	
					Sheet 1 of 4	
	SAMPLING METHOD: <u>3" ID X 5.25" OD</u>				DRILLING	
	10 foot core barrel				START	FINISH
	WATER LEVEL				TIME	TIME
TIME				16:45	14:30	
DATE				DATE	DATE	
CASING DEPTH				10/21/93	10/22/93	

DATUM: Ft. MSL		ELEVATION: 020.50	
DRILL RIG: Badger 1250		SURFACE CONDITIONS:	
ANGLE: 0		BEARING: -	
SAMPLE HAMMER TORQUE: ft.-lbs.		N = 272591.38 E = 2731409.77	

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	CORES				SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS		
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RQD							DEPTH IN FEET		PERMEABILITY CM/SEC
													FROM	TO	
25			1	23<8"	80	0	RED claystone Gray moderately weathered CLAY-SHALE		Red to purple, vertical fracture infilled w/ cement Med gray, horizontal fractures w/ iron oxide staining 0.1 ft apart 15' low angle fractures 0.2 ft apart from 20.8 to 21.4 ft - one 80' fracture @ 25 ft - potentially transmissive zone infilled w/ clay, highly weathered from 25 to 29 ft w/ horizontal to 15' fractures - one 80' fracture @ 29.2 ft						
30			2	2>8"	80	18									
35			3	8>6"	95	58	Gray unweathered CLAY-SHALE		thin bedded, trace fossils, well sorted thin weathered zones w/ clay @ 32.5 - 32.7, 33.7 - 34.2, 34.9 - 35.3, 37.8 - 38 and 39.4 - 39.8 ft		Steel Casing				
40									- no transmissive zones						
45			4	4>6"	69	81									
50															
55			5	3>8"	80	27	gray SHALEY-LIMESTONE		Finely crystalline, strong calcareous cement, no bedding surface visible						

DRILLING CONTRACTOR A. M. Pool
Clinton, Oklahoma

LOGGED BY D. Smith/G. Hasselt
DATE 10/22/93 CHECKED BY G. Hasselt

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: air-Rotary

BORING NUMBER:

P-1/B-5

SAMPLING METHOD: 3" ID X 5.25" OD

Sheet 2 of 4

10 foot core barrel

DRILLING

START

FINISH

WATER LEVEL

TIME

TIME

TIME

18:45

14:30

DATE

DATE

DATE

CASING DEPTH

10/21/93

10/22/93

DATUM: FL MSL

ELEVATION: 829.50

DRILL RIG: Badger 1250

SURFACE CONDITIONS:

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 27259138 E = 2731409.77

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES				SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS		
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RQD							DEPTH IN FEET	PERMEABILITY CM/SEC	
FROM	TO														
60			5	3>6"	80	27	Glauconitic CLAY		wet, fine grained, well sorted						
							Gray SHALEY LIMESTONE		Finely crystalline, strong calcareous cement, argillaceous matrix, thin beds, ripple bedded, CLAY zones @ 57.8 - 58.2, 59.1 - 59.3, & 80.6 to 80.8 ft; wet, potentially transmissive zones						
							Gray LIMY-SHALE		Fine grained, well sorted, strong calcareous cement, thin beds flat bedded, SHALEY LS interbeds (2 @ 0.1 to 0.2 ft thick) - interbedded w/ CLAY, wet, potentially transmissive zones						
65			6	1>6"	100	97	Gray CLAY-SHALE		Wet, fine grained, well sorted, strong quartzitic cement, thin beds, flat bedded, interbedded w/ CLAY, (wet, potentially transmissive)						
							COAL		Coal @ 67.3 to 67.4 ft						
							Gray CLAY-SHALE		Dry, fine grained, well sorted, weak calcareous cement, thin beds, flat bedded						
70							Gray SHALEY-LIMESTONE		Dry, finely crystalline, strong calcareous cement, argillaceous matrix, abundant bivalves, interbedded w/ LIMY SHALE						
			7	2>6"	45	43			- shell hash @ 70.5 to 70.9 ft - thin beds, flat bedded @ 70.9 to 75 ft - CLAY-SHALE interbedded w/ CLAY @ 72.8 to 72.9, 73.5 to 73.6, 74.4 to 74.5 ft						
75							Gray CLAY-SHALE		Wet, fine grained, well sorted, weak quartzitic cement, thin beds, flat bedded, abundant CLAY interbeds, (0.01 to 0.1 ft thick every 0.01 to 0.1 feet), potentially transmissive						
80															
85			8	1>6"	88	80									
90															

DRILLING CONTRACTOR
A. N. Pool
Clinton, Oklahoma

LOGGED BY D. Smith/G. Hassett
DATE 10/22/93 CHECKED BY G. Hassett

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok.
RUST Project # 86251

DRILLING METHOD: air-Rotary

BORING NUMBER:

P-1/B-5

SAMPLING METHOD: 3" ID X 5.25" OD

Sheet 3 of 4

10 foot core barrel

DRILLING

WATER LEVEL

START

FINISH

TIME

TIME

TIME

DATE

DATE

DATE

CASING DEPTH

10/21/93

10/22/93

DATUM: Ft. MSL

ELEVATION: 629.50

DRILL RIG: Badger 1250

SURFACE CONDITIONS:

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 27250L36 E = 2731409.77

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES				SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS		
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	ROD							DEPTH IN FEET	PERMEABILITY CM/SEC	
FROM	TO														
95			9	2>6"	49	21	Gray LIMY SHALE		Met, fine grained, well sorted, strong calcareous cement, thin beds, flat bedded, interbedded w/ CLAY, potentially transmissive *						
							Gray CLAY-SHALE		Met, fine grained, well sorted, weak quartzitic cement, thin beds, flat to ripple bedded, interbedded w/ CLAY, potentially transmissive						
100							Gray LIMY SHALE		as *						
			10	2>6"	88	11	Gray SANDSTONE		medium grained, well sorted, strong quartzitic cement, thin bed, flat bedded, interbedded w/ sand and clayey sand, (potentially transmissive zones)						
105															
110															
			11	7>6"	99	71			- thin to medium beds (0.01 to 0.3 ft) ripple bedded w/ occasional cross beds, mud clasts, interbedded w/ thin shale beds (0.01 to 0.05 ft)						
115															
			12	6>6"	100	48			- inclined bedding (45°) w/ fractures along bedding planes @ 120 to 128 ft - occasional mud clasts @ 120 to 128 ft - abundant rip-up clasts 124.8 to 125.1 ft B						
120															
125															

DRILLING CONTRACTOR A. M. Pool
Clinton, Oklahoma

LOGGED BY D. Smith/G. Hassett
DATE 10/22/93
CHECKED BY G. Hassett

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: air-Rotary

BORING NUMBER:

P-1/B-5

SAMPLING METHOD: 3" ID X 5.25" OD

Sheet 4 of 4

10 foot core barrel

DRILLING

WATER LEVEL

START

FINISH

TIME

TIME

TIME

DATE

DATE

DATE

CASING DEPTH

10/21/93

10/22/93

DATUM: FL MSL

ELEVATION: 629.50

DRILL RIG: Badger 1250

SURFACE CONDITIONS:

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: 11.-16s.

N = 27259136 E = 2731400.77

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	CORES			SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS		
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RCD						DEPTH IN FEET		PERMEABILITY CM/SEC
												FROM	TO	
130			12	8-8"	100	48		- CLAY & CLAY-SHALES @ 127.5 to 128 ft						
						Gray SHALE		Damp, fine grained, well sorted, thin beds, ripple bedded, interbedded w/ CLAY, potentially transmissive						
			13	12-8"	87	40								
						TD @ 133 FT								
135														
140														
145														
150														
155														
160														

DRILLING CONTRACTOR: A. N. Pool
Clinton, Oklahoma

LOGGED BY: D. Smith/G. Hasselt
DATE: 10/22/93
CHECKED BY: G. Hasselt

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:				DRILLING METHOD: Hollow Stem Auger				BORING NUMBER:					
Muskogee Community Landfill 2801 S 54th Street W., Muskogee, Ok. RUST Project # 88251				with 3.25"ID x 7.25"OD augers.				P-2/B-6					
				SAMPLING METHOD: CME 5 foot continuous sampler				Sheet 1 of 2					
								DRILLING					
								START		FINISH			
WATER LEVEL				TIME		TIME							
TIME				14:00		15:30							
DATE				DATE		DATE							
CAVE DEPTH				10/29/93		10/29/93							
DATUM: ft. MSL				ELEVATION: 829.71									
DRILL RIG: Mobil Drill B-81				SURFACE CONDITIONS: clay									
ANGLE: Vertical				BEARING: ---									
SAMPLE HAMMER TORQUE: ft.-lbs.				N = 272535.73 E = 2731414.18									
DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS					
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE	
				Tan, SILTY CLAY; damp, homogeneous structure, occasional iron nodules	CNE			18.4					
					CNE			2.1					
								20.5					
								21.3	46	30			
					CNE			17.2					
								23.8					
				Tan severely weathered clay-shale; dry, fine grained, well sorted. weak quartzite cement, thin beds, flat beds interbedded w/ clay heavy oxidation along bedding planes, intermixed w/ residual soils	CNE			11.9	42	28			
				- ferruginous cemented shale w/ secondary calcite mineralization @ 17 to 17.2 ft.				12.9					
					CNE								
				- moderately weathered @ 22 ft., gray, w/ vertical fractures, wet at 22 ft.				18.7	44	20			
					CNE								
				- numerous vertical fractures @ 27 - 32 ft.									
					CNE								

DRILLING CONTRACTOR A. W. Pool
Clinton, Ok.

LOGGED BY G. Hassell
DATE 12/21/93 CHECKED BY _____

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok.
RUST Project # 86251

DRILLING METHOD: Hollow Stem Auger
with 3.25"ID x 7.25"OD augers.

BORING NUMBER

P-2/B-6

Sheet 2 of 2

SAMPLING METHOD: CME 5 foot continuous sampler

DRILLING

START FINISH

WATER LEVEL

TIME

TIME

TIME

14:00

15:30

DATE

DATE

DATE

CAVE DEPTH

10/29/93

10/29/93

DATUM: ft. MSL

ELEVATION: 629.71

DRILL RIG: Mobil Drill B-81

SURFACE CONDITIONS: clay

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272535.73 E = 2731414.18

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SETVE
40				discontinue hollowstem augering @ 32 ft continue w/ rotary @ 32 ft	C&E	NONE						
45												
50												
55												
60												

DRILLING CONTRACTOR: A. W. Pod
Clinton, Ok.

LOGGED BY: G. Hassett

DATE: 12/21/93

CHECKED BY:

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Air rotary

BORING NUMBER:

P-2/B-8

SAMPLING METHOD: 3" ID X 5.25" OD

Sheet 1 of 2

10 foot core barrel

DRILLING

WATER LEVEL

START

FINISH

TIME

TIME

TIME

DATE

DATE

DATE

CASING DEPTH

10/30/83

10/30/83

DATUM: FL MSL

ELEVATION: 829.71

DRILL RIG: Badger 1250

SURFACE CONDITIONS: clay

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272535.73 E = 2731414.18

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES			SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS	
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY							DEPTH IN FEET	PERMEABILITY CM/SEC
FROM	TO												
35			1	3>8"	77	19		Gray unweathered CLAY-SHALE					
40								Gray thin bedded, vertical fracture infilled w/ iron oxide 32-32.3' infilled w/ cement 32.3 - 33.2' - broken zone interbedded w/ silty clay @ 33.2 - 35.5' - vertical fracture infilled w/ cement 35.5 - 38.4'					
45			2	2>6"	92	32		- broken zones @ 38.4 - 37.3', 40.8 - 41.9', 43.1 - 44.4'					
50								- 40' angular fractures w/ pyrite in the fracture. 44.7 - 45.2'					
55								- 20' angular fractures w/ cement infill @ 47.9'					
60			3	5>8"	100	8		SHALE & COAL Glaucous CLAY Gray LIMESTONE Glaucous CLAY Medium gray SHALEY-LIMESTONE					
65								interbedded dark gray shale and coal (0.01') wet, light gray-green finely crystalline, strong calcareous cement, fossiliferous, interbeds of 0.1 ft thick clay. wet, slickensided cleavage planes strong calcareous cement, ripple bedded w/ shale interbeds					
			4	2>8"	100	12		Gray LIMESTONE-SHALE					
								Thin beds, flat bedded, strong calcareous cement, broken zone @ 63.3 to 65.5, interbed of claystone @ 63.3 - 63.5					

DRILLING CONTRACTOR A. W. Pool
Clinton, Oklahoma

LOGGED BY D. Smith
DATE 10/30/83
CHECKED BY G. Hassett

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Air rotary

BORING NUMBER:

P-2/B-6

SAMPLING METHOD: 3" ID X 5.25" OD

Sheet 2 of 2

10 foot core barrel

DRILLING

WATER LEVEL

START

FINISH

TIME

TIME

TIME

DATE

DATE

DATE

CASING DEPTH

10/30/93

10/30/93

DATUM: FL MSL

ELEVATION: 829.71

DRILL RIG: Badger 1250

SURFACE CONDITIONS: clay

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272535.73 E = 2731414.10

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES			SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS	
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY							DEPTH IN FEET	PERMEABILITY CM/SEC
												FROM	TO
70			4	2-8"	100	12		Gray Limestone COAL Gray CLAY-SHALE Gray Limestone TO 8' 70 ft.					
75								strong calcareous cement, fossiliferous fissile, vertical fractures dry, interbedded w/ clay Thin beds, flat bedded, weak calcareous cement, broken zone @ 83.3 to 85.5					
80													
85													
90													
95													
100													

DRILLING CONTRACTOR
A. W. Pod
Clinton, Oklahoma

LOGGED BY D. Smith
DATE 10/30/93
CHECKED BY G. Hassett

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Hollow Stem Auger

with 3.25"ID x 7.25"OD augers.

air coring

SAMPLING METHOD: 1.5" dia. Split-spoon (SS) and

3" dia. Shelby tube (ST)

BORING NUMBER:

8-7

Sheet 1 of 1

DRILLING

START FINISH

WATER LEVEL dry

TIME 18:10

DATE 9/18/93

CAVE DEPTH Cave @ 11 ft

TIME 12:00

TIME 13:20

DATE 9/18/93

DATE 9/18/93

DATUM: ft. MSL

ELEVATION: 823

DRILL RIG: Mobil Dr/W B-81

SURFACE CONDITIONS: Pit dug to remove saturated surface silt.

ANGLE: Vertical

BEARING: ---

approximate elevation of 823 (-3 ft below surface)

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 274224.01 E = 2730754.49

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE)
	C=3.0	50		Tan CLAY (CL), dry, homogeneous structure, iron nodules & staining	ST		P	25.8				
	C=4.5	75		Brown, Tan and gray @ 2 FT.	ST		P	20.5	48	32		
	TWS			- black oxidation along remnant vertical fractures	TWS		P	20.2	48	31		
	C=3.0	70			ST		P	12.1			5.38	
10	C=4.5	50		Tan severely weathered CLAY-SHALE; dry, fine grained, well sorted, thin bedding (<0.03FT) with oxidized surfaces, flat bedded, vertical fractures (<0.01ft) w/ black oxidized surfaces	ST	NONE						
15	B/50-4			- secondary mineralization and oxidation along bedding planes	SS			11.7				
20	B/50-			- oxidation along bedding planes	SS			11.7				
				Discontinue Hollowstem Augering @ 18'9", resume w/ wet rotary at 20 ft								
25												
30												

DRILLING CONTRACTOR A. M. Pool
Clinton, Ok.

LOGGED BY G. Hassell
DATE 12/17/93
CHECKED BY

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: **air Rotary**

with mist

BORING NUMBER:

B-7

SAMPLING METHOD: **air coring w/ 5.25" OD X 3" ID core barrel**

Sheet 1 of 1

DRILLING

START FINISH

TIME TIME
08:15 10:30

DATE DATE

9/30/93 9/30/93

DATUM: Ft. MSL

ELEVATION: 823

DRILL RIG: **Falling 1500**

SURFACE CONDITIONS: **clay**

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 274227.01 E = 2730754.49

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES			SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS	
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RQD						DEPTH IN FEET	PERMEABILITY CM/SEC
FROM	TO												
25			1	1 > 6"	80	50		Tan and gray severely weathered CLAY-SHALE					
								Damp, fine-grained, well sorted, weak quartzitic cement, thin bedding flat bedded, abundant fractures - red claystone (fireclay) @ 21.9 to 22.0 ft. - interbedded weathered coal seams (0.10 ft to 0.05 ft thick) 22.0 to 23.7 ft. interbedded & interbedded w/ residual soil @ 22 to 26 ft.					
30								Gray unweathered CLAY-SHALE					
								Black COAL					
								Gray SHALEY-LIMESTONE					
35			2	1 > 6"	55	20							
								Finely crystalline, firm calcareous cement, thin to medium bedding (0.01 to 0.5 ft) fossiliferous					
40													
			3	1 > 6"	90	20							
								45' fractures infilled w/ calcite (hard - fine to 0.003 ft) at 2.5 ft separation @ 42 to 45.5 ft. interbedded w/ LIMY-SHALE @ 41.7 to 44.5 ft.					
45								TO @ 45 ft					
50													
55													

DRILLING CONTRACTOR **A. M. Pool**
Clinton, Oklahoma

LOGGED BY **G. Hassell**

DATE **09/30/93** CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION: Muskogee Community Landfill 2801 S 54th Street W., Muskogee, Ok RUST Project # 86251				DRILLING METHOD: Hollow Stem Auger with 3.25"ID x 7.25"OD augers.				BORING NUMBER: B-8					
				air coring				Sheet 1 of 1					
				SAMPLING METHOD: 1.5" dia. Split-spoon (SS) and 3" dia. Shelby tube (ST)				DRILLING					
								START	FINISH				
				WATER LEVEL		dry		TIME	TIME				
				TIME		18:08		9:55	11:05				
DATE		9/18/93		DATE	DATE								
CAVE DEPTH		Cave @ 12 ft		9/18/93	9/18/93								
DATUM: ft. MSL ELEVATION: 829.5				DRILL RIG: Mobil Drill B-81				SURFACE CONDITIONS: brown soil, approximate elevation of 829.5					
ANGLE: Vertical BEARING: ---				Boring was slightly offset to drill on level									
SAMPLE HAMMER TORQUE: ft.-lbs.				ground. N = 272765.17 E = 2730768.82									
DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS					
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE)	
		100		Brown SILTY SAND, dry fine grained, well sorted	ST								
	TWS			Tan CLAY (CL), dry, homogeneous structure,	TWS			20.2	49	32			
	c=4.5			- vertical sand pockets due to bioturbation	ST			18.5					
	C=4.0	72		- damp, blocky structure, iron nodules	ST			21.4				14.0	
	c=4.0	70			ST								
10						NONE							
	C=4.25	100		Tan to gray severely weathered CLAY-SHALE; dry, well-sorted, thin bedding w/ oxidized surfaces, vertical fractures, no fossils	ST			18.8					
15													
	11/50-45			- slicken-sided cleavage planes, iron nodules	SS			14.2					
20				stopped hollowstem @ 19 ft									
25													
30													

DRILLING CONTRACTOR
A. M. Pool
Clinton, Ok.

LOGGED BY D. Smith
DATE 12/17/93
CHECKED BY _____

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: air-Rotary

BORING NUMBER:

B-8

SAMPLING METHOD: 5.25" ID x 3" ID x 5 ft core barrel

Sheet 1 of 1

DRILLING

START FINISH

WATER LEVEL	8.8	6.7			TIME	TIME
TIME	10:48	18:15			14:25	18:15
DATE	9/23	9/23			DATE	DATE
CASING DEPTH	Cave at 18.8				9/22/93	9/22/93

DATUM: Ft. MSL ELEVATION: 829.5

DRILL RIG: Failing 1500

SURFACE CONDITIONS: loose silty sand

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 273752.17 E = 2730786.82

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES			SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS	
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RQD						DEPTH IN FEET	PERMEABILITY CM/SEC
												FROM	TO
25			1	25+ >8"	100	0		Tan and gray severely weathered CLAY-SHALE					
			2	>8"	100	31		- interbedded w/ severely weathered potentially transmissive zones; angular fractures 15" to 85" w/ oxidized surfaces					
30			3	8>8"	100	85		- severely weathered potentially transmissive zones @ 30 to 32 ft					
35								Gray unweathered CLAY-SHALE					
			4	3>8"	78	42		COAL Gray SHALE-LIMESTONE					
40								damp, fine grained, well sorted, thin bedding (<0.03 ft) firm quartzitic cement, thin bedding (<0.03 ft), flat bedded, some fractures @ 45'					
45			5	2>8"	100	85		COAL seam @ 35 to 35.5 ft Damp, finely crystalline; firm calcareous cement, thin to thick beds (0.03 to 0.9 ft), flat bedded, interbedded w/ a GLAUCONITIC CLAY-SHALE from 36.7 to 38 ft fossiferous @ 44.0 - 45.0 ft					
50								TO @ 45 ft					
55													

DRILLING CONTRACTOR A. M. Pool
Clinton, Oklahoma

LOGGED BY G. Hasselt
DATE 09/22/93
CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Hollow Stem Auger
with 3.25"ID x 7.25"OD augers.

BORING NUMBER:

B-9

Sheet 1 of 1

SAMPLING METHOD: 1.5" dia. Split-spoon (SS) and
3" dia. Shelby tube (ST)

DRILLING

WATER LEVEL 7.3 2.2

TIME 10:21 0950

DATE 9/18/93 9/21

CAVE DEPTH 8.3 2.8

START FINISH

TIME TIME

10:15 11:30

DATE DATE

9/17/93 9/17/93

DATUM: ft. MSL

ELEVATION: 625.12

DRILL RIG: Mobil Drill B-81

SURFACE CONDITIONS: dry clay

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 273282.30 E = 2730777.70

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
	c=4.5	50		Tan and Gray CLAY (CL), damp, homogeneous structure, iron nodules	ST		P	21.8				
				iron concretion and sand pockets @ 3ft	TWS		P	21.9				97.3
	c=2.5	85		thin sand streaks (<0.01ft)	ST		P	19.8				
	c=4.5+	50		- remnant bedding planes (<0.03ft) w/ oxidized surfaces, broken sample @ 8 to 8 ft., wet at 7 ft.	ST	HOME	P	15.0			4.08	
	33/50			Tan severely weathered CLAY-SHALE; dry, fine grained, well sorted, weak quartzitic cement. Thin bedding planes (0.03ft), w/ oxidized surfaces, flat bedding, iron nodules intermixed & interbedded w/ residual clay soils	SS			17.8	37	22		
10				- decreased residual soil content	SS			17.2	47	24		
25	50 for 3"			discontinue hollowstem augering, resume w/ rotary @ 15 ft								
15												
20												
25												
30												

DRILLING CONTRACTOR: A. K. Pod
Clinton, Ok.

LOGGED BY: G. Hasselt

DATE: 09/17/93 CHECKED BY:

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 88251

DRILLING METHOD: air-Rotary

BORING NUMBER:

B-9

SAMPLING METHOD: 5 foot core

Sheet 1 of 1

3" ID X 5.25" OD core barrel

DRILLING

START FINISH

WATER LEVEL 17 10.0

TIME TIME

TIME 07:25 18:30

10:10 14:00

DATE 8/22/93 8/23/94

DATE DATE

CASING DEPTH Cave at 51.7'

9/21/93 9/21/93

DATUM: Ft. MSL

ELEVATION: 625.12

DRILL RIG: Falling 1500

SURFACE CONDITIONS: clay

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 273282.30 E = 2730777.70

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	CORES			SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS	
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY							DEPTH IN FEET	PERMEABILITY CM/SEC
												FROM	TO
20			1	1>8"	98	13		Gray weathered CLAY-SHALE					
25			2	0>8"	80	0							
30			3	3>8"	90	46		Gray unweathered CLAY-SHALE					
35			4		92	0							
40			5	2>8"	95	43		COAL LIMESTONE Green CLAYSTONE Gray SHALEY-LIMESTONE					
45			6	3>8"	85	78		Gray LIMY-SHALE Gray SHALEY-LIMESTONE					
50			7	2>8"	87	30		Gray LIMY-SHALE COAL FIRECLAY Gray LIMY-SHALE					
55			8	1>8"	100	75		TO @ 53 ft.					

DRILLING CONTRACTOR
A. M. Pool
Clinton, Oklahoma

LOGGED BY D. Smith
DATE 09/21/93
CHECKED BY G. Hasselt

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Hollow Stem Auger

with 3.25" ID x 7.25" OD augers.

air coring

SAMPLING METHOD: 15" Split-spoon (SS) and

3" dia. Shelby tube (ST)

BORING NUMBER:

B-10

Sheet 1 of 1

DRILLING

START FINISH

TIME TIME

11:45 13:00

DATE DATE

9/17/93 9/17/93

DATUM: ft. MSL

ELEVATION: 630.98

DRILL RIG: Mobil Drill B-01

SURFACE CONDITIONS: clay

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272835.19 E = 2730778.24

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE)
	C=2.5	54		Tan and gray CLAY (CH), damp, homogeneous structure, iron nodules	ST		CL	22.9				
	c=2.5	92		Tan and and gray CLAY w/ sand (CL), damp w/ moisture pockets homo- geneous, iron nodules, sand pockets	ST		CL	18.3	41	28		
	TWS				TWS		CL	21.1				
	c=4.5	75			ST		CL	18.0				
	c=3.0	75		Tan and gray CLAY (CH), damp, homogeneous blocky structure, slicken-sided cleavage planes, iron nodules	ST		CL	19.0			5.03	
	C=4.5	75		Tan and gray CLAY (CL) moist, laminated w/ remnant bedding planes, oxidized bedding surfaces, abundant shell hash (bivalves & crinoids) iron nodules - broken sample @ 13 to 14 ft H ₂ O @ 14 ft	ST			18.9	48	30		
	SS/30-5"			Tan severely weathered CLAY-SHALE	SS			18.8				
				discontinue hollowstem augering @ 19ft, resume w/ rotary operation @ 20 ft								

DRILLING CONTRACTOR A. W. Pool
Clinton, Ok.

LOGGED BY G. Hossell
DATE 09/17/93 CHECKED BY

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: air Rotary to 25 ft

wet rotary to 47 ft

BORING NUMBER:

B-10

SAMPLING METHOD: air coring w/ 3" ID X 5.25" ID core barrel

Sheet 1 of 1

wet coring after 1st h₂ encountered

DRILLING

WATER LEVEL 2.8

TIME 07:30

DATE 9/22/93

CASING DEPTH cave @ 28.0 ft

START FINISH

TIME TIME

14:25 16:45

DATE DATE

9/21/93 9/21/93

DATUM: FL MSL

ELEVATION: 830.98

DRILL RIG: Falling 1500

SURFACE CONDITIONS:

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272835.10 E = 2730778.24

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	CORES			SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS		
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY							DEPTH IN FEET		PERMEABILITY CM/SEC
FROM	TO													
25			1	22 < 8"	97	0		Tan and gray severely weathered CLAY-SHALE						
			2	25 < 8"	100	0								
30			3		100	0								
			4	3 > 8"	45	32		Gray unweathered LIMY-SHALE						
35			5	1 > 6"	100	100								
40			6	1 > 6"	25	25								
45														
50														
55														

DRILLING CONTRACTOR
A. M. Pool
Clinton, Oklahoma

LOGGED BY G. Hessel/ D. Smith
DATE 09/21/93
CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION: Muskogee Community Landfill 2801 S 54th Street W., Muskogee, Ok RUST Project #.86251	DRILLING METHOD: Hollow Stem Auger				BORING NUMBER:	
	with 3.25"ID x 7.25"OD augers.				B-11	
	air coring				Sheet 1 of 1	
	SAMPLING METHOD: 1.5" DIA. Split-spoon (SS) and				DRILLING	
	3" dia. Shelby tube (ST)				START	FINISH
					TIME	TIME
WATER LEVEL					08:53	10:30
TIME					DATE	DATE
DATE					9/24/93	9/24/93
CAVE DEPTH						

DATUM: ft. MSL ELEVATION: 827

DRILL RIG: Mobil Drill B-81 SURFACE CONDITIONS: clay, approximate elevation at 827

ANGLE: Vertical BEARING: --- 75 ft w & 100 ft n of abandoned oil well

SAMPLE HAMMER TORQUE: ft.-lbs. N = 272534.32 E = 2730734.81

DEPTH IN FEET (ELEVATION)	BLOWS/ft. ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
	c=2.5	82		Tan and gray CLAY, damp, homogeneous structure, iron nodules root structures, vertical sandy pockets due to bioturbation	ST							
	TWS			blocky structure, slicken-sided cleavage planes slicken-sided cleavage planes, iron nodules	TWS							
	c=4.5	71			ST							
	TWS	50			TWS			19.3			3.90	85.2
10	1/10/12				SS	NONE						
				- drillers notice change in drill characteristics								
15	18/50			Tan severely weathered CLAY-SHALE; dry, thin beds w/ some oxide along bedding planes fossiliferous (crinoid, tronds, bivalves) 2" iron stained zone.	SS							
				Gray moderately weathered @ 18 ft.	SS			5.8	40	19		
20	32/50-3			discontinue hollowstem augering @ 18.75, resume w/ rotary @ 20ft								
25												
30												

DRILLING CONTRACTOR
A. N. Pool
Clinton, Ok.

LOGGED BY D. Smith
DATE 12/17/93 CHECKED BY _____

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project #86251

DRILLING METHOD: air-rotary to 25 ft

wet-rotary to 45 ft

BORING NUMBER:

B-11

SAMPLING METHOD: 5 foot core

3" ID X 5.25" OD core barrel

Sheet 1 of 1

DRILLING

START FINISH

WATER LEVEL

L1

TIME

10:08

DATE

9/27/94

TIME

14:15

DATE

9/24/93

9/24/93

DATUM: Ft. MSL

ELEVATION: 627

CASING DEPTH Cave at 28.0

DRILL RIG: Failing 1500

SURFACE CONDITIONS:

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272448.23 E = 2730787.80

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	CORES			SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS		
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY							DEPTH IN FEET		PERMEABILITY CM/SEC
FROM	TO													
25			1	>8"	70	17		Tan moderately weathered CLAY-SHALE						
			2	>8"	92	23		Gray unweathered CLAY-SHALE						
30			3	>6"	96	46								
35			4	>8"	100	31								
40			5	>8"	100	92								
45														
50														
55														

wet (20-23 ft) fine
grained, well sorted, weak
quartzitic cement, thin
bedded, fractures 1 @ 80'
6' at 30' with oxidized
surfaces.

red LIMESTONE (fine clay)
at 20.8 to 21.0 ft

vertical fractures (5) from
25 to 27 ft @ 0.8 to 0.2 ft
long stacked atop each
other: 1 @ 40', 5 @ 15', 0.2
feet apart. 3 along
bedding planes; all oxidized
and/or infilled w/
secondary mineralization;
horizontal vertical fractures @
28.5 to 29.8 ft

calcite infilled fractures:
30' @ 31 and 32.5 ft; 80' @
33 ft
potentially transmissive
zone @ 31.8 ft

highly fractured & wet @ 42
- 44 ft; 6" vertical
fracture.

TO @ 45 ft.

DRILLING CONTRACTOR A. M. Pool
Clinton, Oklahoma

LOGGED BY G. Hasselt/D. Smith
DATE 09/24/93
CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Hollow Stem Auger

with 3.25"ID x 7.25"OD augers.

air coring

SAMPLING METHOD: 1.5" dia. Split-spoon (SS) and

3" dia. Shelby tube (ST)

BORING NUMBER:

B-12

Sheet 1 of 1

DRILLING

START

FINISH

WATER LEVEL

TIME

TIME

TIME

14:45

18:25

DATE

DATE

DATE

CAVE DEPTH

9/27/93

9/27/93

DATUM: ft. MSL

ELEVATION: 827.85

DRILL RIG: Mobil Drill B-01

SURFACE CONDITIONS: clay

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272332.87 E = 273081.57

DEPTH IN FEET (ELEVATION)	BLOWS/ft. ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE
	TWS			Tan and grey CLAY (CL), damp, homogeneous structure, iron nodules & iron staining	TWS		CL	26.4				
	c=2.75	85			ST		CL	20.1	48	32		
	TWS				TWS		CL					
	c=3.5	75			ST		CL	18.7			7.29	
	5/7/10				SS		CL	18.9				
10												
	4/10/21			remnant bedding planes @ 14 ft (<0.03 ft), flat bedded	SS			11.3				93.9
15				Tan and gray severely weathered CLAY-SHALE; dry, fine grained, well sorted, weak quartzitic cement, thin bedding planes (<0.03ft) flat bedded, intermixed w/ residual clay soils								
	0/22/2			limestone interbedded (fireclay) @ 18 TO 18.2 ft.	SS			11.8				
20				discontinue hollowstem augering @ 19.5, resume w/ air rotary at 20 ft								
25												
30												

DRILLING CONTRACTOR A. N. Pool
Clinton, Ok.

LOGGED BY G. Hazzell
DATE 12/11/93
CHECKED BY

ROCK BOREHOLE LOG

[illegible]

DRILLING CONTRACTOR A. M. Pool
Clinton, Oklahoma

LOGGED BY G. Hassett
DATE 09/28/93 CHECKED BY _____

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Hollow Stem Auger
with 3.25"ID x 7.25"OD augers.

BORING NUMBER:

B-13A

Sheet 1 of 1

SAMPLING METHOD: 1.5" dia. Split-spoon (SS) and
3" dia. Shelby tube (SP)

DRILLING

START FINISH

WATER LEVEL

TIME

TIME

TIME

13:25

14:40

DATE

DATE

DATE

CAVE DEPTH

10/23/93

10/23/93

DATUM: ft. MSL

ELEVATION: 628

DRILL RIG: Mobil Drill B-61

SURFACE CONDITIONS: clay, pit dug to remove saturated surface

ANGLE: Vertical

BEARING: ---

Silt

Me. Approximate elevation of 628 (-25 ft. below

SAMPLE HAMMER TORQUE: ft.-lbs.

surface) N = 274259.84 E = 2730237.50

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE
	C=4.5	60		Tan CLAY (CH) homogeneous structure, iron nodules	ST			23.8	58	37		
	TWS	TWS			TWS							
	C=4.5	75		Tan & gray @ 4 ft	ST			18.2				81.7
	C=4.5	75			ST			18.9				
	C=3.25	75		remnant bedding planes w/ oxidized surfaces @ 8 ft	ST							
10												
	7/50-5			Tan severely weathered CLAY-SHALE; dry, fine grained, well sorted. weak quartzite cement, thin bedding planes (<0.03 ft), flat bedded	SS	NONE		2.3	32	12		
15												
	50-5.5				SS							
20												
				Total Depth at 20 ft.								
25												
30												

DRILLING CONTRACTOR
A. N. Pool
Clinton, Ok.

LOGGED BY G. Hasselt

DATE 12/17/93 CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # .86251

DRILLING METHOD: Hollow Stem Auger
with 3.25"ID x 7.25"OD augers.

BORING NUMBER:

P4/B13B

Sheet 1 of 1

SAMPLING METHOD: 1.5" dia. Split-spoon (SS) and
3" dia. Shelby tube (SP)

DRILLING

WATER LEVEL

TIME

DATE

CAVE DEPTH

START

TIME

DATE

DATE

FINISH

TIME

DATE

DATE

DATUM: ft. MSL

ELEVATION: 630.77

DRILL RIG: Mobil Drill B-81

SURFACE CONDITIONS: N = 274147.83, E = 2730251.18

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE
				Brown SANDY SILT				23.8	58	37		
				Brown SILTY CLAY				19.2				
								18.9				
10												
				Tan severely weathered CLAY-SHALE				2.3	32	12		
15												
20				Discontinue Hollow-stem operations at 20 ft. Note: 0-20 ft. not sampled. Stratigraphy and lithology based on cuttings, drillers information, and adjacent borings (P-5/B14, P-6)								
25												
30												

DRILLING CONTRACTOR A. N. Pool
Clinton, Ok.

LOGGED BY G. Hasselt
DATE 09/22/93
CHECKED BY LB

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 88251

DRILLING METHOD: air-Rotary

BORING NUMBER:

P-4/B138

SAMPLING METHOD: 3" ID X 5.25" OD

Sheet 1 of 4

10 foot core barrel

DRILLING

WATER LEVEL

START

FINISH

TIME

TIME

15:00

16:00

DATE

DATE

9/22/93

9/25/93

DATUM: Ft. MSL

ELEVATION: 830.77

CASING DEPTH

DRILL RIG: Fawing 1500

SURFACE CONDITIONS:

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 274147.83 E = 273025.18

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES				SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS		
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RQD							DEPTH IN FEET		PERMEABILITY CM/SEC
													FROM	TO	
25			1	8x8"	80	37	gray severely to moderately weathered CLAY-SHALE		wet fine grained, well sorted, thin beds, flat bedded, abundant fractures infilled w/ clay; from vertical to along bedding planes						
30									- 20" angular fractures w/ oxidation, potentially transmissive zones						
35			2	8x8"	100	55	Gray unweathered CLAY-SHALE		thin beds, flat bedded 20" angular fracture w/ cement infilling potentially transmissive zones @ 30.5 - 35.1 ft, 38.8 - 38.9 ft, weathered w/clay infilling						
40									- few fractures from 40 - 43.8 ft						
45			3	4x8"	70	54			potentially transmissive zone w/ secondary cementation in fractures @ 43.8 to 44.5 ft.						
50															
55			4	2x8"	100	58	gray SHALEY-LIMESTONE		Dry, finely crystalline, argillaceous matrix strong calcareous cement, thin beds, ripple to granular						

weathered friable zones 53

DRILLING CONTRACTOR A. M. Pool
Clifton, Oklahoma

LOGGED BY D. Smith/G. Hassett
DATE 09/22/93 CHECKED BY G. Hassett

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: air-Rotary

BORING NUMBER:

P-4/B13B

SAMPLING METHOD: 3" ID X 5.25" OD

Sheet 2 of 4

10 foot core barrel

DRILLING

WATER LEVEL

START

FINISH

TIME

TIME

15:00 16:00

DATE

DATE

9/22/93 9/25/93

CASING DEPTH

DATUM: Ft. MSL

ELEVATION: 830.77

DRILL RIG: Falling 1500

SURFACE CONDITIONS:

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 274147.83 E = 2730251.18

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES				SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS		
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RQD							DEPTH IN FEET	PERMEABILITY CM/SEC	
FROM	TO														
80			4	2>8"	100	58	Gray LIMY-SHALE		fine grained, well sorted, strong calcareous cement, thin beds, ripple bedded to flat bedded, interbedded w/ broken, weathered, friable zones.						
85							SHALEY-LIMESTONE		- interbedded w/ weathered friable zones 5 @ 0.01 to 0.4 ft thick fossiliferous						
							COAL		highly fractured, vertical & horizontal						
							Gray LIMY-SHALE		fine grained, well sorted, strong calcareous cement, thin beds, flat bedded - weathered potentially transmissive clayey zones @ 65.7 - 68.3'; 68.8 - 67.7'; 67.5 - 71'						
70			5	1>6"	79	53			- vertical fracture @ 70.9 to 71 ft						
									- calcite infilling between bedding planes 73 to 83 ft.						
75									- weathered friable zones @ 74.1 - 76'; 77.3 - 78'; 79 - 83'						
80			6	5>8"	100	31									
85									- weathered friable zones @ 85 - 86.6'; 90.9 - 93'						
90			7	4>8"	98	54									

DRILLING CONTRACTOR A. M. Pool
Clinton, Oklahoma

LOGGED BY D. Smith/G. Hasselt
DATE 09/22/93 CHECKED BY G. Hasselt

ROCK BOREHOLE LOG

SITE NAME AND LOCATION: Muskogee Community Landfill 2801 S. 54 Street W., Muskogee, Ok RUST Project # 88251	DRILLING METHOD: air-Rotary				BORING NUMBER: P-4/B138	
					Sheet 3 of 4	
	SAMPLING METHOD: 3" ID X 5.25" OD				DRILLING	
	10 foot core barrel				START	FINISH
	WATER LEVEL				TIME	TIME
DATE				DATE	DATE	
CASING DEPTH				9/22/83	9/25/83	

DATUM: FL. MSL		ELEVATION: 830.77	
DRILL RIG: Falling 1500		SURFACE CONDITIONS:	
ANGLE: 0		BEARING: -	
SAMPLE HAMMER TORQUE: ft.-lbs.		N = 274147.83 E = 2730251.18	

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES			SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS	
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RCD						DEPTH IN FEET	PERMEABILITY CM/SEC
			7	4>8"	98	54							
95								- weathered friable zones @ 95 - 98.4'					
100			8	3>8"	100	52	COAL Gray SHALEY-LIMESTONE	finely crystalline, argillaceous matrix, strong calcareous cement, thin beds, rippled to flat to gnarly bedded, rip-up clasts of shaley limestone					
105								- weathered friable zones @ 97.5 - 98.8'					
110			9	7>8"	100	87	Gray SANDSTONE	thin (0.01 to 0.04 ft) interbedded sandstone @ 108 to 109 ft. fine to medium grained, well sorted, strong quartzite cement, thin (<0.01) to medium (0.3); flat to ripple bedded					
115								interbedded SHALE, LIMESTONE, SHALE, SANDSTONE sequence @ 112.1 (0.02 ft thick each) - two coal seams @ 111.3 to 111.32 & 111.7 to 111.8 ft - 70' angle fault, offset 0.03 ft @ 114.8 to 115 ft - friable zones @ 115 - 115.2' - rip-up clasts to 120 ft - 45' fracture @ 115.8 to 117.2 ft - 70' angle fault fracture @ 117.5 to 118 ft - friable zones @ 118 - 118.8'					
120			10	8>8"	97	70	LIMESTONE Gray SHALE	SHALE & LIMESTONE rip-up clasts @ 120.3 to 120.4 ft					
125			11					wet, fine grained, well sorted, weak matrix cement, thin beds, flat bedded - friable zones @					

DRILLING CONTRACTOR
A. M. Pool
Clinton, Oklahoma

LOGGED BY **D. Smith/G. Hasselt**
DATE **09/22/93** CHECKED BY **G. Hasselt**

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: air-Rotary

BORING NUMBER:

P-4/B13B

SAMPLING METHOD: 3" ID X 5.25" OD

Sheet 4 of 4

10 foot core barrel

DRILLING

START FINISH

WATER LEVEL

TIME TIME

TIME

15:00 16:00

DATE

DATE DATE

CASING DEPTH

9/22/93 9/25/93

DATUM: Ft. MSL

ELEVATION: 830.77

DRILL RIG: Failing 1500

SURFACE CONDITIONS:

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 274147.83 E = 273025.18

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES			SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS	
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY							DEPTH IN FEET	PERMEABILITY CM/SEC
FROM	TO												
130			11										
135													
140													
145													
150													
155													
160													

DRILLING CONTRACTOR A. N. Pool
Clinton, Oklahoma

LOGGED BY D. Smith/G. Hassett
DATE 09/22/93 CHECKED BY G. Hassett

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W.
Muskogee, Oklahoma

DRILLING METHOD: Hollow Stem Auger

with 3.25"ID x 7.25"OD augers.

air coring

SAMPLING METHOD: Split-spoon (SS) with

2' drives and Shelby tube (ST)

BORING NUMBER:

P-5/B-14

Sheet 1 of 2

DRILLING

START FINISH

TIME TIME

08:15 09:40

DATE DATE

9/17/93 9/17/93

DATUM: ft. MSL

ELEVATION: 630.47

DRILL RIG: Mobil Drill B-81

SURFACE CONDITIONS: natural surface - sandy

ANGLE: Vertical

BEARING: ---

N = 27412125. E = 2730239.37

SAMPLE HAMMER TORQUE: ft.-lbs.

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE)
100				Brown SILTY-SAND, dry fine grained, well sorted	CME							
100				Tan CLAY (CL), dry, homogeneous structure, iron nodules, roots	CME			17.4	50	34		
100				- remnant vertical fracture or shrinkage crack infilled with a black oxidized mineral (<0.01 ft) recent bioturbation @ 8 to 10 ft	CME	NONE		17.1				
100					CME			23.5			2.97	
100					CME			18.0				
95				Tan severely weathered CLAY-SHALE; dry, fine grained, well sorted Thin bedding w/ oxidized surfaces, ripple laminated, vertical fractures (<0.01 ft) w/ oxidized surfaces	CME			13.1	35	14		
100				- thin (<0.01ft) vertical fractures; intermixed w/ residual clay soil	CME			14.3				
100				- claystone and water at 20 and 21 ft.	CME			11.9				
100				- gray at 21.5 ft.	CME							
100				- wet at 27 to 29.5 ft.	CME			15.4				

DRILLING CONTRACTOR
A. N. Pool
Clinton, Ok.

LOGGED BY G. Hassett
DATE 12/17/93
CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W.
Muskogee, Oklahoma

DRILLING METHOD: Hollow Stem Auger

with 3.25"ID x 7.25"OD augers.

air coring

SAMPLING METHOD: Split-spoon (SS) with

2' drives and Shelby tube (ST)

BORING NUMBER:

P-5/B-14

Sheet 2 of 2

DRILLING

START FINISH

TIME TIME
08:15 09:40

DATE DATE

9/17/93 9/17/93

DATUM: ft. MSL

ELEVATION: 830.47

DRILL RIG: Mobil Drill B-81

SURFACE CONDITIONS: natural surface - sandy

ANGLE: Vertical

BEARING: ---

N = 27412125, E = 2730230.37

SAMPLE HAMMER TORQUE: ft.-lbs.

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE
100				- wet at 32 to 35.5 ft.	CME							
100				Gray unweathered CLAY-SHALE: (dry, fine-grained, good sorting, strong clacareous cement, thin beds, flat-bedded Discontinue Hollow-stem operations at 37 ft.	CME							
40												
45												
50												
55												
80												

DRILLING CONTRACTOR A. M. Pool
Clinton, Ok.

LOGGED BY G. Hasselt
DATE 12/17/93 CHECKED BY

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Hollowstem Auger (0-37 ft)

air-rotary (37- 87 ft)

BORING NUMBER:

P-5/B14

SAMPLING METHOD: 5 foot CME continuous sampler (0-37 ft)

Sheet 1 of 1

10 foot core barrel:

3" ID X 5.25" OD

DRILLING

START

FINISH

WATER LEVEL

TIME

TIME

TIME

18:00

09:30

DATE

DATE

DATE

CASING DEPTH

9/27/93

9/28/93

DATUM: Ft. MSL

ELEVATION: 830.47

DRILL RIG: Badger 1250

SURFACE CONDITIONS:

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 27412125 E = 273023937

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	CORES				SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS			
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	ROD							DEPTH IN FEET		PERMEABILITY CM/SEC	
													FROM	TO		
40			1	1>6"	83	20	Grey unweathered CLAY-SHALE Gray LIMY-SHALE		dry, fine grained, well sorted, strong calcareous cement, thin beds flat bedded - broken crumbly zones @ 37.5 to 38.1; 38.5 to 41, & 41.3 to 42.4 ft - well @ 37.5 to 38.1 ft & damp @ 38.5 to 41.0 ft							
45																
50			2	3>6"	88	34	COAL GLAUCONITIC SHALE Fossiliferous LIMESTONE Gray SILTY CLAY Gray SHALEY-LIMESTONE		- broken zone @ 48.7 to 49.1 - @ 48.8 to 50.1 - @ 50.1 to 50.7 finely crystalline, argillaceous matrix strong calcareous cement, medium beds, ripple bedded, interbedded w/ SHALE - vertical fracture infilled w/ calcite & pyrite crystals @ 50.7 to 51.1 ft finely crystalline, argillaceous matrix strong calcareous cement, thin beds, nearly to flat bedded							
55																
60			3	5>8"	100	63			- broken zones @ 60.2 to 60.6, 61.3 to 61.7, 62.9 to 63.3 & 83.7 to 85.2 ft							
65							COAL SHALEY-LIMESTONE		COAL @ 65.2 to 65.5							
70							Total Depth @ 67.5 ft.									

DRILLING CONTRACTOR A. N. Pool
Clinton, Oklahoma

LOGGED BY G. Hasselt
DATE 09/28/93
CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Hollow Stem Auger

with 3.25"ID x 7.25"OD augers.

air coring

SAMPLING METHOD: 1.5" dia. Split-spoon (SS) and

3" dia. Shelby tube (ST)

BORING NUMBER:

B-15

Sheet 1 of 1

DRILLING

START FINISH

TIME TIME

08:15 09:40

DATE DATE

9/17/93 9/17/93

DATUM: ft. MSL

ELEVATION: 632.5

DRILL RIG: Mobil Drill B-01

SURFACE CONDITIONS: natural surface - sandy, approximate elevation

ANGLE: Vertical

BEARING: ---

632.5 ft. Boring was slightly offset to drill on

SAMPLE HAMMER TORQUE: ft.-lbs.

level ground N = 273775.17, E = 2730257.84

DEPTH IN FEET (ELEVATION)	BLOWS/ft. ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE)
80				Brown SILTY SAND, dry fine grained, well sorted	ST		ML					92.0
c=4.5 95				Tan CLAY (CL), dry, homogeneous structure, iron nodules, roots	ST		CL	16.4	54	37		
c=4.5 90					ST		CL	14.8			8.51	
C=4.25 89				Tan and gray CLAY (CL), dry, homogeneous blocky structure, slicken-sided cleavage planes	ST		CL	18.8				
c=4.5 78				- remnant vertical fracture or shrinkage crack infilled with a black oxidized mineral (<0.01 ft) recent bioturbation @ 8 to 10 ft	ST		CL	19.9				
31/50-45"				Tan severely weathered CLAY-SHALE: dry, fine grained, well sorted thin bedding w/ oxidized surfaces, ripple laminated, vertical fractures (<0.01 ft) w/ oxidized surfaces	SS			13.7	43	18		
18/31/50-3"				- thin (<0.01ft) vertical fractures; intermixed w/ residual clay soil	SS							
discontinue hollowstem augering @ 19.5 ft. resume w/ rotary operations @ 20 ft												

DRILLING CONTRACTOR: J. M. Pool
Clinton, Ok.

LOGGED BY: G. Hassett
DATE: 12/17/93
CHECKED BY:

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: air-Rotary to 25 ft

wet-rotary to 45 ft

BORING NUMBER:

B-15

SAMPLING METHOD: 5 foot core

3" ID X 5.25" OD

Sheet 1 of 1

DRILLING

WATER LEVEL

5.5

6.1

START

FINISH

TIME

10:45

18:02

TIME

14:30

DATE

9/23/93

9/23/93

DATE

DATE

CASING DEPTH

9/22/93

9/22/93

DATUM: Ft. MSL

ELEVATION: 632.5

DRILL RIG: Falling 1500

SURFACE CONDITIONS: natural surface - sandy

ANGLE: 0

BEARING: -

southwest toe of stockpile

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 2737754.17 E = 2730257.84

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	CORES			SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS		
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY							DEPTH IN FEET	PERMEABILITY CM/SEC	
												FROM	TO	
25			1	25<8"	100	0		Tan and gray severely weathered CLAY-SHALE						
			2	4>8"	100	80								
30														
			3	5<8"	23	0		Gray unweathered CLAY-SHALE						
35														
			4	4>8"	100	83		Gray LIMY-SHALE						
40														
			5	1>8"	80	13		COAL Gray SHALEY-LIMESTONE						
45														
								TO @ 45 ft						
50														
55														

DRILLING CONTRACTOR A. M. Pool
Clinton, Oklahoma

LOGGED BY G. Hassett
DATE 09/22/93

CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 88251

DRILLING METHOD: Hollow Stem Auger

with 3.25"ID x 7.25"OD augers.

BORING NUMBER:

B-16

Sheet 1 of 1

SAMPLING METHOD: 1.5" dia. Split-spoon (SS) and
3" dia. Shelby tube (ST)

DRILLING

START FINISH

WATER LEVEL 10.9

TIME 10:10

DATE 9/18/93

CAVE DEPTH Cave @ 11.3 ft

TIME 15:55

DATE 9/17/93

DATE 9/17/93

DATUM: ft. MSL

ELEVATION: 830.5

DRILL RIG: Mobil Drill B-81

SURFACE CONDITIONS: natural surface - sandy, approximate elevation

ANGLE: Vertical

BEARING: ---

of 830.5 ft. Boring was slightly offset to drill

SAMPLE HAMMER TORQUE: ft.-lbs.

on level ground, N = 273275.35 E = 2730270.72

DEPTH IN FEET (ELEVATION)	BLOWS/ft. ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	1-1200 SEIVE
4.25	54			Brown and tan CLAY (CH) moist, homogeneous structure, iron nodules	ST			19.8				
2.75	60			- sandy clay pockets (from bioturbation) from 2 - 6 ft.	ST							
2.5	58				ST			21.7	47	32		
2.5	79			- interbedded w/ fossils (crinoid fronds, bivalves), iron staining	ST							
TWS					TWS	NONE		18.8				
				- wet at 11.0'								
100				Tan severely weathered CLAY-SHALE; dry, thin bedding planes, 30 - 40' fractures with oxidized surfaces.	SS							
35/50-5'					SS							
20				discontinue hollowstem augering @ 19 ft. resume w/ rotary operations @ 20 ft.								
25												
30												

DRILLING CONTRACTOR
N. Pool
Clinton, Ok.

LOGGED BY D. Smith
DATE 01/08/94 CHECKED BY _____

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 88251

DRILLING METHOD: air-Rotary to 25 ft

wet-rotary to 45 ft

BORING NUMBER:

B-16

Sheet 1 of 1

SAMPLING METHOD: 5 foot core

3" ID X 5.25" OD

DRILLING

WATER LEVEL

3.7

3.7

START

FINISH

TIME

10:37

15:46

TIME

07:30

DATE

9/23/93

9/23/93

DATE

DATE

CASING DEPTH

9/22/93

9/22/93

DATUM: Ft. MSL

ELEVATION: 630.5

DRILL RIG: Falling 1500

SURFACE CONDITIONS: NW corner of stockpile

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 273325.35 E = 2730270.72

DEPTH IN FEET (ELEVATION)	BLOWS/ft. ON SAMPLER	RECOVERY	CORES				SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS			
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	ROD							DEPTH IN FEET		PERMEABILITY CM/SEC	
													FROM	TO		
25			1		91	0	Tan and gray moderately weathered CLAY-SHALE		damp, well sorted, weak quartzitic cement, thin bedded w/ oxidized surfaces; angular fractures of 20" to 50" highly fractured wet zone @ 20.8 to 22.1 highly fractured damp zone @ 23 to 24 ft. highly weathered friable zone @ 25.4 to 26.8 ft							
30			2		95	0										
35			3	2>6"	100	22	Gray unweathered CLAY-SHALE		damp, fine grained, well sorted weak quartzitic cement angular fractures of 30"							
40			4	3<6"	88	0			core came up as 1 to 2" pieces							
45			5	1>6"	30	38	COAL CLAY Gray LIMESTONE		coal seam @ 42.3 to 42.6 ft; clay from 42.8 to 42.9 ft							
			5	3<6"					finely crystalline, fine calcareous cement, argillaceous matrix fossiliferous							
							TD @ 47 ft									
55																

A. M. Pool

DRILLING CONTRACTOR
Clinton, Oklahoma

CHECKED BY

LOGGED BY D. Smith

DATE 09/22/93

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 88251

DRILLING METHOD: Hollow Stem Auger

with 3.25" ID x 7.25" OD augers.

BORING NUMBER:

B-17

Sheet 1 of 1

SAMPLING METHOD: 1.5" dia. Split-spoon (SS) and

3" dia. Shelby tube (ST)

DRILLING

WATER LEVEL

DRY

START

FINISH

TIME

10:13

TIME

14:00

DATE

9/18/93

DATE

DATE

CAVE DEPTH

Cave @ 12.2 ft

9/17/93

9/17/93

DATUM: ft. MSL

ELEVATION: 833.38

DRILL RIG: Mobil Drill B-81

SURFACE CONDITIONS: natural surface - sandy

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272830.40 E = 2730278.21

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE)
	c=4.5+			Brown and tan CLAY (CH) damp, homogeneous structure, roots	ST			20.8				
	c=1.5	82		- gray @ 2 ft with sand streaks	ST			25.8	55	37		
	c=1.5	70			ST			22.2			3.72	
	C=2.0	8		- slickensided cleavage planes, blocky structure & iron nodules @ 8 ft.	ST							94.9
	c=2.75	68			ST			20.7				
10												
	c=2.75	68			ST			21.3	52	35		
15				- slickensided cleavage planes @ 15 ft.								
				Tan severely weathered CLAY-SHALE	SS			12.0				
20	90 for 5'			Discontinue hollowstem augering @ 19 ft. resume w/ rotary operations @ 20 ft								
25												
30												

DRILLING CONTRACTOR A. N. Pool
Clinton, Ok

LOGGED BY D. Smith
DATE 09/17/93
CHECKED BY

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 88251

DRILLING METHOD: air-Rotary - 20 to 25 ft

wet-rotary - 25 to 45 ft

BORING NUMBER:

B-17

Sheet 1 of 1

SAMPLING METHOD: 5 foot core

3" ID X 5.25" OD

DRILLING

START

FINISH

WATER LEVEL

L7

TIME

TIME

TIME

10:15

10:45

14:00

DATE

9/27/93

DATE

DATE

DATUM: Ft. MSL

ELEVATION: 833.38

CASING DEPTH cove @ 27 ft

9/24/93

9/24/93

DRILL RIG: Falling 1500

SURFACE CONDITIONS: clay

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272830.40 E = 2730278.21

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	CORES			SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS	
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY							DEPTH IN FEET	PERMEABILITY CM/SEC
												FROM	TO
			1	2 >8"	92	23		gray LIMESTONE Tan & gray weathered CLAY-SHALE					
			2		98	0		red LIMESTONE Gray weathered CLAY-SHALE					
30			3	2 >8"	92	33		Gray unweathered CLAY-SHALE					
35			4	2 >8"	83	58							
40			5	1 >8"	58	47							
45													
50													

DRILLING CONTRACTOR
A. M. Pool
Clinton, Oklahoma

LOGGED BY D. Smith
DATE 09/24/93
CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project 86251

DRILLING METHOD: Hollow Stem Auger

with 3.25" ID x 7.25" OD augers.

BORING NUMBER:

B-18

Sheet 1 of 1

SAMPLING METHOD: 1.5" dia. Split-spoon (SS) and 3" dia. Shelby tube (ST)

DRILLING

WATER LEVEL

TIME

DATE

CAVE DEPTH

START

TIME

13:40

DATE

9/18/93

FINISH

TIME

13:50

DATE

9/18/93

DATUM: ft. MSL

ELEVATION: 828.85

DRILL RIG: Mobil Drill B-61

SURFACE CONDITIONS: clay

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 27240158 E = 2730290.32

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	1-1200 SEIVE
	C=4.5	40		Tan CLAY (CL); dry, homogeneous structure, iron nodules	ST		CL	14.3	42	28		
	C=3.5	75		Tan and gray CLAY (CH); damp, homogeneous, blocky structure, slicken-sided cleavage planes	ST		CL	19.7				88.8
	C=4.5	85			ST		CL	19.0	47	31	3.80	
	TWS	NR			TWS							
	C=4.5	50		Tan CLAY (CL); damp, homogeneous structure, abundant iron nodules	ST		CL	20.5	34	20		
10						NONE						
	C=2.5	85		- no iron nodules, blocky structure, slicken-sided cleavage planes from 13 to 15 ft	ST		CL	18.8				
15												
	38/50-			Tan severely weathered CLAY-SHALE; dry, fine grained, well sorted, thin bedded (<0.03 ft), flat bedded, oxidized bedding planes with secondary mineralization (calcite)	SS							
20				discontinue hollowstem augering @ 18.7, resume w/ rotary @ 20ft								
25												
30												

DRILLING CONTRACTOR A. N. Pool
Clinton, Ok.

LOGGED BY G. Hassett
DATE 01/08/94
CHECKED BY

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 88251

DRILLING METHOD: air Rotary 20 - 25 ft

wet rotary 25 - 45 ft. with potable water

BORING NUMBER:

B-18

Sheet 1 of 1

SAMPLING METHOD: coring w/ 5.25" OD X 3" ID core barrel

DRILLING

START FINISH

WATER LEVEL

4.95

4.9

TIME

TIME

TIME

13:41

17:12

07:45

08:43

DATE

9/23/93

9/23

DATE

DATE

CASING DEPTH

41.9

9/23/93

9/23/93

DATUM: FL MSL

ELEVATION: 828.85

DRILL RIG: Failing 1500

SURFACE CONDITIONS:

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 27240158 E = 2730290.32

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	CORES				SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS		
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	ROD							DEPTH IN FEET		PERMEABILITY CM/SEC
													FROM	TO	
25			1	3>8"	100	35	Tan severely weathered CLAY-SHALE		wet (20 to 22 ft), fine-grained, well sorted, weak quartzitic cement, thin bedding (<0.01 ft), ripple laminated, bioturbation, fractures 60° to vertical w/ oxidized surfaces - friable @ 25 to 28 ft.						
30			2	1>8"	100	52	Gray unweathered CLAY-SHALE		Damp, fine-grained, well sorted, firm calcareous cement, thin bedding planes (<0.03 ft) flat bedded						
35			3	2>8"	100	75	COAL Gray CLAY-SHALE		COAL seam @ 29.5 to 29.7 ft fine grained, well sorted, firm calcareous cement, thin bedding (<0.03 ft); flat bedded - friable zones @ 31.4 to 31.5, 34 to 34.5 interbedded weathered potentially transmissive zones @ 35.0 to 40.0 ft						
40			4	2>8"	100	27			- Claystone @ 41 ft						
45			5		88	51									
50							TO @ 45 feet								
55															

DRILLING CONTRACTOR A. N. Pool
Clinton, Oklahoma

LOGGED BY G. Hasselt
DATE 09/23/93
CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Hollow Stem Auger

with 3.25"ID x 7.25"OD augers.

BORING NUMBER:

B-19

Sheet 1 of 1

SAMPLING METHOD: CME continuous sampler 0 - 12 ft

Shelby tube (ST) 12 - 24 ft

DRILLING

START FINISH

WATER LEVEL

TIME

DATE

CAVE DEPTH

TIME

10:30

DATE

10/18/93

TIME

13:15

DATE

10/18/93

DATUM: ft. MSL

ELEVATION: 638.50

DRILL RIG: Mobil Drill B-81

SURFACE CONDITIONS: clay

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 271707.818 E = 2730467.810

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE)
0	2/2	100	▲	Fill, tan clay	CME							
5	5/5	100	▲		CME							
10	5/5	100	▲		CME							
15	C=2.5		▲		ST	NONE						
	C=0.75		▲		ST							
	C=0.50		▲		ST							
20	C=0.25		▲		ST							
	C=2.5		▲		ST			22.1				
	C=2.0		▲	Tan and gray CLAY (CH); damp, common to abundant iron nodules	ST			21.5			3.05	
25			▲	Gray severely weathered CLAYSTONE and SHALE								
			▲	Discontinue Hollow-stem augering at 28' resume with rotary to completion depth								
30												

DRILLING CONTRACTOR
A. N. Pool
Clinton, Ok.

LOGGED BY G. Hasselt
DATE 10/18/93
CHECKED BY LB

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 88251

DRILLING METHOD: Air-Rotary

BORING NUMBER:

B-19

SAMPLING METHOD:

3" ID X 5.25" OD core barrel

Sheet 1 of 2

DRILLING

START

FINISH

WATER LEVEL

TIME

TIME

DATE

DATE

DATE

CASING DEPTH

10/23/93

10/23/93

DATUM: Ft. MSL

ELEVATION: 838.50

DRILL RIG: Badger 1250

SURFACE CONDITIONS:

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

DRILLING CONTRACTOR
A. N. Pool
Clinton, Oklahoma

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES			SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS		
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RQD						DEPTH IN FEET		PERMEABILITY CM/SEC
												FROM	TO	
			1	2>8"	73	58		Tan weathered CLAY-SHALE Black CLAY (CL)						
								Gray moderately weathered CLAY-SHALE						
								Gray LIMESTONE, fossiliferous						
								COAL						
			2	3>6"	90			Gray SHALEY-LIMESTONE						
								Gray LIMY-SHALE						
								Gray SHALEY-LIMESTONE						
			3	4>8"	90	57		Gray CLAY w/ interbedded CLAY-SHALE						

LOGGED BY: G. Hassell
DATE: 10/23/93
CHECKED BY: LB

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 88251

DRILLING METHOD: Air-Rotary

BORING NUMBER:

B-19

SAMPLING METHOD:

3" ID X 5.25" OD core barrel

Sheet 2 of 2

DRILLING

START FINISH

WATER LEVEL

TIME

DATE

CASING DEPTH

TIME

DATE

10/23/93 10/23/93

DATUM: FL MSL

ELEVATION: 638.58

DRILL RIG: Badger 1250

SURFACE CONDITIONS:

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES				SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS		
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	ROD							DEPTH IN FEET	PERMEABILITY CM/SEC	
			3	4>6"	90	57	Gray SHALEY-LIMESTONE								
			4		100	85	Gray LIMY-SHALE								
							Gray CLAY-SHALE								
							Total Depth at 81 ft								

Dry; finely crystalline;
strong calcareous cement;
thin-beds; ripple-bedded;
abundant fossils and
carbonate between beds

Damp; fine-grained; strong
calcareous cement; thin
beds; ripple-bedded;
common fossils, 1-45'
fracture with pyrite
crystals along plane

Damp; fine-grained; good
sorting; strong quartzitic
cement; thin beds;
fossil-bedded

DRILLING CONTRACTOR
A. W. Pool
Clinton, Oklahoma

LOGGED BY G. Hassett
DATE 10/23/93
CHECKED BY LB

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 88251

DRILLING METHOD: Hollow Stem Auger

with 3.25"ID x 7.25"OD augers.

BORING NUMBER:

B-20A

Sheet 1 of 1

SAMPLING METHOD: 1.5" dia. Split-spoon (SS) and

3" dia. Shelby tube (ST)

DRILLING

START FINISH

WATER LEVEL 1.8

TIME 18:17

DATE 9/18/93

CAVE DEPTH 22.5'

TIME 15:25

DATE 9/18/93

DATE 9/18/93

DATUM: ft. MSL

ELEVATION: 832.43

DRILL RIG: Mobil Drill B-01

SURFACE CONDITIONS: clay

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272151.22 E = 2730203.50

DEPTH IN FEET (ELEVATION)	BLOWS/ft. ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE)
	C=4.5	85		Tan CLAY (CL); dry, homogeneous structure, iron nodules	ST		P	14.0				
	C=4.5	10			ST		P	18.8	54	37		
	C=3.0	65			ST		P	21.5			1.48	
	C=3.5	65		- blocky structure, clayey sand pockets due to bioturbation @ 8-8 ft	ST		P					
	C=4.0	70		Tan and gray CLAY (CH); damp, homogeneous, blocky structure, slicken-sided cleavage planes.	ST			19.8				92.9
10												
	C=3.5	85		- iron nodules @ 13 ft from 13 to 15 ft	ST	NONE						
15												
				Tan and gray CLAY (CL); damp, remnant bedding planes (<0.03 ft) with oxidized surfaces, vertical fractures (<0.01 ft) with stained oxidized surfaces								
	1/24/38				SS							
20				- COAL seam w/ H ₂ O @ 21 ft								
				- red, gray, and tan CLAY, fractures of 30" to 70" with oxidized surfaces @ 23 ft.	SS		CL	19.8				
25	8/41/53											
				Tan severely weathered CLAY-SHALE; damp, fine grained, well sorted, weak quartzite cement, thin bedding (<0.03 ft), flat bedded, intermixed with residual clay soil				17.7				
30				Total Depth at 28.5 ft.								

DRILLING CONTRACTOR A. M. Pool
Clinton, Ok.

LOGGED BY G. Hassett
DATE 09/18/93
CHECKED BY

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:				DRILLING METHOD: <i>air-Rotary</i>				BORING NUMBER: P-8/B20B						
Muskogee Community Landfill 2801 S. 54 Street W., Muskogee, Ok RUST Project # 88251								Sheet 1 of 5						
				SAMPLING METHOD: 3" ID X 5.25" OD										
				10 foot core barrel				DRILLING						
				WATER LEVEL				START		FINISH				
TIME				TIME		TIME								
DATE				DATE		DATE								
CASING DEPTH				9/21/93		9/24/93								
DATUM: FL. MSL				ELEVATION: 641.47										
DRILL RIG: Badger 1250				SURFACE CONDITIONS: top soil along road on west side of LF										
ANGLE: 0				BEARING: -										
SAMPLE HAMMER TORQUE: ft.-lbs.				N = 272155.26 E = 2730185.25										
DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	CORES			SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS		
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY							ROD	DEPTH IN FEET	PERMEABILITY CM/SEC
												FROM	TO	
						FILL; tan, clay								
						Tan and gray CLAY								
			1	126"	18	11		angular fractures 15 - 20' w/ iron oxide staining, vertical fracture w/ iron oxide staining & cement infilling, concentric iron oxide staining - poor recovery; core pieces has coal specs.						
			2		100	39		Dark gray to maroon CLAY-SHALE interbedded w/ residual clay, sticken, sided cleavage planes						
						Gray unweathered CLAY								

DORILLING CONTRACTOR A. W. Pool
Clinton, Oklahoma

LOGGED BY D. Smith/G. Hassell
DATE 09/24/93 CHECKED BY G. Hassell

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 88251

DRILLING METHOD: air-Rotary

BORING NUMBER:

P-8/B20B

SAMPLING METHOD: 3" ID X 5.25" OD

Sheet 2 of 5

10 foot core barrel

DRILLING

START FINISH

WATER LEVEL

TIME TIME

TIME

13:15 13:30

DATE

DATE DATE

CASING DEPTH

9/21/93 9/24/93

DATUM: Ft. MSL

ELEVATION: 641.47

DRILL RIG: Badger 1250

SURFACE CONDITIONS: top soil along road on west side of LF

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272155.20 E = 2730185.25

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	CORES				SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS		
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RQD							DEPTH IN FEET	PERMEABILITY CM/SEC	
															FROM
40			2		100	39	Gray unweathered SILTY CLAY-SHALE		weak cementation, structureless						
45			3	4>8"	81	52	Gray unweathered CLAY-SHALE Gray SANDSTONE Gray CLAY-SHALE gray LIMESTONE Dark gray SHALE LIMEY-SHALE		Thin bedding planes, strong quartzite cement Medium grained, fine quartzite cement, well sorted, 43 to 43.2 ft. - interbedded w/ thin (<0.02") stringers of SS, fossiliferous, cross-stratification @ base Fine grained, argillaceous matrix, fossiliferous 45.5 - 45.9 ft., strong calcite cement. - fossiliferous @ 45.9 - 46.2 ft. - interbeds of limestone, strong calcite cement						
50							Med gray CLAY-SHALE		thin horizontal bedding, fissile						
55			4	50<8"	71	0									
60							Gray LIMEY-SHALE		fine grained, well sorted, strong calcareous cement, thin beds, flat bedded, interbedded weathered CLAY zones - potentially transmissive CLAY zones @ 62.4 to 63.9 ft. vertical fracture w/ pyrite crystals @ 64.6 to 67.3						
65			5	4>8"	94	78									
70															

DRILLING CONTRACTOR
A. N. Pool
Clinton, Oklahoma

LOGGED BY D. Smith/G. Hasselt
DATE 09/24/93
CHECKED BY G. Hasselt

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: air-Rotary

BORING NUMBER:

P-8/B20B

SAMPLING METHOD: 3" ID X 5.25" OD

Sheet 3 of 5

10 foot core barrel

DRILLING

WATER LEVEL

START

FINISH

TIME

TIME

TIME

DATE

DATE

DATE

CASING DEPTH

9/21/93

9/24/93

DATUM: Ft. MSL

ELEVATION: 841.47

DRILL RIG: Badger 1250

SURFACE CONDITIONS: top soil along road on west side of LF

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272155.28 E = 2730185.25

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	CORES				SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS		
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	ROD							DEPTH IN FEET		PERMEABILITY CM/SEC
													FROM	TO	
75			5	4>8"	94	78									
80			6	6>8"	83	71									
85			7	4>8"	100	59	COAL seams Gray SHALEY-LIMESTONE		LIMEY-SHALE w/ interbedded COAL seams wet, finely crystalline, strong calcareous cement, thin to medium beds ripple bedded - CLAY zone, potentially transmissive @ 83.0 to 83.7 & 83.9 to 84 ft - fossils @ 88.8 to 89.7 & 90.2 to 90.3 ft						
90							Gray LIMEY-SHALE		fine grained, well sorted, strong calcareous cement, thin beds, flat to ripple bedded - weathered, friable SHALE @ 93.5 to 94.8 ft						
95			8	3>6"	100	44	Gray SHALEY-LIMESTONE COAL Gray SILTY-CLAY Gray SHALEY-LIMESTONE		fine crystalline, argillaceous and fossil matrix medium beds, flat bedded potentially transmissive, interbedded w/ SHALE Finely crystalline, argillaceous matrix, strong calcareous cement, thin beds, ripple bedded, common to abundant fossils						
100							Gray LIMEY-SHALE		Damp, fine grained, well sorted, strong calcareous cement, thin beds, flat to ripple bedded - fossiliferous shaley LS @ 101 to 101.1 ft						
105			9	3>6"	95	41									

DRILLING CONTRACTOR
A. N. Pool
Clinton, Oklahoma

LOGGED BY D. Smith/G. Hassett
DATE 09/24/93 CHECKED BY G. Hassett

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: air-Rotary

BORING NUMBER:

P-8/B20B

SAMPLING METHOD: 3" ID X 5.25" OD

Sheet 4 of 5

10' foot core barrel

DRILLING

WATER LEVEL

START

FINISH

TIME

TIME

13:15 13:30

DATE

DATE

9/21/03 9/24/03

CASING DEPTH

DATUM: FL MSL

ELEVATION: 841.47

DRILL RIG: Badger 1250

SURFACE CONDITIONS: top soil along road on west side of LF

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: FL-Rds.

N = 272155.28 E = 2730185.25

DEPTH IN FEET (ELEVATION)	BLOWS/FT ON SAMPLER	RECOVERY	CORES			SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS	
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY							DEPTH IN FEET	PERMEABILITY CM/SEC
FROM	TO												
110			9	3>8"	95	41		- interbedded, weathered, friable SHALE @ 109.3 to 111 ft					
115			10	4>8"	77	35		- weathered, friable zones @ 112.5 to 112.9 & 115.4 to 118.8 ft					
120								- weathered, friable zones @ 121 to 122.9					
125			11		95	35		- interbedded, weathered friable zone @ 123 to 127 ft					
130							Gray SANDSTONE	Medium grained, well sorted, strong quartzitic cement, thin to medium beds (<0.01 to 0.4 ft) ripple bedded, interbedded shale (<0.01 ft thick)					
135			12	3>8"	100	100							
140													

A. M. Pool

DRILLING CONTRACTOR
Clinton, Oklahoma

LOGGED BY D. Smith/G. Hasselt
DATE 09/24/03 CHECKED BY G. Hasselt

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 88251

DRILLING METHOD: air-Rotary

BORING NUMBER:

P-8/B208

SAMPLING METHOD: 3" ID X 5.25" OD

Sheet 5 of 5

10 foot core barrel

DRILLING

WATER LEVEL

START

FINISH

TIME

TIME

13:15 13:30

DATE

DATE

9/21/93 9/24/93

CASING DEPTH

9/21/93

9/24/93

DATUM: FL MSL

ELEVATION: 641.47

DRILL RIG: Badger 1250

SURFACE CONDITIONS: top soil along road on west side of LF

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272155.26 E = 2730185.25

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES				SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS		
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RQD							DEPTH IN FEET		PERMEABILITY CM/SEC
													FROM	TO	
145			12	3>8"	100	100			- occasional trace fossils (vertical burrows) - occasional interbedded SHALE (<0.01 to 0.4 ft thick) - occasional rip-up clasts						
150			13	7>8"	100	79			- rip-up clasts @ 151.4 to 151.6 ft						
155			14		100	33			- interbedded, broken, weathered SHALES & SS, friable @ 158.8 to 157, 158.2 to 158.7, and 158.9 to 159.2 ft - coarse grained @ 159.7 to 160.7 ft						
160			15				SHALEY-LIMESTONE		Fine crystalline, argillaceous matrix, strong calcareous cement, thin beds, ripple laminated, interbedded w/ SHALE, LS rip-up clasts w/in shale						
165				Dark gray SHALE			Gray SHALEY-LIMESTONE		Fine grained, well sorted, weak calcareous cement, thin beds, flat bedded weathered & interbedded w/ clay, transmissive						
170				Dark gray SHALE					Fine crystalline, argillaceous matrix, strong calcareous cement, thin beds, ripple laminated, w/ shale, mud clasts w/in shale						
175							TD @ 171 FT		Fine grained, well sorted, strong quartzitic cement, thin beds, ripple bedded weathered friable zone @ 168 to 171 ft.						

DRILLING CONTRACTOR
A. M. Pool
Clinton, Oklahoma

LOGGED BY O. Smith/G. Hassett
DATE 09/24/93
CHECKED BY G. Hassett

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 88251

DRILLING METHOD: Hollow Stem Auger

with 3.25"ID x 7.25"OD augers.

BORING NUMBER:

P-9/B21

SAMPLING METHOD: CME Continuous Sampler

Sheet 1 of 2

DRILLING

START

FINISH

WATER LEVEL

TIME

TIME

TIME

14:25

08:30

DATE

DATE

DATE

CAVE DEPTH

10/28/93

10/29/93

DATUM: ft. MSL

ELEVATION: 842.32

DRILL RIG: Mobil Drill B-61

SURFACE CONDITIONS: FW

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272H7.180, E = 2730181790

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS					
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE	
				FILL - Clay									
10													
15													
20	100			Tan and gray CLAY, damp, homogeneous blocky structure, slickensided cleavage planes	CME								
25	100				CME								
30	100			Tan severely weathered CLAY-SHALE: interbedded with clay	CME								

DRILLING CONTRACTOR A. M. POW
Clinton, Ok.

LOGGED BY D. Smith
DATE 10/28/93
CHECKED BY LB

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Hollow Stem Auger
with 3.25"ID x 7.25"OD augers.

BORING NUMBER:

P-9/B21

SAMPLING METHOD: CME Continuous Sampler

Sheet 2 of 2

DRILLING

START FINISH

WATER LEVEL

TIME

TIME

TIME

14:25

09:30

DATE

DATE

DATE

CAVE DEPTH

10/28/93

10/28/93

DATUM: ft. MSL

ELEVATION: 842.32

DRILL RIG: Mobil Drill B-61

SURFACE CONDITIONS: FM

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272117.160, E = 2730181.760

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE
100				COAL	CME							
				Gray CLAY (CL); wet, homogeneous structure; very soft								
70				Gray unweathered CLAY-SHALE	CME							
				Discontinue Hollow-stem auger at 37 ft.								
40												
45												
50												
55												
60												

DRILLING CONTRACTOR: A. M. Pool
Clinton, Ok.

LOGGED BY: D. Smith
DATE: 10/28/93
CHECKED BY: LB

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 88251

DRILLING METHOD:

Air rotary (37-85 ft)

BORING NUMBER:

P-9/B21

SAMPLING METHOD: CME continuous sampler

Sheet 1 of 2

3" ID X 5.25" OD

DRILLING

10 ft core barrel (37-85 ft)

START FINISH

WATER LEVEL

TIME TIME

TIME

14:25 09:30

DATE

DATE DATE

CASING DEPTH

9/26/93 9/29/93

DATUM: Ft. MSL

ELEVATION: 642.32

DRILL RIG: Mobil Drill B-81/Badger 1250

SURFACE CONDITIONS: Fm

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272117.10 E = 2730181.79

DEPTH IN FEET (ELEVATION)	BLOWS/ft. ON SAMPLER	RECOVERY	CORES				SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS				
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RQD							DEPTH IN FEET		PERMEABILITY CM/SEC		
													FROM	TO			
40			1	3>8"	95	20	Gray unweathered CLAY-SHALE		Fine grained, well sorted, damp, strong quartzitic cement, thin beds, flat bedded, interbedded w/ LIMEY-SHALE interbeds - broken zone @ 37.5 to 43.5 ft								
45																	
50			2	5>8"	87	44					- fossiliferous shaley LS @ 48.2 to 49.2 ft - broken zones @ 48 to 48.1, 48.4 to 48.5, 48.9 to 49, 49.6 to 50.1 - LS w/ fossils @ 51.4 to 51.8 ft @ 51.8 to 52.1 ft						
55																	
60			3		83												
65																	
70			4	1>8"	84	33											

DRILLING CONTRACTOR A. N. Pool
Clinton, Oklahoma

LOGGED BY G. Hassett
DATE 12/21/93
CHECKED BY G. Hassett

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 88251

DRILLING METHOD:

Air rotary (37-85 ft)

BORING NUMBER:

P-9/B21

SAMPLING METHOD: CME continuous sampler

3" ID X 5.25" OD

10 ft core barrel (37-85 ft)

Sheet 2 of 2

DRILLING

START

FINISH

WATER LEVEL

TIME

TIME

TIME

14:25

08:30

DATE

DATE

DATE

CASING DEPTH

9/28/93

9/29/93

DATUM: FL MSL

ELEVATION: 842.32

DRILL RIG: Mobil Drill B-81/Badger 1250

SURFACE CONDITIONS: Fm

ANGLE: 0

BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272117.16 E = 2730181.79

DEPTH IN FEET (ELEVATION)	BLOWS/ft ON SAMPLER	RECOVERY	CORES				SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS		
			RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	ROD							DEPTH IN FEET		PERMEABILITY CM/SEC
													FROM	TO	
75			4	1>6"	84	33									
80			5	2>6"	98	10									
85			6				Interbedded COAL & SHALE Gray fossiliferous LIMESTONE Glauconitic CLAY Silty LIKEY-SHALE TO @ 85.1	   	@ 82 to 82.4 ft @ 82.4 to 83.2 ft @ 83.2 to 84.1 ft Fine grained, well sorted, strong calcite cement						
90															
95															
100															
105															

DRILLING CONTRACTOR A. M. Pool
Clinton, Oklahoma

LOGGED BY G. Hassell
DATE 12/21/93
CHECKED BY G. Hassell

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W.; Muskogee, Ok
RUST Project # 88251

DRILLING METHOD: Hollow Stem Auger

with 3.25"ID x 7.25"OD augers.

BORING NUMBER:

P-3

Sheet 1 of 1

SAMPLING METHOD: CME 5-foot

Continuous sampler

DRILLING

START FINISH

WATER LEVEL

TIME

DATE

CAVE DEPTH

TIME

DATE

10/27/93 10/27/93

DATUM: ft. MSL

ELEVATION: 629.22

DRILL RIG: Mobil Drill 8-81

SURFACE CONDITIONS: clay

ANGLE: Vertical

BEARING: ---

N = 272568.879, E = 2731412.400

SAMPLE HAMMER TORQUE: ft.-lbs.

DEPTH IN FEET (ELEVATION)	BLOWS/ft. ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE)
				Tan silty CLAY interbedded w/ brown silty fill	CME		P		52	38		
				- tan & gray w/ iron oxide nodules	CME							
				- slickensided cleavage planes	CME							
				- relict bedding, iron oxide staining	CME							
				TD @ 13.5 ft								

DRILLING CONTRACTOR A. H. Pool
Clinton, Ok.

LOGGED BY: D. Smith
DATE: 10/27/93
CHECKED BY:

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W.
Muskogee, Oklahoma

DRILLING METHOD: Hollow Stem Auger

with 3.25"ID x 7.25"OD augers.

BORING NUMBER:

P-6

Sheet 1 of 1

SAMPLING METHOD: CME 5 foot continuous sampler

DRILLING

START

FINISH

WATER LEVEL

TIME

DATE

CAVE DEPTH

TIME

DATE

10/26/93

10/26/93

DATUM: ft. MSL

ELEVATION: 630.29

DRILL RIG: Mobil Drill B-61

SURFACE CONDITIONS: clay

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 274148.58 E = 2730241.03

DEPTH IN FEET (ELEVATION)	BLOWS/ft. ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE)
100				Brown SANDY SILT	CME							
				Tan, SILTY-CLAY;								
				Tan, SANDY-CLAY; iron oxide staining								
100				- gray @ 4 ft	CME							
				- slickensided cleavage planes @ 8 ft								
100					CME							
10												
				Severely weathered CLAY-SHALE; thin relict bedding, iron oxide stain- ing along bedding planes								
				- interbedded w/ moderately weathers clays	CME							
15												
				- color change to green gray @ 16 ft								
				- moist, lin bedded, iron oxide concretions @ 17 ft								
20					CME							
				- shells, calite crystals wet @ base of core; transmissive zone coarse grained broken iron oxide concretions								
					CME							
100												
				TO @ 23 ft								
25												
30												

DRILLING CONTRACTOR A. N. Pool
Clinton, Ok.

LOGGED BY D. Smith
DATE 10/26/93
CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Hollow Stem Auger

with 3.25"ID x 7.25"OD augers.

BORING NUMBER:

P-10

Sheet 1 of 1

SAMPLING METHOD: CME 5-foot

Continuous sampler

DRILLING

START

FINISH

WATER LEVEL

TIME

TIME

TIME

15:50

16:45

DATE

DATE

DATE

CAVE DEPTH

10/26/93

10/26/93

DATUM: ft. MSL

ELEVATION: 841.83

DRILL RIG: Mobil Drill B-81

SURFACE CONDITIONS: clay

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272134.05 E = 2730184.58

DEPTH IN FEET (ELEVATION)	BLOWS/ft. ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE)
100			▲	FILL: tan and gray silty clay	CME							
100			▲	- damp	CME							
100			▲	- dark gray	CME							
100			▲	Base of FILL @ 18.5 ft. wet	CME							
100			▲	Tan & gray SILTY CLAY, iron oxide nodules, root structures	CME							
100			▲	IRONITE beds @ 21.7 to 22.2 ft. orange to dark red iron concretions	CME							
100			▲	Severely weathered CLAY-SHALE; thin relict bedding, oxide staining, vertical fracture	CME							
100			▲	Tan to gray to brown CLAY-SHALE, slickensided cleavage planes, iron oxide nodules	CME							
100			▲	TD @ 25.5 ft								

DRILLING CONTRACTOR A. N. Pool
Clinton, Ok

LOGGED BY D. Smith
DATE 10/26/93
CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 88251

DRILLING METHOD: Hollow Stem Auger

with 3.25"ID x 7.25"OD augers.

BORING NUMBER:

P-11

SAMPLING METHOD: CME 5-foot

Continuous sampler

Sheet 1 of 1

DRILLING

START FINISH

WATER LEVEL

TIME

DATE

CAVE DEPTH

TIME

DATE

10/18/93

10/18/93

DATUM: ft. MSL

ELEVATION: 626.99

DRILL RIG: Mobil Drill B-81

SURFACE CONDITIONS: clay

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272448.24 E = 2730767.80

DEPTH IN FEET (ELEVATION)	BLOMS/B* ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE
100				Tan & gray CLAY (CH); damp, blocky, homogeneous structure, iron nodules & staining, slicken-sided cleavage planes	CME		P		48	32		
100					CME							
100				-H ₂ O @ 9.5 to 10.5 ft w/ heavily oxidized clay zones. Clays are wet, soft, & crumbly. - gray @ 11 ft - gray overconsolidated clay @ 12 ft, interbedded w/ intermittent weathered shale	CME	NONE						
90				- red CLAYSTONE w/ oxidation @ 18.1 to 18.2 ft	CME							
90				Tan severely weathered CLAYSTONE; Wet @ 17 ft, fine grained, good sorting weak calcareous to strong oxidized iron cement, thin beds flat to ripple bedded, overconsolidated CLAY @ 20 to 21.5 ft	CME							
21.6				TD @ 21.6 ft								

DRILLING CONTRACTOR A. M. Pool
Clinton, Ok.

LOGGED BY G. Hassell
DATE 10/18/93
CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Hollow Stem Auger

with 3.25"ID x 7.25"OD augers.

BORING NUMBER:

P-12

SAMPLING METHOD: CME 5-foot

Continuous sampler

Sheet 1 of 1

DRILLING

START

TIME

10:50

DATE

10/17/93

FINISH

TIME

11:30

DATE

10/17/93

DATUM: ft. MSL

ELEVATION: 827.92

DRILL RIG: Mobil Drill B-81

SURFACE CONDITIONS: clay

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272907.07 E = 2730775.85

DEPTH IN FEET (ELEVATION)	BLOWS/8" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	1-200 SEIVE
100				Tan & gray CLAY (CH); damp, homogeneous blocky structure, slicken-sided cleavage planes, carbonaceous material	CME		P		41	25		
100				Tan & gray CLAY w/ sand (CL); damp, homogeneous blocky structure, sand partings, pockets & stringers	CME							
100				Tan & gray CLAY (CH); damp, homogeneous blocky structure, slicken-sided cleavage planes - two heavily oxidized clay zones (0.1 & 0.05 ft thick) @ 7 to 8.5 ft - slightly overconsolidated clay @ 7 to 8.5 ft.	CME							
100				Tan severely weathered CLAY-SHALE; dry, fine grained, well sorted, weak calcareous cement, thin bedds, flat to ripple bedded, heavy oxidation between bedding planes; numerous vertical to high angle fractures w/ oxidation (sample is too broken w/ continuous sampler to note frequency) - gray @ 15 ft - water @ 17.5 ft	CME							
100					CME							
TD @ 22.7 ft												

DRILLING CONTRACTOR A. M. Pool
Clinton, Ok.

LOGGED BY G. Hasselt
DATE 10/17/93

CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W.
Muskogee, Oklahoma

DRILLING METHOD: Hollow Stem Auger

with 3.25"ID x 7.25"OD augers.

BORING NUMBER:

P-13

SAMPLING METHOD: CME 5 foot continuous sampler

Sheet 1 of 1

DRILLING

START

FINISH

WATER LEVEL

TIME

TIME

TIME

15:00

15:40

DATE

DATE

DATE

CAVE DEPTH

10/17/93

10/17/93

DATUM: ft. MSL

ELEVATION: 825.33

DRILL RIG: Mobil Drill B-81

SURFACE CONDITIONS: clay

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 273280.04 E = 2730783.35

DEPTH IN FEET (ELEVATION)	BLOWS/5' ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE
100				Tan & gray CLAY (CL) damp, homogeneous structure, bioturbation infilled w/ SANDY CLAY, remnant vertical fracture infilled w/ black oxidation, slickensided cleavage planes, small iron nodules, roots	CME							
80				Heavily oxidized clay zone @ 4.1 to 4.2 ft overconsolidated clay at @ 4.5 ft	CME							
100				Tan & gray severely weathered CLAY-SHALE; dry, fine grained, well sorted, weak quartzitic cement, thin beds (<0.01 ft), flat to ripple bedded, heavy oxidation along bedding planes, vertical to high angle fractures w/ heavy oxidation, up to 0.01 ft thick (sample is too disturbed to note type & frequency)	CME	NONE						
100				- abundant to vertical to 45° fractures w/ heavy oxidation @ 12 to 17 ft (sample is too disturbed to note frequency) - H ₂ O @ 12 ft	CME							
100				- H ₂ O @ 17 ft	CME							
20				Total Depth at 19.3 ft.								

DRILLING CONTRACTOR
A. M. Pool
Clinton, Ok.

LOGGED BY G. Hassett
DATE 10/17/93
CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUT Project # 86251

DRILLING METHOD: Hollow Stem Auger
with 3.25"ID x 7.25"OD augers.

BORING NUMBER:

P-14

SAMPLING METHOD: CME 5 foot continuous sampler.

Sheet 1 of 1

DRILLING

START

FINISH

WATER LEVEL

TIME

TIME

TIME

10:15

11:10

DATE

DATE

DATE

CAVE DEPTH

10/19/93

10/19/93

DATUM: ft. MSL

ELEVATION: 629.72

DRILL RIG: Mobil Drill B-61

SURFACE CONDITIONS: clay

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 273795.81 E = 2730726.78

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE
	100			Brown SILTY SAND (SM), damp	CME							
				Tan SILTY SAND (SM), damp	CME							
	100			Tan & gray SILTY CLAY (CL) damp, iron nodules, homogeneous structure, occasional sand pockets, occasional crawfish disturbance	CME							
10					CME							
	100				CME							
15	80			Tan & gray, severely weathered CLAY-SHALE; dry, fine grained, well sorted, weak quartzitic cement, thin beds (<0.01 ft), flat to ripple bedded, numerous fractures w/ heavy oxidation	CME							
				- tan & gray @ 17 ft - extensive vertical fracturing @ 17 to 22 ft (sample is too disturbed to note frequency) heavy oxidation along bedding & fracture planes	CME							
20	100			- wet @ 17 to 19 ft	CME							
				- wet @ 22 ft	CME							
	100			- moderately weathered CLAY-SHALE, gray	CME							
25				TO @ 24.7 ft								
30												

DRILLING CONTRACTOR A. M. Pool
Clinton, Ok.

LOGGED BY G. Hasselt

DATE 10/19/93 CHECKED BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Hollow Stem Auger

With 3.25"ID x 7.25"OD augers.

BORING NUMBER:

P-15

Sheet 1 of 1

SAMPLING METHOD: CME 5 foot continuous sampler

DRILLING

START

FINISH

WATER LEVEL

TIME

TIME

TIME

09:15

10:25

DATE

DATE

DATE

CAVE DEPTH

10/27/93

10/27/93

DATUM: ft. MSL

ELEVATION: 624.39

DRILL RIG: Mobil Drill B-61

SURFACE CONDITIONS: clay

ANGLE: Vertical

BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 271174.97 E = 2731376.10

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-1200 SEIVE
	100			Brown SILTY SAND	CME							
	100			Tan & gray SILTY CLAY (CL), homogeneous structure, damp, iron nodules	CME		CL		48	33		
10	100				CME							
15	70				CME	NONE						
				Tan & gray severely weathered CLAY-SHALE: damp, fine grained, well sorted, weak quartzitic cement, Thin beds, flat bedded								
				- broken transmissive zone @ 17 to 17.5 ft								
				- CLAY @ 17.5 to 20 ft								
20	100			- interbedded CLAY @ 20 to 22 ft	CME							
				- interbedded COAL w/ CLAY @ 22.3 to 22.5 ft								
				- CLAYSTONE @ 22.8 to 23.2 ft								
				- Met @ 22.8 ft in claystone								
				- interbedded clay w/ shale @ 23.2 to 24.5 ft								
25	100			- clay soils @ 24.5 to 25.5 ft	CME							
				- interbedded CLAYSTONE w/ SHALE @ 25.5 to 27 ft								
				TO @ 27.2 ft								
30												

DRILLING CONTRACTOR A. N. POW
Chilton, OK

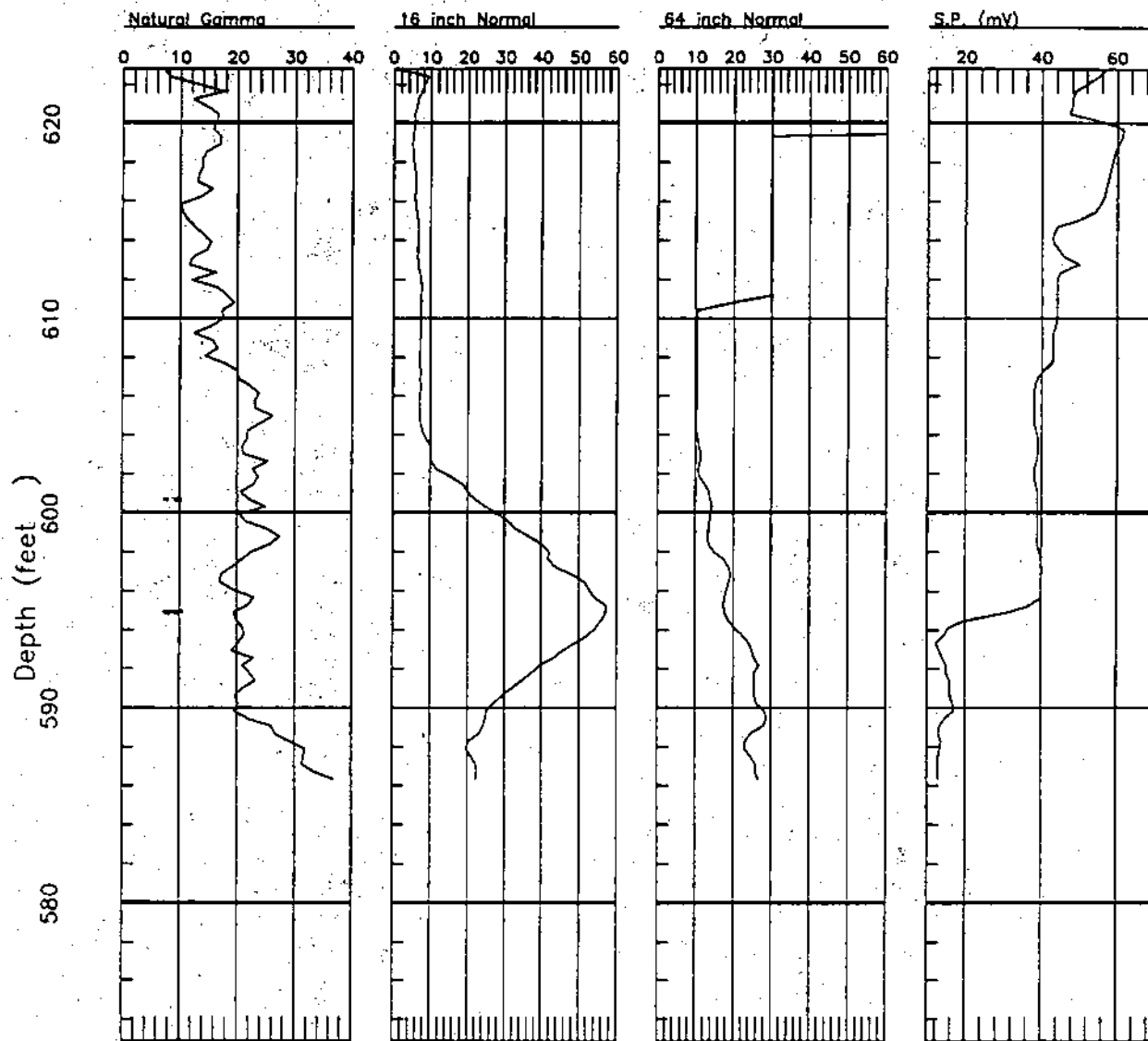
LOGGED BY G. Hassett

DATE 10/27/93 CHECKED BY

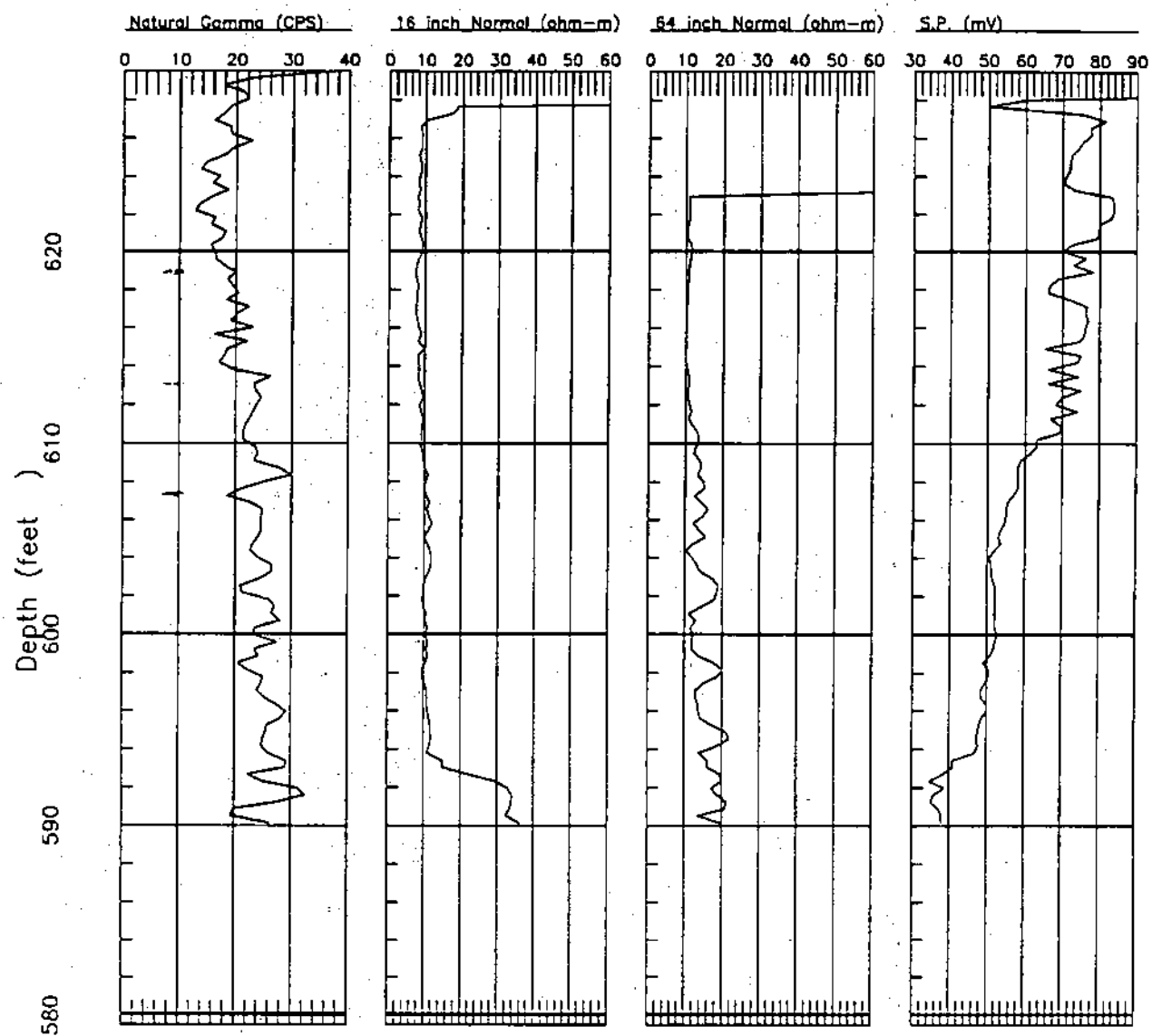
APPENDIX E
GEOPHYSICAL DATA

Muskogee\86251dp2.3rd

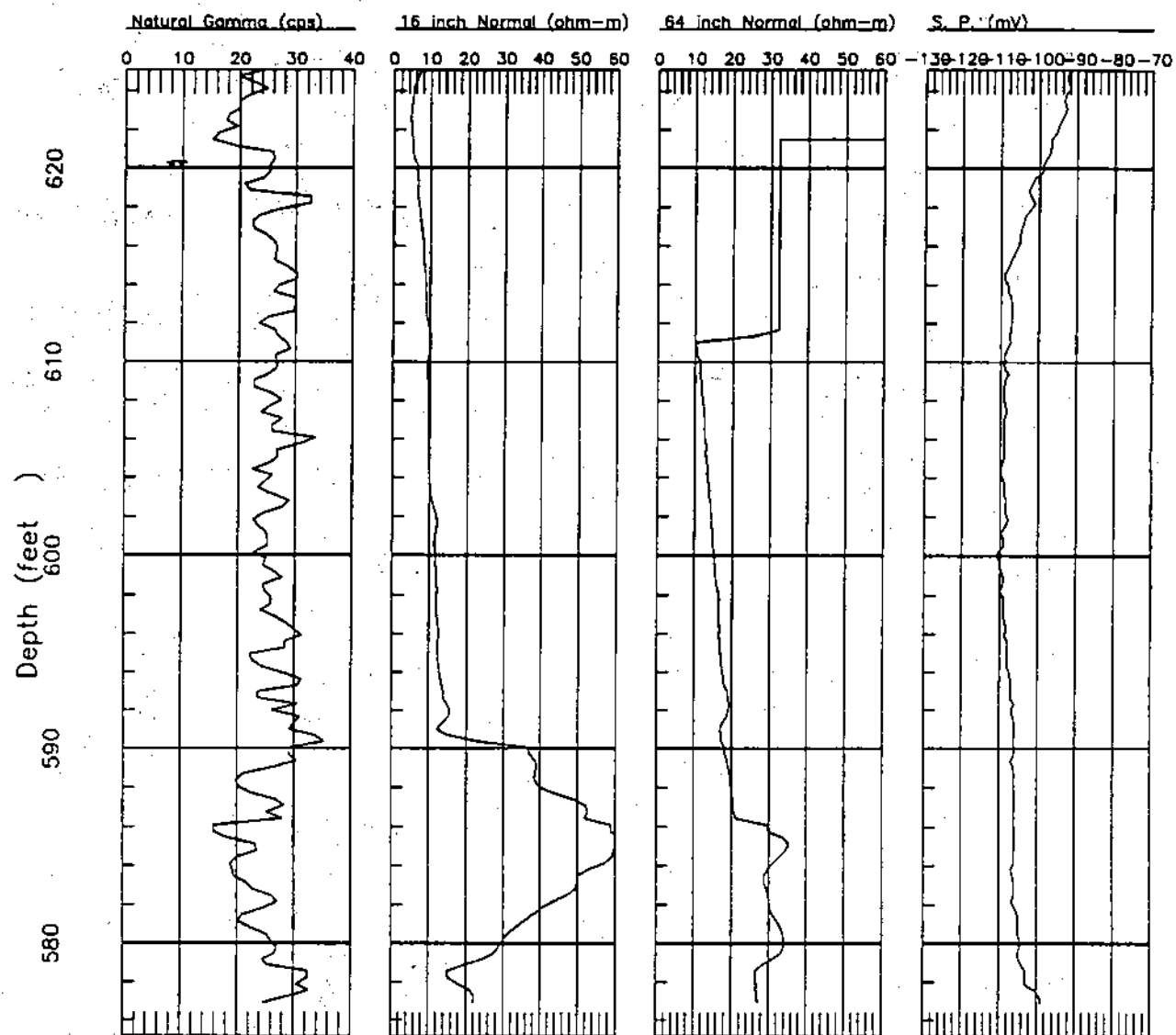
Well Name: B-1
File Name: EDITA01
Location: Muskogee Community Landfill
Elevation: 0 Reference: Sea Level



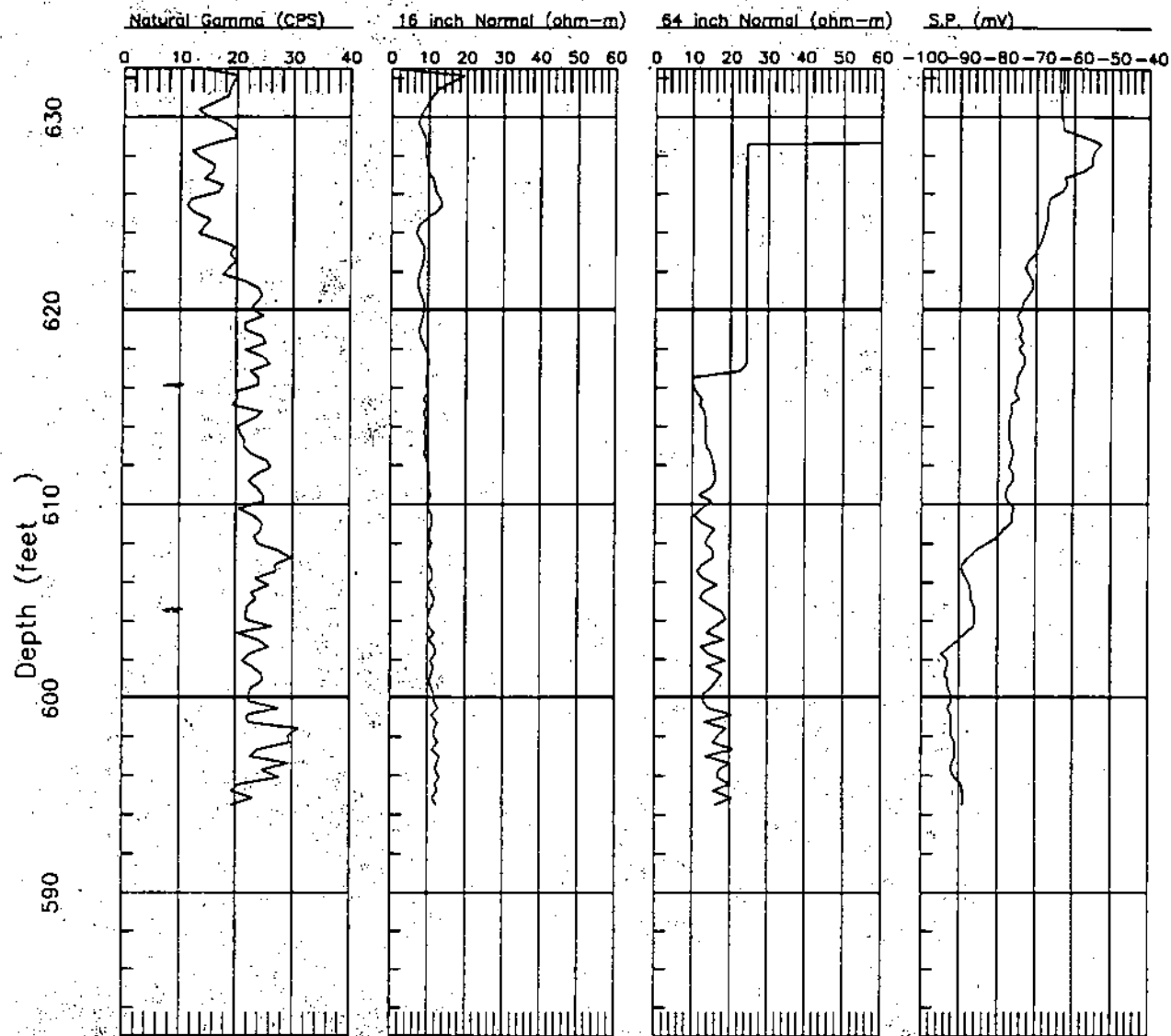
Well Name: B-8
File Name: EDITA208
Location: Muskogee Community Landfill
Elevation: 0 Reference: Sea Level



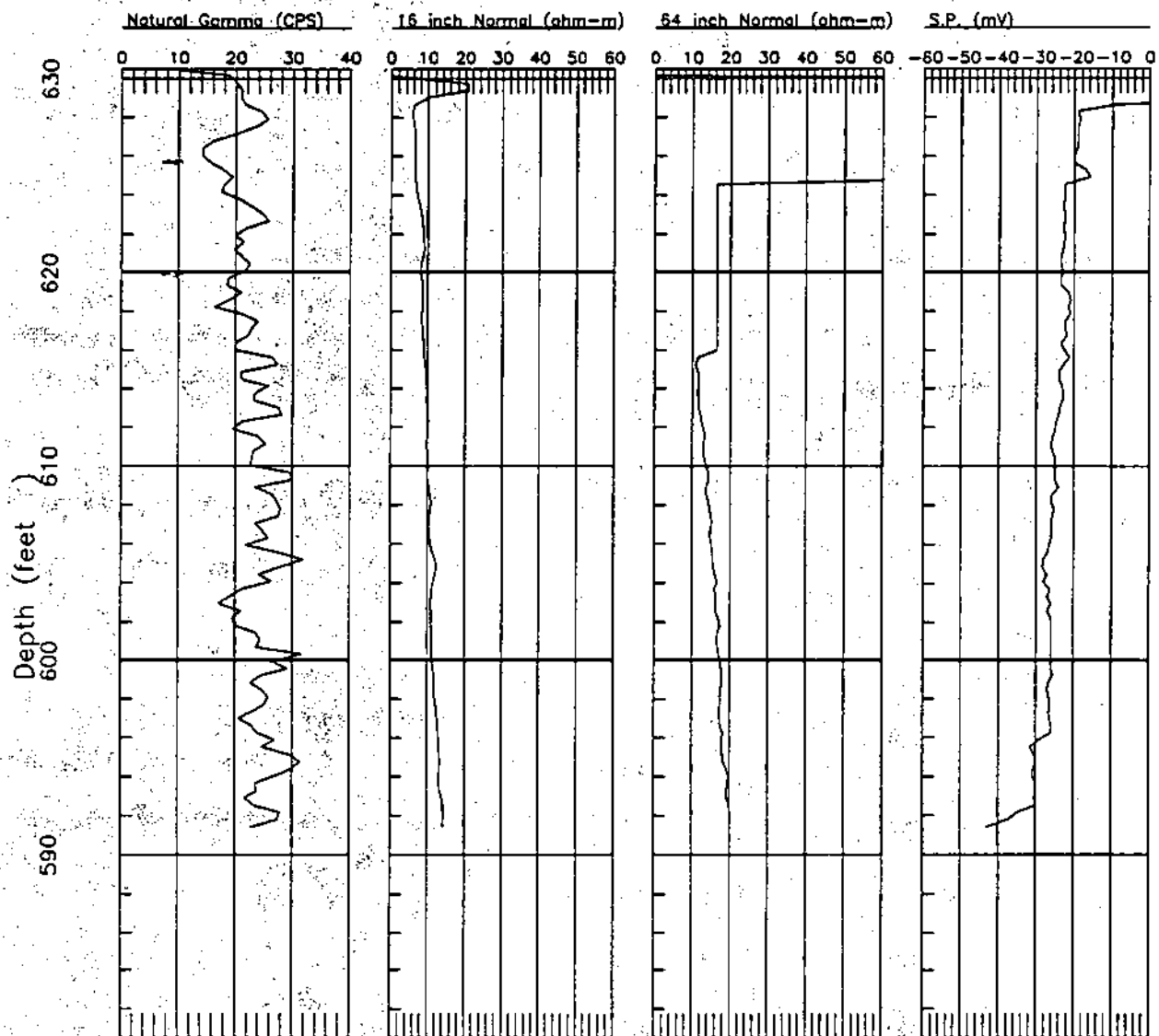
Well Name: B - 9
File Name: EDVTA009
Location: Muskogee Community Landfill
Elevation: 0 Reference: Sea Level



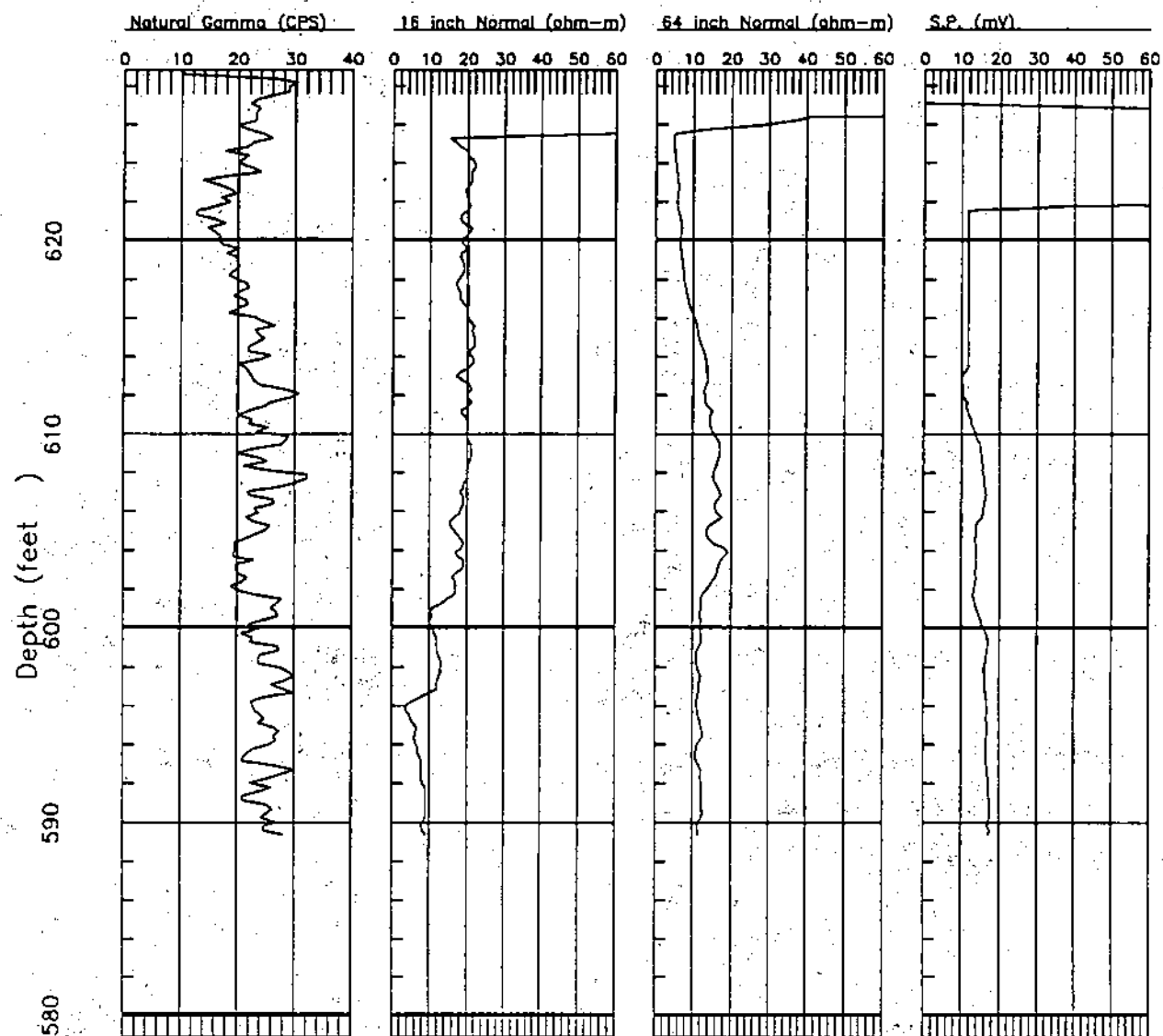
Well Name: b-15
File Name: EDITA215
Location: Muskogee Community Landfill
Elevation: 0 Reference: Sea Level



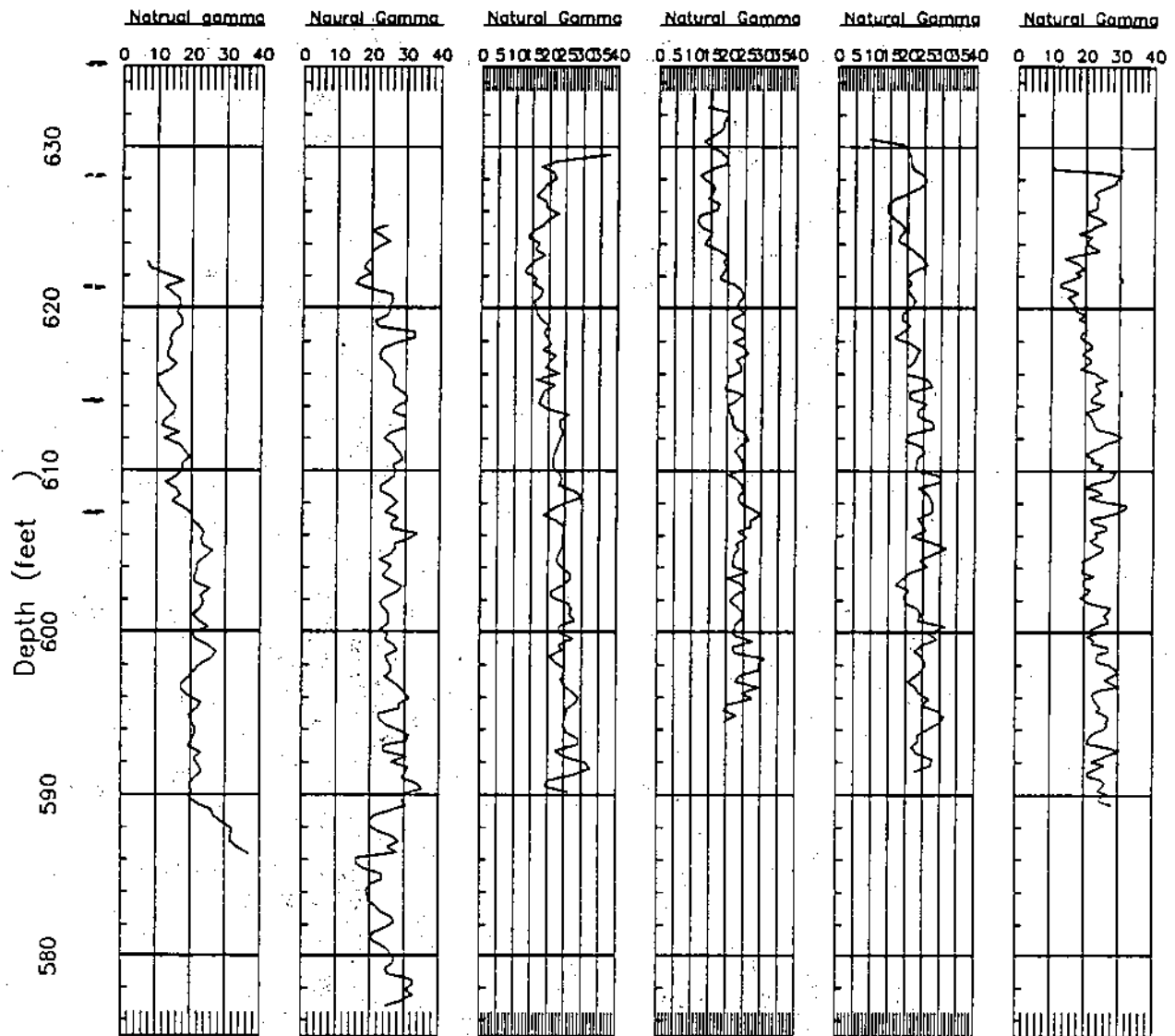
Well Name: B-16
File Name: EDITA216
Location: Muskogee Community Landfill
Elevation: 0 Reference: Sea Level



Well Name: B-18
File Name: EDITA218
Location: Muskogee Community Landfill
Elevation: 0 Reference: Sea Level



Well Name: Wells: B-1, B-9, B-8, B-15, B-16, B-18
 File Name: ALLGAMMA
 Location: Muskogee Community Landfill
 Elevation: 0 Reference: Sea Level

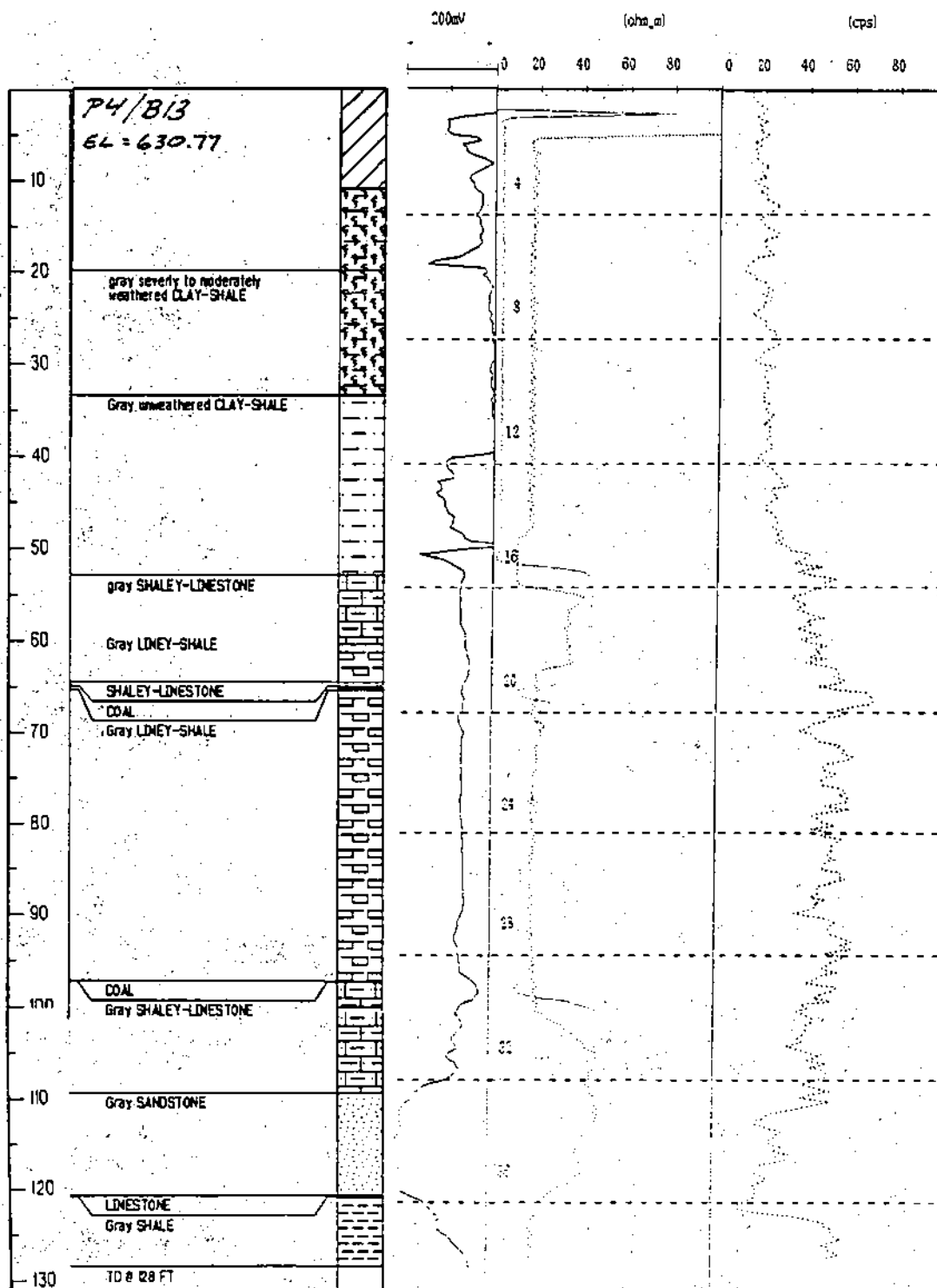


GEOPHYSICAL LOG
BORING # B13/P4
DEPTH (m) 38

DRAFT

FIELD :
 ID NO. : 413
 DATE 25-10-93
 TIME 04:11:46 PM

GAMMA :
 SHORT NORMAL :
 LONG NORMAL :
 SP :



DRAFT

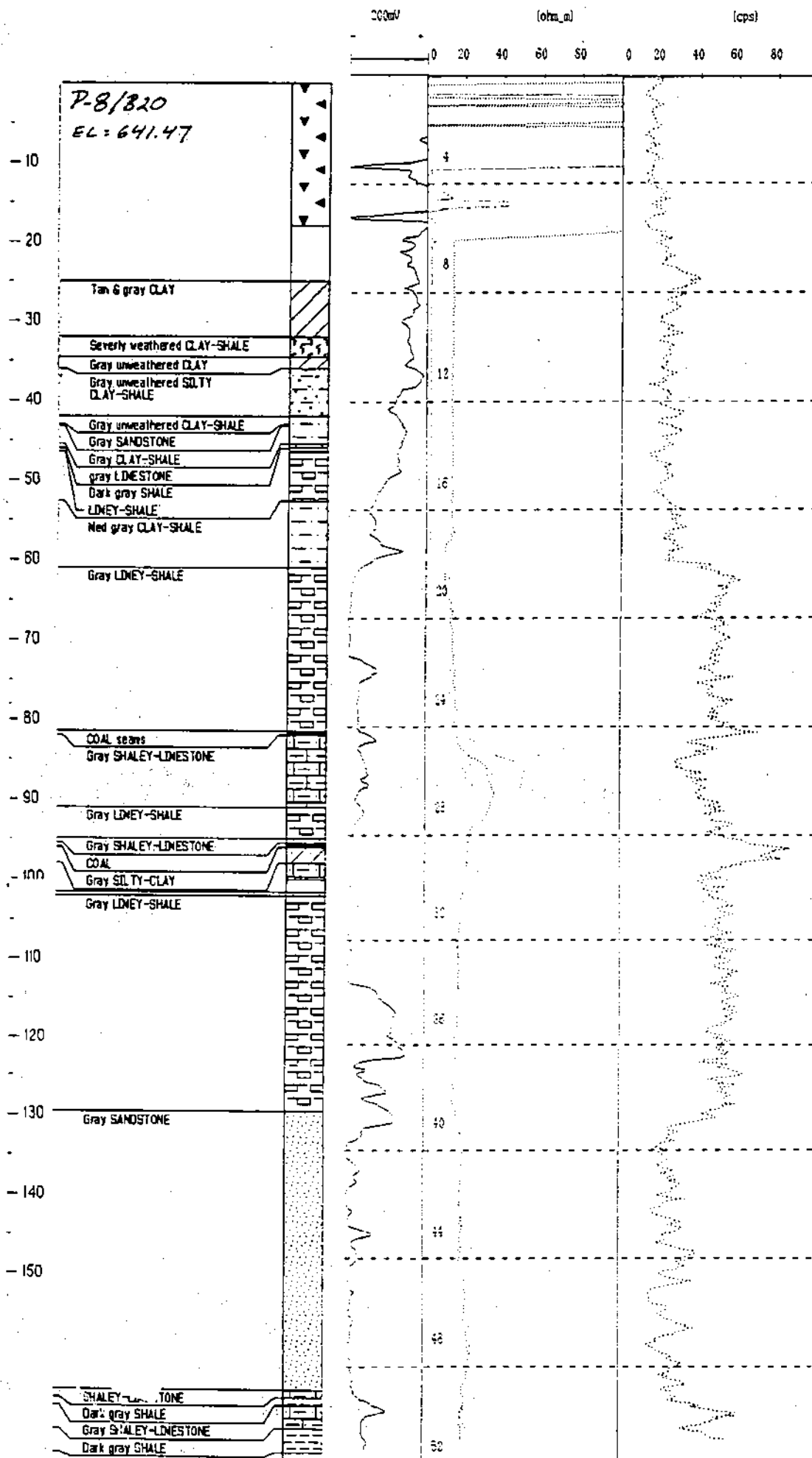
GEOPHYSICAL LOG

BORING # B20/RB

DEPTH (m) 51.3

FIELD :
 ID NO. : 620
 DATE 24-10-93
 TIME 02:19:12 PM

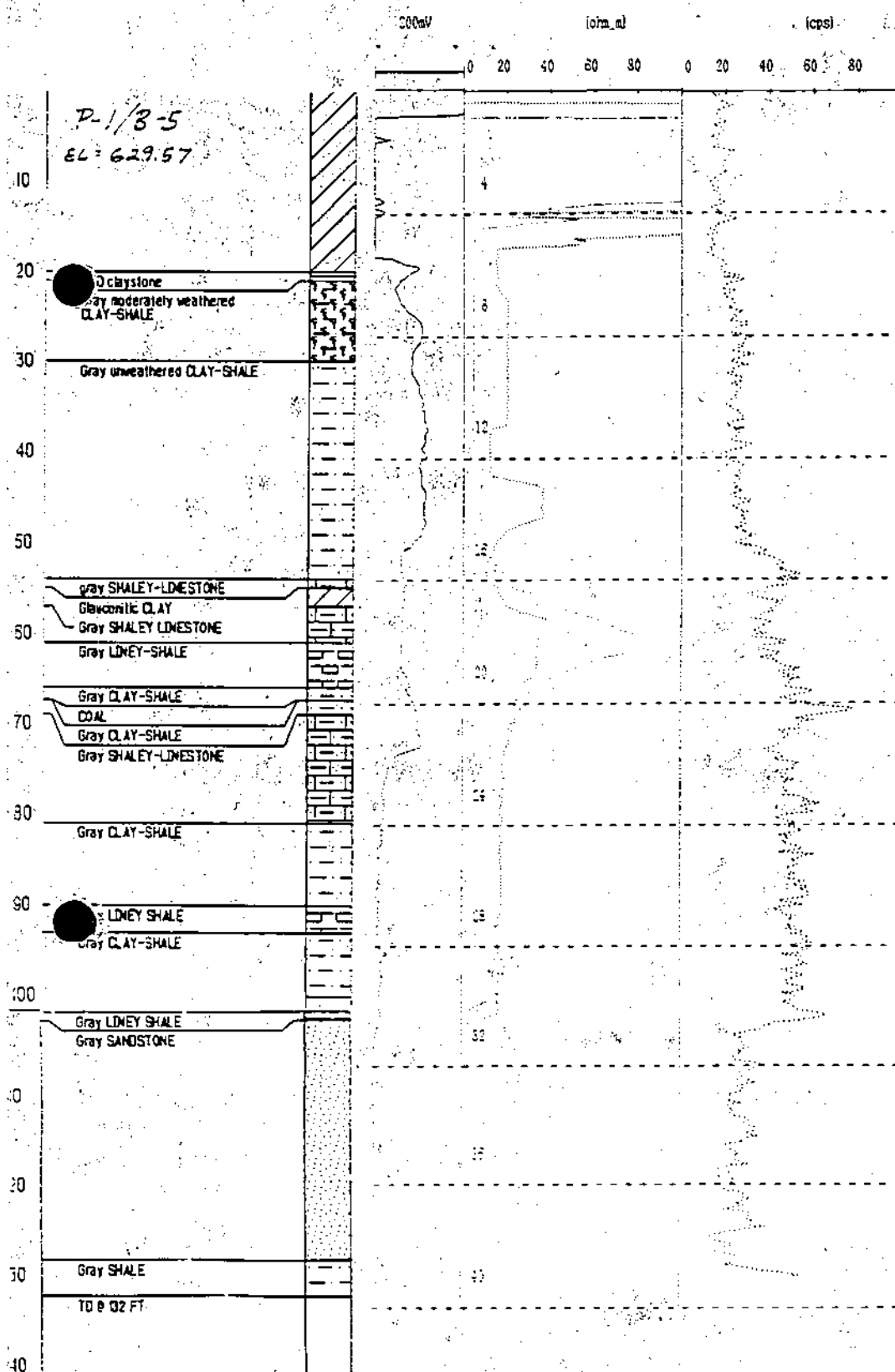
GAMMA :
 SHORT NORMAL :
 LONG NORMAL :
 SP :



DRAFT

GEOPHYSICAL LOG
BORING # B-5/P-1
DEPTH (m) 39

FIELD :
ID NO. : 605
DATE 22-10-93
TIME 03:11:05 PM
GAMMA :
SHORT NORMAL :
LONG NORMAL :
SP :





CEMENT BOND LOG

(918) 652-4925

COMPANY : MUSKOGEE LANDFILL
WELL : WRIGLEY #3
FIELD :
COUNTY : MUSKOGEE
STATE : OK
NATION : USA
LOCATION : NE-1/4
SECTION : 6

OTHER SERVICES

TOWNSHIP : 14N

RANGE : 18E

PERMANENT DATUM : GL
ELEV. PERM. DATUM :
LOG MEASURED FROM : GL
DRLG. MEASURED FROM : GL

ELEVATIONS
KB :
DF :
GL :

DATE : 10/1/93
DEPTH-DRILLER :
DEPTH-LOGGER : 350
LOG BOTTOM : 350
LOG TOP : 0
TOOL TYPE :

BOREHOLE FLUID : H2O
FLUID WT/VIS :
SAMPLE SOURCE :
RM :
RMF :
RMC :
RM @ BHT :
CIRC STOPPED :

CASING-DRILLER :
CASING-LOGGER :
CASING TYPE :
CASING WEIGHT :

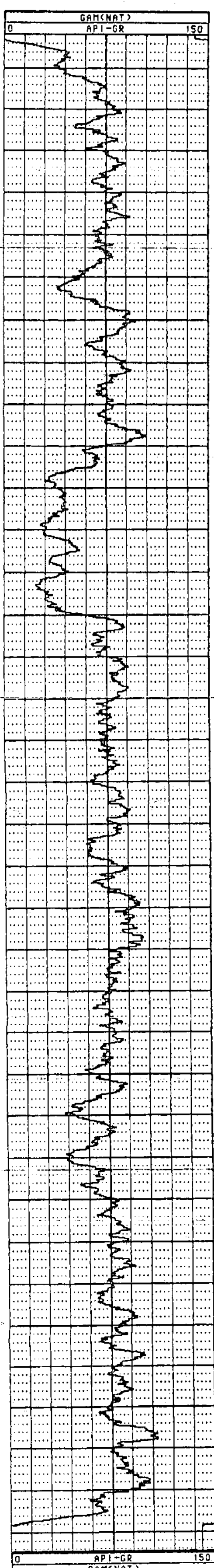
LOGGING UNIT : 7670
FIELD OFFICE : MEN
RECORDED BY : D. ANDREWS
WITNESSED BY : MR. MC QUEEN

BIT SIZE :
DEPTH :

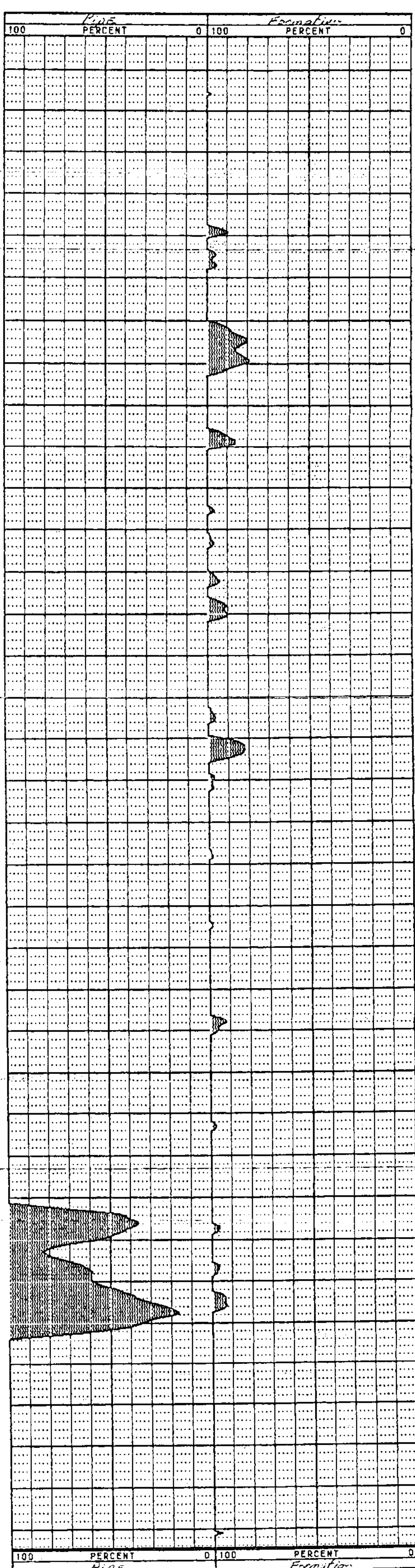
REMARKS : PHONE (918) 652-4925

ALL SERVICES PROVIDED SUBJECT TO CGC STANDARD TERMS AND CONDITIONS

60000 CCL 120000
CPS



60000 CPS 120000
CCL



Appendix F

APPENDIX F

PIEZOMETER INSTALLATION

To address the site-specific hydrogeology, a total of fifteen piezometers were installed. The purpose of the piezometers was to adequately monitor pressure head within individual zones, and determine the potentiometric surface of each zone. The piezometers aided in determining the following information:

- In-situ permeability of geologic units;
- Direction of ground water flow in the uppermost saturated zone, and within the deep saturated zones, if any;
- Rates of ground water flow;
- Maximum high elevation of piezometer surfaces;
- Ground water recharge and discharge areas.

A total of fifteen piezometers were installed which exceeds the ODEQ requirements of at least six piezometers for an 80-acre tract (ODEQ 252-510-11).

A piezometer was installed in each piezometric boring and screened within the specified zones. Three piezometers were set in Zone A, six in Zone B, three in Zone C, and three in Zone D. The actual completion depth of each piezometer was determined in the field after review of the logs and the geophysical logging. The screened interval within each piezometer was based on drilling observations of the permeable zones.

Each piezometer group was clustered together in the same general location. Piezometers P-1, P-2, and P-3 were grouped with monitoring well MW01R in one general location along the eastern buffer zone. Piezometers P-4, P-5, P-6, and P-7 were located in the northwestern corner of the property. Piezometers P-8, P-9, and P-10 were located along the western boundary next to monitoring well MW03R.

The piezometers were constructed of two-inch diameter, flush-threaded, Schedule 40 PVC, with a 0.010-inch slot screen, and a 20/40 washed Colorado silica sand filter pack. The filter pack was installed to approximately two feet above the screen. Bentonite pellets were installed above the filter pack for at least a three-foot seal. When needed, the bentonite pellets were hydrated

using potable water. A four-inch by four-inch square aluminum or six-inch diameter steel protective casing was set in a four-foot by four-foot concrete pad around the piezometers in the piezometer clusters and P-15. Protective casing and concrete pads were not installed in the piezometers in the center of the landfill(P-11 through P-14).

Piezometers yielding ground water were developed to help restore the natural hydraulic properties of the transmissive unit. The water levels were determined and recorded immediately prior to development. Piezometer P-5 was not developed due to an oversight, but the effect appears to be minimal judging by the hydraulic conductivity of the wells screened in Zone C. Development proceeded using a Waterra® inertial hand pump or QED® development pump until specific conductance, pH, and temperature were stabilized for three consecutive readings.

IN-SITU PERMEABILITY TESTING

Hydraulic conductivity tests were performed for all piezometers. Hydraulic conductivity was evaluated using rising-head slug tests. The tests commenced after development, once the hydraulic properties of the transmissive zone were restored. After development, static water levels were allowed to equilibrate. The following sequence of events occurred during each slug test:

1. Determine the static water level.
2. Lower the pump into place and remove a known volume (slug) of water from the piezometer. The analysis assumes an instantaneous change in volume when the slug was removed or added. The elapsed time equal to zero was recorded immediately upon cessation of pumping or the addition of water. An electric water-level meter or transducer measured the rise of water within the piezometer.
3. Water levels in the piezometer was recorded every 30-seconds for five minutes, then every minute until 15 minutes elapsed. Measurements continued with water levels taken every five minutes until 30 minutes elapsed; whereafter, water levels were taken every 10 minutes until one hour elapsed.

4. Successive time-depth measurements proceeded on an hourly or next day basis until the static water level met 90 percent recovery.

Transmissivity and hydraulic conductivity was evaluated using the appropriate approach for the defined ground water system.

SURVEYING

Prior to the initiation of the exploration program, the proposed locations of all boreholes and piezometers were staked in the field by a professional surveyor licensed in the State of Oklahoma. The actual locations were dependent on accessibility and were adjusted in the field with the permission of the ODEQ and Waste Management.

Upon the installation of all the piezometers, the location of the piezometers and the top of PVC casing protective casing, concrete pad, and/or natural ground was surveyed. The elevations were surveyed to the nearest 0.01 foot using a USGS benchmark or National Geodetic Vertical Datum; the location was given in terms of latitude and longitude of the piezometer at least to the nearest tenth of a second, based on the State of Oklahoma coordinate system. Survey data is given in the back of this appendix.

Well No. MW-01RBoring No. X-Ref: B-1**MONITOR WELL CONSTRUCTION SUMMARY**Survey Coords: N272500.8
E2731415.1Elevation Ground Level 630.2 ft
Top of Casing 633.01 ft**Drilling Summary:**

Total Depth 2925 feet from toc
 Borehole Diameter 7 inches
 Casing Stick-up Height: 2.81 ft
 Driller Terracon Environmental, Inc.
 Driller - Allen Brantley
 Helper - Matt Johnson
 Rig QME 75
 Bit(s) 3 1/2-inch I.D. x 7-inch O.D.
hollow-stem augers
 Drilling Fluid None
 Protective Casing 6-inch anodized aluminum

Well Design & Specifications

Basis: Geologic Log ☒ Geophysical Log ☐
 Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
+2.81 - 16.44	C1	633 - 614
16.44 - 26.44	S1	614 - 604
-	-	-
-	-	-
-	-	-

Casing: C1 2-inch schedule 40 PVC,
flush-jointed with O-rings

Screen: S1 2-inch schedule 40 PVC,
flush-jointed with O-rings,
0.010-inch slots

Filter Pack: 10-20 washed Colorado
silica sand, 14.5 to 26.5 ft

Grout Seal: Envirogrout bentonite
grout, 2 to 11.5 ft

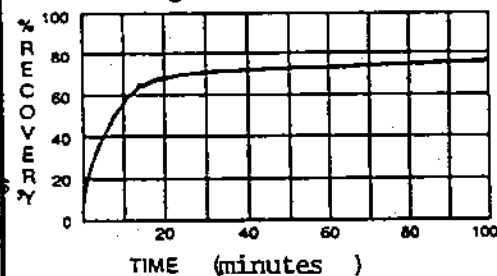
Bentonite Seal: 3/4-inch bentonite pellets
11.5 to 14.5 ft

Construction Time Log:

Task	Start		Finish	
	Date	Time	Date	Time
Drilling 0 to 25 ft	11/18	14:30	11/18	15:30
Geophys. Logging:	NA		NA	
Casing:				
C1	11/18	15:30	11/18	15:32
S1	11/18	15:32	11/18	15:35
Filter Placement:	11/18	15:40	11/18	15:47
Cementing:	11/18	16:15	11/18	16:30
Development:	11/19	16:15	11/19	17:10

Well Development: B-K Hand PumpInitial H₂O level = 15.10 feetTOC/Well volume = 1.7 gallonsAmount developed = 10 gallons or
5.8 well volumes**Stabilization Test Data:**

Time	pH	Spec. Cond.	Temp (C)
16:30	6.90	31.8	61.6°F
16:40	7.03	34.9	61.2°F
16:50	7.05	32.5	61.1°F
17:10	7.10	32.3	60.3°F

Recovery Data:Q = 10 gallons S₀ = 15.10 ftComments: Borehole open to 27.5 ft. 26.5 to 27.5 feet, auger cuttings.

Centralizers (stainless steel) at 5.5 ft and 24.5 ft from ground
surface.

Note: Added fill soil from elevation 627.7 to 630.2 ft prior to completion
of MW01R concrete pad. Adjusted depth and dimensions from the MW01R field
report accordingly.

SITE NAME Muskogee LandfillLOCATION Muskogee, OklahomaDATE 11/18/2008SUPERVISED BY Greg Hassett

Well No. MW02RBoring No. X-Ref: B-2**MONITOR WELL CONSTRUCTION SUMMARY**Survey Coords: N271744.8
E2731158.9Elevation Ground Level 632.2 ft
Top of Casing 635.24 ft**Drilling Summary:**

Total Depth 30 feet from toc
 Borehole Diameter 7 inches
 Casing Stick-up Height: 3 feet
 Driller Terracon Environmental Inc.
 Driller - Allen Brantley
 Helper - Matt Johnson
 Rig CME 75
 Bit(s) 3 1/2-inch I.D. x 7 inch O.D.
hollow-stem augers
 Drilling Fluid: None
 Protective Casing 6-inch anodized aluminum

Well Design & Specifications

Basis: Geologic Log ☒ Geophysical Log ☐
 Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
+3.0 - 17.0	C1	635 - 615
17.0 - 27.0	S1	615 - 605
-	-	-
-	-	-
-	-	-

Casing: C1 2-inch schedule 40 PVC,
flush-jointed with O-rings
 C2 _____
 Screen: S1 2-inch schedule 40 PVC
flush-jointed with O-rings,
xx 0.010-inch slots

Filter Pack: 10-20 washed Colorado
silica sand, 15 to 28 feet

Grout Seal: Envirogrout, bentonite
2 to 12 feet grout

Bentonite Seal: 1/2-inch bentonite
pellets, 12 to 15 feet

Comments: Borehole collapse and settlement of fines 28 to 30 feet,
Centralizers (stainless steel) at 3 feet and 25 feet
from ground surface.

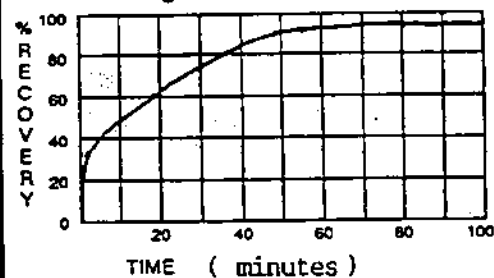
Construction Time Log:

Task	Start		Finish	
	Date	Time	Date	Time
Drilling 0 - 30 ft	11/18	09:00	11/18	10:00
Geophys. Logging:	NA		NA	
Casing:				
C1	11/18	13:30	11/18	13:31
S1	11/18	13:31	11/18	13:34
Filter Placement:	11/18	13:40	11/18	14:00
Cementing:	11/18	16:00	11/18	16:15
Development:	11/18	14:30	11/19	16:10

Well Development: B-K Hand Pump Initial
 H₂O level (estimated) = 9.50 ft,
 TOC/well volume = 3.5 gallons
 Amount developed = 31 gallons
 or 8.8 well volumes

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)
15:25	6.88	32.4	63.5°F
15:30	6.79	32.9	63.4°F
15:35	6.63	33.3	63.0°F
16:00	6.79	33.4	61.5°F
16:05	6.86	33.3	61.9°F

Recovery Data:Q = 31 gallons S₀ = 9.50SITE NAME Muskogee LandfillSUPERVISED BY Greg Hassett

Well No. MW-03RBoring No. X-Ref: B-3**MONITOR WELL CONSTRUCTION SUMMARY**Survey Coords: N272179.4
E2730189.7Elevation Ground Level 641.5 ft
Top of Casing 644.16 ft**Drilling Summary:**

Total Depth 39 feet
 Borehole Diameter 7 inches
 Casing Stick-up Height: 2.66 feet
 Driller Terracon Environmental, Inc.
 Driller - Allan Brantley
 Helper - Matt Johnson
 Rig CME 75
 Bit(s) 3 1/2-inch I.D. x 7-inch O.D.
hollow-stem augers
 Drilling Fluid None

Protective Casing 6-inch anodized aluminum**Well Design & Specifications**

Basis: Geologic Log XX Geophysical Log
 Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
+2.66 - 28.1	C1	644 - 613
28.1 - 38.1	S1	613 - 603
-	-	-
-	-	-
-	-	-
-	-	-

Casing: C1 2-inch schedule 40 PVC,
flush-jointed with O-rings
dz

Screen: S1 2-inch schedule 40 PVC
flush-jointed with O-rings
dz 0.010-inch slots

Filter Pack: 10-20 washed Colorado
silica sand, 26.1 to 39 ft

Grout Seal: Envirogrout bentonite
grout, 2 to 23 ft

Bentonite Seal: 1/2-inch bentonite pellets
23.1 to 26.1 ft

Construction Time Log:

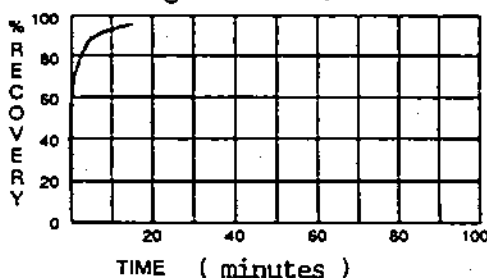
Task	Start		Finish	
	Date	Time	Date	Time
Drilling				
0 to 39.5	11/19	09:00	11/19	10:35
Geophys. Logging:	NA		NA	
Casing:				
C1	11/19	11:00	11/19	11:02
S1	11/19	11:05	11/19	11:08
Filter Placement:	11/19	11:15	11/19	11:45
Cementing:	11/19	11:45	11/19	12:00
Development:	11/20	08:15	11/20	09:12

Well Development: B-K Hand Pump

Initial H₂O level = 13.7
 TOC/Well volume = 4.5 gallons
 Amount developed = 45 gallons or
10 well volumes

Stabilization Test Data: Inoperable Meter

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:Q = 45 gallons S₀ = 13.7 feet

Comments: Centralizers (stainless steel) at 3 feet and 36 feet from
ground surface. Auger cuttings 39 to 39.5 feet

SITE NAME Muskogee LandfillLOCATION Muskogee, OklahomaWIC 00000SUPERVISED BY Greg HassettDATE 11/19/97

WELL No. P-1Boring No X-Ref. B-5**PIEZOMETER CONSTRUCTION SUMMARY**Survey Coords E=2731409.770, N=272581.360 Elevation Ground Level (MSL) 629.50Top of Casing 632.76**Drilling Summary**

Total Depth (ft): 133.0
 Borehole Diameter: 5.0"
 Casing Stickup Height: 3.28 ft.
 Driller: A. W. Pool, Inc.
 Andy Zavasky, Driller
 Rig: Badger 1250
 Bit (s): 3-inch ID x 5-inch OD Core Barrel
 Drilling Fluid: air
 Protective Casing: Steel

Construction Time Log

Task	Start		Finish	
	Date	Time	Date	Time
Drilling HSA:				
0 - 20				
20 - 50	10/18	1645		
50 - 133	10/22		10/22	1430
Geophys. Logging:	10/22	1430	10/22	1530
Casing:				
C ₁ :				
C ₂ :	10/22	1545	10/22	1605
S ₁ 2" PVC:	10/22	1535	10/22	1545
Filter Placement:	10/22	1610	10/22	1730
Bentonite Seal:	10/22	1730	10/22	1745
Development:	11/08	0930	11/08	1615

Well Design & Specifications

Basis: Geologic Log ☒ Geophysical Log ☐
 Casing String (s): C = Casing S = Screen

Depth (ft)	String (s)	Elevation (MSL)
+0.0 - 49.0	C ₁	629.5 - 580.5
+3.26 - 99.7	C ₂	632.76 - 529.80
99.7 - 129.7	S ₁	529.80 - 499.80

Well Development

Developed with GED development pump.
 Initial water level = 24.0 ft.
 Well volume = 17.77 gallons
 Volume pumped = 90 gallons

Stabilization Test Data

Time	pH	Spec. Cond.	Temp (C)
1430	9.60	5170	15.6
1455	9.52	5520	15.1
1515	9.39	6190	15.6
1540	9.27	6780	15.5

Recovery Data

Q = S₀ =

Comments

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling. NOTE: For recovery data, see permeability data.

T.D. = 133.0 ft.

SITE NAME Muskogee Community Landfill
 LOCATION Muskogee, Oklahoma

SUPERVISED BY G. Hasselt
 DATE 10/22/93
 CHECKED BY D. Smith

WELL No. P-2Boring No X-Ref. B-6**PIEZOMETER CONSTRUCTION SUMMARY**Survey Coords E=2731414.180, N=272535.731Elevation Ground Level (MSL) 629.71Top of Casing 632.99**Drilling Summary**

Total Depth (ft): 70.0
 Borehole Diameter: 5.0"
 Casing Stickup Height: 3.28 ft.
 Driller: A. W. Pool, Inc.
 Andy Zavasky, Driller
 Rig: Badger 1250
 Bit (s): 3-inch ID x 5-inch OD Core Barrel
 Drilling Fluid: air
 Protective Casing: Anodized Aluminium

Construction Time Log

Task	Start		Finish	
	Date	Time	Date	Time
Drilling: 0 - 70	10/29	1400	10/30	1145
Geophys. Logging: Casing: C ₁ , S ₁	10/30	1205	10/30	1210
Filter Placement:	10/30	1210	10/30	1225
Bentonite Seal:	10/30	1300	10/30	1325
Development:	11/02	1550	11/03	1130

Well Design & Specifications

Basis: Geologic Log ☒ Geophysical Log ☐
 Casing String (s): C = Casing S = Screen

Depth (ft)	String (s)	Elevation (MSL)
+3.28 - 59.22	C ₁	632.99 - 570.49
59.22 - 69.22	S ₁	570.49 - 560.49
-	-	-
-	-	-
-	-	-

Casing: C1 2" ID Sch. 40 PVC, Flush joint

Casing: C2

Screen: S1 2" ID Sch. 40 PVC,
 0.10" slots, flush joints

Screen: S2

Grout Seal: Econoplug Bentonite grout
 2 to 52.0 ft.

Bentonite Seal: Bentonite Pellets
 52.0 to 58.0 ft.

Filter Pack: 20 - 40 Colorado Silica Sand
 58 to 70 ft.

Well Development

Developed with QED development pump.
 Initial water level = 20.08 ft.
 well volume = 8.54 gallons
 Volume pumped = 33 gallons

Stabilization Test Data

Time	pH	Spec. Cond.	Temp (C)
1050	8.31	7070	15.1
1100	8.30	7130	15.3
1110	8.30	7060	15.8
1120	8.31	7040	16.1
1130	8.33	7200	16.1

Recovery DataQ = S₀ =**Comments**

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling. NOTE: For recovery data, see permeability data.

T.D. = 70.0 ft.

SITE NAME Muskogee Community Landfill
 LOCATION Muskogee, Oklahoma

SUPERVISED BY G. Smith
 DATE 10/30/03
 CHECKED BY G. Hasselt

WELL No. P-3Boring No X-Ref. P-3**MONITOR WELL CONSTRUCTION SUMMARY**Survey Coords E=2731412.400, N=272588.879 Elevation Ground Level 829.22Top of Casing 832.27**Drilling Summary**Total Depth: (ft) 13.5Borehole Diameter: 7.25"Casing Stickup Height: 3.05 ft.Driller: A. W. Pool, Inc.

Andy Zavasky, Driller

Rig: Mobile Drill B-81Bit (s): 3.25-inch ID x 7.25-inch OD Hollowstem AugerDrilling Fluid: NoneProtective Casing: Anodized Aluminium**Construction Time Log**

Task	Start		Finish	
	Date	Time	Date	Time
Drilling : 0 - 13.5	10/27	0755	10/27	0825
Geophys.Logging:				
Casing:				
C ₁	10/27	0826	10/27	0827
S ₁	10/27	0828	10/27	0830
Filter Placement:	10/27	0830	10/27	0845
Bentonite Seal:	10/27	0845	10/27	0900
Development:				

Well Design & SpecificationsBasis: Geologic Log ☒ Geophysical Log ☐

Casing String (s): C = Casing S = Screen

Depth	String (s)	Elevation
+3.05 - 8.15	C ₁	632.27 - 621.07
8.15 - 13.15	S ₁	621.07 - 616.07
-	-	-
-	-	-
-	-	-

Casing: C1 2" ID Sch. 40 PVC, Flush joint

Casing: C2

Screen: S1 2" ID Sch.40 PVC,
0.10" slots, flush joints

Screen: S2

Filter Pack: 20 - 40, Colorado Silica Sand
7 to 13.5 ft.Grout Seal: Bentonite Hole Plug
2 to 4.0 ft.Bentonite Seal: Bentonite Pellets
4 to 7.0 ft.**Well Development**

Well was installed dry and not developed due to slow formation permeability and recharge.

Stabilization Test Data

Time	pH	Spec. Cond.	Temp (C)

Recovery DataQ - S₀ -**Comments**

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling.

T.O. = 13.5 ft.

SITE NAME Muskogee Community Landfill
LOCATION Muskogee, Oklahoma

WL 00129

SUPERVISED BY D. Smith
DATE 10/27/93
CHECKED BY G. Hasselt

WELL No. P-4Boring No X-Ref. B-13**PIEZOMETER CONSTRUCTION SUMMARY**Survey Coords E=2730251.180, N=274147.832 Elevation Ground Level (MSL) 830.77Top of Casing 833.71**Drilling Summary**

Total Depth (ft): 128.0
 Borehole Diameter: 5.0"
 Casing Stickup Height: 2.94 ft.
 Driller: A. W. Pool, Inc.
 Andy Zavasky, Driller

Rig: Badger 1250
 Bit (s): 3-inch ID x 5-inch OD Core Barrel

Drilling Fluid: air

Protective Casing: Steel

Well Design & SpecificationsBasis: Geologic Log ☒ Geophysical Log ☐

Casing String (s): C = Casing S = Screen

Depth (ft)	String (s)	Elevation (MSL)
+0.0 - 49.0	C ₁	630.77 - 581.77
+2.94 - 109.56	C ₂	633.71 - 521.21
109.56 - 119.56	S ₁	521.77 - 511.21
-	-	-
-	-	-

Casing: C1 6" ID x 6 5/8" OD

Steel casing

Casing: C2 2" ID Sch.40 PVC, Flush Joint

Screen: S1 2" ID Sch.40 PVC,

0.10" slots

Screen: S2

Grout Seal: Econoplug Bentonite grout

2 to 100.0 ft.

Bentonite Seal: Bentonite Pellets

100 to 108.0 ft.

Filter Pack: 20 - 40 Colorado Silica Sand

108 to 128 ft.

Comments

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling. NOTE: For recovery data, see permeability data.

Construction Time Log

Task	Start		Finish	
	Date	Time	Date	Time
Drilling:				
0 - 50	10/22	1500	10/22	1630
50 - 128	10/25	0930	10/25	1600
Geophys. Logging:	10/25	1600	10/25	1700
Casing:				
C ₁ :	10/23		10/23	
C ₂ :	10/26	0815	10/26	0823
S ₁ 2" PVC:	10/26	0815	10/26	0816
Filter Placement:	10/26	0830	10/26	0900
Bentonite Seal:	10/26	0900	10/26	0905
Development:	11/06	1200	11/07	1445

Well Development

Developed with GEO development pump.
 Initial water level = 22.5 ft.
 Well volume = 16.29 gallons
 Volume pumped = 28 gallons

Stabilization Test Data

Time	pH	Spec. Cond.	Temp (C)
1405	7.46	7900	15.0
1415	7.64	7510	16.1
1425	7.67	7840	16.2
1435	7.71	7830	16.4
1445	7.70	7750	15.7

Recovery DataQ = S₀ =

SITE NAME Muskogee Community Landfill
 LOCATION Muskogee, Oklahoma

SUPERVISED BY G. Hassett
 DATE 10/26/93
 CHECKED BY D. Smith

T.D. = 128.0 ft.

WELL No. P-5Boring No X-Ref. B-14**PIEZOMETER CONSTRUCTION SUMMARY**Survey Coords E=2730238.370, N=274121.253 Elevation Ground Level (MSL) 630.47Top of Casing 633.32**Drilling Summary**

Total Depth (ft): 67.5

Borehole Diameter: 5.0"

Casing Stickup Height: 2.85 ft.

Driller: A. W. Pool, Inc.

Andy Zavasky, Driller

Rig: Badger 1250

Bit (s): 3-inch ID x 5-inch OD Core Barrel

Drilling Fluid: air

Protective Casing: Anodized Aluminium

Construction Time Log

Task	Start		Finish	
	Date	Time	Date	Time
Drilling : Q - 67	10/27	1800	10/28	0930
Geophys. Logging:				
Casing:				
C ₁ , S ₁	10/28	0945	10/28	0955
Filter Placement:	10/28	0955	10/28	1034
Bentonite Seal:	10/28	1035	10/28	1110
Development:	11/11	1730	11/11	1800

Well Design & SpecificationsBasis: Geologic Log ☒ Geophysical Log ☐

Casing String (s): C = Casing S = Screen

Depth (ft)	String (s)	Elevation (MSL)
+2.85 - 52.47	C ₁	633.32 - 578.00
52.47 - 67.47	S ₁	578.00 - 563.00
-	-	-
-	-	-
-	-	-

Casing: C1 2" ID Sch. 40 PVC, Flush joint

Casing: C2

Screen: S1 2" ID Sch. 40 PVC,
0.10" slots

Screen: S2

Grout Seal: Econoplug Bentonite grout
2 to 41.0 ft.Bentonite Seal: Bentonite Pellets
41.0 to 49.0 ft.Filter Pack: 20 - 40 Colorado Silica Sand
49 to 67.50 ft.**Well Development**Developed with Waterra hand pump.
Initial water level = 15.37 ft.
Well volume = 8.90 gallons
Volume pumped = 5 gallons**Stabilization Test Data**

no data

Time	pH	Spec. Cond.	Temp (C)

Recovery Data

Q =

S_D =**Comments**

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling. NOTE: For recovery data, see permeability data.

T.D. = 67.5 ft.

SITE NAME Muskogee Community Landfill
LOCATION Muskogee, OklahomaSUPERVISED BY G. Smith
DATE 10/28/93
CHECKED BY G. Hassett

WELL No. P-6
Boring No X-Ref. B-6

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords E=2730241.030, N=274148.580 Elevation Ground Level (MSL) 630.29
Top of Casing 633.94

Drilling Summary

Total Depth (ft): 23.0
Borehole Diameter: 7.25"
Casing Stickup Height: 3.65 ft.
Driller: A. W. Pool, Inc.
Andy Zavasky, Driller
Rig: Mobile B-61
Bit (s): 3.25-inch ID x 7.25-inch OD Hollow Stem Auger
Drilling Fluid: none
Protective Casing: Anodized Aluminium

Well Design & Specifications

Basis: Geologic Log ☒ Geophysical Log ☐
Casing String (s): C = Casing S = Screen

Depth (ft)	String (s)	Elevation (MSL)
+3.65 - 12.97	C ₁	633.94 - 617.32
12.97 - 22.97	S ₁	617.32 - 607.32
-	-	-
-	-	-
-	-	-

Casing: C1 2" ID Sch. 40 PVC, Flush joint

Casing: C2

Screen: S1 2" ID Sch. 40 PVC,
0.10" slots, flush joint

Screen: S2

Grout Seal: Econoplug Bentonite grout
2 to 8.5 ft.

Bentonite Seal: Bentonite Pellets
6.5 to 11.0 ft.

Filter Pack: 20 - 40 Colorado Silica Sand
11 to 23 ft.

Construction Time Log

Task	Start		Finish	
	Date	Time	Date	Time
Drilling : 0 - 23	10/26	1320	10/26	1406
Geophys. Logging:				
Casing: C ₁ , S ₁	10/26	1410	10/26	1420
Filter Placement:	10/26	1420	10/26	1454
Bentonite Seal:	10/26	1456	10/26	1520
Development:	11/06	1000	11/07	1630

Well Development

Developed with Waterra hand pump.
Initial water level = 10.92 ft.
Well volume = 2.30 gallons
Volume pumped = 14.5 gallons

Stabilization Test Data

Time	pH	Spec. Cond.	Temp (C)
1550	7.55	4820	14.8
1600	7.53	4810	14.4
1610	7.54	4740	14.4
1620	7.58	4680	14.2
1630	7.54	4800	14.5

Recovery Data

Q = S₀ =

Comments

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling. NOTE: For recovery data, see permeability data.

T.D. = 23.0 ft.

SITE NAME Muskogee Community Landfill
LOCATION Muskogee, Oklahoma

SUPERVISED BY D. Smith
DATE 10/26/93
CHECKED BY G. Hassell

WELL No. P-7Boring No X-Ref. B-13**PIEZOMETER CONSTRUCTION SUMMARY**Survey Coords E=2730248.800, N=274120.820 Elevation Ground Level (MSL) 830.23Top of Casing 833.70**Drilling Summary**Total Depth (ft): 8.10Borehole Diameter: 7.25"Casing Stickup Height: 3.47 ft.Driller: A. W. Pool, Inc.

Andy Zavasky, Driller

Rig: Mobile Drill B-81Bit (s): 3.25-inch ID x 7.25-inch OD Hollowstem AugersDrilling Fluid: NoneProtective Casing: Anodized Aluminium**Construction Time Log**

Task	Start		Finish	
	Date	Time	Date	Time
Drilling :				
0 - 13.5	10/29	1500	10/29	1515
Geophys. Logging:				
Casing:				
C ₁	10/29	1530	10/29	1531
S ₁	10/29	1528	10/29	1529
Filter Placement:	10/29	1535	10/29	1540
Bentonite Seal Development:	10/29	1545	10/29	1550

Well Design & SpecificationsBasis: Geologic Log ☒ Geophysical Log ☐

Casing String (s): C = Casing S = Screen

Depth (ft)	String (s)	Elevation (MSL)
+3.47 - 5.01	C ₁	633.70 - 625.22
5.01 - 8.01	S ₁	625.22 - 622.22
-	-	-
-	-	-
-	-	-

Casing: C1 2" ID Sch. 40 PVC, Flush joint

Casing: C2

Screen: S1 2" ID Sch. 40 PVC,
0.10" slots

Screen: S2

Grout Seal: Bentonite Hole Plug
0.5 to 1.0 ft.Bentonite Seal: Bentonite Pellets
1 to 4.0 ft.Filter Pack: 20 - 40 Colorado Silica Sand
4 to 8.10 ft.**Well Development**

Well was installed dry

Stabilization Test Data

Time	pH	Spec. Cond.	Temp (C)

Recovery Data

Q -

S₀ -**Comments**

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling.

SITE NAME Muskogee Community Landfill
LOCATION Muskogee, OklahomaSUPERVISED BY G. Hassett
DATE 11/29/93
CHECKED BY D. Smith

T.D. = 8.10 ft.

WELL No. P-8Boring No X-Ref. B-20**PIEZOMETER CONSTRUCTION SUMMARY**Survey Coords E=2730185.250, N=272155.268Elevation Ground Level (MSL) 841.47Top of Casing 634.82**Drilling Summary**Total Depth (ft): 171.0Borehole Diameter: 5.0"Casing Stickup Height: 3.15 ft.Driller: A. W. Pool, Inc.

Andy Zavasky, Driller

Rig: Badger 1250Bit (s): 3-inch ID x 5-inch OD Core BarrelDrilling Fluid: airProtective Casing: Steel**Construction Time Log**

Task	Start		Finish	
	Date	Time	Date	Time
Drilling HSA:				
0 - 62	10/21	1315	10/21	1600
50 - 133	10/23	1230	10/24	1335
Geophys. Logging:	10/24	1330	10/24	1500
Casing:				
C ₁	10/23	1610		1710
C ₂	10/24	1525	10/23	1535
S ₁ 2" PVC:	10/24	1515	10/24	1525
Filter Placement:	10/24	1535	10/24	1600
Bentonite Seal:	10/24	1600	10/24	1605
Development:	11/06	1000	11/06	1630

Well Design & SpecificationsBasis: Geologic Log ☒ Geophysical Log ☐

Casing String (s): C = Casing S = Screen

Depth (ft)	String (s)	Elevation (MSL)
+0.0 - 61.0	C ₁	641.47 - 580.47
+3.15 - 128.7	C ₂	644.62 - 512.77
128.7 - 163.7	S ₁	512.77 - 477.77
-	-	-
-	-	-

Casing: C1 8" ID x 8 5/8" OD

Steel casing

Casing: C2 2" ID Sch.40 PVC riser, flush joint

Screen: S1 2" ID Sch.40 PVC.

0.10" slots, flush joints

Screen: S2

Grout Seal: Econoplug Bentonite grout

2 to 112 ft.

Bentonite Seal: Bentonite Pellets

112 to 124 ft.

Filter Pack: 20 - 40 Colorado Silica Sand

124 to 171 ft.

Well Development

Developed with GED development pump.
 Initial water level = 34.75 ft.
 well volume = 21.43 gallons
 Volume pumped = 86 gallons

Stabilization Test Data

Time	pH	Spec. Cond.	Temp (C)
1455	7.36	18050	13.5
1515	7.38	16840	15.8
1530	7.27	16560	15.8
1545	7.26	17110	15.6
1600	7.29	17170	15.7

Recovery Data

Q =

S₀ =**Comments**

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling. NOTE: For recovery data, see permeability data.

SITE NAME Muskogee Community Landfill
 LOCATION Muskogee, Oklahoma

SUPERVISED BY G. Hasselt
 DATE 10/24/93
 CHECKED BY D. Smith

T.D. = 171.0 ft.

WELL No. P-9Boring No X-Ref. B-21**PIEZOMETER CONSTRUCTION SUMMARY**Survey Coords E=2730181.780, N=272117.160Elevation Ground Level (MSL) 842.32Top of Casing 845.57**Drilling Summary**

Total Depth (ft): 85.1
 Borehole Diameter: 5.0"
 Casing Stickup Height: 3.25 ft.
 Driller: A. W. Pool, Inc.
 Andy Zavasky, Driller
 Rig: Badger 1250
 Bit (s): 3-inch ID x 5-inch OD Core Barrel
 Drilling Fluid: air

Protective Casing: Anodized Aluminium

Well Design & SpecificationsBasis: Geologic Log ☒ Geophysical Log ☐

Casing String (s): C = Casing S = Screen

Depth (ft)	String (s)	Elevation (MSL)
+3.25 - 75.08	C ₁	645.57 - 567.24
75.08 - 85.08	S ₁	567.24 - 557.24
-	-	-
-	-	-
-	-	-

Casing: C1 2" ID, Sch. 40 PVC, Flush joint

Casing: C2

Screen: S1 2" ID Sch. 40 PVC,
0.10" slots, flush joints

Screen: S2

Grout Seal: Econoplug Bentonite grout
2 to 58.0 ft.Bentonite Seal: Bentonite Pellets
58 to 65.0 ft.Filter Pack: 20 - 40 Colorado Silica Sand
65 to 85.1 ft.**Comments**

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling. NOTE: For recovery data, see permeability data. NOTE 2: 1 bag (sand) added initially plus 1/2 bag; the tape measure came up to 65 ft. hole was apparently sloughing off. Hole was drilled over two days; 1st day cored 0 - 67'; next morning hole had sloughed to 11' below the surface.

Construction Time Log

Task	Start		Finish	
	Date	Time	Date	Time
Drilling : 0 - 85.1'	10/28	1425	10/29	0930
Geophys. Logging: Casing: C ₁ , S ₁	10/29	0940	10/29	0945
Filter Placement:	10/29	0945	10/29	1015
Bentonite Seal:	10/29	1015	10/29	1130
Development:	11/03	1600	11/05	1050

Well Development

Developed with GED development pump.
 Initial water level = 22.75 ft.
 well volume = 10.64 gallons
 Volume pumped = 46 gallons

Stabilization Test Data

Time	pH	Spec. Cond.	Temp (C)
0950	9.03	5370	13.1
1010	8.27	5150	12.1
1030	8.53	4910	13.9
1050	8.51	4960	13.8

Recovery DataQ = S₀ =
 SITE NAME Muskogee Community Landfill
 LOCATION Muskogee, Oklahoma

 SUPERVISED BY D. Smith
 DATE 10/29/83
 CHECKED BY G. Hassett

T.D. = 85.1 ft.

WELL No. P-10
 Boring No X-Ref. P-10

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords E=2730184.560, N=272134.047 Elevation Ground Level (MSL) 641.83
 Top of Casing 645.27

Drilling Summary

Total Depth (ft): 25.5
 Borehole Diameter: 7.25"
 Casing Slickup Height: 3.44 ft.
 Driller: A. W. Pool, Inc.
 Andy Zavasky, Driller
 Rig: Mobile Drill B-61
 Bit (s): 3.25-inch ID x 7.25-inch OD Hollowstem Auger
 Drilling Fluid: None
 Protective Casing: Anodized Aluminium

Well Design & Specifications

Basis: Geologic Log ☒ Geophysical Log ☐
 Casing String (s): C = Casing S = Screen

Depth (ft)	String (s)	Elevation (MSL)
+3.44 - 22.75	C ₁	645.27 - 619.08
22.75 - 25.25	S ₁	619.08 - 616.58
-	-	-
-	-	-
-	-	-

Casing: C1 2" ID Sch. 40 PVC, Flush joint

Casing: C2

Screen: S1 2" ID Sch. 40 PVC,
 0.10" slots, flush joint

Screen: S2

Grout Seal: Econoplug Bentonite Grout
 2 to 18.0 ft.

Bentonite Seal: Bentonite Pellets
 18 to 21.5 ft.

Filter Pack: 20 - 40 Colorado Silica Sand
 21.5 to 25.5 ft.

Comments

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling. Zone A piezometer drilled on top of road, which was constructed with fill from 0 - 18.5 ft. only small portion of natural clay available to set screen.

Construction Time Log

Task	Start		Finish	
	Date	Time	Date	Time
Drilling : 0 - 25.5	10/26	1550	10/26	1645
Geophys. Logging: Casing: C ₁ , S ₁	10/26	1645	10/26	1650
Filter Placement:	10/26	1650	10/26	1700
Bentonite Seal: Development:	10/26	1700	10/26	1705

Well Development

Well was installed dry and not developed due to slow formation permeability and recharge.

Stabilization Test Data

Time	pH	Spec. Cond.	Temp (C)

Recovery Data

Q = S₀ =

SITE NAME Muskogee Community Landfill
 LOCATION Muskogee, Oklahoma

SUPERVISED BY D. Smith
 DATE 10/26/93
 CHECKED BY G. Hassett

T.D. = 25.5 ft.

WELL No. P-11Boring No X-Ref. P-11**PIEZOMETER CONSTRUCTION SUMMARY**Survey Coords E=2730787.800, N=272448.236 Elevation Ground Level (MSL) 628.99Top of Casing 629.57**Drilling Summary**Total Depth (ft): 21.6Borehole Diameter: 7.25"Casing Stickup Height: 2.58 ft.Driller: A. W. Poot, Inc.

Andy Zavasky, Driller.

Rig: Mobile Drill B-51Bit (s): 3.25-inch ID x 7.25-inch OD Hollow Stem AugerDrilling Fluid: noneProtective Casing: none**Construction Time Log**

Task	Start		Finish	
	Date	Time	Date	Time
Drilling : 0 - 21.6	10/18	0800	10/18	0835
Geophys. Logging:				
Casing:				
C ₁	10/18	0841	10/18	0842
S ₁	10/18	0840	10/18	0841
Filter Placement:	10/18	0845	10/18	0915
Bentonite Seal:	10/19	1205	10/19	1210
Development:	11/02	1158	11/05	1325

Well Design & SpecificationsBasis: Geologic Log ☒ Geophysical Log ☐

Casing String (s): C = Casing S = Screen

Depth (ft)	String (s)	Elevation (MSL)
+2.58 - 11.51	C ₁	629.57 - 615.48
11.53 - 21.53	S ₁	615.48 - 605.48
-	-	-
-	-	-
-	-	-

Casing: C1 2" ID Sch. 40 PVC, Flush joint

Casing: C2

Screen: S1 2" ID Sch. 40 PVC,
0.10" slots, flush joint

Screen: S2

Grout Seal: Cement bentonite grout
0 to 5.0 ft.Bentonite Seal: Bentonite Pellets
5 to 9.0 ft.Filter Pack: 20 - 40 Colorado Silica Sand
9 to 21.6 ft.**Well Development**Developed with Waterra hand pump.
Initial water level = 5.44 ft.
well volume = 3.07 gallons
Volume pumped = 24.4 gallons**Stabilization Test Data**

Time	pH	Spec. Cond.	Temp (C)
1100	8.10	2920	15.1
1125	7.79	2830	15.9
1255	8.10	2970	16.1
1310	8.55	2870	16.1
1325	8.10	2900	15.8

Recovery Data

Q =

S₀ =**Comments**

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling. NOTE: For recovery data, see permeability data.

T.D. = 21.6 ft.

SITE NAME Mustogee Community Landfill
LOCATION Mustogee, OklahomaSUPERVISED BY G. Hassett
DATE 10/18/93
CHECKED BY G. Hassett

WELL No. P-12Boring No X-Ref. P-12**PIEZOMETER CONSTRUCTION SUMMARY**Survey Coords E-2730775.850, N-272907.074 Elevation Ground Level (MSL) 827.92Top of Casing 830.81**Drilling Summary**

Total Depth (ft): 22.7

Borehole Diameter: 7.25"

Casing Stickup Height: 2.89 ft.

Driller: A. W. Pool, Inc.

Andy Zavasky, Driller

Rig: Mobile Drill B-61

Bit (s): 3.25-inch ID x 7.25-inch OD Hollow Stem Auger

Drilling Fluid: none

Protective Casing: none

Construction Time Log

Task	Start		Finish	
	Date	Time	Date	Time
Drilling : 0 - 21.8	10/17	1050	10/17	1130
Geophys. Logging:				
Casing:				
C ₁	10/17	1132	10/17	1135
S ₁	10/17	1131	10/17	1132
Filter Placement:	10/17	1137	10/17	1210
Bentonite Seal:	10/17	1230	10/17	1245
Development:	11/02	1620	11/04	1721

Well Design & SpecificationsBasis: Geologic Log ☒ Geophysical Log ☐

Casing String (s): C = Casing S = Screen

Depth (ft)	String (s)	Elevation (MSL)
+2.69 - 12.58	C ₁	629.57 - 615.34
12.58 - 22.58	S ₁	615.34 - 605.34
-	-	-
-	-	-
-	-	-

Casing: C1 2" ID Sch. 40 PVC, Flush joint

Casing: C2

Screen: S1 2" ID Sch. 40 PVC,
0.10" slots, flush joint

Screen: S2

Grout Seal: Cement bentonite grout
0 to 6.5 ft.Bentonite Seal: Bentonite Pellets
6.5 to 10.0 ft.Filter Pack: 20 - 40 Colorado Silica Sand
10 to 22.7 ft.**Well Development**Developed with Waterloo hand pump.
Initial water level = 7.01 ft.
Well volume = 2.81 gallons
Volume pumped = 17.4 gallons**Stabilization Test Data**

Time	pH	Spec. Cond.	Temp (C)
1440	6.54	>99000	17.3
1458	6.73	>99000	17.4
1510	6.82	>99000	17.3
1525	6.65	>99000	16.7

Recovery Data

Q =

S₀ =**Comments**

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling. NOTE: For recovery data, see permeability data.

SITE NAME Mustogee Community Landfill
LOCATION Mustogee, OklahomaSUPERVISED BY G. Hasselt
DATE 10/17/93
CHECKED BY D. Smith

T.O. = 22.7 ft.

WELL No. P-13Boring No X-Ref. P-13**PIEZOMETER CONSTRUCTION SUMMARY**Survey Coords E=2730184.580, N=272134.047 Elevation Ground Level (MSL) 825.33Top of Casing 828.91**Drilling Summary**

Total Depth (ft): 19.3

Borehole Diameter: 7.25"

Casing Stickup Height: 3.58 ft.

Driller: A. W. Pool, Inc.

Andy Zavasky, Driller

Rig: Mobile Drill B-81

Bit (s): 3.25-inch ID x 7.25-inch OD Hollow Stem Auger

Drilling Fluid: none

Protective Casing: none

Construction Time Log

Task	Start		Finish	
	Date	Time	Date	Time
Drilling:				
0 - 19.3	10/17	1500	10/17	1540
Geophys. Logging:				
Casing:				
C ₁	10/17	1546	10/17	1548
S ₁	10/17	1545	10/17	1546
Filter Placement:	10/17	1550	10/17	1630
Bentonite Seal:	10/17	1635	10/17	1640
Development:	11/02	1620	11/04	1708

Well Design & SpecificationsBasis: Geologic Log ☒ Geophysical Log ☐

Casing String (s): C = Casing S = Screen

Depth (ft)	String (s)	Elevation (MSL)
+3.58 - 9.12	C ₁	628.91 - 616.21
9.12 - 19.12	S ₁	616.21 - 606.21
-	-	-
-	-	-
-	-	-

Casing: C1 2" ID Sch. 40 PVC, Flush joint

Casing: C2

Screen: S1 2" ID Sch. 40 PVC,
0.10" slots, flush joint

Screen: S2

Grout Seal: Cement bentonite grout
0 to 3.0 ft.Bentonite Seal: Bentonite Pellets
3 to 7.0 ft.Filter Pack: 20 - 40 Colorado Silica Sand
7 to 19.3 ft.**Well Development**Developed with Waterra hand pump.
Initial water level = 5.30 ft.
Well volume = 2.83 gallons
Volume pumped = 43.9 gallons**Stabilization Test Data**

Time	pH	Spec. Cond.	Temp (C)
	7.41	2660	20.8
	7.35	2500	19.0
	7.34	2370	18.0
	7.32	2460	17.2
1708	7.27	2500	16.7

Recovery Data

Q =

S₀ =**Comments**

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling. NOTE: For recovery data, see permeability data.

T.D. = 19.3 ft.

SITE NAME Muskogee Community Landfill
LOCATION Muskogee, OklahomaSUPERVISED BY G. Hassett
DATE 10/17/93
CHECKED BY D. Smith

WELL No. P-14Boring No X-Ref. P-14**PIEZOMETER CONSTRUCTION SUMMARY**Survey Coords. E=2730728.780, N=273795.813 Elevation Ground Level (MSL) 629.72Top of Casing 632.77**Drilling Summary**Total Depth (ft): 24.7Borehole Diameter: 7.25"Casing Stickup Height: 3.05 ft.Driller: A. W. Pool, Inc.

Andy Zavasky, Driller

Rig: Mobile Drill B-51Bit (s): 3.25-inch ID x 7.25-inch OD Hollow Stem AugerDrilling Fluid: noneProtective Casing: none**Construction Time Log**

Task	Start		Finish	
	Date	Time	Date	Time
Drilling :				
0 - 24.7	10/19	1015	10/19	1110
Geophys. Logging:				
Casing:				
C ₁	10/19	1112	10/19	1113
S ₁	10/19	1111	10/19	1112
Filter Placement:	10/19	1115	10/19	1145
Bentonite Seal:	10/19	1145	10/19	1150
Development:	11/04	1037	11/09	1239

Well Design & SpecificationsBasis: Geologic Log ☒ Geophysical Log ☐

Casing String (s): C = Casing S = Screen

Depth (ft)	String (s)	Elevation (MSL)
+3.05 - 14.65	C ₁	632.77 - 615.07
14.65 - 24.65	S ₁	615.07 - 605.07
-	-	-
-	-	-
-	-	-

Casing: C1 2" ID Sch. 40 PVC, Flush joint

Casing: C2

Screen: S1 2" ID Sch. 40 PVC,
0.10" slots, flush joint

Screen: S2

Grout Seal: Cement bentonite grout
0 to 7.0 ft.Bentonite Seal: Bentonite Pellets
7 to 10.0 ft.Filter Pack: 20 - 40 Colorado Silica Sand
10 to 24.7 ft.**Well Development**Developed with Waterra hand pump.
Initial water level = 11.77 ft.
Well volume = 2.97 gallons
Volume pumped = 24.0 gallons**Stabilization Test Data**

Time	pH	Spec. Cond.	Temp (C)
1154	7.08	2680	16.6
1209	7.27	2560	16.5
1224	7.29	2660	16.0
1239	7.27	2600	15.8

Recovery DataQ = S₀ =**Comments**

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling. NOTE: For recovery data, see permeability data.

T.D. = 24.7 ft.

SITE NAME Mustogee Community Landfill
LOCATION Mustogee, OklahomaSUPERVISED BY G. Hasselt
DATE 10/19/93
CHECKED BY D. Smith

WELL No. P-15Boring No X-Ref. P-15**PIEZOMETER CONSTRUCTION SUMMARY**Survey Coords E=2731378.100, N=274174.971Elevation Ground Level (MSL) 824.39Top of Casing 827.28**Drilling Summary**

Total Depth (ft): 27.2

Borehole Diameter: 7.25

Casing Stickup Height: 2.89 ft.

Driller: A. W. Pool

Andy Zavasky, Driller

Rig: Mobile Drill B-81

Bit (s): 3.25-inch ID x 7.25-inch OD Hollow Stem Auger

Drilling Fluid: none

Protective Casing: Anodized Aluminum

Well Design & SpecificationsBasis: Geologic Log ☒ Geophysical Log ☐

Casing String (s): C = Casing S = Screen

Depth (ft)	String (s)	Elevation (MSL)
+2.89 - 17.11	C ₁	627.28 - 607.28
17.11 - 27.11	S ₁	607.28 - 597.28
-	-	-
-	-	-
-	-	-

Casing: C1 2" ID Sch. 40 PVC, Flush joint

Casing: C2

Screen: S1 2" ID Sch. 40 PVC,
0.10" slots, flush joint

Screen: S2

Grout Seal: Econoplug Bentonite grout
2 to 10.7 feetBentonite Seal: Bentonite Pellets
10.7 to 14.7 ft.Filter Pack: 20 - 40 Colorado Silica Sand
14.7 to 27.2 ft.**Comments**

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling. NOTE: For recovery data, see permeability data.

Construction Time Log

Task	Start		Finish	
	Date	Time	Date	Time
Drilling: 0 - 27.2	10/27	0915	10/27	1025
Geophys. Logging:				
Casing:				
C ₁	10/27	1028	10/27	1030
S ₁	10/27	1027	10/27	1028
Filter Placement:	10/27	1032	10/27	1045
Bentonite Seal:	10/27	1100	10/27	1200
Development:	11/03	1500	11/03	1620

Well DevelopmentDeveloped with Watterra hand pump.
Initial water level = 11.73 ft.
well volume = 2.48 gallons
Volume pumped = 30.0 gallons**Stabilization Test Data**

Time	pH	Spec. Cond.	Temp (C)
1537	7.30	4050	17.6
1552	7.19	4150	16.2
1609	7.11	4150	16.1
1620	7.11	4210	16.2

Recovery DataQ = S₀ =SITE NAME Muskogee Community Landfill
LOCATION Muskogee, OklahomaSUPERVISED BY G. Hassett
DATE 10/27/93
CHECKED BY D. Smith

T.D. = 27.2 ft.

APPENDIX G
FIELD PERMEABILITY DATA

Muskogee\86251dp2.3rd

CLIENT _____

SUBJECT _____

Prepared By _____ Date _____

PROJECT _____

Reviewed By _____ Date _____

Approved By _____ Date _____

P-1 Rising Head Test

$$\text{Aquifer Thickness, } b = 27 \text{ ft} \times 12 \text{ in/ft} \times 2.54 \text{ cm/in} = 822.96 \text{ cm}$$

Casing radius, $r_c = 1 \text{ in}$

$$\left. \begin{array}{l} H = \\ H_0 = \\ h = \end{array} \right\} \text{ see data sheet}$$

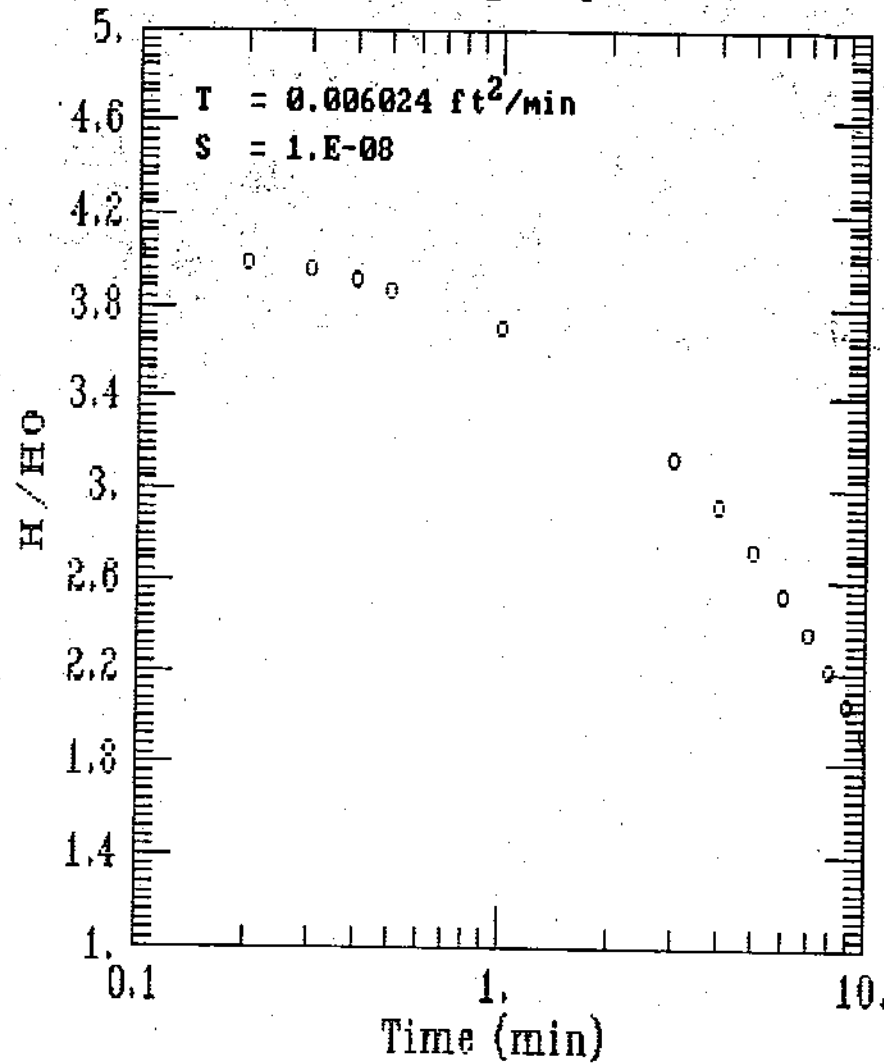
$$\begin{aligned} T r_c^2 / b^2 &= 1 & t &= 4.7 \text{ min @ } \alpha = 10^{-5} \\ T &= b^2 / t \\ &= (1 \text{ in})^2 / 4.7 \text{ min} \times (2.54 \text{ cm/in})^2 \times \text{min} / 60 \text{ sec} \\ T &= 0.023 \text{ cm}^2/\text{sec} \end{aligned}$$

$$\begin{aligned} K &= T/b \\ &= 0.023 \text{ cm}^2/\text{sec} \times 1/822.96 \text{ cm} \\ K &= 2.78 \times 10^{-5} \text{ cm/sec} \end{aligned}$$

W/ Aq solve Program

$$\begin{aligned} \textcircled{1} T &= 6.024 \times 10^{-3} \text{ ft}^2/\text{min} \times (12)^2 \text{ in}^2/\text{ft}^2 \times (2.54)^2 \text{ cm}^2/\text{in}^2 \times \text{min} / 60 \text{ sec} \\ T &= 9.33 \times 10^{-2} \text{ cm}^2/\text{sec} \\ K &= T/b = 9.33 \times 10^{-2} \text{ cm}^2/\text{sec} \times 1/822.96 \text{ cm} = 1.13 \times 10^{-4} \text{ cm/sec} \\ \textcircled{2} T &= 5.567 \times 10^{-3} \text{ ft}^2/\text{min} \times (12)^2 \text{ in}^2/\text{ft}^2 \times (2.54)^2 \text{ cm}^2/\text{in}^2 \times \text{min} / 60 \text{ sec} \\ T &= 8.62 \times 10^{-2} \text{ cm}^2/\text{sec} \\ K &= T/b \\ &= 8.62 \times 10^{-2} \text{ cm}^2/\text{sec} \times 1/822.96 \text{ cm} = 1.05 \times 10^{-4} \text{ cm/sec} \end{aligned}$$

muskogee p-1



AQTESOLV

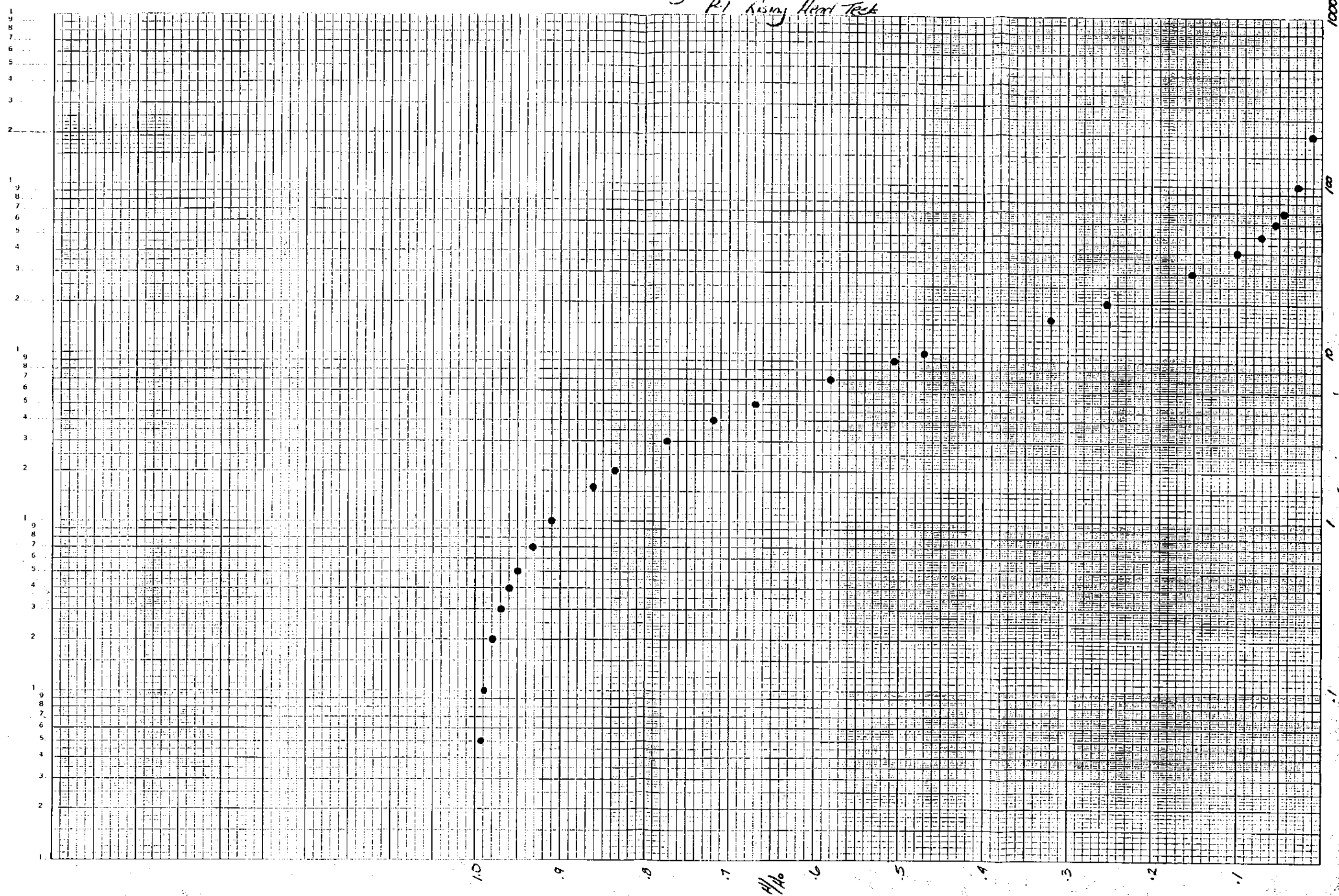
 GERAGHTY
& MILLER, INC.
 Modeling Group

Muskegon Community Landfill #1 Rising Head Test															
Elapsed Time min	H(t), ft	h, ft	Ho, ft	H(t)-Ho, ft	Elapsed Time min	H(t), ft	h, ft	Ho, ft	H(t)-Ho, ft	Elapsed Time min	H(t), ft	h, ft	Ho, ft	H(t)-Ho, ft	
0	12.513	62.58	12.513	0	0.3033	13.878	62.58	12.513	0.968855	9.2	37.502	62.58	12.513	0.498907	
0.0033	12.471	62.58	12.513	0.046857	0.3066	13.864	62.58	12.513	0.968548	9.4	37.504	62.58	12.513	0.499302	
0.0066	12.456	62.58	12.513	0.057538	0.31	13.81	62.58	12.513	0.96823	9.6	38.282	62.58	12.513	0.483379	
0.01	12.487	62.58	12.513	0.036168	0.3133	13.91	62.58	12.513	0.96823	9.8	38.614	62.58	12.513	0.476774	
0.0133	12.503	62.58	12.513	0.016222	0.3166	13.942	62.58	12.513	0.967593	10	38.551	62.58	12.513	0.470468	
0.0166	12.519	62.58	12.513	0.006502	0.32	13.942	62.58	12.513	0.967593	12	41.921	62.58	12.513	0.410985	
0.02	12.519	62.58	12.513	0.006502	0.3233	13.973	62.58	12.513	0.966978	14	44.406	62.58	12.513	0.381549	
0.0233	12.535	62.58	12.513	0.022544	0.3266	13.980	62.58	12.513	0.966658	16	46.494	62.58	12.513	0.320011	
0.0266	12.55	62.58	12.513	0.036885	0.33	13.989	62.58	12.513	0.966658	18	48.267	62.58	12.513	0.284739	
0.03	12.582	62.58	12.513	0.069469	0.3333	14.005	62.58	12.513	0.96634	20	49.818	62.58	12.513	0.253864	
0.0333	12.598	62.58	12.513	0.085433	0.35	14.1	62.58	12.513	0.96445	22	51.163	62.58	12.513	0.227127	
0.0366	12.629	62.58	12.513	0.114714	0.3666	14.179	62.58	12.513	0.962878	24	52.302	62.58	12.513	0.204688	
0.04	12.629	62.58	12.513	0.114714	0.3833	14.258	62.58	12.513	0.961307	26	53.3	62.58	12.513	0.184614	
0.0433	12.661	62.58	12.513	0.146877	0.4	14.337	62.58	12.513	0.959735	28	54.154	62.58	12.513	0.167625	
0.0466	12.629	62.58	12.513	0.114714	0.4166	14.432	62.58	12.513	0.957845	30	54.898	62.58	12.513	0.152824	
0.05	12.677	62.58	12.513	0.162759	0.4333	14.511	62.58	12.513	0.956273	32	55.563	62.58	12.513	0.139595	
0.0533	12.645	62.58	12.513	0.130735	0.45	14.574	62.58	12.513	0.95502	34	56.133	62.58	12.513	0.128255	
0.0566	12.708	62.58	12.513	0.192842	0.4666	14.653	62.58	12.513	0.953449	36	56.639	62.58	12.513	0.118189	
0.06	12.724	62.58	12.513	0.211824	0.4833	14.732	62.58	12.513	0.951877	38	57.098	62.58	12.513	0.109058	
0.0633	12.74	62.58	12.513	0.225855	0.5	14.811	62.58	12.513	0.950305	40	57.494	62.58	12.513	0.10118	
0.0666	12.772	62.58	12.513	0.262669	0.5166	14.89	62.58	12.513	0.948734	42	57.858	62.58	12.513	0.093938	
0.07	12.772	62.58	12.513	0.262669	0.5333	14.954	62.58	12.513	0.947461	44	58.175	62.58	12.513	0.087632	
0.0733	12.803	62.58	12.513	0.288252	0.56	15.033	62.58	12.513	0.945889	46	58.46	62.58	12.513	0.081962	
0.0766	12.788	62.58	12.513	0.276655	0.5666	15.112	62.58	12.513	0.944317	48	58.713	62.58	12.513	0.076929	
0.08	12.835	62.58	12.513	0.321855	0.5833	15.191	62.58	12.513	0.942746	50	58.935	62.58	12.513	0.072513	
0.0833	12.855	62.58	12.513	0.341855	0.6	15.254	62.58	12.513	0.941492	52	59.14	62.58	12.513	0.068435	
0.0866	12.867	62.58	12.513	0.353879	0.6166	15.333	62.58	12.513	0.939921	54	59.33	62.58	12.513	0.064655	
0.09	12.882	62.58	12.513	0.368858	0.6333	15.412	62.58	12.513	0.938349	56	59.489	62.58	12.513	0.061492	
0.0933	12.882	62.58	12.513	0.368858	0.65	15.491	62.58	12.513	0.936778	58	59.647	62.58	12.513	0.058438	
0.0966	12.914	62.58	12.513	0.388044	0.6666	15.554	62.58	12.513	0.935204	60	59.79	62.58	12.513	0.055504	
0.1	12.914	62.58	12.513	0.388044	0.6833	15.633	62.58	12.513	0.933633	62	59.916	62.58	12.513	0.052997	
0.1033	12.946	62.58	12.513	0.431858	0.7	15.697	62.58	12.513	0.932061	64	60.027	62.58	12.513	0.050789	
0.1066	12.946	62.58	12.513	0.431858	0.7166	15.776	62.58	12.513	0.931108	66	60.138	62.58	12.513	0.048581	
0.11	12.977	62.58	12.513	0.462791	0.7333	15.859	62.58	12.513	0.929535	68	60.248	62.58	12.513	0.046392	
0.1133	12.993	62.58	12.513	0.479872	0.75	15.918	62.58	12.513	0.928283	70	60.328	62.58	12.513	0.044481	
0.1166	13.009	62.58	12.513	0.496854	0.7666	15.981	62.58	12.513	0.92703	72	60.423	62.58	12.513	0.042911	
0.12	13.009	62.58	12.513	0.496854	0.7833	16.045	62.58	12.513	0.925756	74	60.486	62.58	12.513	0.041658	
0.1233	13.025	62.58	12.513	0.511854	0.8	16.124	62.58	12.513	0.924485	76	60.581	62.58	12.513	0.039768	
0.1266	13.056	62.58	12.513	0.532119	0.8166	16.187	62.58	12.513	0.923212	78	60.644	62.58	12.513	0.038314	
0.13	13.072	62.58	12.513	0.558851	0.8333	16.25	62.58	12.513	0.921939	80	60.704	62.58	12.513	0.037241	
0.1333	13.072	62.58	12.513	0.558851	0.85	16.313	62.58	12.513	0.920425	82	60.771	62.58	12.513	0.035968	
0.1366	13.088	62.58	12.513	0.575852	0.8666	16.392	62.58	12.513	0.918853	84	60.818	62.58	12.513	0.035053	
0.14	13.104	62.58	12.513	0.588854	0.8833	16.456	62.58	12.513	0.91758	86	60.882	62.58	12.513	0.03378	
0.1433	13.135	62.58	12.513	0.623857	0.9	16.519	62.58	12.513	0.916327	88	60.929	62.58	12.513	0.032845	
0.1466	13.151	62.58	12.513	0.630859	0.9166	16.582	62.58	12.513	0.915074	90	60.977	62.58	12.513	0.031889	
0.15	13.135	62.58	12.513	0.583857	0.9333	16.645	62.58	12.513	0.91382	92	61.04	62.58	12.513	0.030636	
0.1533	13.151	62.58	12.513	0.583859	0.95	16.709	62.58	12.513	0.912547	94	61.088	62.58	12.513	0.029682	
0.1566	13.199	62.58	12.513	0.623754	0.9666	16.772	62.58	12.513	0.911294	96	61.119	62.58	12.513	0.029065	
0.16	13.214	62.58	12.513	0.620766	0.9833	16.835	62.58	12.513	0.91004	98	61.167	62.58	12.513	0.02811	
0.1633	13.23	62.58	12.513	0.617757	1	16.898	62.58	12.513	0.908851	100	61.214	62.58	12.513	0.027175	
0.1666	13.246	62.58	12.513	0.614739	1.2	17.8	62.58	12.513	0.890843	120	61.483	62.58	12.513	0.021823	
0.17	13.246	62.58	12.513	0.614739	1.4	18.511	62.58	12.513	0.876981	140	61.674	62.58	12.513	0.018074	
0.1733	13.225	62.58	12.513	0.717868	1.6	19.223	62.58	12.513	0.862534	160	61.8	62.58	12.513	0.015517	
0.1766	13.293	62.58	12.513	0.980504	1.8	19.903	62.58	12.513	0.849006	180	61.895	62.58	12.513	0.013627	
0.18	13.293	62.58	12.513	0.980504	2	20.567	62.58	12.513	0.835797	200	61.974	62.58	12.513	0.012056	
0.1833	13.309	62.58	12.513	0.980186	2.2	21.215	62.58	12.513	0.822906	220	62.038	62.58	12.513	0.010782	
0.1866	13.325	62.58	12.513	0.979868	2.4	21.848	62.58	12.513	0.810313	240	62.101	62.58	12.513	0.009529	
0.19	13.341	62.58	12.513	0.979549	2.6	22.465	62.58	12.513	0.798038	260	62.148	62.58	12.513	0.008554	
0.1933	13.357	62.58	12.513	0.979231	2.8	23.081	62.58	12.513	0.785764	280	62.18	62.58	12.513	0.007958	
0.1966	13.388	62.58	12.513	0.978614	3	23.688	62.58	12.513	0.774146	300	62.212	62.58	12.513	0.007321	
0.2	13.388	62.58	12.513	0.978614	3.2	24.281	62.58	12.513	0.762508	320	62.243	62.58	12.513	0.006704	
0.2033	13.404	62.58	12.513	0.978296	3.4	24.821	62.58	12.513	0.751169	340	62.275	62.58	12.513	0.006068	
0.2066	13.42	62.58	12.513	0.977978	3.6	25.39	62.58	12.513	0.739849	360	62.307	62.58	12.513	0.005431	
0.21	13.436	62.58	12.513	0.977659	3.8	25.928	62.58	12.513	0.729146	380	62.323	62.58	12.513	0.005113	
0.2133	13.452	62.58	12.513	0.977341	4	26.466	62.58	12.513	0.718444	400	62.354	62.58	12.513	0.004496	
0.2166	13.467	62.58	12.513	0.977023	4.2	27.004	62.58	12.513	0.707741	420	62.37	62.58	12.513	0.004178	
0.22	13.483	62.58	12.513	0.976704	4.4	27.509	62.58	12.513	0.697039	440	62.388	62.58	12.513	0.003859	
0.2233	13.499	62.58	12.513	0.976386	4.6	28.016	62.58	12.513	0.686336	460	62.402	62.58	12.513	0.003541	
0.2266	13.515	62.58	12.513	0.976068	4.8	28.506	62.58	12.513	0.675634	480	62.417	62.58	12.513	0.003224	
0.23	13.531	62.58	12.513	0.975750	5	28.996	62.58	12.513	0.664931	500	62.433	62.58	12.513	0.002907	
0.2333	13.546	62.58	12.513	0.975432	5.2	29.487	62.58	12.513	0.654228	520	62.449	62.58	12.513	0.002590	
0.2366	13.562	62.58	12.513	0.975114	5.4	29.961	62.58	12.513	0.643525	540	62.465	62.58	12.513	0.002272	
0.24	13.578	62.58	12.513	0.974796	5.6	30.42	62.58								

K-E SEMI-LOGARITHMIC 5 CYCLES X 150 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

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PERCENTAGE CONVERSION TABLE
R1 Rising Head Test



SIRRINE

ENVIRONMENTAL CONSULTANTS

CALCULATION SHEET

CLIENT _____ LOCATION _____ JOB NO. _____

SUBJECT _____

BY _____ DATE _____ CHECKED BY _____ DATE _____

$$H_0 = 12.313$$

$$h = 62.58$$

$$S = 50.27 \quad t = 0$$

$$H_t = 12.914$$

..

$$49.67 \quad t = 1$$

$$13.38$$

$$49.20 \quad t = 2$$

$$13.863$$

$$48.72 \quad t = 3$$

$$14.337$$

$$48.24 \quad t = 4$$

$$14.881$$

$$47.70 \quad t = 5$$

$$16.883$$

$$45.70 \quad t = 1$$

$$23.666$$

$$38.91 \quad t = 3.8$$

$$26.466$$

$$36.11 \quad t = 4$$

$$28.996$$

$$33.58 \quad t = 5$$

$$31.322$$

$$31.258 \quad t = 6$$

$$33.441$$

$$29.14 \quad t = 7$$

$$35.419$$

$$27.16 \quad t = 8$$

$$37.254$$

$$25.33 \quad t = 9$$

$$38.931$$

$$23.65 \quad t = 10$$

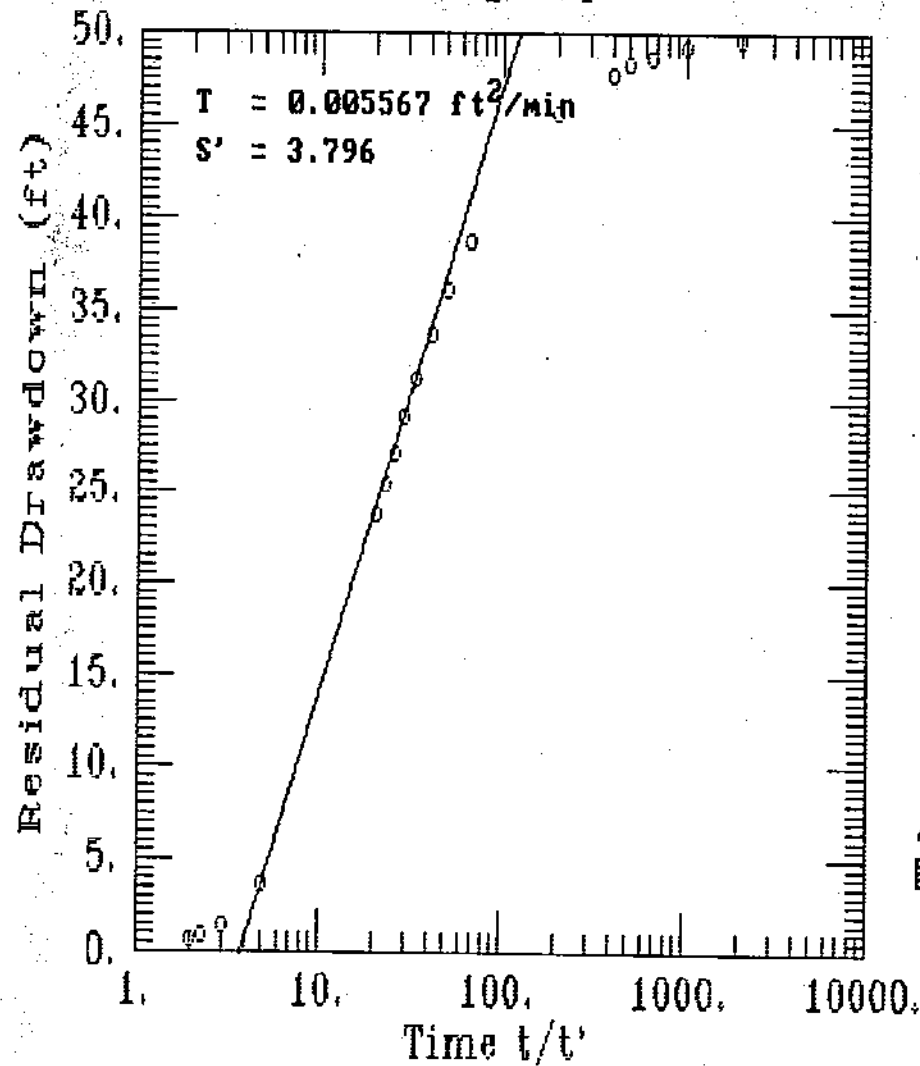
$$3.64 \quad 50$$

$$1.37 \quad 100$$

$$0.78 \quad 150$$

$$0.61 \quad 200$$

muskogee p-1



AQTESOLV

 GERAGHTY
& MILLER, INC.
 Modeling Group

CLIENT WMO

 SUBJECT Perm Test

 Prepared By GH Date 12/10

 PROJECT Muskogee
Results

Reviewed By ____ Date ____

Hydrogen

Approved By ____ Date ____

of Aqtesolve Program (Theiss Recor)

$$T = 5.59 \times 10^{-3} \text{ ft}^2/\text{min} \times (12)^2/\text{ft}^2 \times (2.54 \text{ cm})/\text{in}^2 \times \text{min}/60 \text{ sec}$$

$$K = T/b = 8.66 \times 10^{-2} \text{ cm}^2/\text{sec} \times 1/365.76 \text{ cm}$$

$$K = 2.37 \times 10^{-4} \text{ cm}^2/\text{sec}$$

P-2

Aquifer Thickness, $b = 12 \text{ ft (filter pack)} \times 12 \text{ in/ft} \times 2.54 \text{ cm/in}$
 $= 365.76 \text{ cm}$

Note: H₂O level elev. = 612.15
 Top of shale elev. 597.71

Casing radius, $r_c = 1 \text{ in}$, Initial H₂O level = $\hat{h}_i = 21.23$, from TOC

$$H_0 = 66.30 \text{ ft}$$

$$h = 21.23 \text{ ft}$$

$H =$ as noted in field notes

$$H/H_0 = (H - h)/(H_0 - h)$$

Time	H , from TOC	Time	H'	Time	H'
1.0	65.64	3.5	60.74	6.0	55.96
1.5	64.84	4.0	59.68		
2.0	64.04	4.5	—	7.0	54.24
2.5	63.0	5.0	57.80		
3.0	62.80			8.0	52.60

CLIENT

 SUBJECT

 Prepared By Date

 PROJECT

 Reviewed By Date

 Approved By Date
P-2
Time H'
Time H'

		20.0	39.06
		25.0	35.84
9.0	51.07	30.0	33.35
		42.0	29.54
10.0	49.06	50.0	27.96
11.0	48.22	60.0	26.59
12.0	46.92	81.0	24.92
13.0	45.70	100.0	24.06
14.0	44.58	120.0	23.50
15.0	43.52	977.0	21.46

Time H/Ho
Time H/Ho
Time H/Ho
Time H/Ho

1.0	98.5	6.0	77.1	14.0	51.8	100	6.3
1.5	96.8	7.0	73.2	15.0	49.5	120	5.0
2.0	95.0	8.0	69.6	20.0	39.6	977	0.5
2.5	92.7	9.0	66.2	25.0	32.4		
3.0	92.2	10.0	61.7	30.0	26.9		
3.5	87.7	11.0	59.9	42.0	18.4		
4.0	85.3	12.0	57.0	50.0	14.9		
4.5	-	13.0	54.3	60.0	11.9		
5.0	81.1			81.0	8.2		

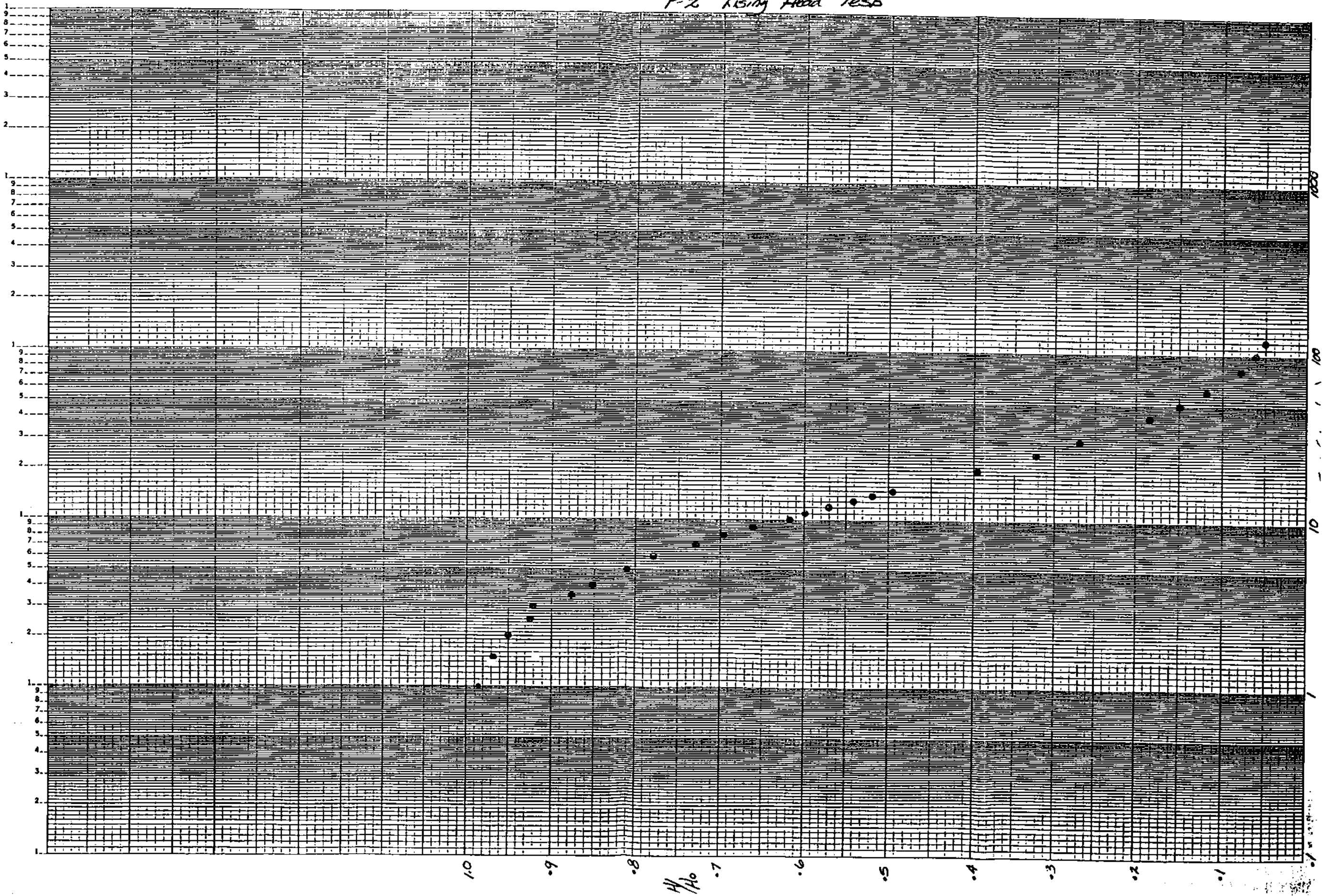
$$Tb/rc^2 = 1 \quad , \quad \alpha = 10^{-7} \quad @ \quad t = 6 \text{ minutes}$$

$$\begin{aligned}
 T &= rc^2/t \\
 &= (1\text{in})^2 / 6\text{min} \\
 &= 0.167 \text{ in}^2/\text{min} \times (2.54\text{cm/in})^2 \times \text{min}/60\text{sec} \\
 T &= 0.018 \text{ cm}^2/\text{sec} \\
 K &= T/b = 0.018 \text{ cm}^2/\text{sec} / 365.76 \text{ cm} \\
 K &= 4.90 \times 10^{-5} \text{ cm/sec}
 \end{aligned}$$

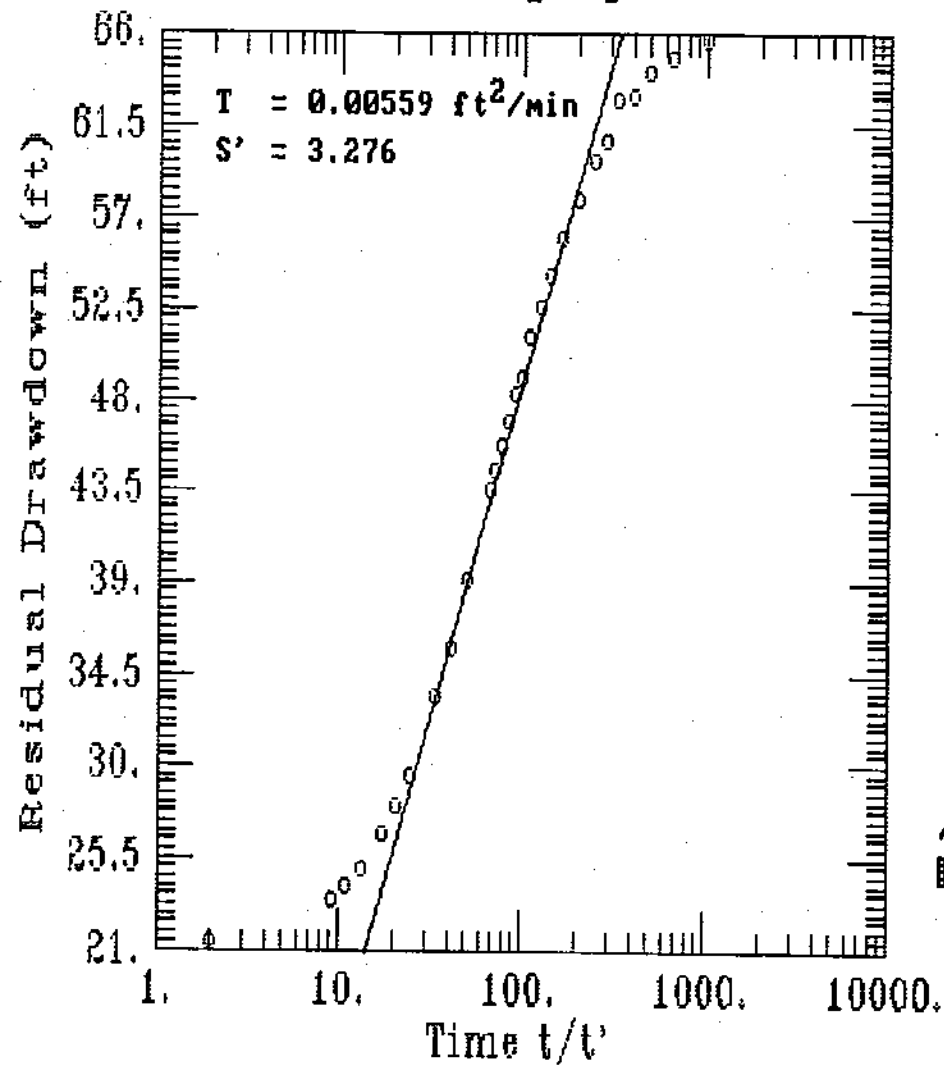
Handwritten: P-2 Rising Head Test

47 6210

K-E SEMI-LOGARITHMIC 5 CYCLES X 10 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.



muskogee p2



$T = 0.087 \text{ cm}^2/\text{sec}$
This recovery

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Modeling Group

CLIENT WMO

 SUBJECT Perm Tests

 Prepared By GH Date 12/2/93

 PROJECT Muck - Hydrogeol

Reviewed By ____ Date ____

Approved By ____ Date ____

P-3 Rising Head Test - Bauer & Rice (modified)

$$K = \frac{r_c'^2 \ln(R_e/r_w)}{2 L_e} \frac{1}{t} \ln y_0/y_k$$

$$r_c' = [(1-n)r_c^2 + nr_w^2]^{1/2}$$

$n = 0.30$, porosity for average gravel pack

r_c = radius of casing = 0.08 ft

r_w = radius from center of well to aquifer = 3.625 in $\times$ ft/in
= 0.30 ft

L_e = length of screened section of well = 10.0 ft

R_e = effective radial distance over which y is dissipated

y_0 = water level at time, $t=0$

y_k = water level at time t

t = time since test began

$$H_0 = 15.53 \text{ ft}$$

$$H = \text{as per field notes}$$

$$h = 11.16 \text{ ft}$$

$$H-h/H_0-h = H/H_0$$

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

$$= \left[\frac{1.1}{\ln(5.35/0.3)} + \frac{2.55 + 0.40 \ln[(21.85-5.35)/0.3]}{33.33} \right]^{-1}$$

$$\ln \frac{R_e}{r_w} = 1.93$$

Note: water level for calculation of L_w (Difference between water level and bottom of screen) and H (difference between water level and bottom of formation) taken on 12/22/93 = 11.20', etc

CLIENT _____ SUBJECT _____ Prepared By _____ Date _____

PROJECT _____ Reviewed By _____ Date _____

Approved By _____ Date _____

P-3 Rising Head Test

$$r_c = [(1-n)r_e^2 + nr_w^2]^{1/2}$$

$$[(1-0.3)(10.00)^2 + 0.3(0.3)^2]^{1/2}$$

$$r_c = 0.17$$

$$K = \frac{r_c^2 \ln(r_e/r_w)}{2Le} \frac{1}{t} \ln \frac{y_0}{y_t}, \quad y_0 = .81$$

$$y_t = .74 \text{ @ } t = 500 \text{ min}$$

$$= \frac{(0.17)^2 (1.98)}{2(10)} \frac{1}{500} \ln \left(\frac{.81}{.74} \right)$$

$$K = 5.17 \times 10^{-7} \text{ ft}^2/\text{min} \times 12 \text{ in}/\text{ft} \times 2.54 \text{ cm}/\text{in} \times \text{min}/60 \text{ sec}$$

$$K = 2.63 \times 10^{-7} \text{ cm}^2/\text{sec}$$

.508 cm/sec

w/ Aqtesolve Program

$$K = 1.461 \times 10^{-6} \text{ ft}^2/\text{min} \times 12 \text{ in}/\text{ft} \times \text{min}/60 \text{ sec} \times 2.54 \text{ cm}/\text{in}$$

$$K = 7.42 \times 10^{-7} \text{ cm}^2/\text{sec}$$

CLIENT _____

SUBJECT _____

Prepared By _____ Date _____

PROJECT _____

Reviewed By _____ Date _____

Approved By _____ Date _____

P-3 Rising Head Test

Time H, ft

0.5	15.41
1.0	15.33
1.5	15.30
2.0	15.27
2.5	15.25
3.0	15.26
3.5	15.22
4.0	15.19
4.5	15.17
5.0	15.15
6.0	15.13
7.0	15.12
8.0	15.10
9.0	15.08
10.0	15.06

Time H/H₀

0.5	.973
1.0	.954
1.5	.947
2.0	.941
2.5	.936
3.0	.938
3.5	.929
4.0	.922
4.5	.918
5.0	.913
6.0	.908
7.0	.906
8.0	.902
9.0	.897

Time H, ft

11.0	15.04
12.0	15.02
13.0	15.01
14.0	15.00
15.0	14.98
20.0	14.94
25.0	14.89
30.0	14.85
35.0	14.82
40.0	14.80
50.0	14.76
60.0	14.73
70.0	14.70
80.0	14.68
100.0	14.63
936.0	14.20
2373.0	13.83

Time H/H₀

10.0	.892
11.0	.888
12.0	.883
13.0	.881
14.0	.879
15.0	.874
20.0	.865
25.0	.854
30.0	.844
35.0	.838
40.0	.833
50.0	.824
60.0	.817
70.0	.810

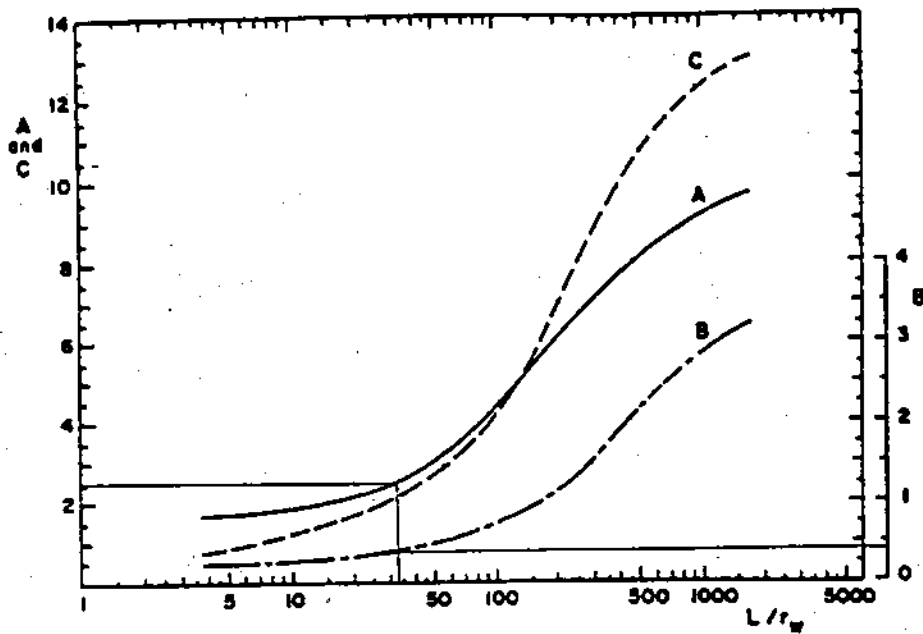
Time H/H₀

80.0	.805
100.0	.794
936.0	.696
2373.0	.611

	Muskogee Community Landfill			
	P3 Rising	Head Test		
Elapsed	H(t),ft	h,ft	Ho,ft	H(t)-h/Ho-h
Time,min				
0.5	15.41	11.16	15.53	0.97254
1	15.33	11.16	15.53	0.954233
1.5	15.3	11.16	15.53	0.947368
2	15.27	11.16	15.53	0.940503
2.5	15.25	11.16	15.53	0.935927
3	15.26	11.16	15.53	0.938215
3.5	15.22	11.16	15.53	0.929062
4	15.19	11.16	15.53	0.922197
4.5	15.17	11.16	15.53	0.91762
5	15.15	11.16	15.53	0.913043
6	15.13	11.16	15.53	0.908467
7	15.12	11.16	15.53	0.906178
8	15.1	11.16	15.53	0.901602
9	15.08	11.16	15.53	0.897025
10	15.06	11.16	15.53	0.892449
11	15.04	11.16	15.53	0.887872
12	15.02	11.16	15.53	0.883295
13	15.01	11.16	15.53	0.881007
14	15	11.16	15.53	0.878719
15	14.98	11.16	15.53	0.874142
20	14.94	11.16	15.53	0.864989
25	14.89	11.16	15.53	0.853547
30	14.85	11.16	15.53	0.844394
35	14.82	11.16	15.53	0.837529
40	14.8	11.16	15.53	0.832952
50	14.76	11.16	15.53	0.823799
60	14.73	11.16	15.53	0.816934
70	14.7	11.16	15.53	0.810069
80	14.68	11.16	15.53	0.805492
100	14.63	11.16	15.53	0.79405
936	14.2	11.16	15.53	0.695652
2373	13.83	11.16	15.53	0.610984

P-3 Rising Head Test

BOLWER AND RICE: GROUNDWATER HYDRAULICS



Curves relating coefficients A, B, and C to L/r_w .

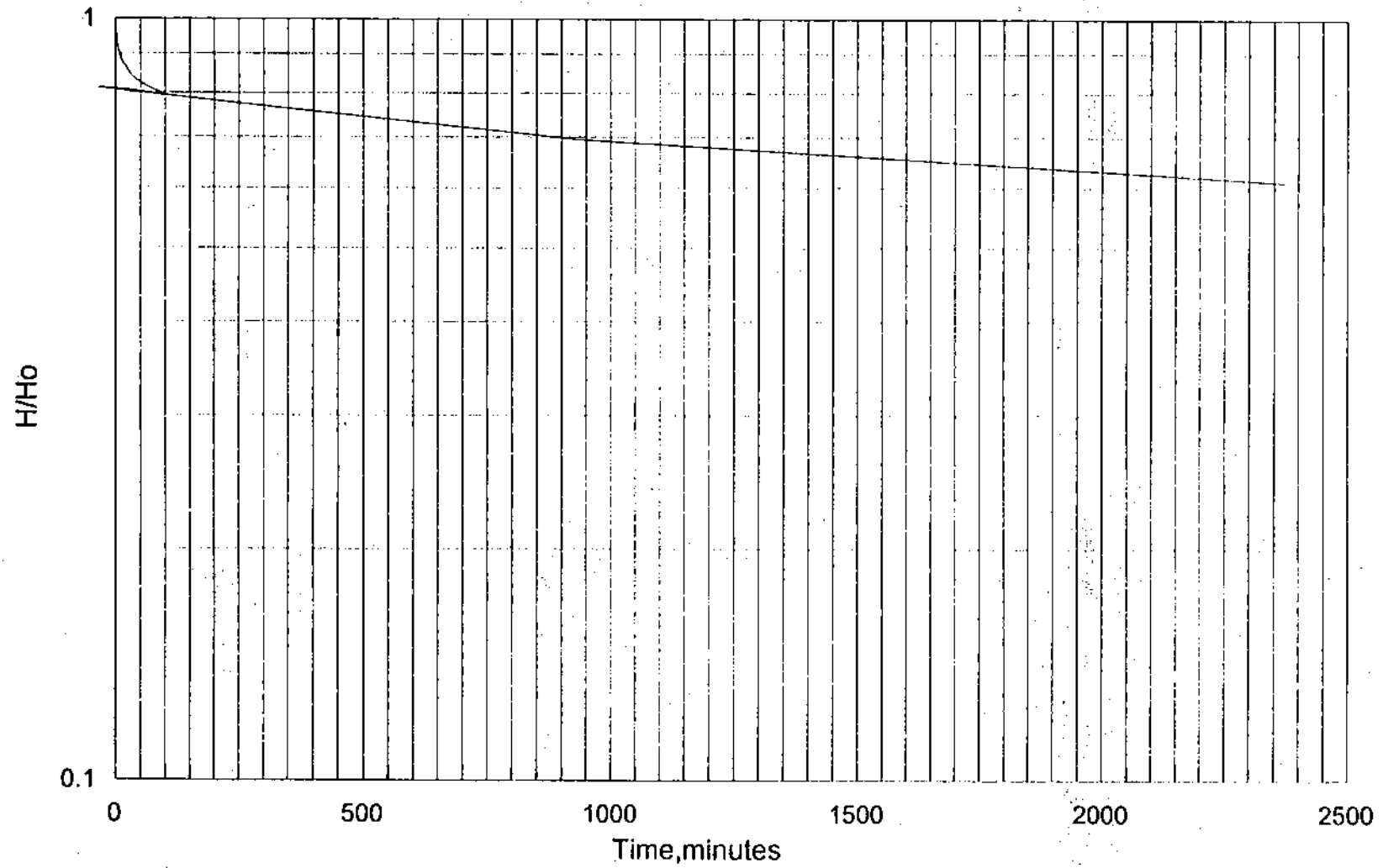
$$L/r_w = 10/.3 = 33.33$$

$$A = 2.55$$

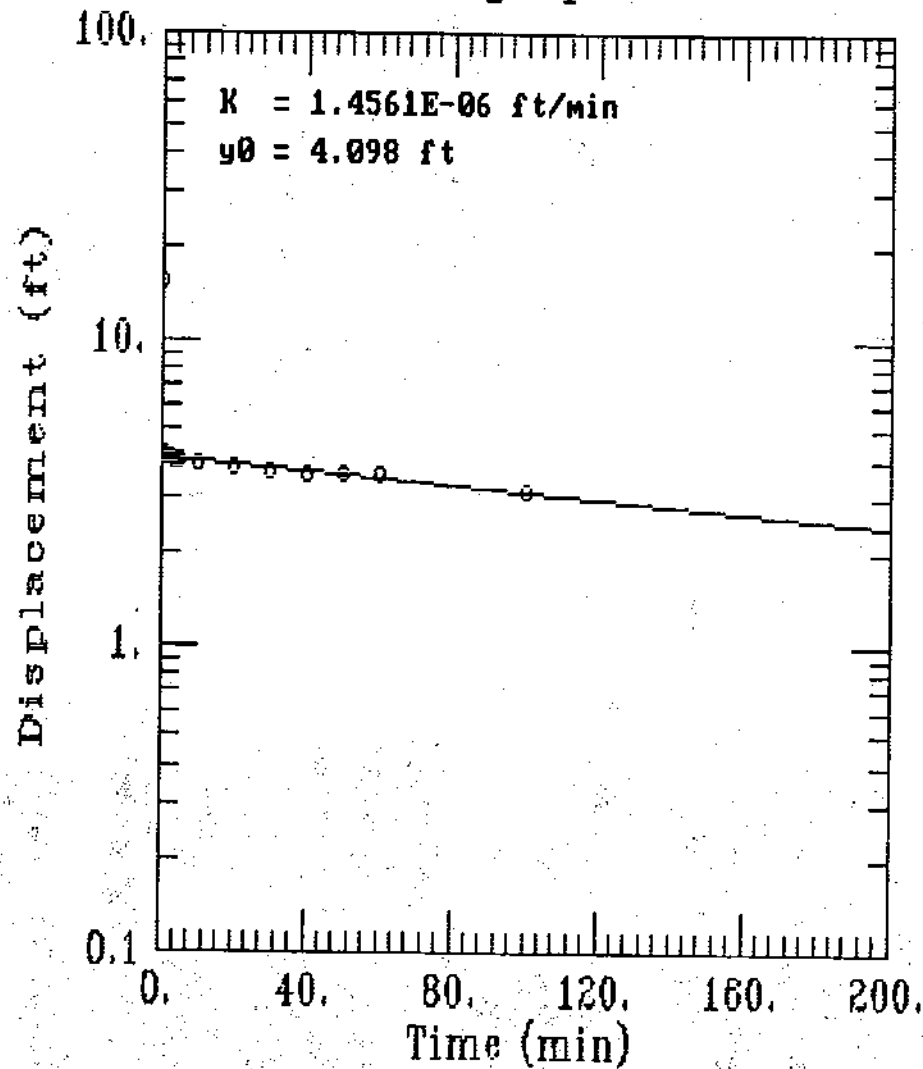
$$B = 0.40$$

Muskogee Community Landfill

P3 Rising Head Test



muskogee p3 B&R



AQTESOLV

GERAGHTY
& MILLER, INC.
Modeling Group

CLIENT _____

SUBJECT _____

Prepared By _____ Date _____

PROJECT _____

Reviewed By _____ Date _____

Approved By _____ Date _____

P-4 Rising Head Test

$$\text{Aquifer Thickness, } b = 120 - 109 = 11 \text{ ft} \times 12 \text{ in/ft} \times 2.54 \text{ cm/in}$$

$$b = 335.28 \text{ cm}$$

$$\text{Casing Radius, } r_c = 1 \text{ in}$$

$$H_0 =$$

$$h = 22.58 \text{ ft, TPC}$$

$$H = \text{as noted in field notes (transducer values)}$$

$$T \pm / r_c^2 = 1 \quad \alpha = 10^{-6} \quad C t = 10 \text{ min}$$

$$T = r_c^2 / C$$

$$= (1 \text{ in})^2 / 10 \text{ min}$$

$$= .1 \text{ in}^2 / \text{min} \times (2.54 \text{ cm/in})^2 \times \text{min} / 60 \text{ sec}$$

$$T = .011 \text{ cm}^2 / \text{sec}$$

$$K = T / b$$

$$= .011 \text{ cm}^2 / \text{sec} \times 1 / 335.28 \text{ cm}$$

$$K = 3.28 \times 10^{-5} \text{ cm/sec}$$

$$3.28$$

Muskegon Community Landfill PA Rating: Good Test															
Good no. run	MQR	N.R.	Mo	MQR/NR	Elapsed Time, min	MQR	N.R.	Mo	MQR/NR	Elapsed Time, min	MQR	N.R.	Mo	MQR/NR	Elapsed Time, min
0	0.774	70.88	0.774	1	0.3033	1.454	70.88	0.774	0.990298	9.2	16.26	70.88	0.774	0.750078	
0.0033	0.774	70.88	0.774	1	0.3068	1.460	70.88	0.774	0.990084	9.4	16.375	70.88	0.774	0.746042	
0.0066	0.76	70.88	0.774	0.990772	0.31	1.468	70.88	0.774	0.990084	9.6	16.443	70.88	0.774	0.742188	
0.01	0.76	70.88	0.774	0.990772	0.3123	1.485	70.88	0.774	0.990555	9.8	16.126	70.88	0.774	0.738122	
0.0133	0.806	70.88	0.774	0.990543	0.3168	1.455	70.88	0.774	0.990555	10	16.367	70.88	0.774	0.734294	
0.0166	0.806	70.88	0.774	0.990543	0.32	1.501	70.88	0.774	0.990527	12	22.037	70.88	0.774	0.686014	
0.02	0.821	70.88	0.774	0.990329	0.3233	1.501	70.88	0.774	0.990527	14	24.336	70.88	0.774	0.680060	
0.0233	0.821	70.88	0.774	0.990329	0.3268	1.517	70.88	0.774	0.990399	16	26.077	70.88	0.774	0.637558	
0.0266	0.837	70.88	0.774	0.990101	0.33	1.517	70.88	0.774	0.990399	18	26.091	70.88	0.774	0.638568	
0.03	0.837	70.88	0.774	0.990101	0.3333	1.517	70.88	0.774	0.990399	20	31.170	70.88	0.774	0.588178	
0.0333	0.853	70.88	0.774	0.990873	0.35	1.504	70.88	0.774	0.990728	22	33.141	70.88	0.774	0.535182	
0.0366	0.853	70.88	0.774	0.990873	0.3668	1.812	70.88	0.774	0.990043	24	34.991	70.88	0.774	0.511788	
0.04	0.860	70.88	0.774	0.990845	0.3833	1.643	70.88	0.774	0.991601	26	36.746	70.88	0.774	0.468718	
0.0433	0.860	70.88	0.774	0.990845	0.4	1.875	70.88	0.774	0.991744	28	38.426	70.88	0.774	0.463017	
0.0466	0.865	70.88	0.774	0.990816	0.4168	1.722	70.88	0.774	0.990474	30	36.961	70.88	0.774	0.440445	
0.05	0.865	70.88	0.774	0.990816	0.4333	1.77	70.88	0.774	0.990786	32	41.478	70.88	0.774	0.419228	
0.0533	0.9	70.88	0.774	0.990202	0.45	1.801	70.88	0.774	0.990547	34	42.886	70.88	0.774	0.399134	
0.0566	0.9	70.88	0.774	0.990202	0.4668	1.833	70.88	0.774	0.990490	36	44.215	70.88	0.774	0.380178	
0.06	0.9	70.88	0.774	0.990202	0.4833	1.88	70.88	0.774	0.990218	38	45.466	70.88	0.774	0.362326	
0.0633	0.918	70.88	0.774	0.990704	0.5	1.912	70.88	0.774	0.990783	40	48.688	70.88	0.774	0.345178	
0.0666	0.932	70.88	0.774	0.990748	0.5168	1.860	70.88	0.774	0.990302	42	47.609	70.88	0.774	0.32891	
0.07	0.932	70.88	0.774	0.990748	0.5333	1.901	70.88	0.774	0.990351	44	48.884	70.88	0.774	0.312558	
0.0733	0.948	70.88	0.774	0.990717	0.55	2.022	70.88	0.774	0.990193	46	49.913	70.88	0.774	0.298878	
0.0766	0.948	70.88	0.774	0.990717	0.5668	2.07	70.88	0.774	0.991508	48	50.894	70.88	0.774	0.284879	
0.08	0.964	70.88	0.774	0.990729	0.5833	2.102	70.88	0.774	0.991051	50	51.812	70.88	0.774	0.27178	
0.0833	0.964	70.88	0.774	0.990729	0.6	2.148	70.88	0.774	0.990382	52	52.696	70.88	0.774	0.259136	
0.0866	0.964	70.88	0.774	0.990729	0.6168	2.181	70.88	0.774	0.990795	54	53.537	70.88	0.774	0.247188	
0.09	0.979	70.88	0.774	0.990705	0.6333	2.229	70.88	0.774	0.990254	56	54.328	70.88	0.774	0.235862	
0.0933	0.979	70.88	0.774	0.990705	0.65	2.26	70.88	0.774	0.990707	58	55.072	70.88	0.774	0.225264	
0.0966	0.995	70.88	0.774	0.990847	0.6668	2.291	70.88	0.774	0.990355	60	55.785	70.88	0.774	0.215053	
0.1	0.995	70.88	0.774	0.990847	0.6833	2.339	70.88	0.774	0.990787	62	56.485	70.88	0.774	0.205391	
0.1033	1.011	70.88	0.774	0.990818	0.7	2.37	70.88	0.774	0.990728	64	57.114	70.88	0.774	0.19613	
0.1066	1.011	70.88	0.774	0.990818	0.7168	2.418	70.88	0.774	0.990543	66	57.746	70.88	0.774	0.187841	
0.11	1.027	70.88	0.774	0.990536	0.7333	2.465	70.88	0.774	0.991051	68	58.302	70.88	0.774	0.179318	
0.1133	1.027	70.88	0.774	0.990536	0.75	2.481	70.88	0.774	0.990544	70	58.64	70.88	0.774	0.171184	
0.1166	1.043	70.88	0.774	0.990182	0.7668	2.528	70.88	0.774	0.990474	72	59.378	70.88	0.774	0.163627	
0.12	1.043	70.88	0.774	0.990182	0.7833	2.56	70.88	0.774	0.990517	74	59.969	70.88	0.774	0.156822	
0.1233	1.060	70.88	0.774	0.990546	0.8	2.607	70.88	0.774	0.990548	76	60.344	70.88	0.774	0.150644	
0.1266	1.060	70.88	0.774	0.990546	0.8168	2.639	70.88	0.774	0.99139	78	60.603	70.88	0.774	0.143495	
0.13	1.074	70.88	0.774	0.990572	0.8333	2.671	70.88	0.774	0.990733	80	61.214	70.88	0.774	0.137631	
0.1333	1.074	70.88	0.774	0.990572	0.85	2.718	70.88	0.774	0.990283	82	61.828	70.88	0.774	0.131752	
0.1366	1.09	70.88	0.774	0.990501	0.8668	2.75	70.88	0.774	0.991608	84	62.006	70.88	0.774	0.126331	
0.14	1.09	70.88	0.774	0.990501	0.8833	2.797	70.88	0.774	0.991135	86	62.388	70.88	0.774	0.120909	
0.1433	1.106	70.88	0.774	0.990503	0.9	2.829	70.88	0.774	0.990789	88	62.734	70.88	0.774	0.115943	
0.1466	1.106	70.88	0.774	0.990503	0.9168	2.88	70.88	0.774	0.990237	90	63.067	70.88	0.774	0.111182	
0.15	1.106	70.88	0.774	0.990503	0.9333	2.908	70.88	0.774	0.990552	92	63.363	70.88	0.774	0.106843	
0.1533	1.122	70.88	0.774	0.990503	0.95	2.936	70.88	0.774	0.990109	94	63.684	70.88	0.774	0.102388	
0.1566	1.137	70.88	0.774	0.990421	0.9668	2.971	70.88	0.774	0.990853	96	63.969	70.88	0.774	0.098322	
0.16	1.137	70.88	0.774	0.990421	0.9833	3.018	70.88	0.774	0.990782	98	64.238	70.88	0.774	0.094484	
0.1633	1.137	70.88	0.774	0.990421	1	3.05	70.88	0.774	0.990526	100	64.507	70.88	0.774	0.090646	
0.1666	1.153	70.88	0.774	0.990492	1.2	3.556	70.88	0.774	0.990306	120	68.516	70.88	0.774	0.061852	
0.17	1.153	70.88	0.774	0.990492	1.4	4.014	70.88	0.774	0.990771	140	67.785	70.88	0.774	0.043875	
0.1733	1.169	70.88	0.774	0.990434	1.6	4.457	70.88	0.774	0.990475	160	68.592	70.88	0.774	0.032336	
0.1766	1.169	70.88	0.774	0.990434	1.8	4.899	70.88	0.774	0.991144	180	69.131	70.88	0.774	0.02487	
0.18	1.185	70.88	0.774	0.990438	2	5.342	70.88	0.774	0.990483	200	69.495	70.88	0.774	0.019476	
0.1833	1.185	70.88	0.774	0.990438	2.2	5.789	70.88	0.774	0.99073	220	69.748	70.88	0.774	0.015688	
0.1866	1.201	70.88	0.774	0.990397	2.4	6.211	70.88	0.774	0.992424	240	69.939	70.88	0.774	0.013147	
0.19	1.201	70.88	0.774	0.990397	2.6	6.638	70.88	0.774	0.991631	260	70.081	70.88	0.774	0.011115	
0.1933	1.218	70.88	0.774	0.990393	2.8	7.065	70.88	0.774	0.990239	280	70.176	70.88	0.774	0.009759	
0.1966	1.218	70.88	0.774	0.990393	3	7.478	70.88	0.774	0.990375	300	70.271	70.88	0.774	0.008404	
0.2	1.232	70.88	0.774	0.990345	3.2	7.887	70.88	0.774	0.990851	320	70.334	70.88	0.774	0.007505	
0.2033	1.252	70.88	0.774	0.990345	3.4	8.286	70.88	0.774	0.990548	340	70.397	70.88	0.774	0.006688	
0.2066	1.268	70.88	0.774	0.990337	3.6	8.709	70.88	0.774	0.990182	360	70.445	70.88	0.774	0.005921	
0.21	1.268	70.88	0.774	0.990337	3.8	9.12	70.88	0.774	0.990018	380	70.493	70.88	0.774	0.005236	
0.2133	1.284	70.88	0.774	0.990337	4	9.515	70.88	0.774	0.990782	400	70.54	70.88	0.774	0.004568	
0.2166	1.284	70.88	0.774	0.990337	4.2	9.91	70.88	0.774	0.990548	420	70.572	70.88	0.774	0.0039109	
0.22	1.29	70.88	0.774	0.990378	4.4	10.306	70.88	0.774	0.99061	440	70.603	70.88	0.774	0.003267	
0.2233	1.29	70.88	0.774	0.990378	4.6	10.701	70.88	0.774	0.990638	460	70.635	70.88	0.774	0.002721	
0.2266	1.29	70.88	0.774	0.990378	4.8	11.096	70.88	0.774	0.990724	480	70.651	70.88	0.774	0.002282	
0.23	1.296	70.88	0.774	0.9903452	5	11.475	70.88	0.774	0.990718	500	70.683	70.88	0.774	0.002525	
0.2333	1.296	70.88	0.774	0.9903452	5.2	11.871	70.88	0.774	0.991688	520	70.699	70.88	0.774	0.002267	
0.2366	1.311	70.88	0.774	0.990338	5.4	12.25	70.88	0.774	0.990758	540	70.73	70.88	0.774	0.001855	
0.24	1.311	70.88	0.774	0.990338	5.6	12.596	70.88	0.774	0.991263	560	70.748	70.88	0.774	0.001627	

CLIENT _____

SUBJECT Musk Hydro 1

Prepared By _____ Date _____

PROJECT _____

Parm Tests

Reviewed By _____ Date _____

Approved By _____ Date _____

P-5 Rising Head Test

$$\text{Aquifer Thickness, } b = 67' - 49' = 18 \text{ ft (fracture pack)} \times \frac{12 \text{ in}}{\text{ft}} \times \frac{2.54 \text{ cm}}{\text{in}} = 548.64 \text{ cm}$$

Note: H₀ Level Elev. = 617.95'
Top of shale Elev. = 594.91'

Casing radius, $r_c = 1 \text{ in}$

$H_0 = 62.02 \text{ ft}$
 $h = 15.37 \text{ ft}$
 $H = \text{as per field notes}$

$$H/H_0 = (H - h) / (H_0 - h)$$

<u>Time</u>	<u>H'</u>	<u>Time</u>	<u>H'</u>	<u>Time</u>	<u>H'</u>
1.0	61.34	11.0	45.74	117.0	17.35
1.5	60.62	12.0	44.45	158.0	16.98
2.0	59.88	13.0	43.20	200.0	16.77
2.5	58.92	14.0	42.02	1096.0	16.04
3.0	58.10	15.0	40.84		
3.5	57.32	20.0	35.82		
4.0	56.42	25.0	31.78		
4.5	55.60	30.0	28.58		
5.0	54.82	40.0	24.16		
6.0	53.04	50.0	21.47		
7.0	51.54	60.0	19.65		
8.0	50.00	70.0	18.88		
9.0	48.54	80.0	18.29		
10.0	47.10				

CLIENT _____
 PROJECT _____

SUBJECT _____

 Prepared By _____ Date _____
 Reviewed By _____ Date _____
 Approved By _____ Date _____

P-5 Rising Head Tests

Time	H/H ₀	Time	H/H ₀	Time	H/H ₀
1.0	98.5	11.0	65.1	117.0	4.2
1.5	97.0	12.0	62.3	158.0	3.5
2.0	95.4	13.0	59.7	200.0	3.0
2.5	93.4	14.0	57.1	1096.0	2.2
3.0	91.6	15.0	54.6		
3.5	89.9	20.0	43.8		
4.0	88.0	25.0	35.2		
4.5	86.2	30.0	28.3		
5.0	84.6	40.0	18.8		
6.0	80.8	50.0	13.1		
7.0	77.5	60.0	9.6		
8.0	74.2	70.0	7.5		
9.0	71.1	80.0	6.3		
10.0	68.0				

$$Tb/rc^2 = 1$$

$$\alpha = 10^{-7} \text{ @ } b = 6 \text{ minutes}$$

$$T = rc^2/b$$

$$= (1 \text{ in})^2 / 6 \text{ min}$$

$$= .167 \text{ in}^2/\text{min} \times (2.54 \text{ cm}^2/\text{in}^2 \times \text{min}/60 \text{ sec})$$

$$= 0.018 \text{ cm}^2/\text{sec}$$

$$K = T/b$$

$$= 0.018 \text{ cm}^2/\text{sec} \times 1/548.64 \text{ cm}$$

$$K = 3.27 \times 10^{-5} \text{ cm/sec}$$

w/ Aquasolve Program (thru Recovery)

$$T = 4.877 \times 10^{-3} \text{ ft}^2/\text{min} \times (12 \text{ in}^2/\text{ft}^2 \times 0.54 \text{ cm}^2/\text{in}^2 \times \text{min}/60 \text{ sec})$$

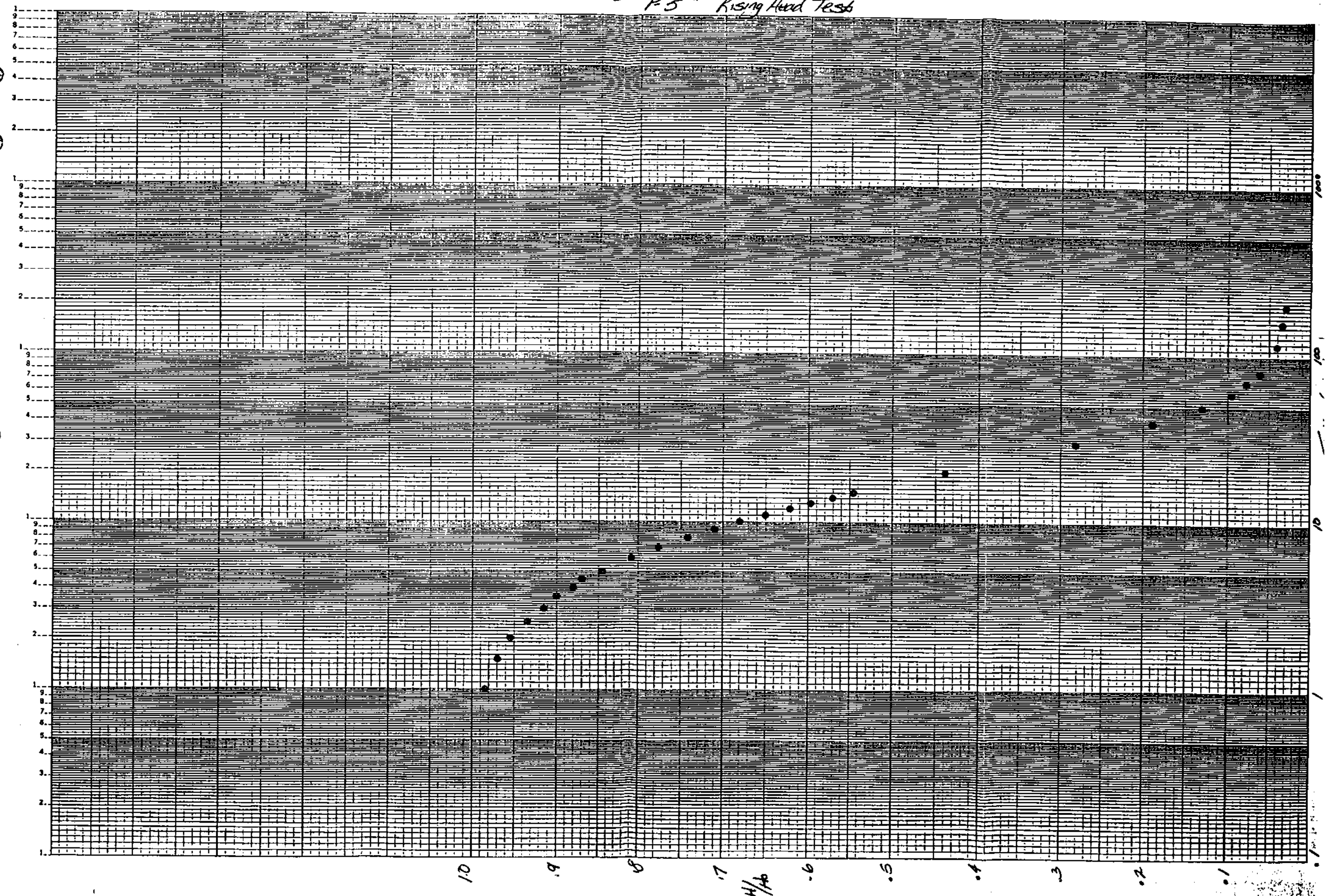
$$T = 7.53 \times 10^{-2} \text{ cm}^2/\text{sec}$$

$$K = T/b = 1.38 \times 10^{-4} \text{ cm}^2/\text{sec}$$

P-5 Rising Head Test

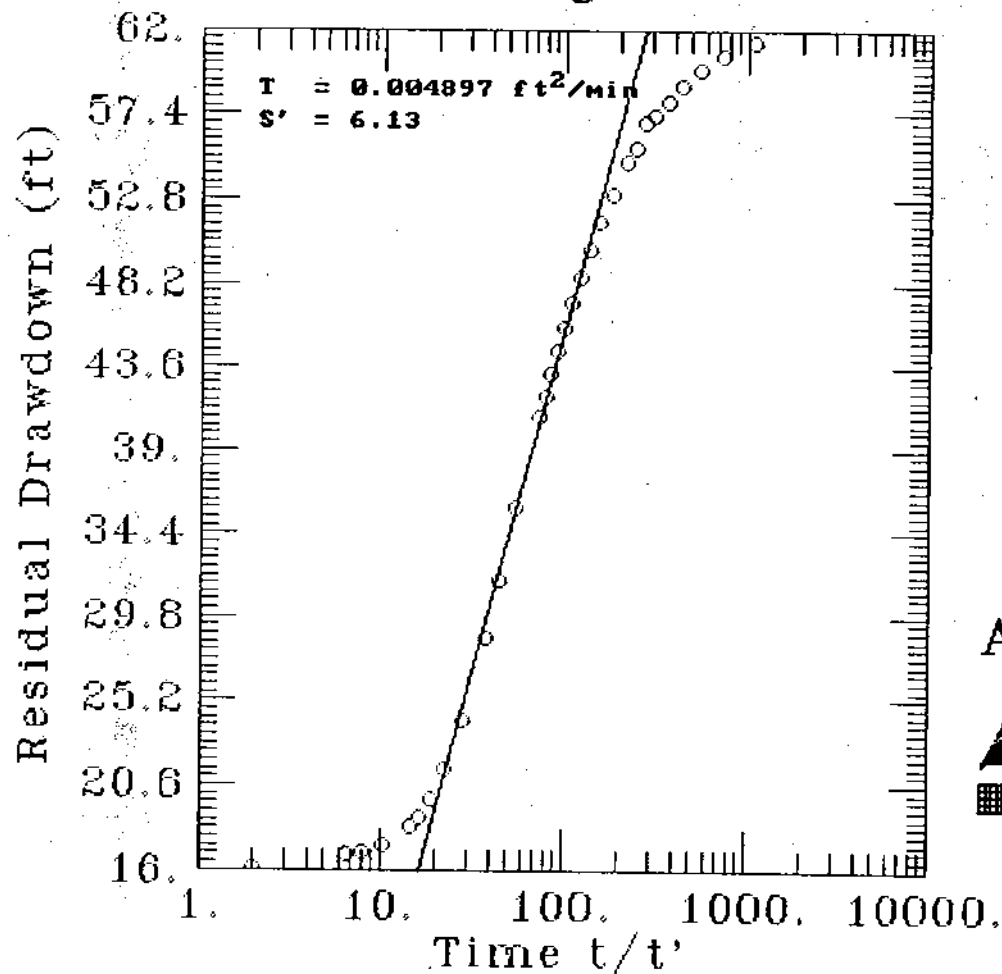
47 6210

K-E SEMI-LOGARITHMIC 5 CYCLES X 150 DIVISIONS
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muskogee P5

$$T = 0.076 \text{ cm}^2/\text{s.}$$



AQTESOLV



GERAGHTY
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Modeling Group

CLIENT WMO
 PROJECT Muskogee Hydro

 SUBJECT Pena Tests

 Prepared By CH Date _____

Reviewed By _____ Date _____

Approved By _____ Date _____

P-6 Ring Head Test

$$\text{Aquifer Thickness, } b = 35.5 - 11 = 24.5 \text{ ft} \times 12 \text{ in/ft} \times 2.54 \text{ cm/in} \\ = 746.76 \text{ cm for entire zone B}$$

* Use just like pack zone since well/piezometer is partially penetrating

$$b = 23 - 11 = 12 \text{ ft} \times 12 \text{ in/ft} \times 2.54 \text{ cm/in}$$

$$b = 365.76 \text{ cm}$$

 Radius, $r_c = 1 \text{ in}$

$$H-h / H_0-h = H/H_0$$

$$H_0 = 25.35 \text{ ft}$$

 $H = \text{as per field notes}$

$$h = 12.35 \text{ ft}$$

Time, H, ft
Time H, ft

0.5	24.35	11.0	20.05
1.0	23.55	12.0	19.91
1.5	23.15	13.0	19.77
2.0	22.88	14.0	19.64
2.5	22.66	15.0	19.49
3.0	22.50	20.0	18.89
3.5	22.31	25.0	18.38
4.0	22.13	30.0	17.93
4.5	21.82	40.0	16.90
5.0	21.49	50.0	15.45
6.0	21.10	70.0	13.73
7.0	20.87	80.0	13.27
8.0	20.74	90.0	12.96
9.0	20.55	100.0	12.74
10.0	20.22	179.0	12.35

 $< 35.0 \quad 17.54$
 $< 60. \quad 14.45$

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SUBJECT _____

Prepared By _____ Date _____

PROJECT _____

Reviewed By _____ Date _____

Approved By _____ Date _____

Time , H/Ao

0.5	.923
1.0	.862
1.5	.831
2.0	.810
2.5	.793
3.0	.781
3.5	.766
4.0	.752
4.5	.728
5.0	.703
6.0	.673
7.0	.655
8.0	.645
9.0	.631
10.0	.605

Time , H/Ao

11.0	.592
12.0	.582
13.0	.571
14.0	.561
15.0	.549
20.0	.503
25.0	.464
30.0	.429
35.0	.399
40.0	.350
50.0	.238
60.0	.162
70.0	.106
80.0	.071
90.0	.047
100.0	.030
179.0	0

$$T \cdot t / r^2 = 1$$

$$\alpha = 10^{-2} \text{ cm}^2/\text{sec} \quad C_b = 18 \text{ min}$$

$$T = r^2 / t$$

$$= (1 \text{ in})^2 / 18 \text{ min} \times (2.54 \text{ cm})^2 / \text{in}^2 \times \text{min} / 60 \text{ sec}$$

$$T = .006 \text{ cm}^2/\text{sec}$$

$$K = T / b$$

$$= .006 \text{ cm}^2/\text{sec} \times 365.76 \text{ cm}$$

$$K = 1.63 \times 10^{-5} \text{ cm/sec}$$

ii/ Analyze Program (Theiss Recovery)

$$T = 3.93 \times 10^{-2} \text{ ft}^2/\text{min} \times \text{min}/60 \text{ sec} \times (12 \text{ in})^2 / \text{ft}^2 \times (2.54)^2 \text{ cm}^2 / \text{in}^2$$

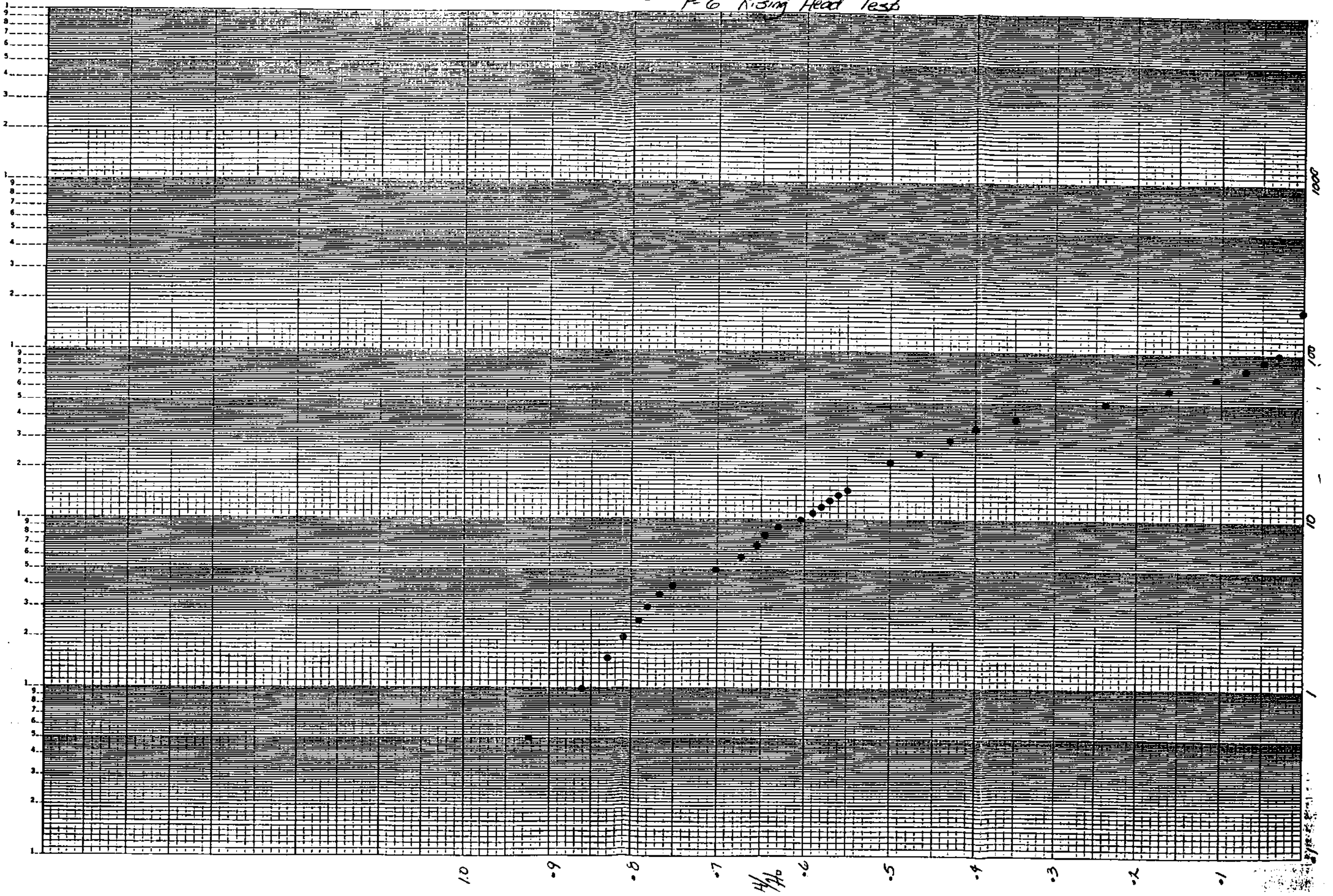
$$T = 6.09 \times 10^{-3} \text{ cm}^2/\text{sec}$$

$$K = T / b = 1.66 \times 10^{-3} \text{ cm/sec}$$

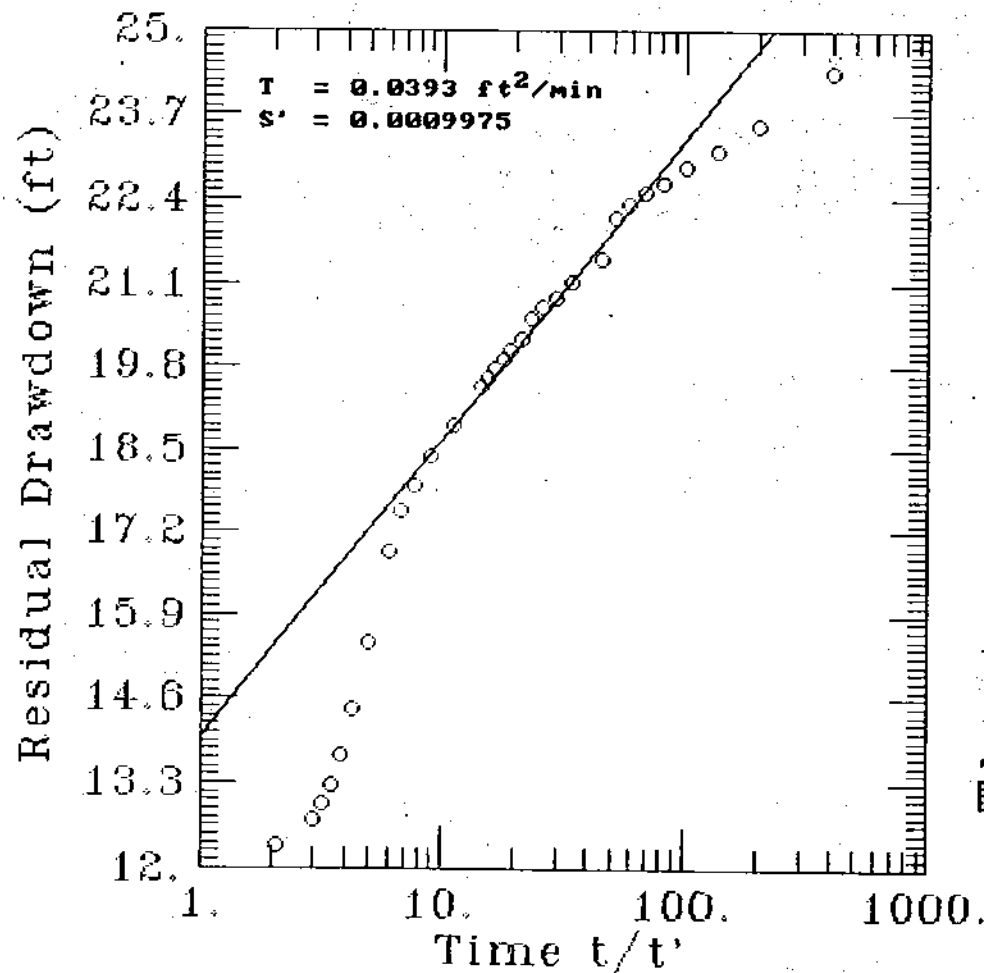
MUSKOGEE COMMUNITY CENTER
P-6 Rising Head Test

47 6210

K-E SEMI-LOGARITHMIC 3 CYCLES X 150 DIVISIONS
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MUSKOGEE P6



$$T = 0.6^{\circ} \text{cm}^2/\text{s}$$

$$K = 2 \times 10^{-3}$$

AQTESOLV

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& MILLER, INC.

Modeling Group

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Prepared By _____ Date _____

PROJECT _____

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Approved By _____ Date _____

P-9 Rising Head Test

$$\text{Aquifer thickness, } b = 85' - 65' = 20 \text{ ft} \left(\frac{1 \text{ ft}}{12 \text{ in}} \times 12 \text{ in} \times 2.5 \text{ ft/in} \right) \text{ plus core}$$

$$= 609.60 \text{ cm}$$

 Casing radius, $r_c = 1 \text{ in}$
 $H_0 = 83.65$
 $H = \text{As per field notes}$
 $h = 20.56$

$$H/H_0 = H - h / H_0 - h$$

Time, min H, ft

1.0	83.44
1.5	83.31
2.0	83.18
2.5	83.05
3.0	82.94
3.5	82.86
4.0	82.77
4.5	82.69
5.0	82.59
6.0	82.42
7.0	82.25
8.0	82.08
9.0	81.94
10.0	81.80
11.0	—
12.0	81.53
13.0	81.38
14.0	81.25
15.0	81.12

Time, min H, ft

20.0	80.43
25.0	79.65
30.0	79.32
40.0	78.22
50.0	76.69
60.0	75.19
70.0	—
80.0	—
90.0	70.92
100.0	69.63
110.0	68.36
120.0	67.12
150.0	63.64
180.0	60.48
210.0	57.46
225.0	55.82
1321.0	23.90
2756.0	21.44

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P-9 Rising Head Test

<u>Time</u>	<u>H/H₀</u>	<u>Time</u>	<u>H/H₀</u>
1.0	.997	20.0	.949
1.5	.995	25.0	.940
2.0	.993	30.0	.931
2.5	.990	40.0	.914
3.0	.990	50.0	.890
3.5	.987	60.0	.866
4.0	.986	70.0	—
4.5	.985	80.0	—
5.0	.983	90.0	.798
6.0	.981	100.0	.778
7.0	.978	110.0	.758
8.0	.975	120.0	.738
9.0	.973	150.0	.682
10.0	.971	180.0	.623
11.0	—	210.0	.585
12.0	.966	228.0	.559
13.0	.964	1321.0	.053
14.0	.962	2756.0	.014
15.0	.960		

$$Tt/rc^2 = 1$$

$$@ \alpha = 10^{-9} \quad @ t = 16 \text{ min}$$

$$T = rc^2/k$$

$$= (1 \text{ in})^2 / 16 \text{ min} \times (2.54 \text{ cm/in})^2 \times \text{min}/60 \text{ sec}$$

$$T = .001 \text{ cm}^2/\text{sec}$$

$$K = T/b$$

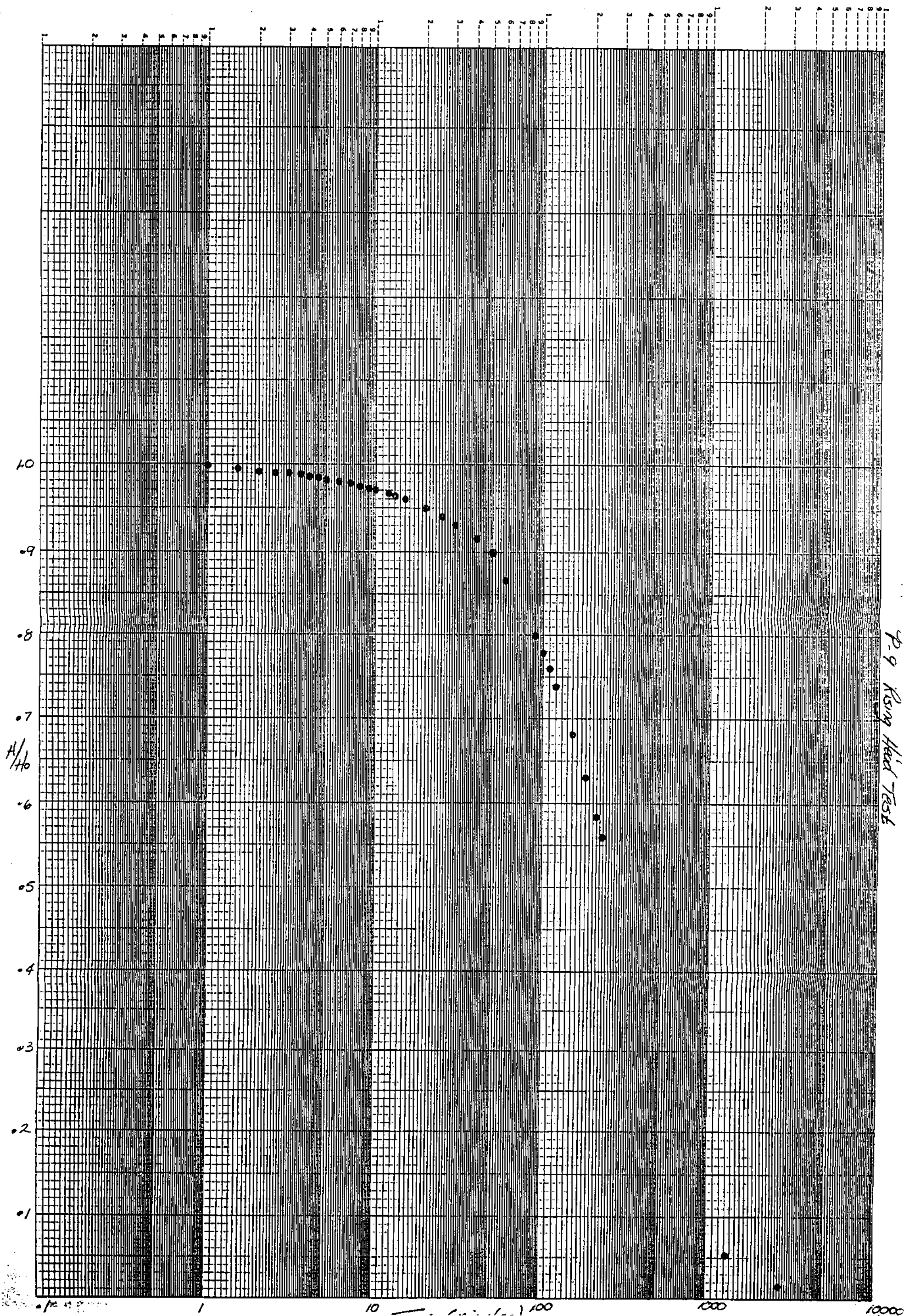
$$= .001 \text{ cm}^2/\text{sec} \times 1/609.60 \text{ cm}$$

$$K = 2.32 \times 10^{-6} \text{ cm}^2/\text{sec}$$

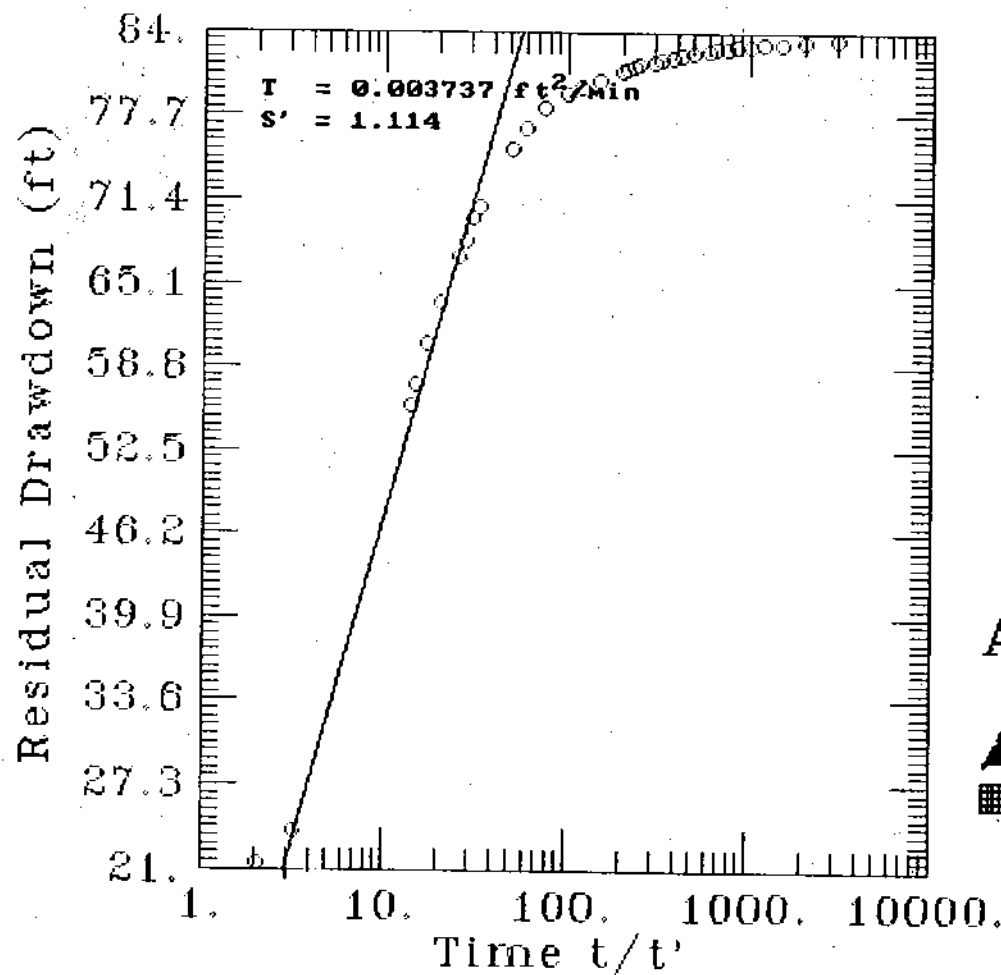
w/ Aqle 301/11

$$T = 3.737 \times 10^{-3} \text{ cm}^2/\text{min} \times (12 \text{ in})^2/k \times (2.54 \text{ cm/in})^2 \times \text{min}/60 \text{ sec}$$

$$K = T/b = 5.79 \times 10^{-2} \text{ cm}^2/\text{sec} / 609.60 \text{ cm} = 9.49 \times 10^{-5} \text{ cm}^2/\text{sec}$$



MUSKOGEE P9



$$T = 6.0 \text{ cm}^2/\text{s}$$

$$K = 9.49 \times 10^{-5}$$

AQTESOLV

GERAGHTY
 & MILLER, INC.
 Modeling Group

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P-8 Rising Head Tests

Aquifer Thickness, $b = 35 \frac{ft}{ft} \times 12 \frac{in}{ft} \times 2.54 \frac{cm}{in} = 1066.80 \text{ cm}$

Casing radius, $r_c = 1 \text{ in}$

$H =$
 $H_0 =$
 $h =$

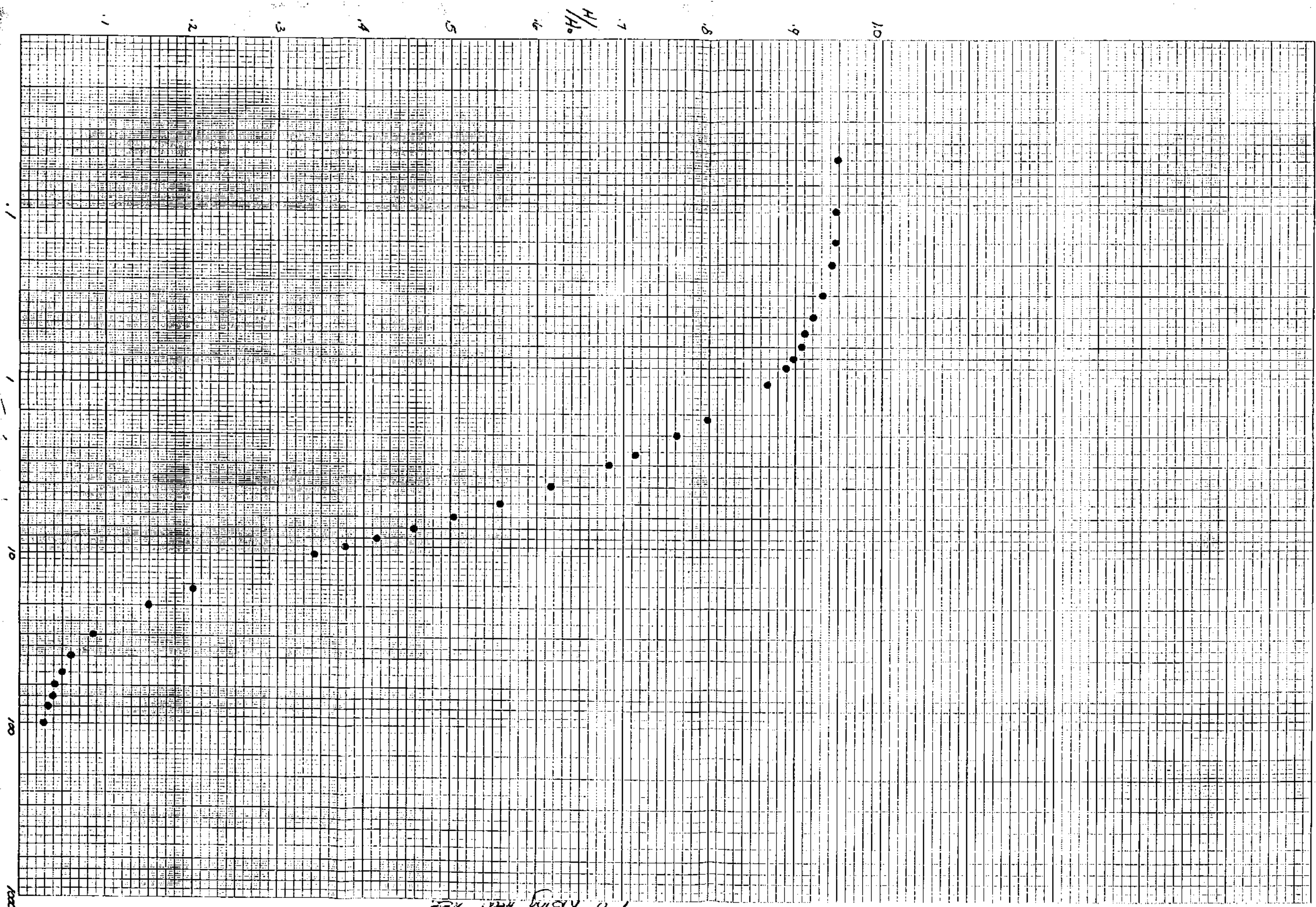
} see data sheet

$$T \frac{b}{r_c^2} = 1 \quad L = 3.7 \text{ mm} \quad \alpha = 10^{-4}$$

$$\begin{aligned}
 T &= r_c^2 / L \\
 &= (1 \text{ in})^2 / 3.7 \text{ mm} \times (2.54 \text{ cm/in})^2 \times \text{min} / 60 \text{ sec} \\
 T &= 0.029 \text{ cm}^2/\text{sec}
 \end{aligned}$$

$$\begin{aligned}
 K &= T / b \\
 &= 0.029 \text{ cm}^2/\text{sec} \times 1 / 1066.80 \text{ cm} \\
 K &= 2.72 \times 10^{-5} \text{ cm/sec}
 \end{aligned}$$

Muskogee Community Landfill PS Rising Head Test															
read no. min	H(t).ft	h.ft	Ho.ft	H(t)-h/ Ho-h	Elapsed Time.min	H(t).ft	h.ft	Ho.ft	H(t)-h/ Ho-h	Elapsed Time.min	H(t).ft	h.ft	Ho.ft	H(t)-h/ Ho-h	
0	39.58	95.91	34.548	0.817995	0.3	39.725	95.91	34.548	0.931929	9.2	73.217	95.91	34.548	0.365822	
0.0033	37.943	95.91	34.548	0.945324	0.3033	38.788	95.91	34.548	0.930902	9.4	73.644	95.91	34.548	0.362865	
0.0066	36.479	95.91	34.548	0.988531	0.3066	38.757	95.91	34.548	0.931407	9.8	74.072	95.91	34.548	0.365886	
0.01	35.34	95.91	34.548	0.987093	0.31	38.82	95.91	34.548	0.930304	9.8	74.484	95.91	34.548	0.369174	
0.0133	34.548	95.91	34.548	1	0.3133	38.788	95.91	34.548	0.930602	10	74.878	95.91	34.548	0.372737	
0.0166	33.577	95.91	34.548	0.983251	0.3166	38.852	95.91	34.548	0.929459	12	75.474	95.91	34.548	0.378415	
0.02	40.054	95.91	34.548	0.91027	0.32	38.788	95.91	34.548	0.930502	14	81.294	95.91	34.548	0.238193	
0.0233	42.259	95.91	34.548	0.874678	0.3233	38.867	95.91	34.548	0.929814	16	83.543	95.91	34.548	0.201542	
0.0266	42.744	95.91	34.548	0.868432	0.3266	38.836	95.91	34.548	0.93012	18	85.349	95.91	34.548	0.17211	
0.03	40.655	95.91	34.548	0.900476	0.33	38.931	95.91	34.548	0.928571	20	88.791	95.91	34.548	0.14881	
0.0333	39.374	95.91	34.548	0.927352	0.3333	38.899	95.91	34.548	0.929093	22	87.948	95.91	34.548	0.129755	
0.0366	37.428	95.91	34.548	0.953065	0.3366	39.042	95.91	34.548	0.926762	24	88.883	95.91	34.548	0.114517	
0.04	36.684	95.91	34.548	0.96519	0.3666	39.152	95.91	34.548	0.92497	26	89.626	95.91	34.548	0.102409	
0.0433	36.463	95.91	34.548	0.968792	0.3633	39.295	95.91	34.548	0.922638	28	90.229	95.91	34.548	0.092582	
0.0466	36.922	95.91	34.548	0.961312	0.4	39.39	95.91	34.548	0.921091	30	90.72	95.91	34.548	0.08458	
0.05	37.728	95.91	34.548	0.948176	0.4166	39.406	95.91	34.548	0.92083	32	91.116	95.91	34.548	0.078127	
0.0533	38.314	95.91	34.548	0.938627	0.4333	39.564	95.91	34.548	0.918256	34	91.465	95.91	34.548	0.072439	
0.0566	38.82	95.91	34.548	0.93038	0.45	39.659	95.91	34.548	0.916707	36	91.75	95.91	34.548	0.067794	
0.06	38.856	95.91	34.548	0.93012	0.4666	39.785	95.91	34.548	0.914654	38	91.887	95.91	34.548	0.063832	
0.0633	38.63	95.91	34.548	0.933477	0.4833	39.785	95.91	34.548	0.914654	40	92.194	95.91	34.548	0.060559	
0.0666	38.203	95.91	34.548	0.940435	0.5	39.898	95.91	34.548	0.912848	42	92.368	95.91	34.548	0.057723	
0.07	37.855	95.91	34.548	0.946107	0.5166	39.959	95.91	34.548	0.911818	44	92.528	95.91	34.548	0.055148	
0.0733	37.602	95.91	34.548	0.95023	0.5333	40.023	95.91	34.548	0.910775	46	92.869	95.91	34.548	0.052816	
0.0766	37.539	95.91	34.548	0.951256	0.55	40.086	95.91	34.548	0.909749	48	92.78	95.91	34.548	0.051009	
0.08	37.602	95.91	34.548	0.95023	0.5666	40.149	95.91	34.548	0.908722	50	92.89	95.91	34.548	0.049216	
0.0833	37.776	95.91	34.548	0.947394	0.5833	40.228	95.91	34.548	0.907435	52	92.966	95.91	34.548	0.047652	
0.0866	37.871	95.91	34.548	0.945846	0.6	40.26	95.91	34.548	0.906913	54	93.081	95.91	34.548	0.046103	
0.09	37.997	95.91	34.548	0.943793	0.6166	40.371	95.91	34.548	0.905104	56	93.16	95.91	34.548	0.044616	
0.0933	37.968	95.91	34.548	0.944298	0.6333	40.45	95.91	34.548	0.903817	58	93.239	95.91	34.548	0.04329	
0.0966	37.95	95.91	34.548	0.944559	0.65	40.529	95.91	34.548	0.902529	60	93.303	95.91	34.548	0.042486	
0.1	37.839	95.91	34.548	0.948367	0.6666	40.624	95.91	34.548	0.900981	62	93.382	95.91	34.548	0.041198	
0.1033	37.776	95.91	34.548	0.947394	0.6833	40.687	95.91	34.548	0.899954	64	93.445	95.91	34.548	0.040171	
0.1066	37.713	95.91	34.548	0.948421	0.7	40.782	95.91	34.548	0.898406	66	93.493	95.91	34.548	0.039389	
0.11	37.681	95.91	34.548	0.948942	0.7166	40.861	95.91	34.548	0.897119	68	93.557	95.91	34.548	0.038348	
0.1133	37.76	95.91	34.548	0.947855	0.7333	40.94	95.91	34.548	0.895831	70	93.603	95.91	34.548	0.037597	
0.1166	37.681	95.91	34.548	0.948942	0.75	41.019	95.91	34.548	0.894544	72	93.651	95.91	34.548	0.036814	
0.12	37.819	95.91	34.548	0.946367	0.7666	41.13	95.91	34.548	0.892735	74	93.699	95.91	34.548	0.036032	
0.1233	37.728	95.91	34.548	0.948176	0.7833	41.209	95.91	34.548	0.891447	76	93.747	95.91	34.548	0.03525	
0.1266	37.855	95.91	34.548	0.946107	0.8	41.304	95.91	34.548	0.889899	78	93.794	95.91	34.548	0.034484	
0.13	37.728	95.91	34.548	0.948176	0.8166	41.399	95.91	34.548	0.888351	80	93.826	95.91	34.548	0.033927	
0.1333	37.808	95.91	34.548	0.946873	0.8333	41.51	95.91	34.548	0.886542	82	93.873	95.91	34.548	0.033196	
0.1366	37.697	95.91	34.548	0.948502	0.85	41.605	95.91	34.548	0.884994	84	93.921	95.91	34.548	0.032414	
0.14	37.792	95.91	34.548	0.947133	0.8666	41.747	95.91	34.548	0.88268	86	93.952	95.91	34.548	0.031909	
0.1433	37.728	95.91	34.548	0.948176	0.8833	41.826	95.91	34.548	0.881392	88	93.984	95.91	34.548	0.031388	
0.1466	37.808	95.91	34.548	0.946873	0.9	41.969	95.91	34.548	0.879062	90	94.018	95.91	34.548	0.030866	
0.15	37.776	95.91	34.548	0.947394	0.9166	42.064	95.91	34.548	0.877514	92	94.047	95.91	34.548	0.030381	
0.1533	37.823	95.91	34.548	0.946678	0.9333	42.174	95.91	34.548	0.875721	94	94.079	95.91	34.548	0.029893	
0.1566	37.839	95.91	34.548	0.946367	0.95	42.317	95.91	34.548	0.873391	96	94.111	95.91	34.548	0.029318	
0.16	37.871	95.91	34.548	0.945846	0.9666	42.444	95.91	34.548	0.871321	98	94.142	95.91	34.548	0.028813	
0.1633	37.839	95.91	34.548	0.946367	0.9833	42.538	95.91	34.548	0.869789	100	94.174	95.91	34.548	0.028291	
0.1666	37.871	95.91	34.548	0.945846	1	42.681	95.91	34.548	0.867459	120	94.412	95.91	34.548	0.024413	
0.17	37.871	95.91	34.548	0.945846	1.2	44.373	95.91	34.548	0.838842	140	94.602	95.91	34.548	0.021316	
0.1733	37.916	95.91	34.548	0.94508	1.4	45.782	95.91	34.548	0.816923	160	94.744	95.91	34.548	0.019002	
0.1766	37.934	95.91	34.548	0.943819	1.6	46.985	95.91	34.548	0.797518	180	94.871	95.91	34.548	0.016937	
0.18	37.981	95.91	34.548	0.941053	1.8	48.061	95.91	34.548	0.779782	200	94.983	95.91	34.548	0.015107	
0.1833	37.981	95.91	34.548	0.941053	2	49.137	95.91	34.548	0.762247	220	95.061	95.91	34.548	0.013836	
0.1866	37.981	95.91	34.548	0.941053	2.2	50.166	95.91	34.548	0.745478	240	95.141	95.91	34.548	0.012532	
0.19	38.029	95.91	34.548	0.943271	2.4	51.147	95.91	34.548	0.729491	260	95.22	95.91	34.548	0.011245	
0.1933	37.997	95.91	34.548	0.943793	2.6	52.113	95.91	34.548	0.713748	280	95.283	95.91	34.548	0.010218	
0.1966	38.029	95.91	34.548	0.943271	2.8	53.03	95.91	34.548	0.698804	300	95.296	95.91	34.548	0.009957	
0.2	38.045	95.91	34.548	0.94301	3	53.933	95.91	34.548	0.684088	320	95.347	95.91	34.548	0.009175	
0.2033	38.045	95.91	34.548	0.94301	3.2	54.803	95.91	34.548	0.66991	340	95.394	95.91	34.548	0.008409	
0.2066	38.092	95.91	34.548	0.942244	3.4	55.658	95.91	34.548	0.655976	360	95.442	95.91	34.548	0.007627	
0.21	38.077	95.91	34.548	0.942489	3.6	56.497	95.91	34.548	0.642203	380	95.491	95.91	34.548	0.006845	
0.2133	38.14	95.91	34.548	0.941462	3.8	57.304	95.91	34.548	0.629152	400	95.521	95.91	34.548	0.006339	
0.2166	38.14	95.91	34.548	0.941462	4	58.086	95.91	34.548	0.616245	420	95.553	95.91	34.548	0.005818	
0.22	38.172	95.91	34.548	0.940941	4.2	58.871	95.91	34.548	0.603615	440	95.584	95.91	34.548	0.005313	
0.2233	38.187	95.91	34.548	0.940896	4.4	59.631	95.91	34.548	0.591229	460	95.618	95.91	34.548	0.004919	
0.2266	38.235	95.91	34.548	0.939914	4.6	60.359	95.91	34.548	0.579365	480	95.632	95.91	34.548	0.00453	
0.23	38.235	95.91	34.548	0.939914	4.8	61.072	95.91	34.548	0.567746	500	95.664	95.91	34.548	0.004009	
0.2333	38.266	95.91	34.548	0.939409	5	61.752	95.91	34.548	0.556664	520	95.696	95.91	34.548	0.003488	
0.2366	38.296	95.91	34.548	0.938897	5.2	62.433	95.91	34.548	0.545566	540	95.711	95.91	34.548	0.003243	
0.24	38.33	95.91	34.548	0.938365	5.4	63.098	95.91	3							



Plot of H/A vs. $\log H/A$
for rising flow

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P-10 Rising Head Test

$$L_w = 14.17$$

$$H = 23.42$$

$$K = \frac{r_c^2 \ln(R_e/r_w)}{2Le} \frac{1}{b} \ln \frac{y_0}{y_1}$$

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

$$= \left[\frac{1.1}{\ln(14.17/1.3)} + \frac{1.75 + 0.35 \ln[(23.42 - 14.17)/1.3]}{8.33} \right]^{-1}$$

$$\ln R_e/r_w = 1.56$$

Note: water level used for calculation of L_w and H
taken on 12/22/93

$$r_c = \left[(1-.3)(1.08)^2 + (.3)(.3)^2 \right]^{1/2}$$

$$= 0.17$$

$$K = \frac{r_c^2 \ln(R_e/r_w)}{2Le} \frac{1}{b} \ln \frac{y_0}{y_1}$$

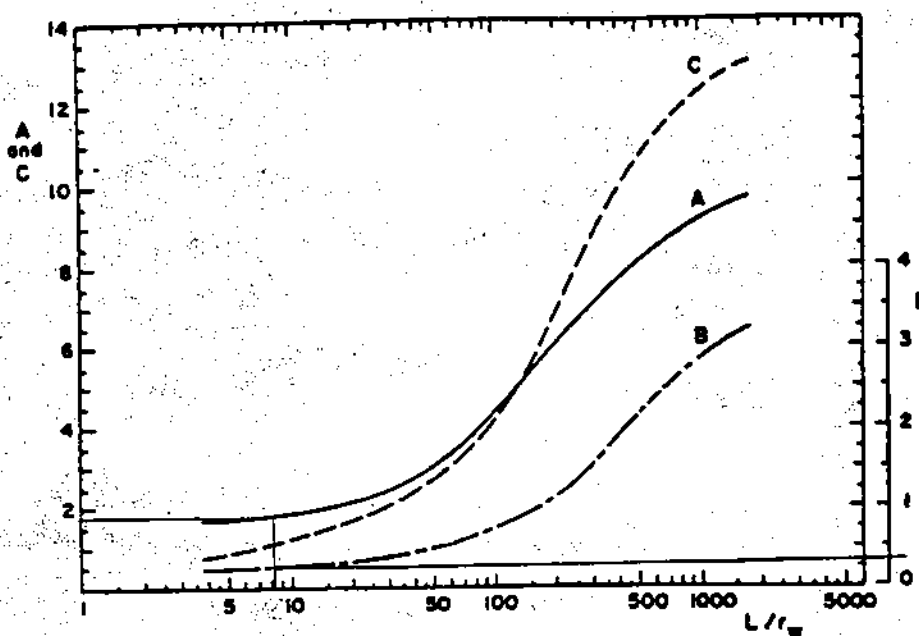
$$= \frac{(0.17)^2 (1.56)}{2(2.5)} \frac{1}{500} \ln \left(\frac{0.96}{1.89} \right)$$

$$K = 1.37 \times 10^{-6} \text{ ft}^2/\text{min} \times 12 \text{ in/ft} \times 2.54 \text{ cm/in} \times \text{min}/60 \text{ sec}$$

$$K = 6.94 \times 10^{-7} \text{ cm}^2/\text{sec}$$

P-10 Rising Head Test

BOLWER AND RICE: GROUNDWATER HYDRAULICS



Curves relating coefficients A, B, and C to L/r_w

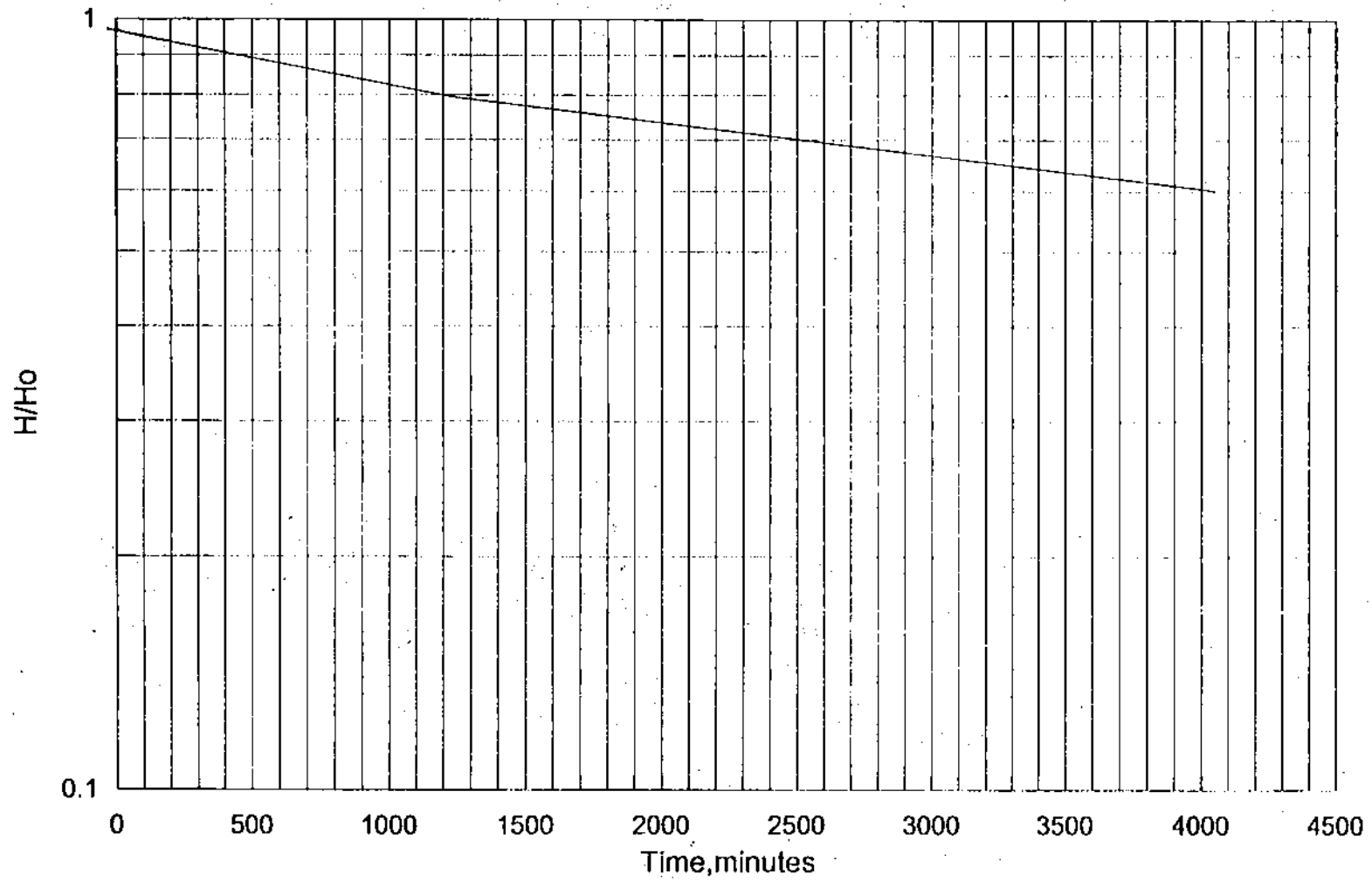
$$L/r_w = \frac{25}{3} = 8.33$$

$$A = 1.75$$

$$B = 0.35$$

Muskogee Community Landfill

P10 Rising Head Test



	Muskogee Community Landfill			
	P10 Rising Head Test			
Elapsed Time,min	H(t),ft	h,ft	Ho,ft	H(t)-h/Ho-h
0	27.1	16.39	27.1	1
0.5	26.95	16.39	27.1	0.985994
1	26.95	16.39	27.1	0.985994
1.5	26.91	16.39	27.1	0.98226
2	26.88	16.39	27.1	0.979458
2.5	26.87	16.39	27.1	0.978525
3	26.85	16.39	27.1	0.976657
3.5	26.84	16.39	27.1	0.975724
4	26.83	16.39	27.1	0.97479
4.5	26.81	16.39	27.1	0.972923
6	26.79	16.39	27.1	0.971055
7	26.78	16.39	27.1	0.970121
8	26.77	16.39	27.1	0.969188
9	26.76	16.39	27.1	0.968254
10	26.75	16.39	27.1	0.96732
15	26.73	16.39	27.1	0.965453
20	26.71	16.39	27.1	0.963585
30	26.68	16.39	27.1	0.960784
60	26.62	16.39	27.1	0.955182
90	26.57	16.39	27.1	0.950514
120	26.53	16.39	27.1	0.946779
1230	24.91	16.39	27.1	0.795518
4055	22.84	16.39	27.1	0.602241

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Approved By _____ Date _____

P-11 Rising Head Test - Modified Boussinesq

$$\ln \frac{r_e}{r_w} = \left[\frac{1.1}{\ln(L_w/r_w)} + \frac{4.53 \ln[(H-L_w)/r_w]}{L_e/r_w} \right]^{-1}$$

$H = 21.54$
 $L_w = 18.07$

$$= \left[\frac{1.1}{\ln(18.07/1.3)} + \frac{2.55 + 0.4 \ln[(21.54 - 18.07)/1.3]}{33.33} \right]^{-1}$$

$$\ln \frac{r_e}{r_w} = 2.67$$

$$r_c = \left[(1-n)r_e^2 + n r_w^2 \right]^{1/2}$$

$$= \left[(1-.3)(1.08)^2 + (.3)(1.3)^2 \right]^{1/2}$$

$$= 0.17$$

$$K = \frac{r_c^2 \ln(r_e/r_w)}{2 L_e} \times \frac{1}{\ln(1/1/4)}$$

$$= \frac{(0.17)^2 (2.67)}{2(10)} \times \frac{1}{200} \ln(1.74/1.49)$$

$$K = 7.95 \times 10^{-6} \text{ ft}^2/\text{min} \times 12 \text{ in/ft} \times 2.54 \text{ cm/in} \times \text{min}/60 \text{ sec}$$

$$K = 4.04 \times 10^{-6} \text{ cm/sec}$$

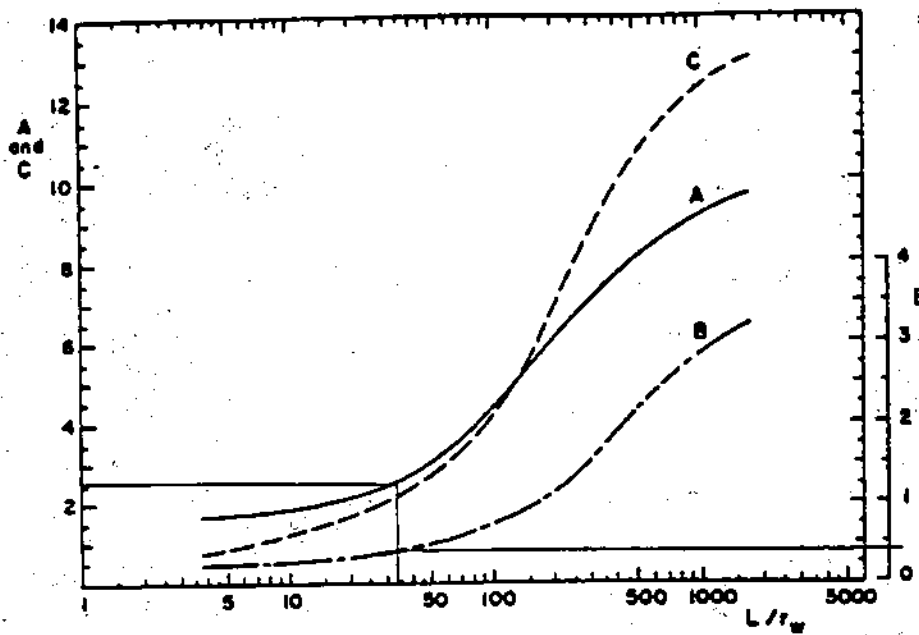
w/ Aqtesolve Program

$$K = 5.41 \times 10^{-5} \text{ ft}^2/\text{min} \times 12 \text{ in/ft} \times 2.54 \text{ cm/in} \times \text{min}/60 \text{ sec}$$

$$= 2.75 \times 10^{-5} \text{ cm/sec}$$

P-11 Rising Head Test

BOLWER AND RICE: GROUNDWATER HYDRAULICS



Curves relating coefficients A, B, and C to L/r_w .

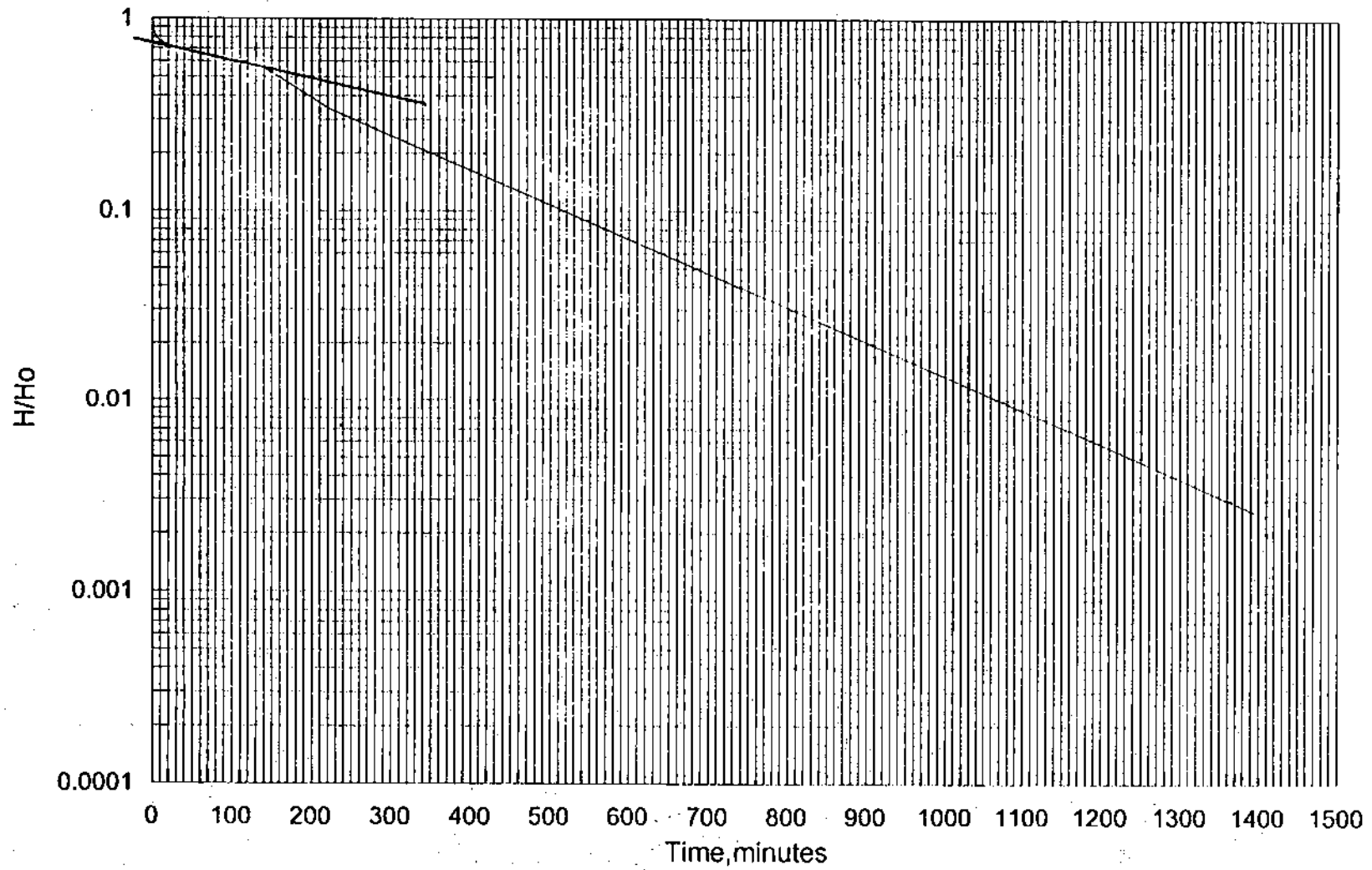
$$L_e/r_w = 10/.3 = 33.33$$

$$A = 2.55$$

$$B = 0.40$$

Muskogee Community Landfill

P11 Rising Head Test



	Muskogee Community Landfill			
	P11 Rising Head Test			
Elapsed Time,min	H(t),ft	h,ft	Ho,ft	H(t)-h/Ho-h
0	21.6	6.18	21.6	1
1	20.94	6.18	21.6	0.957198
1.5	20.34	6.18	21.6	0.918288
2	19.86	6.18	21.6	0.88716
2.5	19.5	6.18	21.6	0.863813
3	19.14	6.18	21.6	0.840467
3.5	18.91	6.18	21.6	0.825551
4	18.76	6.18	21.6	0.815824
4.5	18.63	6.18	21.6	0.807393
5	18.53	6.18	21.6	0.800908
6	18.36	6.18	21.6	0.789883
7	18.23	6.18	21.6	0.781453
8	18.13	6.18	21.6	0.774968
9	18.04	6.18	21.6	0.769131
10	17.95	6.18	21.6	0.763294
11	17.88	6.18	21.6	0.758755
12	17.81	6.18	21.6	0.754215
13	17.74	6.18	21.6	0.749676
14	17.68	6.18	21.6	0.745785
15	17.63	6.18	21.6	0.742542
20	17.41	6.18	21.6	0.728275
25	17.22	6.18	21.6	0.715953
30	17.07	6.18	21.6	0.706226
40	16.78	6.18	21.6	0.687419
50	16.52	6.18	21.6	0.670558
60	16.29	6.18	21.6	0.655642
70	16.07	6.18	21.6	0.641375
80	15.84	6.18	21.6	0.626459
90	15.66	6.18	21.6	0.614786
100	15.46	6.18	21.6	0.601816
139	14.78	6.18	21.6	0.557717
157	13.98	6.18	21.6	0.505837
222	11.42	6.18	21.6	0.339818
1396	6.22	6.18	21.6	0.002594

CLIENT WMO

 SUBJECT Pem Tests

 Prepared By GH Date 12/13/93

 PROJECT Mux. Hydro -

Reviewed By ____ Date ____

geo

Approved By ____ Date ____

P-11 Rising Head Test

$$\text{Aquifer Thickness, } b = 21.6' - 9' = 12.6 \text{ (filter pack) } \times \frac{12 \text{ in}}{1 \text{ ft}} \times \frac{2.54 \text{ cm}}{1 \text{ in}}$$

$$= 384.05 \text{ cm}$$

 Casing Radius, $r_c = 1 \text{ in}$

$$H_0 = 21.60 \text{ ft}$$

$$H/H_0 = H-h/H_0-h$$

$$H = \text{As per field notes}$$

$$h = 6.18 \text{ ft}$$

Time, H, ft
Time, H, ft

1.0	20.94
1.5	20.34
2.0	19.86
2.5	19.50
3.0	19.14
3.5	18.91
4.0	18.76
4.5	18.63
5.0	18.53
6.0	18.36
7.0	18.23
8.0	18.13
9.0	18.04
10.0	17.95
11.0	17.88
12.0	17.81
13.0	17.74
14.0	17.68
15.0	17.63

20.0	17.41
25.0	17.22
30.0	17.07
40.0	16.78
50.0	16.52
60.0	16.29
70.0	16.07
80.0	15.84
90.0	15.66
100.0	15.46
139.0	14.78
157.0	13.98
222.0	11.42
1396.0	6.05 6.22

CLIENT _____

SUBJECT _____

Prepared By _____ Date _____

PROJECT _____

Reviewed By _____ Date _____

Approved By _____ Date _____

P. 11 Rising Head Test

<u>Time</u>	<u>H/H₀</u>	<u>Time</u>	<u>H/H₀</u>
1.0	.957	20.0	.728
1.5	.918	25.0	.716
2.0	.887	30.0	.706
2.5	.864	40.0	.687
3.0	.840	50.0	.671
3.5	.826	60.0	.656
4.0	.816	70.0	.641
4.5	.807	80.0	.626
5.0	.801	90.0	.615
6.0	.790	100.0	.602
7.0	.781	139.0	.558
8.0	.775	157.0	.506
9.0	.769	222.0	.340
10.0	.763	1396.0	0.003
11.0	.759		
12.0	.754		
13.0	.750		
14.0	.746		
15.0	.743		

Cooper eq. a)

$$Tb/rc^2 = 1$$

$$T = rc^2/t$$

$$= (in)^2 / 45 \text{ min} \times (2.54 \text{ cm}^2/in^2 \times \text{min}/60 \text{ sec})$$

$$T = .002 \text{ cm}^2/\text{sec}$$

$$K = T/b$$

$$= .002 \text{ cm}^2/\text{sec} \times 1/384.05 \text{ cm}$$

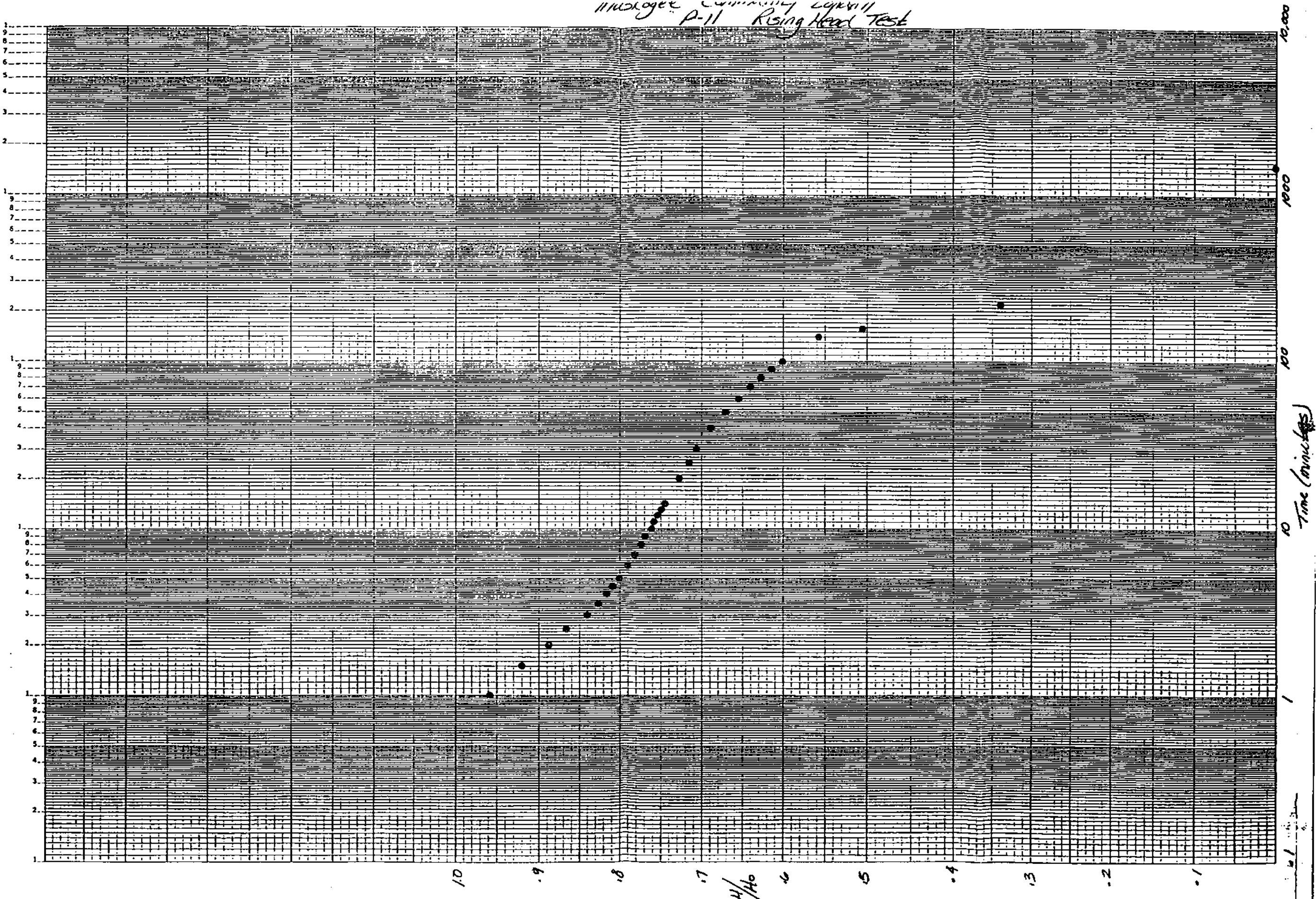
$$K = 6.22 \times 10^{-6} \text{ cm}^2/\text{sec}$$

$\alpha = 10^{-8} \text{ @ } b = 45 \text{ minutes}$

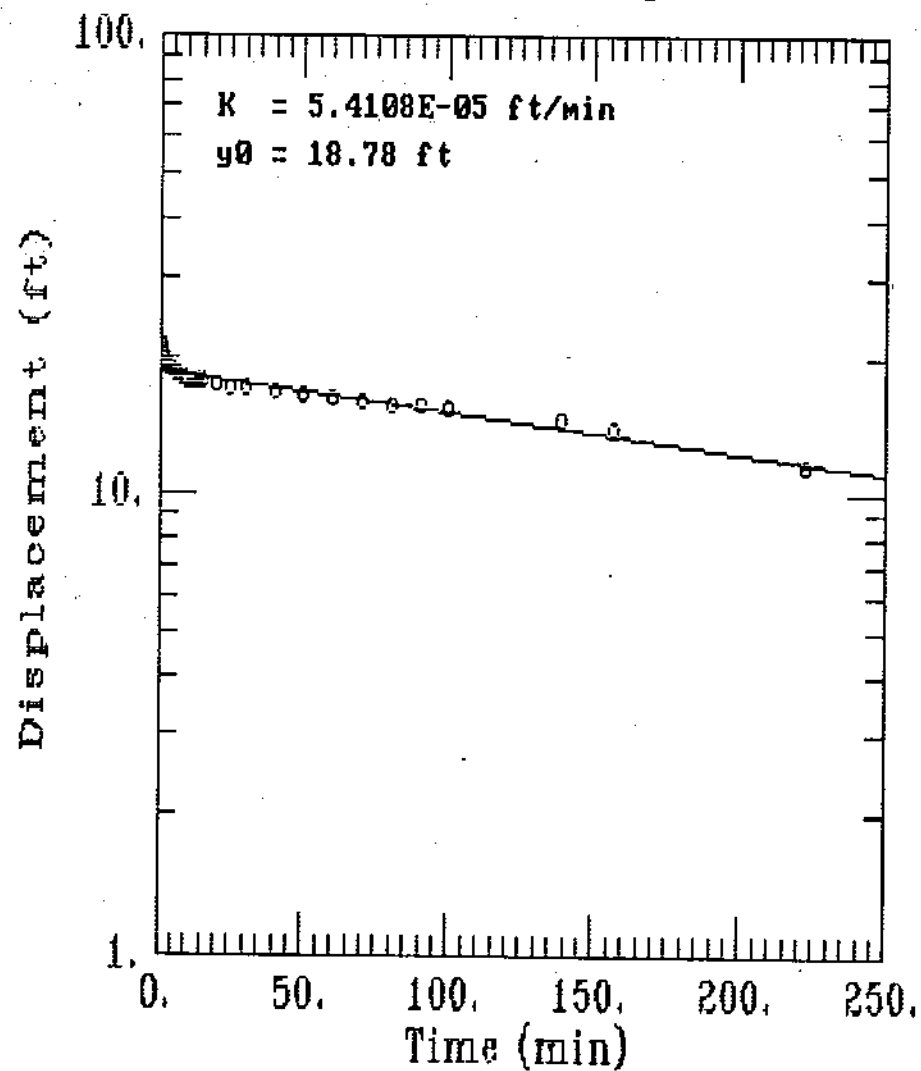
Hydrogeology Community College
 P-11 Rising Head Test

47 6210

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 KEUFFEL & ESSER CO. MADE IN U.S.A.



MUSKOGEE P11



$$K = 2.749 \times 10^{-5} \text{ cm/sec}$$

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Modeling Group

CLIENT WMO

 SUBJECT Perm Tests

 Prepared By GH Date 12/13/93

 PROJECT Mux. Hydrogen

Reviewed By ____ Date ____

Approved By ____ Date ____

P-12 Rising Head Tests

$$\text{Aquifer Thickness, } b = 22.7 - 10 \text{ ft} = 12.7 \text{ ft (11 ft pack)} \times 12 \text{ in/ft} \times 2.54 \text{ cm/in}$$

$$b = 387.10 \text{ cm}$$

 Casing Radius, $r_c = 1 \text{ in}$

$$H_0 = 23.7 \text{ ft}$$

 $H = \text{As per field notes}$

$$h = 7.01 \text{ ft}$$

$$H - h / H_0 - h = H / H_0$$

Time H, ft

0.5 23.99

1.0 23.41

1.5 23.36

2.0 23.33

2.5 23.30

3.0 23.28

3.5 23.25

4.0 23.23

4.5 23.21

5.0 23.19

6.0 23.15

7.0 23.12

8.0 23.09

9.0 23.06

10.0 23.03

11.0 23.01

12.0 22.97

13.0 22.94

14.0 22.91

15.0 22.89

Time H, ft

20.0 22.78

25.0 22.65

30.0 22.54

40.0 22.34

50.0 22.12

60.0 21.94

90.0 21.32

120.0 20.30

1033.0 10.18

1204.0 9.60

CLIENT _____ SUBJECT _____ Prepared By _____ Date _____

PROJECT _____ Reviewed By _____ Date _____

Approved By _____ Date _____

P-12 Ring Head Tests
Time H/Ho

0.5	.987
1.0	.983
1.5	.980
2.0	.978
2.5	.976
3.0	.975
3.5	.973
4.0	.972
4.5	.971
5.0	.969
6.0	.967
7.0	.965
8.0	.963
9.0	.962
10.0	.960

Time H/Ho

11.0	.959
12.0	.956
13.0	.954
14.0	.953
15.0	.951
20.0	.945
25.0	.937
30.0	.930
40.0	.919
50.0	.905
80.0	.857
120.0	.796
153.0	.790
1204.0	.155

$$Tt/rc^2 = 1$$

$$\alpha = 10^{-7} \text{ @ } t = 140 \text{ min}$$

$$T = rc^2/b$$

$$= (1 \text{ in})^2 / 140 \text{ min} \times (2.54 \text{ cm})^2 / \text{in}^2 \times \text{min} / 60 \text{ sec}$$

$$T = 0.001 \text{ cm}^2 / \text{sec}$$

$$K = T/b$$

$$= 0.001 \text{ cm}^2 / \text{sec} \times 1 / 387.10 \text{ cm}$$

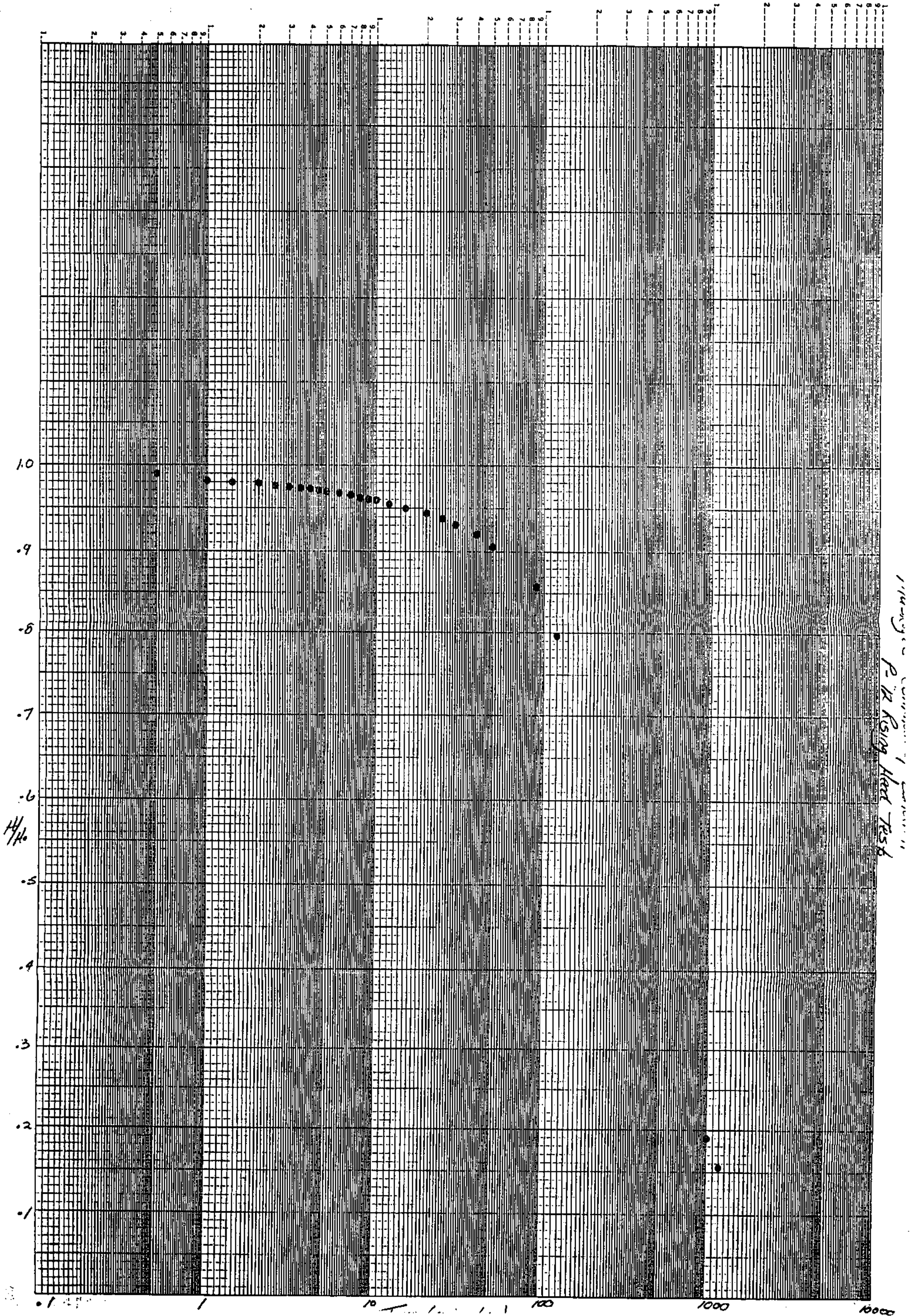
$$K = \frac{1}{387.10} \times 10^{-6} \text{ cm} / \text{sec}$$

$$2.58$$

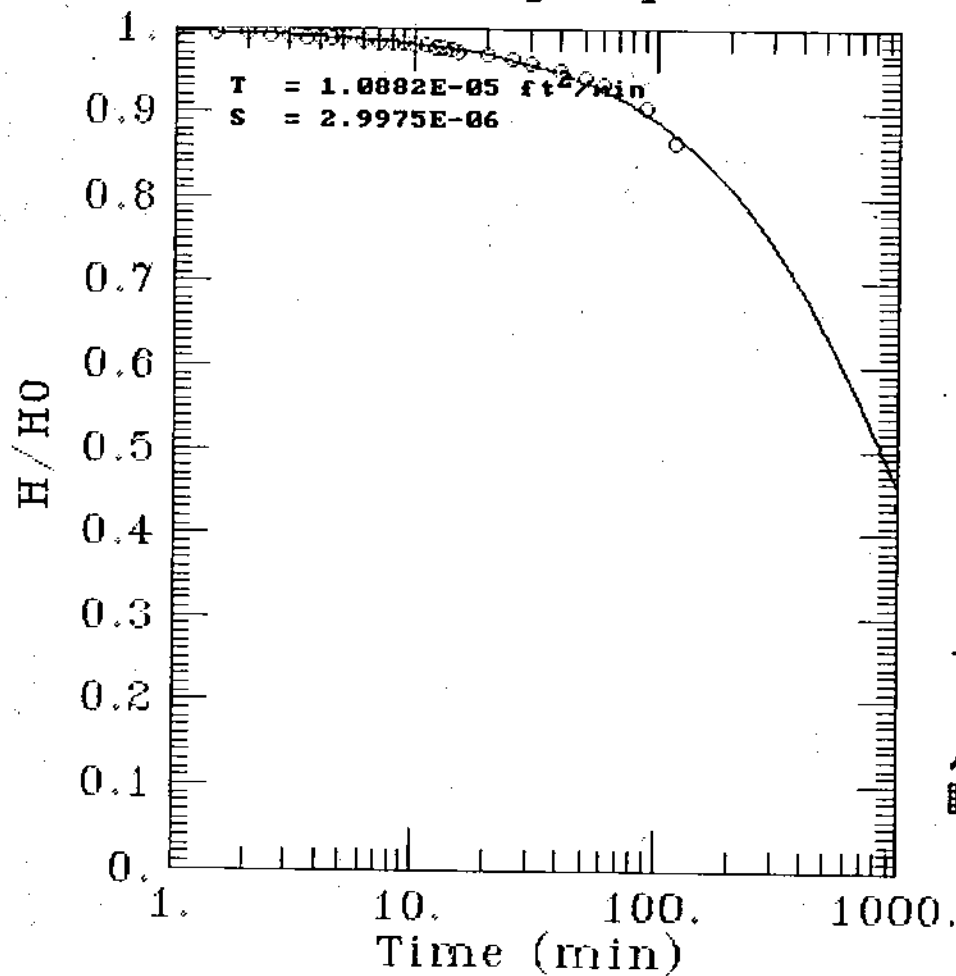
via Ariesolve Program

$$T = 1.0882 \times 10^{-5} \text{ ft}^2 / \text{min} \times (12 \text{ in})^2 / \text{ft}^2 \times (0.54 \text{ cm})^2 / \text{in}^2 \times \text{min} / 60 \text{ sec}$$

$$T = 1.68 \times 10^{-4} \text{ cm}^2 / \text{sec}, K = T/b = 4.35 \times 10^{-7} \text{ cm} / \text{sec}$$



muskogee p12



$$T = 1.675 \times 10^{-4} \text{ cm}^2/\text{s}$$

$$K = 4.327 \times 10^{-7} \text{ cm/s}$$

AQTESOLV


**GERAGHTY
& MILLER, INC.**
 Modeling Group

CLIENT WMO
PROJECT Musk Hydrogeo

 SUBJECT Pem Tests

 Prepared By GH Date 12/10/93

Reviewed By ____ Date ____

Approved By ____ Date ____

P-13 Rising Head Test

$$\text{Aquifer Thickness, } b = 19.3 - 7 \text{ ft} = 12.3 \text{ ft (filter pack)} \times 12 \frac{\text{in}}{\text{ft}} \times 2.54 \frac{\text{cm}}{\text{in}}$$

$$b = 374.90 \text{ cm}$$

$$\text{Casing Radius, } r_c = 1 \text{ in}$$

$$H_0 = 21.15 \text{ ft} \quad H-h/H_0-h = H/H_0$$

$$H = \text{as per field notes}$$

$$h = 6.46 \text{ ft}$$

<u>Time</u>	<u>H, ft</u>	<u>Time</u>	<u>H, ft</u>
0.5	20.50	11.0	15.12
1.0	20.18	12.0	14.82
1.5	19.60	13.0	14.62
2.0	19.15	14.0	14.43
2.5	18.54	15.0	14.20
3.0	18.16	20.0	12.61
3.5	17.90	25.0	11.41
4.0	17.68	30.0	10.33
4.5	17.47	35.0	9.46
5.0	17.26	40.0	8.61
6.0	16.80	50.0	7.91
7.0	16.22	60.0	7.35
8.0	15.91	70.0	7.02
9.0	15.64	80.0	6.84
10.0	15.37	100.0	6.66
		120.0	6.58
		140.0	6.49
		166.0	6.47
		241.0	6.44

CLIENT _____

SUBJECT _____

Prepared By _____ Date _____

PROJECT _____

Reviewed By _____ Date _____

Approved By _____ Date _____

P-13 Rising Head Test

Time	H/H ₀
0.5	.956
1.0	.934
1.5	.894
2.0	.864
2.5	.826
3.0	.796
3.5	.779
4.0	.764
4.5	.749
5.0	.735
6.0	.704
7.0	.664
8.0	.643
9.0	.625
10.0	.607
11.0	.590
12.0	.569
13.0	.555
14.0	.543
15.0	.527

Time	H/H ₀
20.0	.432
25.0	.337
30.0	.263
35.0	.204
40.0	.160
50.0	.099
60.0	.061
70.0	.038
80.0	.026
100.0	.014
120.0	.008
140.0	.002
166.0	.001
241.0	0

$$T \cdot L / r_c^2 = 1$$

$$Q = 10^{-2} \text{ @ } t = 18 \text{ min}$$

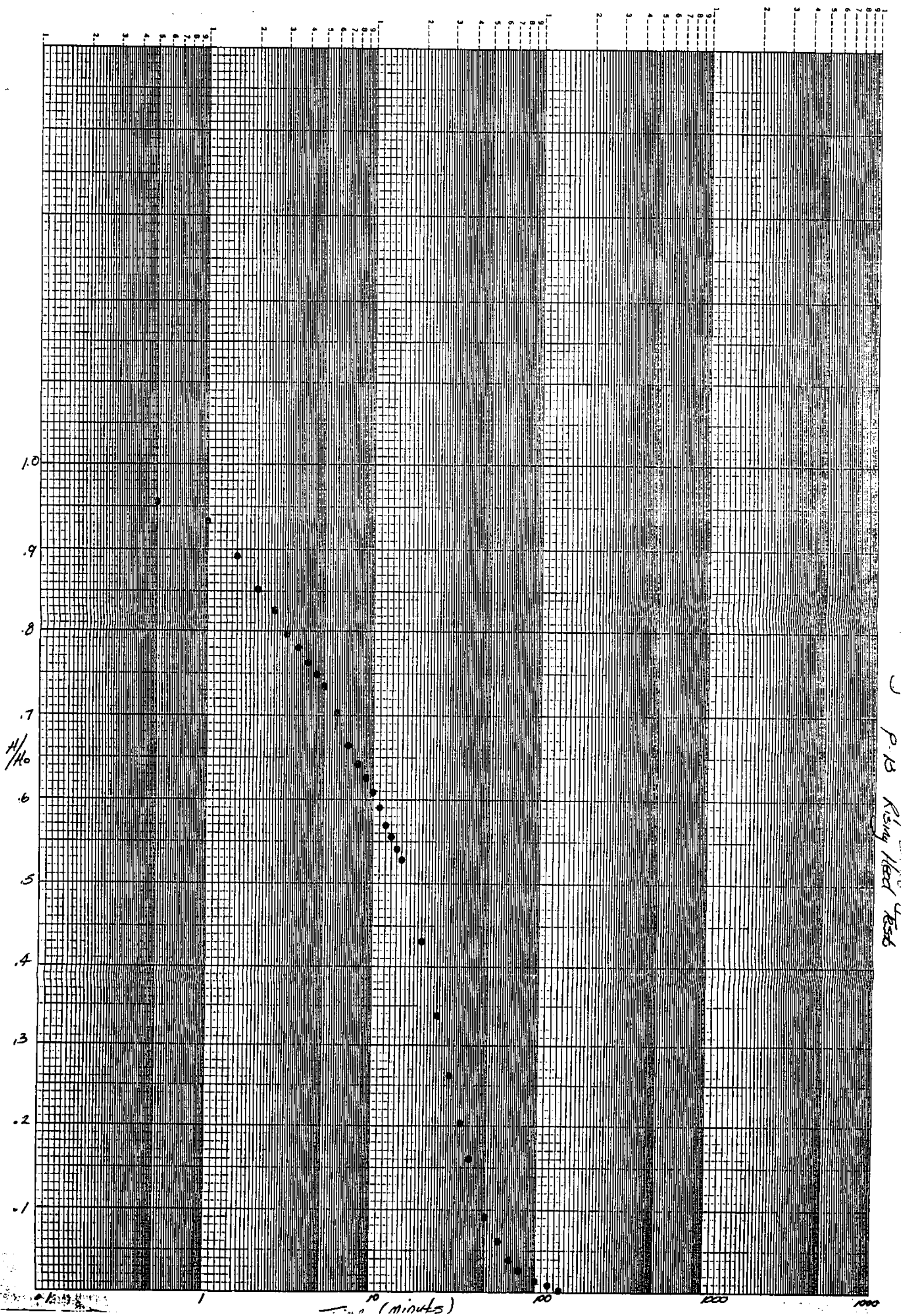
$$T = \frac{r_c^2}{L} \cdot \frac{(U_m)^2}{18 \text{ min}} \times (2.54 \text{ cm})^2 / \text{in}^2 \times \frac{\text{min}}{60 \text{ sec}}$$

$$T = .006 \text{ cm}^2 / \text{sec}$$

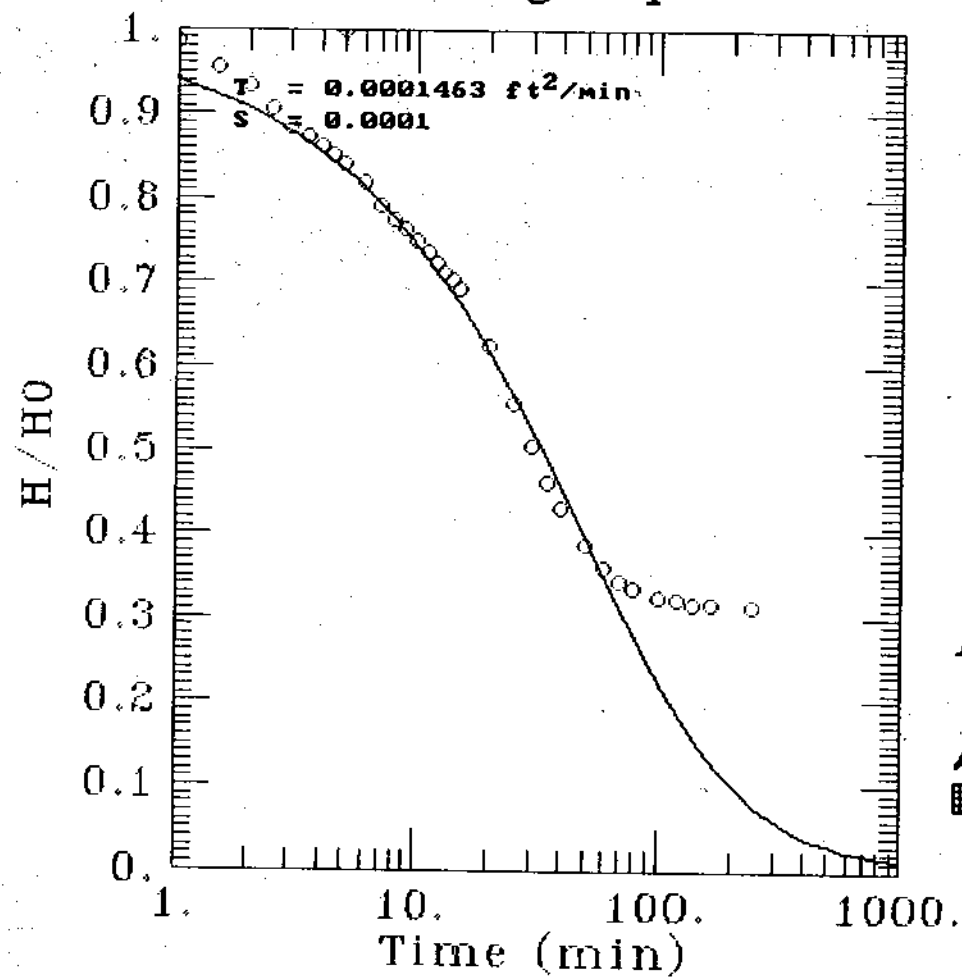
$$K = T / b$$

$$= .006 \text{ cm}^2 / \text{sec} \times 1 / 374.9 \text{ cm}$$

$$K = 1.59 \times 10^{-5} \text{ cm}^2 / \text{sec}$$



muskogee p13



$$\bar{I} = 2 \times 10^{-3} \text{ cm}^2/\text{s}$$

$$K = 6.042 \times 10^{-6} \text{ cm/s}$$

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Modeling Group

CLIENT _____ SUBJECT _____ Prepared By _____ Date _____
PROJECT _____ Reviewed By _____ Date _____
Approved By _____ Date _____

P-14 Rising Head Test - Modified Bowler & Rice

$$\ln r_e/r_w = \left[\frac{1.1}{\ln(L_w/r_w)} + \frac{A + B \ln[(H-L_w)/r_w]}{L_e/r_w} \right]^{-1} \quad \begin{array}{l} H = 22.9 \\ L_w = 15.64 \end{array}$$

$$= \left[\frac{1.1}{\ln(15.64/1.3)} + \frac{2.55 + 0.4 \ln[(22.9 - 15.64)/1.3]}{33.33} \right]^{-1}$$

$$\ln r_e/r_w = 2.55$$

Note: water level for calculation of L_w & H taken on 12/22/93 = 12.06' TOC

$$r_c = \left[(1-n)r_c^2 + nr_w^2 \right]^{1/2}$$

$$= \left[(1-.3)(1.08)^2 + .3(.3)^2 \right]^{1/2}$$

$$= .17$$

$$K = \frac{r_c^2 \ln(r_e/r_w)}{2Le} \frac{1}{\frac{1}{K} \ln \frac{r_e}{r_w}}$$

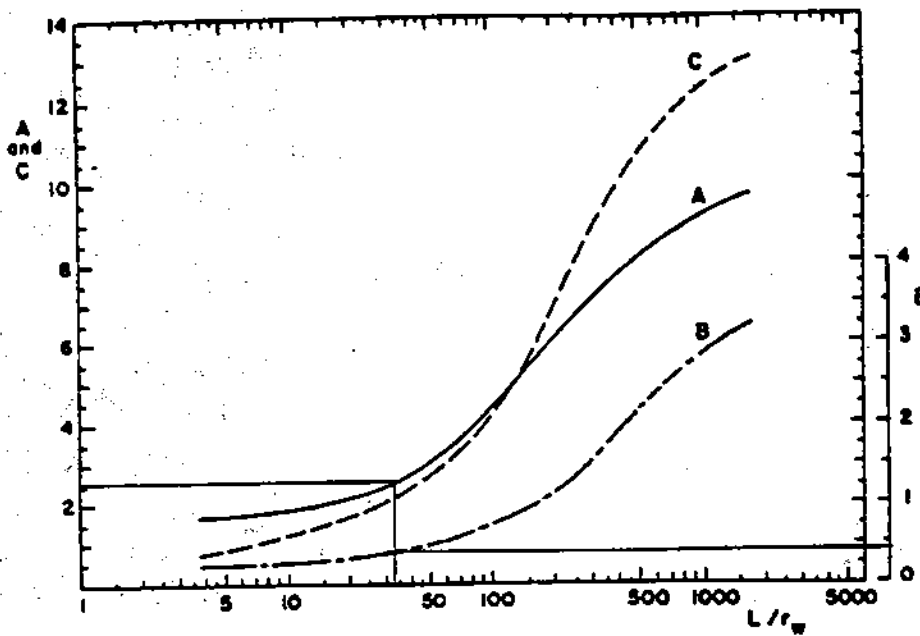
$$= \frac{(.17)^2 (2.55)}{2(10)} \frac{1}{150 \ln(1.10/.07)}$$

$$K = 6.5 \times 10^{-5} \text{ ft}^2/\text{min} \times 12 \text{ in}/\text{ft} \times 2.54 \text{ cm}/\text{in} \times \text{min}/60 \text{ sec}$$

$$K = 3.32 \times 10^{-5} \text{ cm}/\text{sec}$$

P-14 Rising Head Test

BOLWER AND RICE: GROUNDWATER HYDRAULICS



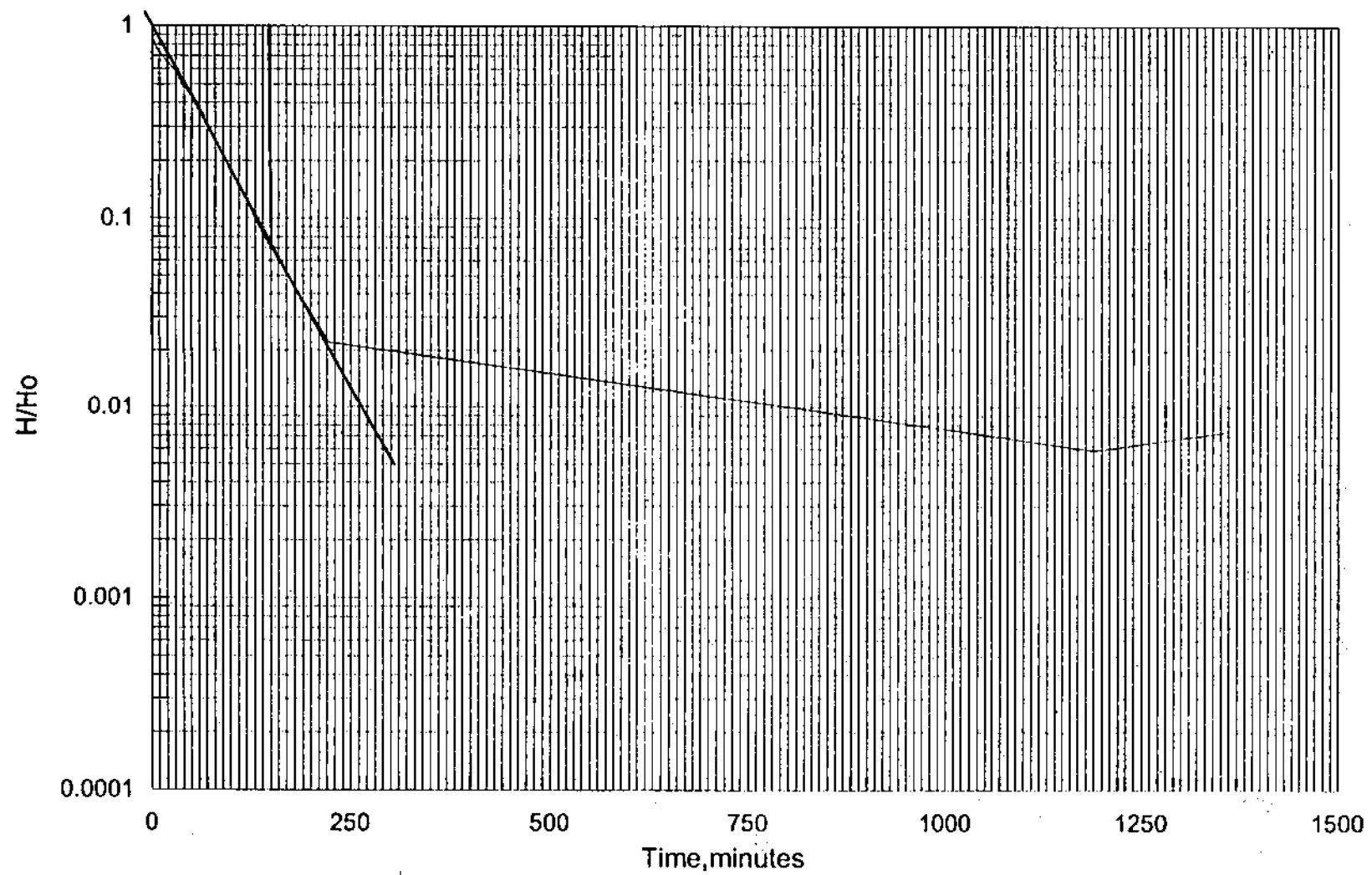
Curves relating coefficients A, B, and C to L/r_w .

$$\begin{aligned} L_e/r_w &= 10/0.3 = 33.33 \\ A &= 2.55 \\ B &= 0.40 \end{aligned}$$

Muskogee Community Landfill				
P14 Rising Head Test				
Elapsed Time,min	H(t),ft	h,ft	Ho,ft	H(t)-h/Ho-h
0	25.5	11.92	25.5	1
1	24.7	11.92	25.5	0.94109
1.5	23.74	11.92	25.5	0.870398
2	23.38	11.92	25.5	0.843888
2.5	23.2	11.92	25.5	0.830633
3	23	11.92	25.5	0.815906
3.5	22.86	11.92	25.5	0.805596
4	22.75	11.92	25.5	0.797496
4.5	22.65	11.92	25.5	0.790133
5	22.56	11.92	25.5	0.783505
6	22.35	11.92	25.5	0.768041
7	22.17	11.92	25.5	0.754786
8	22.09	11.92	25.5	0.748895
9	21.95	11.92	25.5	0.738586
10	21.83	11.92	25.5	0.72975
11	21.7	11.92	25.5	0.720177
12	21.58	11.92	25.5	0.71134
13	21.46	11.92	25.5	0.702504
14	21.34	11.92	25.5	0.693667
15	21.22	11.92	25.5	0.684831
20	20.69	11.92	25.5	0.645803
25	20.25	11.92	25.5	0.613402
30	19.85	11.92	25.5	0.583947
40	18.48	11.92	25.5	0.483063
50	17.86	11.92	25.5	0.437408
60	16.94	11.92	25.5	0.369661
70	16.05	11.92	25.5	0.304124
80	15.36	11.92	25.5	0.253314
100	14.3	11.92	25.5	0.175258
120	13.59	11.92	25.5	0.122975
140	13.05	11.92	25.5	0.083211
222	12.22	11.92	25.5	0.022091
1191	12	11.92	25.5	0.005891
1355	12.02	11.92	25.5	0.007364

Muskogee Community Landfill

P14 Rising Head Test



CLIENT WMO
PROJECT Musk. Hydrants

SUBJECT Perm Tests

Prepared By GH Date 12/14/93
Reviewed By ____ Date ____
Approved By ____ Date ____

P-14 Rising Head Test

$$\text{Aquifer Thickness, } b = 24.7 - 10 = 14.7 \text{ ft (filter pack)} \times \frac{12 \text{ in}}{\text{ft}} \times 2.54 \frac{\text{cm}}{\text{in}} = 448.06$$

Casing radius $r_c = 1 \text{ in}$

$H_0 = 25.5'$
 $H = 15 \text{ ft}$ field notes
 $h = 11.92'$

$$H/H_0 = (H - h)/(H_0 - h)$$

Time H/H₀

1.0	24.7
1.5	23.74
2.0	23.38
2.5	23.20
3.0	23.0
3.5	22.86
4.0	22.75
4.5	22.65
5.0	22.56
6.0	22.35
7.0	22.17
8.0	22.09
9.0	21.95
10.0	21.83
11.0	21.70
12.0	21.58
13.0	21.46

Time H/H₀

14.0	21.34
15.0	21.22
20.0	20.69
25.0	20.25
30.0	19.85
40.0	18.48
50.0	17.86
60.0	16.94
70.0	16.05
80.0	15.36
100.0	14.30
120.0	13.59
140.0	13.05
222.0	12.22
1191.0	12.00
1355.0	12.02

CLIENT _____ SUBJECT _____ Prepared By _____ Date _____
 PROJECT _____ Reviewed By _____ Date _____
 Approved By _____ Date _____

P-14 Ring Road Test
Time H/H₀

1.0	.941
1.5	.870
2.0	.844
2.5	.831
3.0	.816
3.5	.806
4.0	.797
4.5	.790
5.0	.784
6.0	.768
7.0	.755
8.0	.749
9.0	.739
10.0	.730
11.0	.720
12.0	.711
13.0	.703

Time H/H₀

14.0	.694
15.0	.685
20.0	.646
25.0	.613
30.0	.584
40.0	.483
50.0	.437
60.0	.370
70.0	.304
80.0	.253
100.0	.175
120.0	.123
140.0	.083
222.5	.022
1191.0	.006
1355.0	.007

$$\frac{Tb}{r^2} = 1$$

$$Q = 10^{-4}, \quad b = 22.5 \text{ minutes}$$

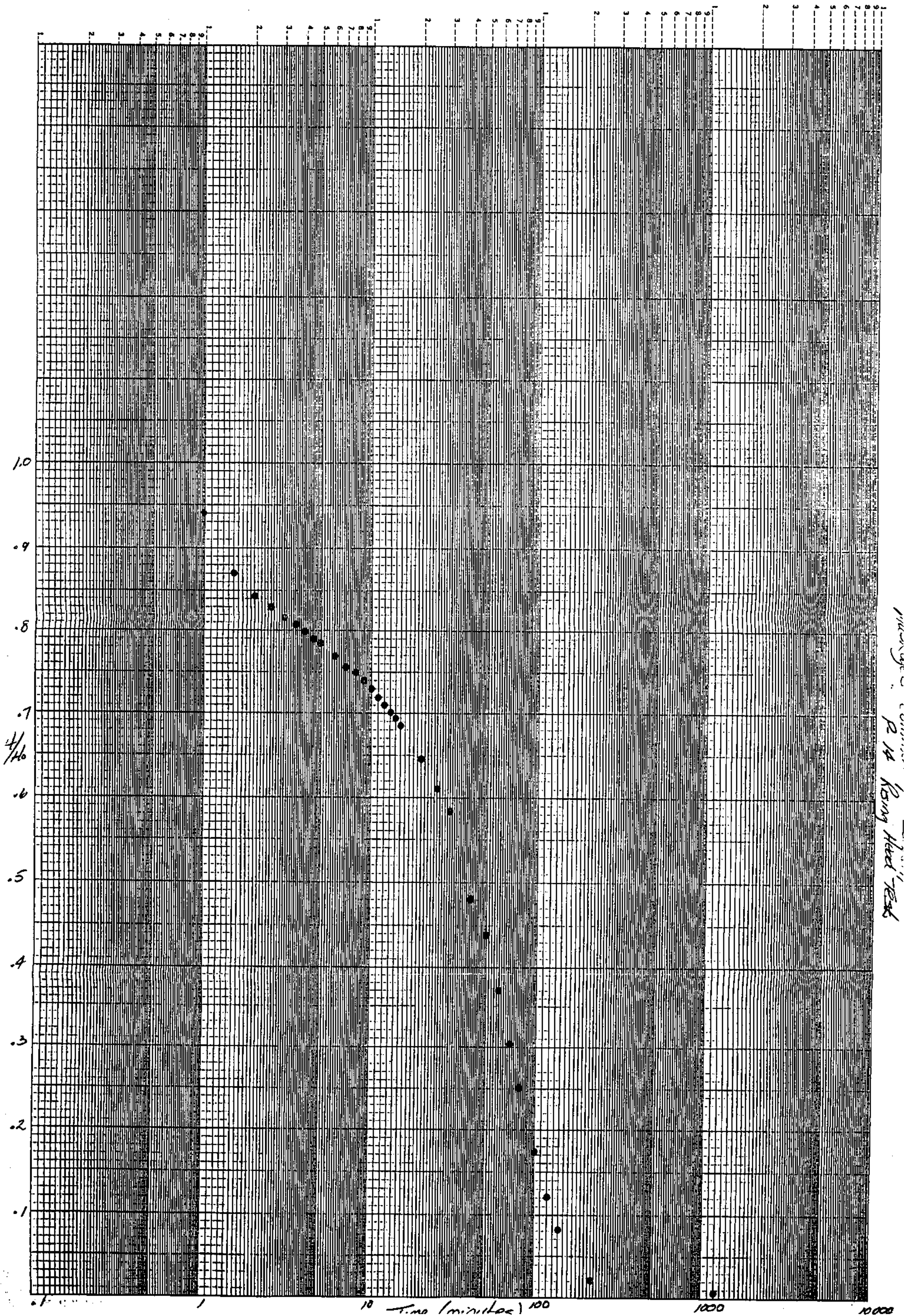
$$T = \frac{r^2/b}{(V_{in})^2} \times (2.54 \text{ cm})^2 / \text{in}^2 \times \text{min}/60 \text{ sec}$$

$$T = .005 \text{ cm}^2/\text{sec}$$

$$K = T/b$$

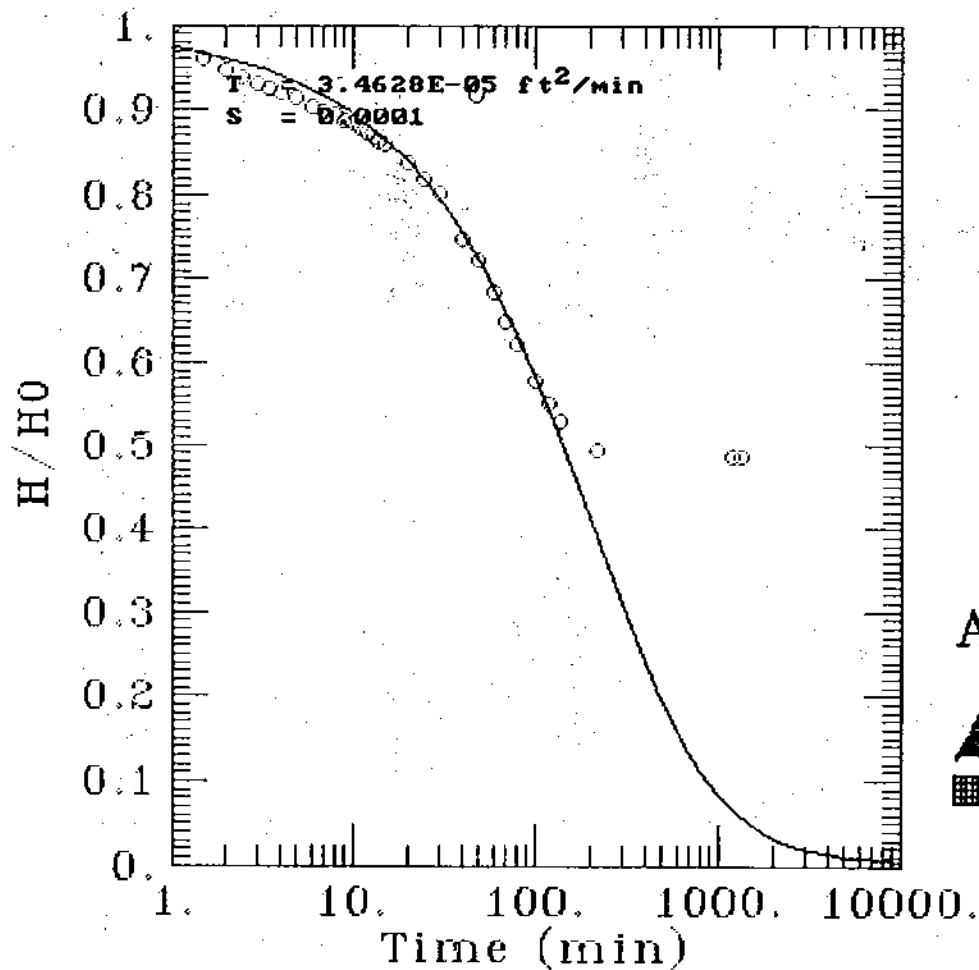
$$= .005 \text{ cm}^2/\text{sec} \times 1/448.06 \text{ cm}$$

$$K = 1.07 \times 10^{-5} \text{ cm/sec}$$



pressure in vacuum
p. 14 King Head Test

P-14



$$T = 1 \times 10^{-3} \text{ cm}^2/\text{s}$$

$$K = 1.197 \times 10^{-6} \text{ cm/s}$$

AQTESOLV

GERAGHTY
& MILLER, INC.

Modeling Group

CLIENT _____

SUBJECT _____

Prepared By _____ Date _____

PROJECT _____

Reviewed By _____ Date _____

Approved By _____ Date _____

P-15 Rising Head Test - Modified Bode & Rice

$$\ln r_e/r_w = \left[\frac{1.1}{\ln(Lw/r_w)} + \frac{A + B \ln[(H-Lw)/r_w]}{Le/r_w} \right]^{-1} \quad H = 23.71$$

$$Lw = 18.82$$

$$= \left[\frac{1.1}{\ln(18.82/3)} + \frac{2.55 + 0.40 \ln[(23.71 - 18.82)/3]}{33.33} \right]^{-1}$$

$$\ln r_e/r_w = 2.66$$

$$r'_c = \left[(1-n) r_c^2 + n r_w^2 \right]^{1/2}$$

$$= \left[(1-.3)(.08)^2 + .3(.3)^2 \right]^{1/2}$$

$$r'_c = .17$$

$$K = \frac{r'_c{}^2 \ln(r_e/r_w)}{2Le} = \frac{1}{20} \ln(10/.17)$$

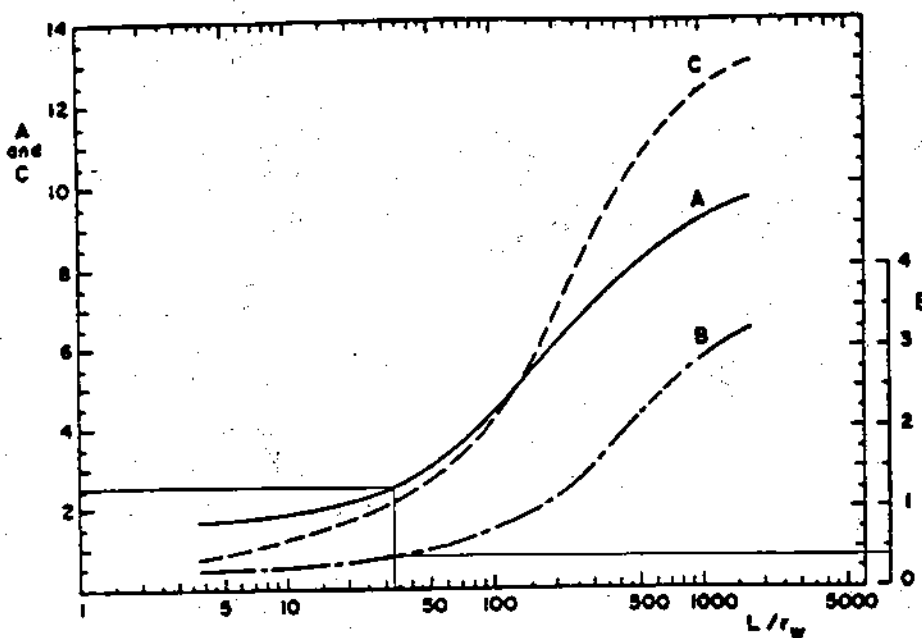
$$= \frac{(.17)^2 (2.66)}{2(10)} = \frac{1}{20} \ln(10/.17)$$

$$K = 2.57 \times 10^{-4} \text{ ft}^2/\text{min} \times 12 \text{ in}/\text{ft}^2 \times 2.54 \text{ cm}/\text{in} \times \text{min}/60 \text{ sec}$$

$$K = 1.20 \times 10^{-4} \text{ cm}/\text{sec}$$

P-15 Rising Head Test

BOLWER AND RICE: GROUNDWATER HYDRAULICS



Curves relating coefficients A, B, and C to L/r_w .

$$L_e/r_w = 10/3 = 33.33$$

$$A = 2.55$$

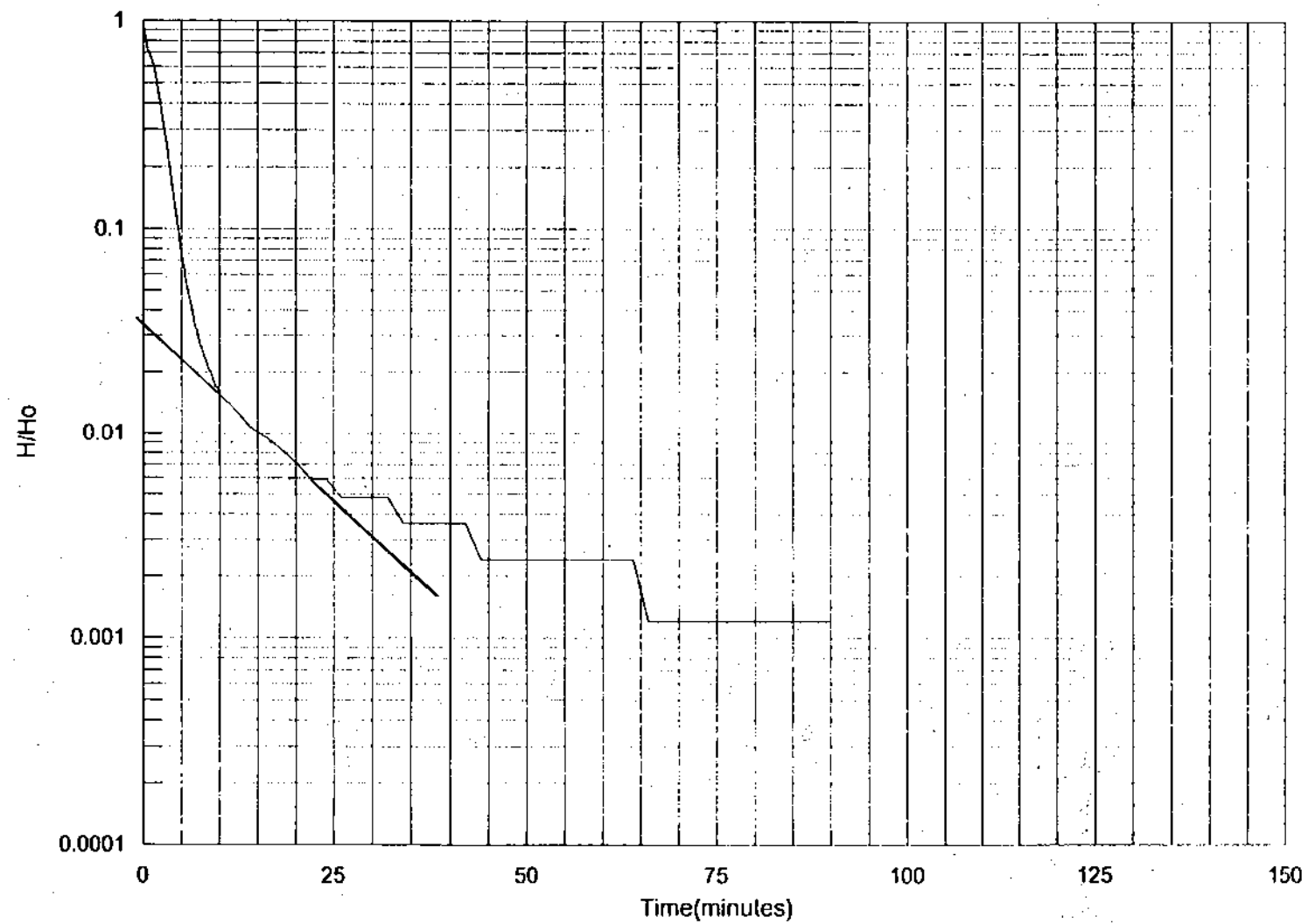
$$B = 0.40$$

Muskegon Community Landfill P15 Ramp Head Test														
sgzd me(min)	H(j).ft	Mo.ft	h.ft	H(j)-h/ft-h	Elapsed Time(min)	H(j).ft	Mo.ft	h.ft	H(j)-h/ft-h	Elapsed Time(min)	H(j).ft	Mo.ft	h.ft	H(j)-h/ft-h
0	5.01	5.01	18.29	1	0.2566	8.749	5.01	18.29	0.865051	4	16.456	5.01	18.29	0.138102
0.0033	5.041	5.01	18.29	0.967666	0.28	8.764	5.01	18.29	0.867922	4.2	16.561	5.01	18.29	0.122666
0.0068	5.057	5.01	18.29	0.996461	0.2633	8.796	5.01	18.29	0.865512	4.4	16.851	5.01	18.29	0.108353
0.01	5.089	5.01	18.29	0.994051	0.2666	8.812	5.01	18.29	0.864307	4.6	16.963	5.01	18.29	0.097688
0.0133	5.105	5.01	18.29	0.992846	0.27	8.828	5.01	18.29	0.863102	4.8	17.136	5.01	18.29	0.086858
0.0168	5.136	5.01	18.29	0.990512	0.2733	8.859	5.01	18.29	0.860768	5	17.262	5.01	18.29	0.07741
0.02	5.152	5.01	18.29	0.988307	0.2766	8.875	5.01	18.29	0.859563	5.2	17.373	5.01	18.29	0.069051
0.0233	5.184	5.01	18.29	0.985968	0.28	8.891	5.01	18.29	0.858358	5.4	17.452	5.01	18.29	0.063102
0.0268	5.199	5.01	18.29	0.985768	0.2833	8.922	5.01	18.29	0.856024	5.6	17.547	5.01	18.29	0.055949
0.03	5.231	5.01	18.29	0.983358	0.2866	8.958	5.01	18.29	0.854819	5.8	17.61	5.01	18.29	0.051205
0.0333	5.247	5.01	18.29	0.982154	0.29	8.954	5.01	18.29	0.853614	6	17.673	5.01	18.29	0.048461
0.0368	5.279	5.01	18.29	0.979744	0.2933	8.937	5.01	18.29	0.85241	6.2	17.721	5.01	18.29	0.042846
0.04	5.294	5.01	18.29	0.978614	0.2966	7.002	5.01	18.29	0.85	6.4	17.768	5.01	18.29	0.039307
0.0433	5.326	5.01	18.29	0.976205	0.3	7.017	5.01	18.29	0.84887	6.6	17.8	5.01	18.29	0.036996
0.0468	5.342	5.01	18.29	0.975	0.3033	7.033	5.01	18.29	0.847666	6.8	17.847	5.01	18.29	0.0339307
0.05	5.373	5.01	18.29	0.972668	0.3066	7.065	5.01	18.29	0.845258	7	17.883	5.01	18.29	0.032154
0.0533	5.389	5.01	18.29	0.971461	0.31	7.081	5.01	18.29	0.844051	7.2	17.895	5.01	18.29	0.029744
0.0568	5.421	5.01	18.29	0.969051	0.3133	7.096	5.01	18.29	0.842922	7.4	17.926	5.01	18.29	0.02741
0.06	5.437	5.01	18.29	0.967846	0.3166	7.112	5.01	18.29	0.841717	7.6	17.942	5.01	18.29	0.026205
0.0633	5.468	5.01	18.29	0.965512	0.32	7.144	5.01	18.29	0.839307	7.8	17.958	5.01	18.29	0.025
0.0668	5.484	5.01	18.29	0.964307	0.3233	7.16	5.01	18.29	0.838102	8	17.974	5.01	18.29	0.023765
0.07	5.516	5.01	18.29	0.961896	0.3266	7.175	5.01	18.29	0.836973	8.2	17.989	5.01	18.29	0.022666
0.0733	5.531	5.01	18.29	0.960768	0.33	7.191	5.01	18.29	0.835768	8.4	18.005	5.01	18.29	0.021461
0.0768	5.547	5.01	18.29	0.959563	0.3333	7.223	5.01	18.29	0.833358	8.6	18.021	5.01	18.29	0.020256
0.08	5.579	5.01	18.29	0.957154	0.35	7.334	5.01	18.29	0.825	8.8	18.021	5.01	18.29	0.020256
0.0833	5.611	5.01	18.29	0.954744	0.3666	7.428	5.01	18.29	0.817822	9	18.037	5.01	18.29	0.019051
0.0868	5.626	5.01	18.29	0.953614	0.3833	7.523	5.01	18.29	0.810768	9.2	18.053	5.01	18.29	0.017846
0.09	5.642	5.01	18.29	0.95241	0.4	7.634	5.01	18.29	0.80241	9.4	18.069	5.01	18.29	0.016717
0.0933	5.674	5.01	18.29	0.95	0.4166	7.745	5.01	18.29	0.794051	9.6	18.086	5.01	18.29	0.016717
0.0968	5.69	5.01	18.29	0.948795	0.4333	7.839	5.01	18.29	0.786973	9.8	18.068	5.01	18.29	0.016717
0.1	5.721	5.01	18.29	0.946461	0.45	7.95	5.01	18.29	0.778614	10	18.084	5.01	18.29	0.015312
0.1033	5.737	5.01	18.29	0.945256	0.4666	8.045	5.01	18.29	0.771461	12	18.116	5.01	18.29	0.013102
0.1068	5.769	5.01	18.29	0.942846	0.4833	8.14	5.01	18.29	0.764307	14	18.148	5.01	18.29	0.010683
0.11	5.784	5.01	18.29	0.941717	0.5	8.234	5.01	18.29	0.757229	16	18.163	5.01	18.29	0.009563
0.1133	5.816	5.01	18.29	0.939307	0.5166	8.328	5.01	18.29	0.750075	18	18.179	5.01	18.29	0.008358
0.1168	5.832	5.01	18.29	0.938102	0.5333	8.424	5.01	18.29	0.742922	20	18.195	5.01	18.29	0.007154
0.12	5.848	5.01	18.29	0.936896	0.55	8.503	5.01	18.29	0.735973	22	18.211	5.01	18.29	0.005949
0.1233	5.879	5.01	18.29	0.934563	0.5666	8.567	5.01	18.29	0.732154	24	18.211	5.01	18.29	0.005949
0.1268	5.895	5.01	18.29	0.933358	0.5833	8.63	5.01	18.29	0.72741	26	18.228	5.01	18.29	0.004819
0.13	5.927	5.01	18.29	0.930949	0.6	8.693	5.01	18.29	0.722666	28	18.226	5.01	18.29	0.004819
0.1333	5.942	5.01	18.29	0.929819	0.6166	8.74	5.01	18.29	0.719127	30	18.228	5.01	18.29	0.004819
0.1368	5.974	5.01	18.29	0.92741	0.6333	8.772	5.01	18.29	0.716717	32	18.226	5.01	18.29	0.004819
0.14	5.99	5.01	18.29	0.926205	0.65	8.819	5.01	18.29	0.713178	34	18.242	5.01	18.29	0.003614
0.1433	6.021	5.01	18.29	0.92387	0.6666	8.851	5.01	18.29	0.710768	36	18.242	5.01	18.29	0.003614
0.1468	6.037	5.01	18.29	0.922666	0.6833	8.883	5.01	18.29	0.708358	38	18.242	5.01	18.29	0.003614
0.15	6.053	5.01	18.29	0.921461	0.7	8.914	5.01	18.29	0.706024	40	18.242	5.01	18.29	0.003614
0.1533	6.085	5.01	18.29	0.919051	0.7166	8.945	5.01	18.29	0.703614	42	18.242	5.01	18.29	0.003614
0.1568	6.1	5.01	18.29	0.917822	0.7333	8.978	5.01	18.29	0.701205	44	18.258	5.01	18.29	0.00241
0.16	6.116	5.01	18.29	0.916717	0.75	9.009	5.01	18.29	0.69887	46	18.258	5.01	18.29	0.00241
0.1633	6.148	5.01	18.29	0.914307	0.7666	9.041	5.01	18.29	0.696461	48	18.258	5.01	18.29	0.00241
0.1668	6.164	5.01	18.29	0.913102	0.7833	9.072	5.01	18.29	0.694127	50	18.258	5.01	18.29	0.00241
0.17	6.195	5.01	18.29	0.910768	0.8	9.104	5.01	18.29	0.691717	52	18.258	5.01	18.29	0.00241
0.1733	6.211	5.01	18.29	0.909563	0.8166	9.136	5.01	18.29	0.689307	54	18.258	5.01	18.29	0.00241
0.1768	6.227	5.01	18.29	0.908358	0.8333	9.167	5.01	18.29	0.686973	56	18.258	5.01	18.29	0.00241
0.18	6.259	5.01	18.29	0.905949	0.85	9.199	5.01	18.29	0.684563	58	18.258	5.01	18.29	0.00241
0.1833	6.274	5.01	18.29	0.904819	0.8666	9.23	5.01	18.29	0.682229	60	18.258	5.01	18.29	0.00241
0.1868	6.306	5.01	18.29	0.90241	0.8833	9.262	5.01	18.29	0.679819	62	18.258	5.01	18.29	0.00241
0.19	6.322	5.01	18.29	0.901205	0.9	9.278	5.01	18.29	0.678614	64	18.258	5.01	18.29	0.00241
0.1933	6.338	5.01	18.29	0.9	0.9166	9.31	5.01	18.29	0.678205	66	18.274	5.01	18.29	0.001205
0.1968	6.369	5.01	18.29	0.897668	0.9333	9.341	5.01	18.29	0.67387	68	18.274	5.01	18.29	0.001205
0.2	6.385	5.01	18.29	0.896461	0.95	9.373	5.01	18.29	0.671461	70	18.274	5.01	18.29	0.001205
0.2033	6.417	5.01	18.29	0.894051	0.9666	9.389	5.01	18.29	0.670256	72	18.274	5.01	18.29	0.001205
0.2068	6.432	5.01	18.29	0.892822	0.9833	9.42	5.01	18.29	0.667922	74	18.274	5.01	18.29	0.001205
0.21	6.448	5.01	18.29	0.891717	1	9.452	5.01	18.29	0.665512	76	18.274	5.01	18.29	0.001205
0.2133	6.48	5.01	18.29	0.889307	1.2	9.815	5.01	18.29	0.638178	78	18.274	5.01	18.29	0.001205
0.2168	6.496	5.01	18.29	0.888102	1.4	10.4	5.01	18.29	0.594127	80	18.274	5.01	18.29	0.001205
0.22	6.511	5.01	18.29	0.886973	1.6	11.066	5.01	18.29	0.541717	82	18.274	5.01	18.29	0.001205
0.2233	6.543	5.01	18.29	0.884563	1.8	11.76	5.01	18.29	0.491717	84	18.274	5.01	18.29	0.001205
0.2268	6.559	5.01	18.29	0.883358	2	12.376	5.01	18.29	0.445331	86	18.274	5.01	18.29	0.001205
0.23	6.575	5.01	18.29	0.882154	2.2	12.961	5.01	18.29	0.40128	88	18.274	5.01	18.29	0.001205
0.2333	6.606	5.01	18.29	0.879819	2.4	13.515	5.01	18.29	0.359663	90	18.274	5.01	18.29	0.001205
0.2368	6.622	5.01	18.29	0.878614	2.6	14.037	5.01	18.29	0.320256	92	18.29	5.01	18.29	0
0.24	6.654	5.01	18.29	0.876205	2.8	14.511	5.01	18.29	0.284563	94	18.29	5.01	18.29	0
0.2433	6.67	5.01	18.29	0.875	3	14.938	5.01	18.29	0.25241	96	18.29	5.01	18.29	0
0.2468	6.685	5.01	18.29	0.87387	3.2	15.317	5.01	18.29	0.22387	98	18.29	5.01	18.29	0
0.25	6.701	5.01	18.29	0.872666	3.4	15.649	5.01	18.29	0.19887	100	18.29	5.01	18.29	0
0.2533	6.733	5.01	18.29	0.870256	3.6	15.95	5.01	1						

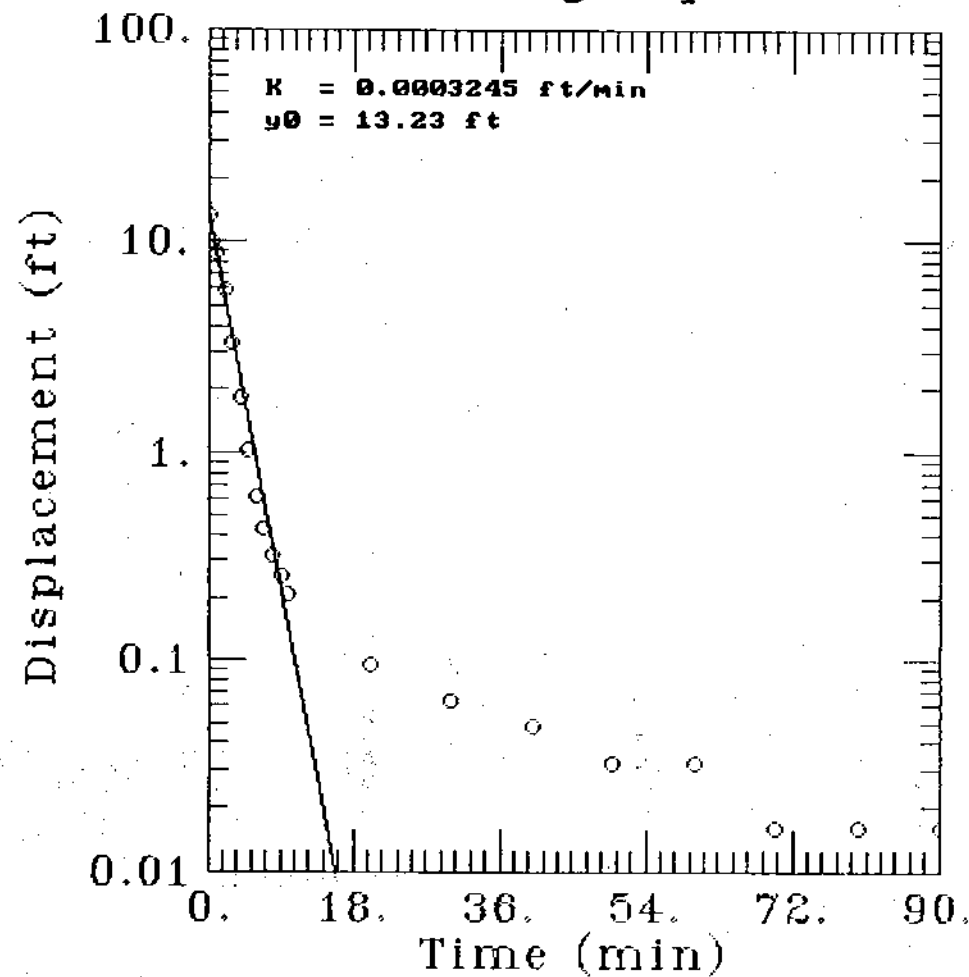
Muskegon Community Landfill P15 Rising Head Test															
No. R	h, R	H ₀ - h ₀ - h	O-S	Elapsed (Time:min)	H ₀ R	No. R	h, R	H ₀ - h ₀ - h	Elapsed (Time:min)	H ₀ R	No. R	h, R	H ₀ - h ₀ - h	Elapsed (Time:min)	H ₀ R
5.01	18.29	1	13.28	0.2506	6.749	5.01	18.29	0.869051	11.541	4	18.456	5.01	18.29	0.138102	1.834
5.01	18.29	0.997699	13.249	0.26	6.784	5.01	18.29	0.867922	11.529	4.2	18.681	5.01	18.29	0.122688	1.829
5.01	18.29	0.998461	13.233	0.2633	6.796	5.01	18.29	0.865512	11.494	4.4	18.651	5.01	18.29	0.108358	1.439
5.01	18.29	0.984051	13.201	0.2666	6.812	5.01	18.29	0.864307	11.478	4.6	18.693	5.01	18.29	0.097688	1.297
5.01	18.29	0.992846	13.185	0.27	6.828	5.01	18.29	0.863102	11.462	4.8	17.136	5.01	18.29	0.086898	1.154
5.01	18.29	0.990512	13.154	0.2733	6.859	5.01	18.29	0.860786	11.431	5	17.282	5.01	18.29	0.07741	1.028
5.01	18.29	0.989307	13.138	0.2766	6.875	5.01	18.29	0.858563	11.415	5.2	17.373	5.01	18.29	0.069051	0.917
5.01	18.29	0.988688	13.108	0.28	6.891	5.01	18.29	0.856358	11.399	5.4	17.452	5.01	18.29	0.063102	0.838
5.01	18.29	0.985768	13.091	0.2833	6.922	5.01	18.29	0.854024	11.368	5.6	17.547	5.01	18.29	0.055849	0.743
5.01	18.29	0.983358	13.059	0.2866	6.938	5.01	18.29	0.854819	11.352	5.8	17.61	5.01	18.29	0.051205	0.68
5.01	18.29	0.982154	13.043	0.29	6.954	5.01	18.29	0.853814	11.336	6	17.673	5.01	18.29	0.046481	0.617
5.01	18.29	0.979744	13.011	0.2933	6.97	5.01	18.29	0.85241	11.32	6.2	17.721	5.01	18.29	0.042848	0.589
5.01	18.29	0.978014	12.998	0.2989	7.002	5.01	18.29	0.85	11.288	6.4	17.768	5.01	18.29	0.039307	0.522
5.01	18.29	0.976205	12.984	0.3	7.017	5.01	18.29	0.84887	11.273	6.6	17.8	5.01	18.29	0.036898	0.49
5.01	18.29	0.975	12.948	0.3033	7.033	5.01	18.29	0.847686	11.257	6.8	17.847	5.01	18.29	0.033358	0.443
5.01	18.29	0.972988	12.917	0.3066	7.055	5.01	18.29	0.845258	11.225	7	17.893	5.01	18.29	0.032154	0.427
5.01	18.29	0.971481	12.901	0.31	7.081	5.01	18.29	0.844051	11.209	7.2	17.895	5.01	18.29	0.028744	0.385
5.01	18.29	0.969051	12.889	0.3133	7.096	5.01	18.29	0.842922	11.194	7.4	17.926	5.01	18.29	0.02741	0.384
5.01	18.29	0.967846	12.853	0.3166	7.112	5.01	18.29	0.841717	11.178	7.6	17.942	5.01	18.29	0.026205	0.348
5.01	18.29	0.965512	12.822	0.32	7.144	5.01	18.29	0.839307	11.146	7.8	17.958	5.01	18.29	0.025	0.332
5.01	18.29	0.964307	12.808	0.3233	7.16	5.01	18.29	0.838102	11.13	8	17.974	5.01	18.29	0.023785	0.316
5.01	18.29	0.961888	12.774	0.3266	7.175	5.01	18.29	0.836973	11.115	8.2	17.989	5.01	18.29	0.022688	0.301
5.01	18.29	0.960768	12.758	0.33	7.191	5.01	18.29	0.835768	11.099	8.4	18.005	5.01	18.29	0.021481	0.285
5.01	18.29	0.958563	12.743	0.3333	7.223	5.01	18.29	0.833358	11.087	8.6	18.021	5.01	18.29	0.020258	0.269
5.01	18.29	0.957154	12.711	0.35	7.334	5.01	18.29	0.825	10.958	8.8	18.021	5.01	18.29	0.020258	0.269
5.01	18.29	0.954744	12.679	0.3666	7.428	5.01	18.29	0.817922	10.882	9	18.037	5.01	18.29	0.019051	0.253
5.01	18.29	0.953814	12.664	0.3633	7.523	5.01	18.29	0.816786	10.787	9.2	18.053	5.01	18.29	0.017848	0.237
5.01	18.29	0.95241	12.648	0.4	7.534	5.01	18.29	0.80241	10.658	9.4	18.068	5.01	18.29	0.018717	0.227
5.01	18.29	0.95	12.616	0.4166	7.745	5.01	18.29	0.794051	10.545	9.6	18.068	5.01	18.29	0.018717	0.222
5.01	18.29	0.948785	12.6	0.4333	7.839	5.01	18.29	0.788973	10.451	9.8	18.068	5.01	18.29	0.018717	0.222
5.01	18.29	0.946481	12.569	0.45	7.95	5.01	18.29	0.776814	10.34	10	18.084	5.01	18.29	0.015612	0.206
5.01	18.29	0.945258	12.553	0.4666	8.045	5.01	18.29	0.771461	10.245	12	18.118	5.01	18.29	0.013102	0.174
5.01	18.29	0.942848	12.521	0.4833	8.14	5.01	18.29	0.764307	10.15	14	18.148	5.01	18.29	0.010893	0.142
5.01	18.29	0.941717	12.508	0.5	8.234	5.01	18.29	0.757229	10.058	16	18.163	5.01	18.29	0.009563	0.127
5.01	18.29	0.939307	12.474	0.5166	8.329	5.01	18.29	0.750075	9.961	18	18.179	5.01	18.29	0.008358	0.111
5.01	18.29	0.938102	12.458	0.5333	8.424	5.01	18.29	0.742922	9.866	20	18.195	5.01	18.29	0.007154	0.095
5.01	18.29	0.936898	12.442	0.55	8.503	5.01	18.29	0.736973	9.787	22	18.211	5.01	18.29	0.005948	0.079
5.01	18.29	0.934563	12.411	0.5666	8.587	5.01	18.29	0.732154	9.723	24	18.211	5.01	18.29	0.005848	0.079
5.01	18.29	0.933358	12.395	0.5833	8.63	5.01	18.29	0.72741	9.68	26	18.226	5.01	18.29	0.004818	0.064
5.01	18.29	0.930948	12.383	0.6	8.693	5.01	18.29	0.722888	9.597	28	18.226	5.01	18.29	0.004818	0.064
5.01	18.29	0.928819	12.348	0.6166	8.74	5.01	18.29	0.719727	9.55	30	18.226	5.01	18.29	0.004818	0.064
5.01	18.29	0.92741	12.316	0.6333	8.772	5.01	18.29	0.716717	9.518	32	18.226	5.01	18.29	0.004818	0.064
5.01	18.29	0.926205	12.3	0.65	8.819	5.01	18.29	0.713768	9.471	34	18.242	5.01	18.29	0.003814	0.048
5.01	18.29	0.92367	12.269	0.6666	8.851	5.01	18.29	0.710768	9.439	36	18.242	5.01	18.29	0.003814	0.048
5.01	18.29	0.922688	12.253	0.6833	8.883	5.01	18.29	0.708358	9.407	38	18.242	5.01	18.29	0.003814	0.048
5.01	18.29	0.921481	12.237	0.7	8.914	5.01	18.29	0.706024	9.378	40	18.242	5.01	18.29	0.003814	0.048
5.01	18.29	0.919051	12.205	0.7166	8.948	5.01	18.29	0.703814	9.344	42	18.242	5.01	18.29	0.003814	0.048
5.01	18.29	0.917922	12.19	0.7333	8.978	5.01	18.29	0.701205	9.312	44	18.258	5.01	18.29	0.00241	0.032
5.01	18.29	0.916717	12.174	0.75	9.008	5.01	18.29	0.69887	9.281	46	18.258	5.01	18.29	0.00241	0.032
5.01	18.29	0.914307	12.142	0.7666	9.041	5.01	18.29	0.696481	9.249	48	18.258	5.01	18.29	0.00241	0.032
5.01	18.29	0.913102	12.126	0.7833	9.072	5.01	18.29	0.694127	9.218	50	18.258	5.01	18.29	0.00241	0.032
5.01	18.29	0.910768	12.095	0.8	9.104	5.01	18.29	0.691717	9.188	52	18.258	5.01	18.29	0.00241	0.032
5.01	18.29	0.909563	12.079	0.8166	9.136	5.01	18.29	0.689307	9.154	54	18.258	5.01	18.29	0.00241	0.032
5.01	18.29	0.908358	12.063	0.8333	9.167	5.01	18.29	0.686973	9.123	56	18.258	5.01	18.29	0.00241	0.032
5.01	18.29	0.905948	12.031	0.85	9.199	5.01	18.29	0.684563	9.091	58	18.258	5.01	18.29	0.00241	0.032
5.01	18.29	0.904819	12.016	0.8666	9.23	5.01	18.29	0.682229	9.06	60	18.258	5.01	18.29	0.00241	0.032
5.01	18.29	0.90241	11.984	0.8833	9.262	5.01	18.29	0.679819	9.028	62	18.258	5.01	18.29	0.00241	0.032
5.01	18.29	0.901205	11.968	0.9	9.276	5.01	18.29	0.678614	9.012	64	18.258	5.01	18.29	0.00241	0.032
5.01	18.29	0.9	11.952	0.9166	9.31	5.01	18.29	0.676205	8.98	66	18.274	5.01	18.29	0.001205	0.016
5.01	18.29	0.897688	11.921	0.9333	9.341	5.01	18.29	0.67387	8.949	68	18.274	5.01	18.29	0.001205	0.016
5.01	18.29	0.896481	11.905	0.95	9.373	5.01	18.29	0.671481	8.917	70	18.274	5.01	18.29	0.001205	0.016
5.01	18.29	0.894051	11.873	0.9666	9.389	5.01	18.29	0.670258	8.901	72	18.274	5.01	18.29	0.001205	0.016
5.01	18.29	0.892922	11.858	0.9833	9.42	5.01	18.29	0.667922	8.87	74	18.274	5.01	18.29	0.001205	0.016
5.01	18.29	0.891717	11.842	1	9.452	5.01	18.29	0.665512	8.838	76	18.274	5.01	18.29	0.001205	0.016
5.01	18.29	0.889307	11.81	1.2	9.615	5.01	18.29	0.663102	8.795	78	18.274	5.01	18.29	0.001205	0.016
5.01	18.29	0.888102	11.794	1.4	10.4	5.01	18.29	0.660786	8.759	80	18.274	5.01	18.29	0.001205	0.016
5.01	18.29	0.886898	11.779	1.6	11.098	5.01	18.29	0.658358	8.7194	82	18.274	5.01	18.29	0.001205	0.016
5.01	18.29	0.884563	11.747	1.8	11.78	5.01	18.29	0.656024	8.653	84	18.274	5.01	18.29	0.001205	0.016
5.01	18.29	0.883358	11.731	2	12.378	5.01	18.29	0.653331	8.5914	86	18.274	5.01	18.29	0.001205	0.016
5.01	18.29	0.882154	11.715	2.2	12.961	5.01	18.29	0.65128	8.529	88	18.274	5.01	18.29	0.001205	0.016
5.01	18.29	0.879819	11.684	2.4	13.515	5.01	18.29	0.648563	8.475	90	18.274	5.01			

Muskogee Community Landfill

P15 Rising Head Test



muskogee p15



$$K = 1.65 \times 10^{-4} \text{ cm/s}$$

AQTESOLV

GERAGHTY
& MILLER, INC.

Modeling Group

APPENDIX H
CONTINUOUS GROUND-WATER MONITORING DATA
MW02R AND MW03R

Muskogee\86251dp2.3rd

Muskogee Community Landfill
2801 S. 54th Street W.
Muskogee, Oklahoma 74401
(918) 682-7284
(918) 682-2867 fax



A Waste Management Company

December 23, 1993

Mr. James Warram
Solid Waste Management Service
Department of Environmental Quality
1000 NE Tenth Street
Oklahoma City, OK 73117-1212

**SUBJECT: Groundwater Elevation Data
Muskogee Community Landfill
Permit No. 3551020
Muskogee, Oklahoma**

Dear Mr. Warram:

On behalf of Waste Management of Oklahoma, Inc., I am forwarding the groundwater elevation data from monitor wells MW01R and MW02R for the month of November 1993; these wells are equipped with water level recorders. If you have questions or require additional information, please call me at (405)427-6030 or Dan Gibson at (918)437-7773.

Sincerely,

WASTE MANAGEMENT OF OKLAHOMA, INC.

Mark Daniels, P.E.
Environmental Engineer

Enclosure

cc: Dan Gibson
Mike McCloud
Raymond DeBose
Fenton Road, DEQ
Carey Bell, Muskogee County DEQ

(FILE: GROUNDWATER ELEVATION DATA)

(MUSKOGWEL1193.RPT)

Muskogee Community Landfill

Groundwater Elevations During November 1993

From Continuous Recorders in MW01R and MW02R

Date	MW01R Elevation	MW02R Elevation	Comments
11/01/93	621.8	628.7	
11/02/93	621.8	628.6	
11/03/93	621.7	628.5	Data collector removed on
11/04/93			11-03-93 for downloading
11/05/93	621.7	628.6	Re-installed on 11-05-93
11/06/93	621.6	628.5	
11/07/93	621.6	628.4	Groundwater sampling event on
11/08/93	621.5	628.5	11-09-93; recorded elevations were:
11/09/93	621.3	628.3	MW01R = 621.34, MW02R = 628.64
11/10/93	621.2	628.3	
11/11/93	621.3	628.4	
11/12/93	621.5	628.6	
11/13/93	621.5	628.5	
11/14/93	621.6	628.4	
11/15/93	621.5	628.4	
11/16/93	621.5	628.3	
11/17/93	621.5	628.3	
11/18/93	621.6	628.4	
11/19/93	621.7	628.4	
11/20/93	621.5	628.2	
11/21/93	621.6	628.2	
11/22/93	621.7	628.2	
11/23/93	621.7	628.4	
11/24/93	621.7	628.4	
11/25/93	621.5	628.2	
11/26/93	621.4	628.1	
11/27/93	621.5	628.2	
11/28/93	621.5	628.2	
11/29/93	621.4	628.2	
11/30/93	621.3	628.2	
Minimum	621.2	628.1	Summary of Data
Average	621.54	628.32	November 1993
Maximum	621.8	628.6	

Note: The daily groundwater elevation data reported is the highest value of 96 data points; data was recorded every 15 minutes.

Printed on: 12/23/93

(123\MUSK\GWN0V93.WK1)

Muskogee Community Landfill
2801 S. 54th Street W.
Muskogee, Oklahoma 74401
(918) 682-7284
(918) 682-2867 fax



A Waste Management Company

December 13, 1993

Mr. James Warram
Solid Waste Management Service
Department of Environmental Quality
1000 NE Tenth Street
Oklahoma City, OK 73117-1212

**SUBJECT: Groundwater Elevation Data
Muskogee Community Landfill
Permit No. 3551020
Muskogee, Oklahoma**

Dear Mr. Warram:

On behalf of Waste Management of Oklahoma, Inc., I am forwarding monthly groundwater elevation data for the monitor wells (MW) equipped with water level recorders. The data is collected from MW01R and MW02R as required by permit condition 2 of Attachment "C". For this report, data collection began 06-15-93 for MW01R and 07-08-93 for MW02R and continued through 10-31-93. Future submittals will be completed on a monthly basis.

If you have questions or require additional information, please call me at (405)427-6030 or Dan Gibson at (918)437-7773.

Sincerely,

WASTE MANAGEMENT OF OKLAHOMA, INC.

Mark Daniels, P.E.
Environmental Engineer

Enclosure

cc: Dan Gibson
Mike McCloud
Raymond DeBose
Fenton Road, DEQ
Carey Bell, Muskogee County DEQ

(FILE: GROUNDWATER ELEVATION DATA)

(MUSKIGWEL1093.RPT)

Muskogee Community Landfill

Groundwater Elevations During June 1993

From Continuous Recorders in MW01R and MW02R

Date	MW01R Elevation	MW02R Elevation	Comments
06/01/93			Recorders not installed
06/02/93			
06/03/93			
06/04/93			
06/05/93			
06/06/93			
06/07/93			
06/08/93			
06/09/93			
06/10/93			
06/11/93			
06/12/93			
06/13/93			
06/14/93			
06/15/93	624.7		Recorder installed in MW01R
06/16/93	624.7		
06/17/93	624.7		
06/18/93	624.7		
06/19/93	624.7		
06/20/93	624.8		
06/21/93	624.8		
06/22/93	624.9		
06/23/93	624.9		
06/24/93	624.9		
06/25/93	624.8		
06/26/93	624.8		
06/27/93	624.8		
06/28/93	624.9		
06/29/93	624.9		
06/30/93	624.8		
Minimum	624.7	NoData	Summary of Data
Average	624.80	NoData	June 1993
Maximum	624.9	NoData	
Note: The daily groundwater elevation data reported is the highest value of 96 data points; data was recorded every 15 minutes.			
Printed on: 12/13/93		(123\MUSK\GWJUNE93.WK1)	

Muskogee Community Landfill

Groundwater Elevations During July 1993

From Continuous Recorders in MW01R and MW02R

Date	MW01R Elevation	MW02R Elevation	Comments
07/01/93	624.8		Recorder not installed in MW02R
07/02/93	624.8		
07/03/93	624.8		
07/04/93	624.8		
07/05/93	624.8		
07/06/93	624.8		
07/07/93	624.5		
07/08/93	624.4	627.8	Recorder installed in MW02R
07/09/93	624.3	627.8	
07/10/93	624.1	627.7	
07/11/93	624.0	627.7	
07/12/93	623.9	627.7	
07/13/93	623.8	627.8	
07/14/93	623.7	627.8	
07/15/93	623.6	627.6	
07/16/93	623.5	627.6	
07/17/93	623.2	627.6	
07/18/93	623.0	627.6	
07/19/93	623.1	627.5	
07/20/93	623.2	627.5	
07/21/93	623.4	627.6	
07/22/93	623.4	627.5	
07/23/93	623.5	627.5	
07/24/93	623.3	627.6	
07/25/93	623.3	627.5	
07/26/93	623.3	627.5	
07/27/93	623.3	627.5	
07/28/93	623.3	627.5	
07/29/93	623.3	627.4	
07/30/93	623.4	627.4	
07/31/93	623.4	627.4	
Minimum	623.0	627.4	Summary of Data
Average	623.81	627.59	July 1993
Maximum	624.8	627.8	

Note: The daily groundwater elevation data reported is the highest value of 96 data points; data was recorded every 15 minutes.

Printed on: 12/13/93

(123\MUSK\GWJULY93.WK1)

Muskogee Community Landfill

Groundwater Elevations During August 1993

From Continuous Recorders in MW01R and MW02R

Date	MW01R Elevation	MW02R Elevation	Comments
08/01/93	623.5	627.4	
08/02/93	623.5	627.4	
08/03/93	623.5	627.4	
08/04/93	623.4	627.4	
08/05/93	623.6	627.5	
08/06/93	623.6	627.5	
08/07/93	623.6	627.4	
08/08/93	623.6	627.4	
08/09/93	623.5	627.4	
08/10/93	623.6	627.4	
08/11/93	623.6	627.6	
08/12/93	623.6	627.6	
08/13/93	623.6	627.6	
08/14/93	623.6	627.6	
08/15/93	623.6	627.6	Groundwater sampling event on
08/16/93	623.6	627.6	08-17-93; recorded elevations were:
08/17/93	623.7	627.6	MW01R = 623.75, MW02R = 627.63
08/18/93	623.7	627.8	
08/19/93	623.6	627.8	
08/20/93	623.4	627.8	
08/21/93	623.1	627.9	
08/22/93	623.1	627.9	
08/23/93	623.1	627.9	
08/24/93	622.8	627.9	
08/25/93	622.7	627.9	
08/26/93	622.7	627.9	
08/27/93	622.7	628.0	
08/28/93	622.7	628.0	
08/29/93	622.4	628.1	
08/30/93	622.5	628.1	
08/31/93	622.5	628.1	
Minimum	622.4	627.4	Summary of Data
Average	623.28	627.77	August 1993
Maximum	623.7	628.1	
Note: The daily groundwater elevation data reported is the highest value of 96 data points; data was recorded every 15 minutes.			
Printed on: 12/13/93		(123\MUSK\GWAUG93.WK1)	

Muskogee Community Landfill

Groundwater Elevations During September 1993

From Continuous Recorders in MW01R and MW02R

Date	MW01R Elevation	MW02R Elevation	Comments
09/01/93	622.5	628.0	
09/02/93	622.5	628.0	
09/03/93	622.5	628.0	
09/04/93	622.5	627.9	
09/05/93	622.5	627.9	
09/06/93	622.5	627.9	
09/07/93	622.4	627.8	
09/08/93	622.5	627.9	
09/09/93	622.5	627.9	
09/10/93	622.5	627.9	
09/11/93	622.5	627.9	
09/12/93	622.5	628.1	
09/13/93	622.9	628.3	
09/14/93	623.1	628.3	
09/15/93	622.8	627.9	
09/16/93	622.7	628.0	
09/17/93	622.6	628.0	
09/18/93	622.6	628.2	
09/19/93	622.7	628.2	
09/20/93	622.7	628.2	
09/21/93	622.6	628.1	
09/22/93	622.6	628.2	
09/23/93	622.6	628.1	
09/24/93	622.7	628.3	
09/25/93	622.8	628.3	
09/26/93	622.7	628.3	
09/27/93	622.7	628.2	
09/28/93	622.7	628.3	
09/29/93	622.5	628.3	
09/30/93	622.5	628.5	
Minimum	622.4	627.8	Summary of Data
Average	622.61	628.10	September 1993
Maximum	623.1	628.5	
Note: The daily groundwater elevation data reported is the highest value of 96 data points; data was recorded every 15 minutes.			
Printed on: 12/13/93		(123\MUSK\GWSEPT93.WK1)	

Muskogee Community Landfill

Groundwater Elevations During October 1993

From Continuous Recorders in MW01R and MW02R

Date	MW01R Elevation	MW02R Elevation	Comments
10/01/93	622.5	628.7	
10/02/93	622.5	628.7	
10/03/93	622.3	628.5	
10/04/93	622.3	628.6	
10/05/93	622.2	628.7	
10/06/93	622.1	628.6	
10/07/93	622.2	628.7	
10/08/93	622.3	628.8	
10/09/93	622.2	628.7	
10/10/93	622.1	628.6	
10/11/93	622.1	628.7	
10/12/93	622.1	628.6	
10/13/93	622.1	628.7	
10/14/93	622.0	628.7	
10/15/93	622.1	628.7	
10/16/93	622.3	628.8	
10/17/93	622.3	628.8	
10/18/93	622.3	628.8	
10/19/93	622.3	628.8	
10/20/93	622.3	628.7	
10/21/93	622.1	628.6	
10/22/93	622.0	628.6	
10/23/93	622.1	628.6	
10/24/93	622.1	628.6	
10/25/93	622.2	628.8	
10/26/93	622.2	628.7	
10/27/93	622.1	628.7	
10/28/93	622.3	628.8	
10/29/93	622.3	628.8	
10/30/93	621.9	628.6	
10/31/93	621.8	628.5	
Minimum	621.8	628.5	Summary of Data
Average	622.18	628.68	October 1993
Maximum	622.5	628.8	

Note: The daily groundwater elevation data reported is the highest value of 96 data points; data was recorded every 15 minutes.

Printed on: 12/13/93

(123\MUSK\GW OCT93.WK1)

APPENDIX I
ANALYTICAL GROUND-WATER DATA

Muskogee166251dp2.3rd

METLAB Testing Services, Inc.

6825 East 38th Street Tulsa, Oklahoma 74145
(918) 664-7767

MLTS 83-3576

October 21, 1983

M.R. McComas & Associates Inc.
1808 So. Main
Broken Arrow, Ok 74012

Attn: Mr. Marty ~~Smitz~~ *Schmitt*

Dear Mr. Smitz,

In accordance with your instructions chemical analysis was performed on five (5) water samples submitted on October 14, 1983.

All testing was performed in accordance with EPA analytical guidelines. The results of the chemical analysis are summarized in Table I.

If you have any questions regarding this report please contact Mr. Dan Lawson or myself.

Sincerely,

METLAB TESTING SERVICES, INC.

Tony Mummolo
Tony Mummolo
Analytical Chemist

TCM/sc



Table I

Summary of Chemical Analysis of Five (5) Muskogee Water Samples
 Tested for M.R. McComas and Associates, Inc.

<u>Constituents</u>	<u>Units</u>	<u>MW-1</u>	<u>MW-2</u>	<u>MW-3</u>	<u>Abd. Well</u>	<u>Cody Creek</u>
As	mg/l	.002	<.001	.001	<.001	<.001
Ba	mg/l	<.30	<.30	<.30	65.4	<.30
Cd	mg/l	<.006	<.006	<.006	<.006	<.006
Cr	mg/l	<.05	<.05	<.05	<.05	<.05
Pb	mg/l	<.05	<.05	<.05	<.05	<.05
Hg	mg/l	0.0001	0.0004	<0.0001	<0.0001	<0.0001
Nitrate Nitrogen	mg/l	5.6	9.1	1.0	48.	0.41
Se	mg/l	0.010	<.001	<.001	<.001	<.001
Total Dissolved Solids	mg/l	2449	9487	1120	45450	560
pH	STD	7.60	7.18	7.50	7.41	7.16
Chloride	mg/l	204	3693	119	24420	389.0
Sulfate	mg/l	1600	102	51.0	16.0	21.0
Alkalinity (as CaCO ₃)	mg/l	320.	318.	464.	432.	45.
Color	(Pt. Co.)	10	10	5	30	50
Fe	mg/l	<.03	<.03	<.03	.23	.50
Mn	mg/l	<.02	1.43	<.02	.12	<.02

Approved by



Tony Mommolo, Analytical Chemist

Test Hole	pH	mmhos/cm	Chlorides mg/l	Temp °F
		Specific Conductivity		
1	--	--	--	--
2	5.6	4,100	100	16.0
3	5.8	4,000	820	18.0
4	5.1	10,000	20,000	17.0
5	--	--	--	--
6	6.0	800	50	18.0
7	5.4	10,000	3,700	19.0
8	--	--	--	--
9	--	--	--	--
10	6.4	1,300	25	17.0
11	6.2	1,200	50	17.0
12	5.9	2,600	500	18.0
13	6.0	1,600	150	17.0
14	5.6	10,000	825	17.0
15	6.1	1,400	250	16.0
MW1	5.7	3,100	--	16.0
MW2	5.8	10,000	--	--
MW3	6.0	1,650	--	--

SAMPLES ANALYZED IN FIELD BY WM. BULLER, M. SCHMIDT



WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

Page

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000FNS: 92-13344
MP: 852921
Rev / Task: 00 / 01
Sample Type: WELL
Reported: 23-DEC-1992

Analyte	Sample Point: Sample Number: Sampled:	852-01FB AG1339 24-NOV-1992	EML RL	852-MW01 AG1342 02-DEC-1992	EML RL	852-MW01R AG1345 23-NOV-1992	EML RL	Units
FIELD DATA:								
COLOR	NA			LT. YELLOW		LT. BROWN		FT
DEPTH TO WATER FROM TOP OF CASING	NA			15.90		8.70		MG/L
FIELD DISSOLVED OXYGEN	NA			NA		NA		FT MSI
GROUNDWATER ELEV.	NA			627.04		NA		
ODOR	NA			ROTTEN EGG		NONE		
PH FIELD	NA			6.52		7.31		PH UNITS
SPECIFIC CONDUCTANCE FIELD	NA			5810.		1910.		UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS	NA			15.2		15.9		DEGREES C
WELL DEPTH TOTAL	NA			43.18		24.70		FT
CHEMICAL METHODS & ROBOTICS:								
ALKALINITY, BICARBONATE	ND	10.000	536	10.000	290	10.000	MG/L	
CHEMICAL OXYGEN DEMAND	419	10.000	21	10.000	ND	10.000	MG/L	
CHLORIDE	ND	0.500	305	5.000	388	0.500	MG/L	
CYANIDE, TOTAL	ND	0.020	ND	0.020	ND	0.020	MG/L	
FLUORIDE	ND	0.050	0.36	0.050	0.47	0.050	MG/L	
NITROGEN, AMMONIA	ND	0.020	1.46	0.020	ND	0.020	MG/L	
NITROGEN, NITRATE	ND	0.050	ND	0.050	0.55	0.050	MG/L	
PH	5.70	0.050	6.81	0.050	7.31	0.050	PH UNITS	
PHENOLS	ND	0.050	ND	0.050	ND	0.050	MG/L	
SOLIDS, TOTAL DISSOLVED	ND	5.000	5010	5.000	964	5.000	MG/L	
SPECIFIC CONDUCTANCE	ND	1.000	5800	1.000	1870	1.000	UMHOS/CM	
SULFATE	ND	5.000	2580	50.000	67.0	5.000	MG/L	
TOTAL ORGANIC CARBON	ND	1.000	3.1	1.000	ND	1.000	MG/L	
TOTAL ORGANIC CARBON	ND	1.000	3.2	1.000	ND	1.000	MG/L	
INORGANICS:								
ARSENIC-TOTAL	ND	10.000	ND	35.000	ND	10.000	UG/L	
BARIUM-TOTAL	ND	200.000	ND	200.000	ND	200.000	UG/L	
BORON-TOTAL	72.1	10.000	693	10.000	108	10.000	UG/L	
CADMIUM-TOTAL	ND	5.000	ND	5.000	ND	5.000	UG/L	
CALCIUM-TOTAL	ND	5000.000	460000	5000.000	107000	5000.000	UG/L	
CHROMIUM-TOTAL	ND	10.000	ND	10.000	13.8	10.000	UG/L	
COPPER-TOTAL	ND	25.000	ND	25.000	31.6	25.000	UG/L	
IRON-TOTAL	ND	100.000	1040	100.000	15600	100.000	UG/L	
LEAD-TOTAL	ND	5.000	ND	25.000	5.1	5.000	UG/L	
MAGNESIUM-TOTAL	ND	5000.000	241000	5000.000	35000	5000.000	UG/L	
MANGANESE-TOTAL	ND	15.000	3000	15.000	398	15.000	UG/L	
MERCURY-TOTAL	ND	0.200	ND	0.200	ND	0.200	UG/L	
NICKEL-TOTAL	ND	40.000	ND	40.000	ND	40.000	UG/L	
POTASSIUM-TOTAL	ND	5000.000	ND	5000.000	ND	5000.000	UG/L	
SELENIUM-TOTAL	ND	5.000	ND	25.000	ND	5.000	UG/L	
SILVER-TOTAL	ND	25.000	ND	25.000	ND	25.000	UG/L	
SODIUM-TOTAL	ND	5000.000	719000	5000.000	143000	5000.000	UG/L	
ZINC-TOTAL	ND	20.000	ND	20.000	262	20.000	UG/L	
VOLATILE ORGANICS:								
1,1,1,2-TETRACHLOROETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	

NA = Not Analyzed

ND = Not Detected

TBK = Trip Blank

a = EML Subcontract Data



WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000ENS: 92-13344
MP: 852921
Rev / Task: 00 / 01
Sample Type: WELL
Reported: 23-DEC-1992

Analyte	Sample Point: Sample Number: Sampled:	852-01FB AG1339 24-NOV-1992	EML RL	852-MW01 AG1342 02-DEC-1992	EML RL	852-MW01R AG1345 23-NOV-1992	EML RL	Units
1,1,1-TRICHLOROETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
1,1,2,2-TETRACHLOROETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
1,1,2-TRICHLOROETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
1,1-DICHLOROETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
1,1-DICHLOROETHENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
1,2,3-TRICHLOROPROPANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
1,2-DIBROMO-3-CHLOROPROPANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
1,2-DIBROMOETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
1,2-DICHLOROBENZENE	ND	10.000	ND	10.000	ND	10.000	UG/L	
1,2-DICHLOROETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
1,2-DICHLOROPROPANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
1,4-DICHLOROBENZENE	ND	10.000	ND	10.000	ND	10.000	UG/L	
2-BUTANONE	ND	10.000	ND	10.000	ND	10.000	UG/L	
2-HEXANONE	ND	10.000	ND	10.000	23.	10.000	UG/L	
4-METHYL-2-PENTANONE	ND	10.000	ND	10.000	ND	10.000	UG/L	
ACETONE	ND	34.000	ND	34.000	ND	34.000	UG/L	
ACRYLONITRILE	ND	100.000	ND	100.000	ND	100.000	UG/L	
BENZENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
BROMOCHLOROMETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
BROMODICHLOROMETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
BROMOFORM	ND	5.000	ND	5.000	ND	5.000	UG/L	
BROMOMETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
CARBON DISULFIDE	ND	5.000	ND	5.000	ND	5.000	UG/L	
CARBON TETRACHLORIDE	ND	5.000	ND	5.000	ND	5.000	UG/L	
CHLOROBENZENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
CHLOROETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
CHLOROFORM	ND	5.000	ND	5.000	ND	5.000	UG/L	
CHLOROMETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
CIS-1,2-DICHLOROETHENE	ND	10.000	ND	10.000	ND	10.000	UG/L	
CIS-1,3-DICHLOROPROPENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
DIBROMOCHLOROMETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
DIBROMOMETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
ETHYLBENZENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
IODOMETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
METHYLENE CHLORIDE	ND	5.000	ND	5.000	ND	5.000	UG/L	
STYRENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
TETRACHLOROETHENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
TOLUENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
TRANS-1,2-DICHLOROETHENE	ND	10.000	ND	10.000	ND	10.000	UG/L	
TRANS-1,3-DICHLOROPROPENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
TRANS-1,4-DICHLORO-2-BUTENE	ND	10.000	ND	10.000	ND	10.000	UG/L	
TRICHLOROETHENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
TRICHLOROFLUOROMETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
VINYL ACETATE	ND	10.000	ND	10.000	ND	10.000	UG/L	
VINYL CHLORIDE	ND	10.000	ND	10.000	ND	10.000	UG/L	
XYLENE (TOTAL)	ND	10.000	ND	10.000	ND	10.000	UG/L	

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WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE, OK 73111-0000ENS: 92-13344
MP: 852921
Rev / Tank: 00 / 01
Sample Type: WELL
Reported: 23-DEC-1992

Analyte	Sample Point: Sample Number: Sampled:	852-MW02 AG1341 02-DEC-1992	EML RL	852-MW02R AG1346 23-NOV-1992	EML RL	852-MW03 AG1347 23-NOV-1992	EML RL	Units
FIELD DATA:								
COLOR		MD. BROWN		DRK. GREY		LT. BROWN		FT
DEPTH TO WATER FROM TOP OF CASING		11.59		9.60		12.10		FT
FIELD DISSOLVED OXYGEN		NA		NA		NA		MG/L
GROUNDWATER ELEV.		615.93		NA		622.58		FT MSL
ODOR		NONE		NONE		NONE		
PH FIELD		6.97		6.82		7.18		PH UNITS
SPECIFIC CONDUCTANCE FIELD		5600.		4100.		1670.		UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS		15.8		17.7		16.1		DEGREES C
WELL DEPTH TOTAL		29.50		29.70		31.04		FT
CHEMICAL METHODS & ROBOTICS:								
ALKALINITY, BICARBONATE		369	10.000	717	10.000	405	10.000	MG/L
CHEMICAL OXYGEN DEMAND		63	10.000	15	10.000	12	10.000	MG/L
CHLORIDE		1450	5.000	360	5.000	321	2.500	MG/L
CYANIDE, TOTAL		ND	0.020	ND	0.020	ND	0.020	MG/L
FLUORIDE		ND	0.050	0.69	0.050	0.58	0.050	MG/L
NITROGEN, AMMONIA		0.47	0.020	ND	0.020	ND	0.020	MG/L
NITROGEN, NITRATE		ND	0.050	0.057	0.050	0.46	0.050	MG/L
PH		7.09	0.050	6.92	0.050	7.35	0.050	PH UNITS
PHENOLS		ND	0.050	ND	0.050	ND	0.050	MG/L
SOLIDS, TOTAL DISSOLVED		2900	5.000	2580	5.000	956	5.000	MG/L
SPECIFIC CONDUCTANCE		5270	1.000	4110	1.000	1760	1.000	UMHOS/CM
SULFATE		142	50.000	904	50.000	36.7	25.000	MG/L
TOTAL ORGANIC CARBON		2.0	1.000	1.5	1.000	1.9	1.000	MG/L
TOTAL ORGANIC CARBON		1.9	1.000	1.5	1.000	1.9	1.000	MG/L
INORGANICS:								
ARSENIC-TOTAL		ND	35.000	ND	14.000	ND	10.000	UG/L
BARIUM-TOTAL		765	200.000	ND	200.000	ND	200.000	UG/L
BORON-TOTAL		288	10.000	590	10.000	129	10.000	UG/L
CADMIUM-TOTAL		ND	5.000	ND	5.000	ND	5.000	UG/L
CALCIUM-TOTAL		230000	5000.000	140000	5000.000	68100	5000.000	UG/L
CHROMIUM-TOTAL		19.8	10.000	30.3	10.000	ND	10.000	UG/L
COPPER-TOTAL		41.0	25.000	58.7	25.000	ND	25.000	UG/L
IRON-TOTAL		21000	100.000	23600	100.000	1988	100.000	UG/L
LEAD-TOTAL		ND	25.000	ND	25.000	ND	5.000	UG/L
MAGNESIUM-TOTAL		115000	5000.000	45600	5000.000	28100	5000.000	UG/L
MANGANESE-TOTAL		3000	15.000	661	15.000	60.0	15.000	UG/L
MERCURY-TOTAL		ND	0.200	ND	0.200	ND	0.200	UG/L
NICKEL-TOTAL		ND	40.000	95.8	40.000	ND	40.000	UG/L
POTASSIUM-TOTAL		5950	5000.000	5820	5000.000	ND	5000.000	UG/L
SELENIUM-TOTAL		ND	25.000	ND	25.000	5.9	5.000	UG/L
SILVER-TOTAL		ND	25.000	ND	25.000	ND	25.000	UG/L
SODIUM-TOTAL		539000	5000.000	532000	5000.000	188000	5000.000	UG/L
ZINC-TOTAL		79.6	20.000	188	20.000	25.6	20.000	UG/L
VOLATILE ORGANICS:								
1,1,1,2-TETRACHLOROETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L

NA = Not Analyzed

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WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

Pa

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000ENS: 92-13344
MP: 852921
Rev / Tank: 00 / 01
Sample Type: WELL
Reported: 23-DEC-1992

Analyte	Sample Point: Sample Number: Sampled:	852-MW02 AG1341 02-DEC-1992	EML RL	852-MW02R AG1346 23-NOV-1992	EML RL	852-MW03 AG1347 23-NOV-1992	EML RL	Units
1,1,1-TRICHLOROETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,1,2,2-TETRACHLOROETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,1,2-TRICHLOROETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,1-DICHLOROETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,1-DICHLOROETHENE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,2,3-TRICHLOROPROPANE		ND	10.000	ND	10.000	ND	10.000	UG/L
1,2-DIBROMO-3-CHLOROPROPANE		ND	10.000	ND	10.000	ND	10.000	UG/L
1,2-DIBROMOETHANE		ND	10.000	ND	10.000	ND	10.000	UG/L
1,2-DICHLOROBENZENE		ND	10.000	ND	10.000	ND	10.000	UG/L
1,2-DICHLOROETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,2-DICHLOROPROPANE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,4-DICHLOROBENZENE		ND	10.000	ND	10.000	ND	10.000	UG/L
2-BUTANONE		ND	10.000	ND	10.000	ND	10.000	UG/L
2-HEXANONE		ND	10.000	ND	10.000	ND	10.000	UG/L
4-METHYL-2-PENTANONE		ND	10.000	ND	10.000	ND	10.000	UG/L
ACETONE		ND	34.000	ND	34.000	ND	34.000	UG/L
ACRYLONITRILE		ND	100.000	ND	100.000	ND	100.000	UG/L
BENZENE		ND	5.000	ND	5.000	ND	5.000	UG/L
BROMOCHLOROMETHANE		ND	10.000	ND	10.000	ND	10.000	UG/L
BROMODICHLOROMETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L
BROMOFORM		ND	5.000	ND	5.000	ND	5.000	UG/L
BROMOMETHANE		ND	10.000	ND	10.000	ND	10.000	UG/L
CARBON DISULFIDE		ND	5.000	ND	5.000	ND	5.000	UG/L
CARBON TETRACHLORIDE		ND	5.000	ND	5.000	ND	5.000	UG/L
CHLOROBENZENE		ND	5.000	ND	5.000	ND	5.000	UG/L
CHLOROETHANE		ND	10.000	ND	10.000	ND	10.000	UG/L
CHLOROFORM		ND	5.000	ND	5.000	ND	5.000	UG/L
CHLOROMETHANE		ND	10.000	ND	10.000	ND	10.000	UG/L
CIS-1,2-DICHLOROETHENE		ND	10.000	ND	10.000	ND	10.000	UG/L
CIS-1,3-DICHLOROPROPENE		ND	5.000	ND	5.000	ND	5.000	UG/L
DIBROMOCHLOROMETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L
DIBROMOMETHANE		ND	10.000	ND	10.000	ND	10.000	UG/L
ETHYLBENZENE		ND	5.000	ND	5.000	ND	5.000	UG/L
IODOMETHANE		ND	10.000	ND	10.000	ND	10.000	UG/L
METHYLENE CHLORIDE		ND	5.000	ND	5.000	ND	5.000	UG/L
STYRENE		ND	5.000	ND	5.000	ND	5.000	UG/L
TETRACHLOROETHENE		ND	5.000	ND	5.000	ND	5.000	UG/L
TOLUENE		ND	5.000	ND	5.000	ND	5.000	UG/L
TRANS-1,2-DICHLOROETHENE		ND	10.000	ND	10.000	ND	10.000	UG/L
TRANS-1,3-DICHLOROPROPENE		ND	5.000	ND	5.000	ND	5.000	UG/L
TRANS-1,4-DICHLORO-2-BUTENE		ND	10.000	ND	10.000	ND	10.000	UG/L
TRICHLOROETHENE		ND	5.000	ND	5.000	ND	5.000	UG/L
TRICHLOROFLUOROMETHANE		ND	10.000	ND	10.000	ND	10.000	UG/L
VINYL ACETATE		ND	10.000	ND	10.000	ND	10.000	UG/L
VINYL CHLORIDE		ND	10.000	ND	10.000	ND	10.000	UG/L
XYLENE (TOTAL)		ND	10.000	ND	10.000	ND	10.000	UG/L

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ND = Not Detected

TBR = Trip Blank

s = EML Subcontract Data



WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000ENS: 92-13344
MP: 852921
Rev / Task: 00 / 01
Sample Type: WELL
Reported: 23-DEC-1992

Analyte	Sample Point: Sample Number: Sampled:	852-MW03R AG1340 24-NOV-1992	EML RL	852-MW04 AG1344 02-DEC-1992	EML RL	852-MW06 AG1343 02-DEC-1992	EML RL	Units
FIELD DATA:								
COLOR		LT. BROWN		NONE		NONE		
DEPTH TO WATER FROM TOP OF CASING		13.5		9.23		25.83		FT
FIELD DISSOLVED OXYGEN		NA		NA		NA		MG/L
GROUNDWATER ELEV.		NA		645.64		638.01		FT-MSL
ODOR		NONE		NONE		NONE		
PH FIELD		5.86		6.72		6.61		PH UNITS
SPECIFIC CONDUCTANCE FIELD		3970.		8580.		2570.		UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS		18.8		18.0		17.2		DEGREES C
WELL DEPTH TOTAL		39.7		34.90		68.90		FT
CHEMICAL METHODS & ROBOTICS:								
ALKALINITY, BICARBONATE		212	10.000	1110	10.000	542	10.000	MG/L
CHEMICAL OXYGEN DEMAND		81	10.000	105	10.000	32	10.000	MG/L
CHLORIDE		222	0.500	943	5.000	168	2.500	MG/L
CYANIDE, TOTAL		ND	0.020	ND	0.020	ND	0.020	MG/L
FLUORIDE		0.43	0.050	ND	0.050	0.29	0.050	MG/L
NITROGEN, AMMONIA		1.21	0.020	ND	0.020	1.13	0.020	MG/L
NITROGEN, NITRATE		ND	0.050	ND	0.050	0.11	0.050	MG/L
PH		6.07	0.050	6.78	0.050	6.61	0.050	PH UNITS
PHENOLS		ND	0.050	ND	0.050	ND	0.050	MG/L
SOLIDS, TOTAL DISSOLVED		3250	5.000	7720	5.000	1490	5.000	MG/L
SPECIFIC CONDUCTANCE		4430	1.000	8790	1.000	2350	1.000	UMHOS/CM
SULFATE		1760	100.000	3160	50.000	437	25.000	MG/L
TOTAL ORGANIC CARBON		15.2	1.000	24.2	1.000	2.0	1.000	MG/L
TOTAL ORGANIC CARBON		14.8	1.000	23.8	1.000	2.0	1.000	MG/L
INORGANICS:								
ARSENIC-TOTAL		ND	10.000	ND	10.000	ND	10.000	UG/L
BARIUM-TOTAL		ND	200.000	ND	200.000	ND	200.000	UG/L
BORON-TOTAL		255	50.000	2000	10.000	236	10.000	UG/L
CADMIUM-TOTAL		ND	25.000	ND	5.000	ND	5.000	UG/L
CALCIUM-TOTAL		430000	7650.000	569000	15300.000	116000	5000.000	UG/L
CHROMIUM-TOTAL		ND	50.000	15.5	10.000	ND	10.000	UG/L
COPPER-TOTAL		ND	125.000	ND	25.000	ND	25.000	UG/L
IRON-TOTAL		3460	500.000	1560	100.000	6920	100.000	UG/L
LEAD-TOTAL		ND	25.000	ND	25.000	ND	5.000	UG/L
MAGNESIUM-TOTAL		145000	7250.000	630000	14500.000	82700	5000.000	UG/L
MANGANESE-TOTAL		449	75.000	5550	15.000	1830	15.000	UG/L
MERCURY-TOTAL		ND	0.200	ND	0.200	ND	0.200	UG/L
NICKEL-TOTAL		ND	200.000	41.1	40.000	ND	40.000	UG/L
POTASSIUM-TOTAL		ND	5000.000	7750	5000.000	ND	5000.000	UG/L
SELENIUM-TOTAL		ND	50.000	ND	50.000	ND	5.000	UG/L
SILVER-TOTAL		ND	125.000	ND	25.000	ND	25.000	UG/L
SODIUM-TOTAL		482000	20000.000	838000	5000.000	116000	5000.000	UG/L
ZINC-TOTAL		ND	100.000	20.8	20.000	56.3	20.000	UG/L
VOLATILE ORGANICS:								
1,1,1,2-TETRACHLOROETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L

NA = Not Analyzed

ND = Not Detected

TBK = Trip Blank

N = EML Subcontract Data



WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

Page

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL
2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000

ENS: 92-13344
MP: 852921
Rev / Task: 00 / 01
Sample Type: WELL
Reported: 23-DEC-1992

Analyte	Sample Point: Sample Number: Sampled:	852-MW03R AG1340 24-NOV-1992	EML RL	852-MW04 AG1344 02-DEC-1992	EML RL	852-MW06 AG1343 02-DEC-1992	EML RL	Units
1,1,1-TRICHLOROETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,1,2,2-TETRACHLOROETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,1,2-TRICHLOROETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,1-DICHLOROETHANE		ND	5.000	ND	5.000	21.	5.000	UG/L
1,1-DICHLOROETHENE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,2,3-TRICHLOROPROPANE		ND	10.000	ND	10.000	ND	10.000	UG/L
1,2-DIBROMO-3-CHLOROPROPANE		ND	10.000	ND	10.000	ND	10.000	UG/L
1,2-DIBROMOETHANE		ND	10.000	ND	10.000	ND	10.000	UG/L
1,2-DICHLOROBENZENE		ND	10.000	ND	10.000	ND	10.000	UG/L
1,2-DICHLOROETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,2-DICHLOROPROPANE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,4-DICHLOROBENZENE		ND	10.000	ND	10.000	ND	10.000	UG/L
2-BUTANONE	19.	10.000	10.000	ND	10.000	ND	10.000	UG/L
2-HEXANONE	ND	10.000	10.000	ND	10.000	ND	10.000	UG/L
4-METHYL-2-PENTANONE	ND	10.000	10.000	ND	10.000	ND	10.000	UG/L
ACETONE	ND	10.000	10.000	ND	10.000	ND	10.000	UG/L
ACRYLONITRILE	ND	34.000	100.000	ND	34.000	ND	34.000	UG/L
BENZENE	ND	100.000	100.000	ND	100.000	ND	100.000	UG/L
BROMOCHLOROMETHANE	ND	5.000	5.000	ND	5.000	ND	5.000	UG/L
BROMODICHLOROMETHANE	ND	10.000	10.000	ND	10.000	ND	10.000	UG/L
BROMOFORM	ND	5.000	5.000	ND	5.000	ND	5.000	UG/L
BROMOMETHANE	ND	5.000	5.000	ND	5.000	ND	5.000	UG/L
CARBON DISULFIDE	ND	10.000	10.000	ND	10.000	ND	10.000	UG/L
CARBON TETRACHLORIDE	ND	5.000	5.000	ND	5.000	ND	5.000	UG/L
CHLOROBENZENE	ND	5.000	5.000	ND	5.000	ND	5.000	UG/L
CHLOROETHANE	ND	10.000	10.000	ND	10.000	ND	10.000	UG/L
CHLOROFORM	ND	5.000	5.000	ND	5.000	ND	5.000	UG/L
CHLOROMETHANE	ND	10.000	10.000	ND	10.000	ND	10.000	UG/L
CIS-1,2-DICHLOROETHENE	ND	10.000	10.000	ND	10.000	ND	10.000	UG/L
CIS-1,3-DICHLOROPROPENE	ND	5.000	5.000	ND	5.000	ND	5.000	UG/L
DIBROMOCHLOROMETHANE	ND	5.000	5.000	ND	5.000	ND	5.000	UG/L
DIBROMOMETHANE	ND	10.000	10.000	ND	10.000	ND	10.000	UG/L
ETHYLBENZENE	ND	5.000	5.000	ND	5.000	ND	5.000	UG/L
IODOMETHANE	ND	10.000	10.000	ND	10.000	ND	10.000	UG/L
METHYLENE CHLORIDE	ND	5.000	5.000	ND	5.000	ND	5.000	UG/L
STYRENE	ND	5.000	5.000	ND	5.000	ND	5.000	UG/L
TETRACHLOROETHENE	ND	5.000	5.000	ND	5.000	ND	5.000	UG/L
TOLUENE	ND	5.000	5.000	ND	5.000	ND	5.000	UG/L
TRANS-1,2-DICHLOROETHENE	ND	10.000	10.000	ND	10.000	ND	10.000	UG/L
TRANS-1,3-DICHLOROPROPENE	ND	5.000	5.000	ND	5.000	ND	5.000	UG/L
TRANS-1,4-DICHLORO-2-BUTENE	ND	10.000	10.000	ND	10.000	ND	10.000	UG/L
TRICHLOROETHENE	ND	5.000	5.000	ND	5.000	ND	5.000	UG/L
TRICHLOROFLUOROMETHANE	ND	10.000	10.000	ND	10.000	ND	10.000	UG/L
VINYL ACETATE	ND	10.000	10.000	ND	10.000	ND	10.000	UG/L
VINYL CHLORIDE	ND	10.000	10.000	ND	10.000	ND	10.000	UG/L
XYLENE (TOTAL)	ND	10.000	10.000	ND	10.000	ND	10.000	UG/L

NA = Not Analyzed

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n = EML Subcontract Data



RMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

Page

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000

ENS: 92-13422
MP: 852923
Rev / Task: 00 / 01
Sample Type: WELL
Reported: 22-DEC-1992

Analyte	Sample Point: Sample Number: Sampled:	852-01FB AG1730 24-NOV-1992	EML RL	852-MW01 AG1733 02-DEC-1992	EML RL	852-MW01R AG1727 23-NOV-1992	EML RL	Units
INORGANICS:								
ANTIMONY-TOTAL		ND	100.000	ND	100.000	ND	100.000	UG/L
BERYLLIUM-TOTAL		ND	5.000	ND	5.000	ND	5.000	UG/L
COBALT-TOTAL		ND	50.000	ND	50.000	ND	50.000	UG/L
THALLIUM-TOTAL		ND	10.000	ND	10.000	ND	10.000	UG/L
VANADIUM-TOTAL		ND	50.000	ND	50.000	ND	50.000	UG/L

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WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000

ENS: 92-13422
MP: 852923
Rev / Task: 00 / 01
Sample Type: WELL
Reported: 22-DEC-1992

Analyte	Sample Point: Sample Number: Sampled:	852-MW02 AG1728 02-DEC-1992	EML RL	852-MW02R AG1731 23-NOV-1992	EML RL	852-MW03 AG1729 23-NOV-1992	EML RL	Units
INORGANICS:								
ANTIMONY-TOTAL		ND	100.000	130	100.000	ND	100.000	UG/L
BERYLLIUM-TOTAL		ND	5.000	ND	5.000	ND	5.000	UG/L
COBALT-TOTAL		ND	50.000	ND	50.000	ND	50.000	UG/L
THALLIUM-TOTAL		ND	10.000	ND	40.000	ND	10.000	UG/L
VANADIUM-TOTAL		ND	50.000	ND	50.000	ND	50.000	UG/L

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000ENS: 92-13422
MP: 852923
Rev / Task: 00 / 01
Sample Type: WELL
Reported: 22-DEC-1992

Analyte	Sample Point: Sample Number: Sampled:	852-MW03R AG1732 24-NOV-1992	EML RL	852-MW04 AG1734 02-DEC-1992	EML RL	852-MW06 AG1735 02-DEC-1992	EML RL	Units
INORGANICS:								
ANTIMONY-TOTAL		ND	100.000	ND	500.000	ND	100.000	UG/L
BERYLLIUM-TOTAL		ND	5.000	ND	5.000	ND	5.000	UG/L
COBALT-TOTAL		ND	50.000	ND	50.000	ND	50.000	UG/L
THALLIUM-TOTAL		ND	10.000	ND	10.000	ND	10.000	UG/L
VANADIUM-TOTAL		ND	50.000	ND	50.000	ND	50.000	UG/L

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Muskogee Community Landfill
2801 S. 54th Street W.
Muskogee, Oklahoma 74401
(918) 682-7284
(918) 682-2667 fax



A Waste Management Company

April 2, 1993

Mr. Fenton Rood, Chief
Solid Waste Management Service - 0206
Oklahoma State Department of Health
1000 NE Tenth Street
Oklahoma City, OK 73117-1299

SUBJECT: 1st Quarter 1993 Groundwater Monitoring
Muskogee Community Landfill
Permit No. 3551020
Muskogee, Oklahoma

Dear Mr. Rood:

On behalf of the Muskogee Community Landfill I am forwarding three (3) copies of the groundwater monitoring report for the sampling conducted on February 17, 1993. The three (3) new monitor wells recently installed by Waste Management of Oklahoma (#01R, #02R and #03R) and the five (5) existing City of Muskogee monitor wells (#01, #02, #03, #04 and #06) were sampled.

All wells were sampled for the parameters required by the OSDH and Federal Subtitle D regulations. We will repeat these sampling parameters at all wells again in the 2nd quarter 1993. If you have questions or require additional information, please call me or Dan Gibson at (918) 437-7773.

Sincerely,

WASTE MANAGEMENT OF OKLAHOMA, INC.

Mark Daniels, P.E.
Environmental Engineer

Enclosure

cc: Larry Cohn, WMNA South
Mark Snyder, WMNA South
Mike McCloud, Muskogee Landfill
Dan Gibson, Quarry Landfill
Walter Beckham, City of Muskogee
J.C. Shutler, Muskogee County Health Department

(MUSKOGEE\93GW10.LTR)

N/4 COR
SEC. 6
T 14 N
R 18 E



SOUTH 3972.87'

WEST 1320.0'

WEST 1320.0'

NE COR
SEC. 6
T 14 N
R 18 E

EXISTING
PERMIT AREA
159.00 ACRES

MUSKOGEE LANDFILL
AND RECYCLING CENTER

WASTE MANAGEMENT OF
OKLAHOMA, INC.

SOUTH 2659.30'

NORTH 2655.74'

MW03R ⊕

MW03 ⊕

MW01R ⊕

MW01 ⊕

CELL 2

CELL 1

MW02R ⊕

EAST 1320.0'

⊕ MW01R - MONITORING WELL LOCATION

280.0'
190.0'
280.0'

NORTH 1320.0'

⊕ MW04

⊕ MW06

EAST 2640.0'

NOT TO SCALE

ATTACHMENT 2



SEC DONOHUE
Environment & Infrastructure

MUSKOGEE LANDFILL AND
RECYCLING CENTER

MONITORING WELL LOCATION MAP



WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000KNS: 93-10497
MP: 852931
Rev / Task: 00 / 01
Sample Type: WELL
Reported: 12-MAR-1993

Analyte	Sample Point: Sample Number: Sampled:	852-01FB AG5211 17-FEB-1993	EML RL	852-MW01 AG5212 17-FEB-1993	EML RL	852-MW01R AG5213 17-FEB-1993	EML RL	Units
FIELD DATA:								
COLOR		NONE		NONE		NONE		
DEPTH TO WATER FROM TOP OF CASING		NA		14.44		8.78		FT
FIELD DISSOLVED OXYGEN	10.40			5.80		6.80		MG/L
GROUNDWATER ELEV.		NA		628.50		624.23		FT MSL
ODOR		NO		NO		NO		
PH FIELD	9.03			7.65		7.51		PH UNITS
SPECIFIC CONDUCTANCE FIELD	160.			5860.		1730.		UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS	3.3			10.1		14.5		DEGREES C
WELL DEPTH TOTAL		NA		43.18		29.25		FT
CHEMICAL METHODS & ROBOTICS:								
ALKALINITY, BICARBONATE		ND	10.000	539	10.000	278	10.000	MG/L
CHEMICAL OXYGEN DEMAND		ND	10.000	11	10.000	ND	10.000	MG/L
CHLORIDE		ND	0.500	340	5.000	403	1.000	MG/L
CYANIDE, TOTAL		ND	0.020	ND	0.020	ND	0.020	MG/L
FLUORIDE		ND	0.050	0.41	0.050	0.45	0.050	MG/L
NITROGEN, AMMONIA		ND	0.020	1.37	0.020	ND	0.020	MG/L
NITROGEN, NITRATE		ND	0.050	ND	0.050	0.69	0.050	MG/L
PH	7.12		0.050	6.64	0.050	7.24	0.050	PH UNITS
PHENOLS		ND	0.050	ND	0.050	ND	0.050	MG/L
SOLIDS, TOTAL DISSOLVED		ND	5.000	4990	25.000	965	5.000	MG/L
SPECIFIC CONDUCTANCE	2.76		1.000	6130	1.000	1860	1.000	UMHOS/CM
SULFATE		ND	5.000	2990	50.000	63.1	10.000	MG/L
TOTAL ORGANIC CARBON		ND	1.000	2.3	1.000	ND	1.000	MG/L
TOTAL ORGANIC CARBON		ND	1.000	2.3	1.000	ND	1.000	MG/L
INORGANICS:								
ARSENIC-TOTAL		ND	10.000	ND	10.000	ND	10.000	UG/L
BARIUM-TOTAL		ND	200.000	ND	200.000	ND	200.000	UG/L
BORON-TOTAL	35.9		10.000	678	10.000	90.5	10.000	UG/L
CADMIUM-TOTAL		ND	5.000	ND	5.000	ND	5.000	UG/L
CALCIUM-TOTAL		ND	5000.000	468000	5000.000	116000	5000.000	UG/L
CHROMIUM-TOTAL		ND	10.000	ND	10.000	ND	10.000	UG/L
COPPER-TOTAL		ND	25.000	ND	25.000	ND	25.000	UG/L
IRON-TOTAL		ND	100.000	1090	100.000	221	100.000	UG/L
LEAD-TOTAL		ND	5.000	ND	25.000	ND	5.000	UG/L
MAGNESIUM-TOTAL		ND	5000.000	244000	5000.000	37500	5000.000	UG/L
MANGANESE-TOTAL		ND	15.000	2910	15.000	22.7	15.000	UG/L
MERCURY-TOTAL		ND	0.200	ND	0.200	ND	0.200	UG/L
NICKEL-TOTAL		ND	40.000	ND	40.000	ND	40.000	UG/L
POTASSIUM-TOTAL		ND	5000.000	ND	5000.000	ND	5000.000	UG/L
SELENIUM-TOTAL		ND	5.000	ND	25.000	ND	5.000	UG/L
SILVER-TOTAL		ND	25.000	ND	25.000	ND	25.000	UG/L
SODIUM-TOTAL		ND	5000.000	723000	5000.000	171000	5000.000	UG/L
ZINC-TOTAL		ND	20.000	ND	20.000	ND	20.000	UG/L
VOLATILE ORGANICS:								
1,1,1,2-TETRACHLOROETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L

NA - Not Analyzed

ND - Not Detected

TBB - Trip Blank

S - EML Subcontract Data



WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000ENS: 93-10497
MP: 852931
Rev / Task: 00 / 01
Sample Type: WELL
Reported: 12-MAR-1993

Analyte	Sample Point: Sample Number: Sampled:	852-01FB AG5211 17-FEB-1993	EML RL	852-MW01 AG5212 17-FEB-1993	EML RL	852-MW01R AG5213 17-FEB-1993	EML RL	Units
1,1,1-TRICHLOROETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,1,2,2-TETRACHLOROETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,1,2-TRICHLOROETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,1-DICHLOROETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,1-DICHLOROETHENE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,2,3-TRICHLOROPROPANE		ND	10.000	ND	10.000	ND	10.000	UG/L
1,2-DIBROMO-3-CHLOROPROPANE		ND	10.000	ND	10.000	ND	10.000	UG/L
1,2-DIBROMOETHANE		ND	10.000	ND	10.000	ND	10.000	UG/L
1,2-DICHLOROBENZENE		ND	10.000	ND	10.000	ND	10.000	UG/L
1,2-DICHLOROETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,2-DICHLOROPROPANE		ND	5.000	ND	5.000	ND	5.000	UG/L
1,4-DICHLOROBENZENE		ND	10.000	ND	10.000	ND	10.000	UG/L
2-BUTANONE		ND	10.000	ND	10.000	ND	10.000	UG/L
2-HEXANONE		ND	10.000	ND	10.000	ND	10.000	UG/L
4-METHYL-2-PENTANONE		ND	10.000	ND	10.000	ND	10.000	UG/L
ACETONE		ND	34.000	ND	34.000	ND	34.000	UG/L
ACRYLONITRILE		ND	100.000	ND	100.000	ND	100.000	UG/L
BENZENE		ND	5.000	ND	5.000	ND	5.000	UG/L
BROMOCHLOROMETHANE		ND	10.000	ND	10.000	ND	10.000	UG/L
BROMODICHLOROMETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L
BROMOFORM		ND	5.000	ND	5.000	ND	5.000	UG/L
BROMOMETHANE		ND	10.000	ND	10.000	ND	10.000	UG/L
CARBON DISULFIDE		ND	5.000	ND	5.000	ND	5.000	UG/L
CARBON TETRACHLORIDE		ND	5.000	ND	5.000	ND	5.000	UG/L
CHLOROBENZENE		ND	5.000	ND	5.000	ND	5.000	UG/L
CHLOROETHANE		ND	10.000	ND	10.000	ND	10.000	UG/L
CHLOROFORM		ND	5.000	ND	5.000	ND	5.000	UG/L
CHLOROMETHANE		ND	10.000	ND	10.000	ND	10.000	UG/L
CIS-1,2-DICHLOROETHENE		ND	10.000	ND	10.000	ND	10.000	UG/L
CIS-1,3-DICHLOROPROPENE		ND	5.000	ND	5.000	ND	5.000	UG/L
DIBROMOCHLOROMETHANE		ND	5.000	ND	5.000	ND	5.000	UG/L
DIBROMOMETHANE		ND	10.000	ND	10.000	ND	10.000	UG/L
ETHYLBENZENE		ND	5.000	ND	5.000	ND	5.000	UG/L
IODOMETHANE		ND	10.000	ND	10.000	ND	10.000	UG/L
METHYLENE CHLORIDE		ND	5.000	ND	5.000	ND	5.000	UG/L
STYRENE		ND	5.000	ND	5.000	ND	5.000	UG/L
TETRACHLOROETHENE		ND	5.000	ND	5.000	ND	5.000	UG/L
TOLUENE		ND	5.000	ND	5.000	ND	5.000	UG/L
TRANS-1,2-DICHLOROETHENE		ND	10.000	ND	10.000	ND	10.000	UG/L
TRANS-1,3-DICHLOROPROPENE		ND	5.000	ND	5.000	ND	5.000	UG/L
TRANS-1,4-DICHLORO-2-BUTENE		ND	10.000	ND	10.000	ND	10.000	UG/L
TRICHLOROETHENE		ND	5.000	ND	5.000	ND	5.000	UG/L
TRICHLOROFUOROMETHANE		ND	10.000	ND	10.000	ND	10.000	UG/L
VINYL ACETATE		ND	10.000	ND	10.000	ND	10.000	UG/L
VINYL CHLORIDE		ND	10.000	ND	10.000	ND	10.000	UG/L
XYLENE (TOTAL)		ND	10.000	ND	10.000	ND	10.000	UG/L

NA = Not Analyzed

ND = Not Detected

TMB = Trip Blank

a = EML Subcontract Data



WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000RNS: 93-10497
MP: 852931
Rev / Task: 00 / 01
Sample Type: WELL
Reported: 12-MAR-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW02 AG5216 17-FEB-1993	EML RL	852-MW02R AG5214 17-FEB-1993	EML RL	852-MW03 AG5215 17-FEB-1993	EML RL	Units
FIELD DATA:								
COLOR	LT/GREY			GREY		NONE		
DEPTH TO WATER FROM TOP OF CASING	11.32			8.58		10.84		FT
FIELD DISSOLVED OXYGEN	7.80			5.80		7.40		MG/L
GROUNDWATER ELEV.	615.42			655.26		622.80		FT MSL
ODOR	NO			NO		NO		
PH FIELD	6.33			7.28		7.38		PH UNITS
SPECIFIC CONDUCTANCE FIELD	4970.			3350.		1960.		UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS	11.5			16.2		13.1		DEGREES C
WELL DEPTH TOTAL	28.72			30.01		30.10		FT
CHEMICAL METHODS & ROBOTICS:								
ALKALINITY, BICARBONATE	354	10.000		717	10.000	400	10.000	MG/L
CHEMICAL OXYGEN DEMAND	28	10.000		ND	10.000	ND	10.000	MG/L
CHLORIDE	1340	5.000		382	2.500	353	1.000	MG/L
CYANIDE, TOTAL	ND	0.020		ND	0.020	ND	0.020	MG/L
FLUORIDE	0.22	0.050		0.62	0.050	0.52	0.050	MG/L
NITROGEN, AMMONIA	0.28	0.020		0.87	0.020	ND	0.020	MG/L
NITROGEN, NITRATE	ND	0.050		ND	0.050	0.49	0.050	MG/L
PH	6.96	0.050		6.92	0.050	7.37	0.050	PH UNITS
PHENOLS	ND	0.050		ND	0.050	ND	0.050	MG/L
SOLIDS, TOTAL DISSOLVED	2750	25.000		2620	25.000	957	10.000	MG/L
SPECIFIC CONDUCTANCE	5050	1.000		4000	1.000	1900	1.000	UMHOS/CM
SULFATE	385	50.000		963	25.000	40.5	10.000	MG/L
TOTAL ORGANIC CARBON	1.9	1.000		1.3	1.000	ND	1.000	MG/L
TOTAL ORGANIC CARBON	1.8	1.000		1.2	1.000	ND	1.000	MG/L
INORGANICS:								
ARSENIC-TOTAL	21.1	10.000		23.0	14.000	ND	10.000	UG/L
BARIUM-TOTAL	1090	200.000		ND	200.000	ND	200.000	UG/L
BORON-TOTAL	262	10.000		686	10.000	169	10.000	UG/L
CADMIUM-TOTAL	ND	5.000		ND	5.000	ND	5.000	UG/L
CALCIUM-TOTAL	278000	5000.000		143000	5000.000	86900	5000.000	UG/L
CHROMIUM-TOTAL	23.7	10.000		ND	10.000	ND	10.000	UG/L
COPPER-TOTAL	26.8	25.000		ND	25.000	ND	25.000	UG/L
IRON-TOTAL	25800	100.000		961	100.000	1480	100.000	UG/L
LEAD-TOTAL	ND	25.000		34.5	25.000	ND	5.000	UG/L
MAGNESIUM-TOTAL	114000	5000.000		48400	5000.000	37500	5000.000	UG/L
MANGANESE-TOTAL	2940	15.000		679	15.000	34.8	15.000	UG/L
MERCURY-TOTAL	ND	0.200		ND	0.200	ND	0.200	UG/L
NICKEL-TOTAL	43.9	40.000		ND	40.000	ND	40.000	UG/L
POTASSIUM-TOTAL	ND	5000.000		6130	5000.000	ND	5000.000	UG/L
SELENIUM-TOTAL	ND	25.000		ND	25.000	ND	5.000	UG/L
SILVER-TOTAL	ND	25.000		ND	25.000	ND	25.000	UG/L
SODIUM-TOTAL	557000	5000.000		601000	5000.000	249000	5000.000	UG/L
ZINC-TOTAL	84.1	20.000		ND	20.000	ND	20.000	UG/L
VOLATILE ORGANICS:								
1,1,1,2-TETRACHLOROETHANE	ND	5.000		ND	5.000	ND	5.000	UG/L

NA - Not Analyzed

ND - Not Detected

TBL - Trip Blank

n - EML Subcontract Data



WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000FNS: 93-10497
MP: 052931
Rev / Task: 00 / 01
Sample Type: WELL
Reported: 12-MAR-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW02 AG5216 17-FEB-1993	EML RL	852-MW02R AG5214 17-FEB-1993	EML RL	852-MW03 AG5215 17-FEB-1993	EML RL	Units
1,1,1-TRICHLOROETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
1,1,2,2-TETRACHLOROETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
1,1,2-TRICHLOROETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
1,1-DICHLOROETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
1,1-DICHLOROETHENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
1,2,3-TRICHLOROPROPANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
1,2-DIBROMO-3-CHLOROPROPANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
1,2-DIBROMOETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
1,2-DICHLOROBENZENE	ND	10.000	ND	10.000	ND	10.000	UG/L	
1,2-DICHLOROETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
1,2-DICHLOROPROPANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
1,4-DICHLOROBENZENE	ND	10.000	ND	10.000	ND	10.000	UG/L	
2-BUTANONE	ND	10.000	ND	10.000	ND	10.000	UG/L	
2-HEXANONE	ND	10.000	ND	10.000	ND	10.000	UG/L	
4-METHYL-2-PENTANONE	ND	10.000	ND	10.000	ND	10.000	UG/L	
ACETONE	ND	34.000	ND	34.000	ND	34.000	UG/L	
ACRYLONITRILE	ND	100.000	ND	100.000	ND	100.000	UG/L	
BENZENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
BROMOCHLOROMETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
BROMODICHLOROMETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
BROMOFORM	ND	5.000	ND	5.000	ND	5.000	UG/L	
BROMOMETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
CARBON DISULFIDE	ND	5.000	ND	5.000	ND	5.000	UG/L	
CARBON TETRACHLORIDE	ND	5.000	ND	5.000	ND	5.000	UG/L	
CHLOROBENZENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
CHLOROETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
CHLOROFORM	ND	5.000	ND	5.000	ND	5.000	UG/L	
CHLOROMETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
CIS-1,2-DICHLOROETHENE	ND	10.000	ND	10.000	ND	10.000	UG/L	
CIS-1,3-DICHLOROPROPENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
DIBROMOCHLOROMETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
DIBROMOMETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
ETHYLBENZENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
IODOMETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
METHYLENE CHLORIDE	ND	5.000	ND	5.000	ND	5.000	UG/L	
STYRENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
TETRACHLOROETHENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
TOLUENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
TRANS-1,2-DICHLOROETHENE	ND	10.000	ND	10.000	ND	10.000	UG/L	
TRANS-1,3-DICHLOROPROPENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
TRANS-1,4-DICHLORO-2-BUTENE	ND	10.000	ND	10.000	ND	10.000	UG/L	
TRICHLOROETHENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
TRICHLOROFLUOROMETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
VINYL ACETATE	ND	10.000	ND	10.000	ND	10.000	UG/L	
VINYL CHLORIDE	ND	10.000	ND	10.000	ND	10.000	UG/L	
XYLENE (TOTAL)	ND	10.000	ND	10.000	ND	10.000	UG/L	

NA - Not Analyzed

ND - Not Detected

TBK - Trip Blank

EML Subcontract Data



WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

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Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000ENS: 93-10497
MP: 852931
Rev / Task: 00 / 01
Sample Type: WELL
Reported: 12-MAR-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW03R AG5219 17-FEB-1993	EML RL	852-MW04 AG5217 17-FEB-1993	EML RL	852-MW06 AG5218 17-FEB-1993	EML RL	Units
FIELD DATA:								
COLOR		SLT/YELLO		NONE		LT. BROWN		
DEPTH TO WATER FROM TOP OF CASING		13.96		5.18		69.38		FT
FIELD DISSOLVED OXYGEN		8.40		2.80		9.20		MG/L
GROUNDWATER ELEV.		630.20		646.19		0.3		FT MSL
ODOR		NO		NO		NO		
PH FIELD		7.34		7.15		8.08		PH UNITS
SPECIFIC CONDUCTANCE FIELD		4250.		9750.		3450.		UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS		9.6		6.2		0.3		DEGREES C
WELL DEPTH TOTAL		40.76		32.50		630.24		FT
CHEMICAL METHODS & ROBOTICS:								
ALKALINITY, BICARBONATE		225	10.000	1110	10.000	500	10.000	MG/L
CHEMICAL OXYGEN DEMAND		51	10.000	91	10.000	18	10.000	MG/L
CHLORIDE		222	5.000	955	5.000	180	2.500	MG/L
CYANIDE, TOTAL	ND		0.020	ND	0.020	ND	0.020	MG/L
FLUORIDE		0.45	0.050	0.080	0.050	0.30	0.050	MG/L
NITROGEN, AMMONIA		1.15	0.020	ND	0.020	1.31	0.020	MG/L
NITROGEN, NITRATE	ND		0.050	ND	0.050	0.073	0.050	MG/L
PH		6.05	0.050	6.74	0.050	6.51	0.050	PH UNITS
PHENOLS	ND		0.050	ND	0.050	ND	0.050	MG/L
SOLIDS, TOTAL DISSOLVED		3620	25.000	7620	25.000	1680	10.000	MG/L
SPECIFIC CONDUCTANCE		4370	1.000	8990	1.000	2540	1.000	UMHOS/CM
SULFATE		2150	50.000	3610	50.000	589	25.000	MG/L
TOTAL ORGANIC CARBON		15.3	1.000	23.3	1.000	2.0	1.000	MG/L
TOTAL ORGANIC CARBON		15.1	1.000	23.4	1.000	2.2	1.000	MG/L
INORGANICS:								
ARSENIC-TOTAL	ND		10.000	ND	10.000	ND	10.000	UG/L
BARIUM-TOTAL	ND		200.000	ND	200.000	ND	200.000	UG/L
BORON-TOTAL	181		10.000	1780	10.000	246	10.000	UG/L
CADMIUM-TOTAL	ND		5.000	ND	5.000	ND	5.000	UG/L
CALCIUM-TOTAL	378000		5000.000	599000	5000.000	117000	5000.000	UG/L
CHROMIUM-TOTAL	ND		10.000	12.3	10.000	ND	10.000	UG/L
COPPER-TOTAL	ND		25.000	ND	25.000	ND	25.000	UG/L
IRON-TOTAL	1840		100.000	168	100.000	4150	100.000	UG/L
LEAD-TOTAL	ND		25.000	ND	25.000	83.0	50.000	UG/L
MAGNESIUM-TOTAL	129000		5000.000	655000	5000.000	80300	5000.000	UG/L
MANGANESE-TOTAL	903		15.000	5260	15.000	1540	15.000	UG/L
MERCURY-TOTAL	ND		0.200	ND	0.200	ND	0.200	UG/L
NICKEL-TOTAL	ND		40.000	40.2	40.000	ND	40.000	UG/L
POTASSIUM-TOTAL	ND		5000.000	7980	5000.000	ND	5000.000	UG/L
SELENIUM-TOTAL	ND		25.000	ND	25.000	ND	25.000	UG/L
SILVER-TOTAL	ND		25.000	ND	125.000	ND	25.000	UG/L
SODIUM-TOTAL	437000		5000.000	766000	5000.000	307000	5000.000	UG/L
ZINC-TOTAL	34.0		20.000	ND	20.000	712	20.000	UG/L
VOLATILE ORGANICS:								
1,1,1,2-TETRACHLOROETHANE	ND		5.000	ND	5.000	ND	5.000	UG/L

NA = Not Analyzed

ND = Not Detected

TBK = Trip Blank

S = EML Subcontract Data



WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000ENS: 93-10497
MP: 852931
Rev / Task: 00 / 01
Sample Type: WEL
Reported: 12-MAR-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW03R AG5219 17-FEB-1993	EML RL	852-MW04 AG5217 17-FEB-1993	EML RL	852-MW06 AG5218 17-FEB-1993	EML RL	Units
1,1,1-TRICHLOROETHANE	ND	5.000	ND	5.000	5.	5.000	UG/L	
1,1,2,2-TETRACHLOROETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
1,1,2-TRICHLOROETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
1,1-DICHLOROETHANE	ND	5.000	ND	5.000	30.	5.000	UG/L	
1,1-DICHLOROETHENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
1,2,3-TRICHLOROPROPANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
1,2-DIBROMO-3-CHLOROPROPANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
1,2-DIBROMOETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
1,2-DICHLOROBENZENE	ND	10.000	ND	10.000	ND	10.000	UG/L	
1,2-DICHLOROETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
1,2-DICHLOROPROPANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
1,4-DICHLOROBENZENE	ND	10.000	ND	10.000	ND	10.000	UG/L	
2-BUTANONE	ND	10.000	ND	10.000	ND	10.000	UG/L	
2-HEXANONE	ND	10.000	ND	10.000	ND	10.000	UG/L	
4-METHYL-2-PENTANONE	ND	10.000	ND	10.000	ND	10.000	UG/L	
ACETONE	ND	34.000	ND	34.000	ND	34.000	UG/L	
ACRYLONITRILE	ND	100.000	ND	100.000	ND	100.000	UG/L	
BENZENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
BROMOCHLOROMETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
BROMODICHLOROMETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
BROMOFORM	ND	5.000	ND	5.000	ND	5.000	UG/L	
BROMOMETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
CARBON DISULFIDE	ND	5.000	ND	5.000	ND	5.000	UG/L	
CARBON TETRACHLORIDE	ND	5.000	ND	5.000	ND	5.000	UG/L	
CHLOROBENZENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
CHLOROETHANE	ND	10.000	ND	10.000	38.	10.000	UG/L	
CHLOROFORM	ND	5.000	ND	5.000	ND	5.000	UG/L	
CHLOROMETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
CIS-1,2-DICHLOROETHENE	ND	10.000	ND	10.000	ND	10.000	UG/L	
CIS-1,3-DICHLOROPROPENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
DIBROMOCHLOROMETHANE	ND	5.000	ND	5.000	ND	5.000	UG/L	
DIBROMOMETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
ETHYLBENZENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
IODOMETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
METHYLENE CHLORIDE	ND	5.000	ND	5.000	6.	5.000	UG/L	
STYRENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
TETRACHLOROETHENE	ND	5.000	ND	5.000	6.	5.000	UG/L	
TOLUENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
TRANS-1,2-DICHLOROETHENE	ND	10.000	ND	10.000	ND	10.000	UG/L	
TRANS-1,3-DICHLOROPROPENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
TRANS-1,4-DICHLORO-2-BUTENE	ND	10.000	ND	10.000	ND	10.000	UG/L	
TRICHLOROETHENE	ND	5.000	ND	5.000	ND	5.000	UG/L	
TRICHLOROFLUOROMETHANE	ND	10.000	ND	10.000	ND	10.000	UG/L	
VINYL ACETATE	ND	10.000	ND	10.000	ND	10.000	UG/L	
VINYL CHLORIDE	ND	10.000	ND	10.000	ND	10.000	UG/L	
XYLENE (TOTAL)	ND	10.000	ND	10.000	ND	10.000	UG/L	

NA = Not Analyzed

ND = Not Detected

TBK = Trip Blank

s = EML Subcontract Data



A Waste Management Company

June 10, 1993

Mr. Fenton Rood, Chief
Solid Waste Management Service - 0206
Oklahoma State Department of Health
1000 NE Tenth Street
Oklahoma City, OK 73117-1299

SUBJECT: 2nd Quarter 1993 Groundwater Monitoring
Muskogee Community Landfill
Permit No. 3551020
Muskogee, Oklahoma

Dear Mr. Rood:

On behalf of the Muskogee Community Landfill, I am forwarding three (3) copies of the groundwater monitoring report for the sampling conducted on April 27, 1993. The three (3) new monitor wells recently installed by Waste Management of Oklahoma (#01R, #02R and #03R) and the five (5) existing City of Muskogee monitor wells (#01, #02, #03, #04 and #06) were sampled.

All wells were sampled for the parameters required by the OSDH and Federal Subtitle D regulations. If you have questions or require additional information, please call me or Mark Daniels at (405) 427-6030.

Sincerely,

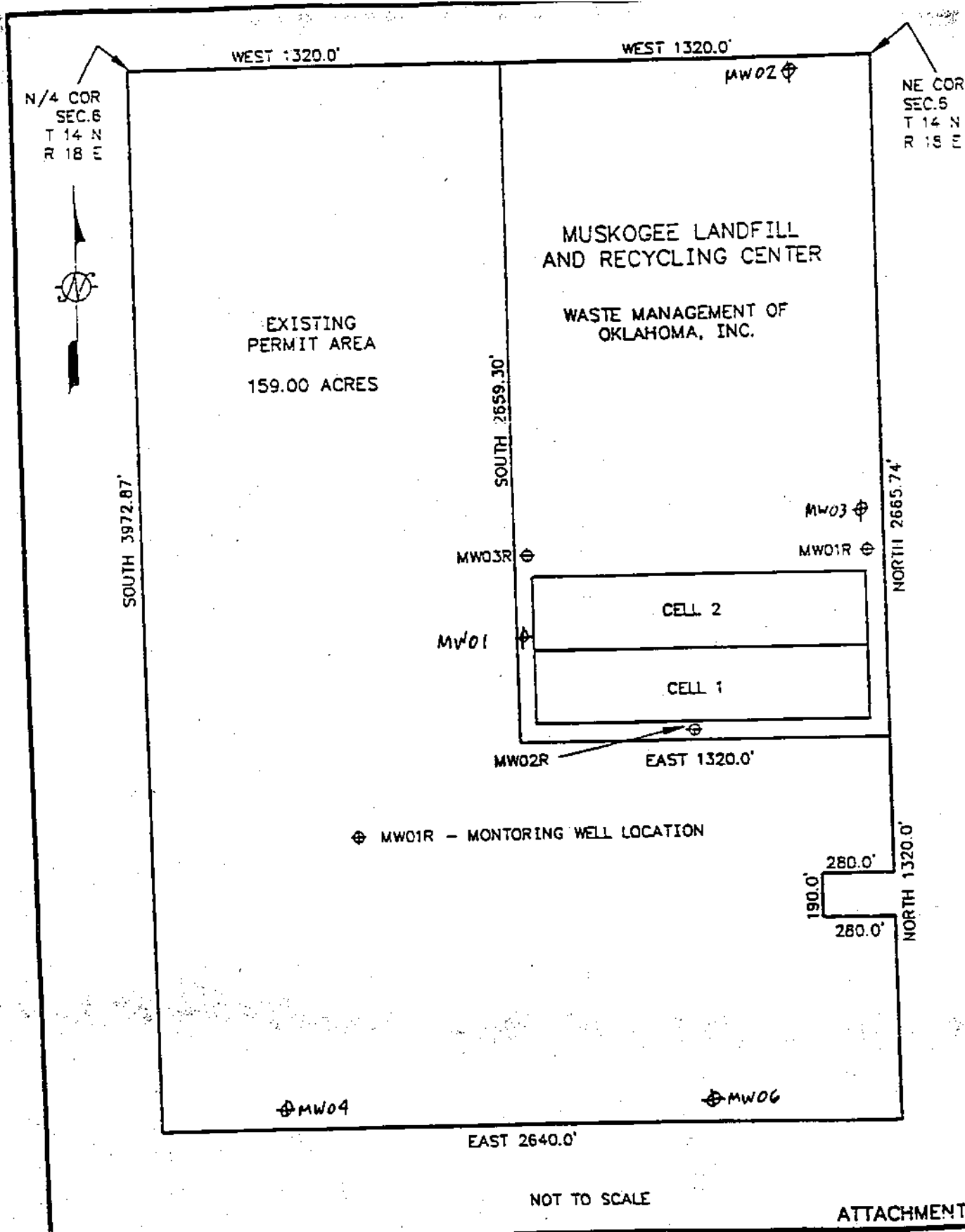
WASTE MANAGEMENT OF OKLAHOMA, INC.

Dan P. Gibson
Environmental Engineer

Enclosure

cc: Larry Cohn, WMNA South
Mark Snyder, WMNA South
Mike McCloud, Muskogee Landfill
Mark Daniels, East Oak Landfill
Walter Beckham, City of Muskogee
J.C. Shutler, Muskogee County Health Department

(MUSKOGEE\2093H20.LTR)



 **SEC DONOHUE**

**MUSKOGEE LANDFILL AND
RECYCLING CENTER**
MONITORING WELL LOCATION MAP



WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

Page

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000ENS: 93-11523
MP: 852931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

Analyte	Sample Point: Sample Number: Sampled:	852-01FB AH0591 27-APR-1993	EML RL	852-MW01 AH0585 27-APR-1993	EML RL	852-MW01R AH0587 27-APR-1993	EML RL	Units
FIELD DATA:								
COLOR		CLEAR		BROWN		BROWN		
DEPTH TO WATER FROM TOP OF CASING		NA		14.38		8.68		FT
FIELD DISSOLVED OXYGEN		7.50		3.50		6.10		MG/L
GROUNDWATER ELEV.		NA		628.56		624.33		FT MSL
ODOR		NONE		STRONG		NONE		
PH FIELD		8.98		6.52		6.96		PH UNITS
SPECIFIC CONDUCTANCE FIELD		45.1		5560		4850		UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS		20.9		14.8		14.8		DEGREES C
WELL DEPTH TOTAL		NA		43.18		29.25		FT
CHEMICAL METHODS & ROBOTICS:								
CHEMICAL OXYGEN DEMAND		ND	10.	12	10.	ND	10.	MG/L
CYANIDE, TOTAL		ND	0.020	ND	0.020	ND	0.020	MG/L
NITROGEN, AMMONIA		0.27	0.020	1.30	0.020	ND	0.020	MG/L
NITROGEN, NITRATE		ND	0.050	ND	0.050	0.52	0.050	MG/L
PH		6.87	0.05	6.67	0.05	7.20	0.05	PH UNITS
PHENOLS		ND	0.050	ND	0.050	ND	0.050	MG/L
SOLIDS, TOTAL DISSOLVED		11	5.	5800	25.	1110	5.	MG/L
SPECIFIC CONDUCTANCE		4.1	1.0	6120	1.0	1860	1.0	UMHOS/CM
TOTAL ORGANIC CARBON		ND	1.0	2.4	1.0	ND	1.0	MG/L
TOTAL ORGANIC CARBON		ND	1.0	2.4	1.0	ND	1.0	MG/L
INORGANICS:								
ALKALINITY, BICARBONATE		ND	10.	534	10.	282	10.	MG/L
ANTIMONY-TOTAL		ND	100.	ND	100.	ND	100.	UG/L
ARSENIC-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L
BARIUM-TOTAL		ND	200.	ND	200.	ND	200.	UG/L
BERYLLIUM-TOTAL		ND	5.0	ND	5.0	ND	5.0	UG/L
BORON-TOTAL		24.2	10.0	677	10.0	86.7	10.0	UG/L
CADMIUM-TOTAL		ND	5.0	ND	5.0	ND	5.0	UG/L
CALCIUM-TOTAL		ND	5000	461000	5000	133000	5000	UG/L
CHLORIDE		ND	0.5	315	5.0	404	0.5	MG/L
CHROMIUM-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L
COBALT-TOTAL		ND	50.0	ND	50.0	ND	50.0	UG/L
COPPER-TOTAL		ND	25.0	ND	25.0	ND	25.0	UG/L
FLUORIDE		ND	0.050	0.38	0.050	0.43	0.050	MG/L
IRON-TOTAL		ND	100.	729	100.	622	100.	UG/L
LEAD-TOTAL		ND	5.0	ND	16.0	ND	5.0	UG/L
MAGNESIUM-TOTAL		ND	5000	240000	5000	41200	5000	UG/L
MANGANESE-TOTAL		ND	15.0	2960	15.0	20.8	15.0	UG/L
MERCURY-TOTAL		ND	0.20	ND	0.20	ND	0.20	UG/L
NICKEL-TOTAL		ND	40.0	ND	40.0	ND	40.0	UG/L
POTASSIUM-TOTAL		ND	5000	ND	5000	ND	5000	UG/L
SELENIUM-TOTAL		ND	5.0	ND	16.0	ND	5.0	UG/L
SILVER-TOTAL		ND	25.0	ND	25.0	ND	25.0	UG/L
SODIUM-TOTAL		ND	5000	719000	5000	188000	5000	UG/L
SULFATE		ND	5.0	2780	50.0	54.7	5.0	MG/L
THALLIUM-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L



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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL
2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000

ENS: 93-11523
MP: 852931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

Analyte	Sample Point: Sample Number: Sampled:	852-01FB AH0591 27-APR-1993	EML RL	852-MW01 AH0585 27-APR-1993	EML RL	852-MW01R AH0587 27-APR-1993	EML RL	Units
VANADIUM-TOTAL		ND	50.0	ND	50.0	ND	50.0	UG/L
ZINC-TOTAL		ND	20.0	ND	20.0	ND	20.0	UG/L
VOLATILE ORGANICS:								
1,1,1,2-TETRACHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,1-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2,2-TETRACHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1-DICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1-DICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
1,2,3-TRICHLOROPROPANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DIBROMO-3-CHLOROPROPANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DIBROMOETHANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,2-DICHLOROPROPANE		ND	5.	ND	5.	ND	5.	UG/L
1,4-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
2-BUTANONE		ND	10.	ND	10.	ND	10.	UG/L
2-HEXANONE		ND	10.	ND	10.	ND	10.	UG/L
4-METHYL-2-PENTANONE		ND	10.	ND	10.	ND	10.	UG/L
ACETONE		ND	34.	ND	34.	ND	34.	UG/L
ACRYLONITRILE		ND	100	ND	100	ND	100	UG/L
BENZENE		ND	5.	ND	5.	ND	5.	UG/L
BROMOCHLOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
BROMODICHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
BROMOFORM		ND	5.	ND	5.	ND	5.	UG/L
BROMOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
CARBON DISULFIDE		ND	5.	ND	5.	ND	5.	UG/L
CARBON TETRACHLORIDE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROBENZENE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROETHANE		ND	10.	ND	10.	ND	10.	UG/L
CHLOROFORM		ND	5.	ND	5.	ND	5.	UG/L
CHLOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
CIS-1,2-DICHLOROETHENE		ND	10.	ND	10.	ND	10.	UG/L
CIS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
DIBROMOCHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
DIBROMOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
ETHYLBENZENE		ND	5.	ND	5.	ND	5.	UG/L
IODOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
METHYLENE CHLORIDE		ND	5.	ND	5.	ND	5.	UG/L
STYRENE		ND	5.	ND	5.	ND	5.	UG/L
TETRACHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TOLUENE		ND	5.	ND	5.	ND	5.	UG/L
TRANS-1,2-DICHLOROETHENE		ND	10.	ND	10.	ND	10.	UG/L
TRANS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
TRANS-1,4-DICHLORO-2-BUTENE		ND	10.	ND	10.	ND	10.	UG/L
TRICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TRICHLOROFLUOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L



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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL
2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000

ENS: 93-11523
MP: 852931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

Analyte	Sample Point: Sample Number: Sampled:	852-01FB AH0591 27-APR-1993	EML RL	852-MW01 AH0585 27-APR-1993	EML RL	852-MW01R AH0587 27-APR-1993	EML RL	Units
VINYL ACETATE		ND	10.	ND	10.	ND	10.	UG/L
VINYL CHLORIDE		ND	10.	ND	10.	ND	10.	UG/L
XYLENE(TOTAL)		ND	10.	ND	10.	ND	10.	UG/L

NA = Not Analyzed

ND = Not Detected

TBK = Trip Blank

a = EML Subcontract Data



EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000ENS: 93-11523
MP: 852931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW02 AH0589 27-APR-1993	EML RL	852-MW02R AH0590 27-APR-1993	EML RL	852-MW03 AH0588 27-APR-1993	EML RL	Units
FIELD DATA:								
COLOR		CLEAR		CLEAR		CLEAR		FT
DEPTH TO WATER FROM TOP OF CASING		19.72		8.50		9.39		MG/L
FIELD DISSOLVED OXYGEN		2.75		6.20		5.80		FT MSL
GROUNDWATER ELEV.		607.02		655.34		624.25		
ODOR		NONE		NONE		SLIGHT		
PH FIELD		7.25		6.20		8.25		PH UNITS
SPECIFIC CONDUCTANCE FIELD		4860		3880		8850		UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS		18.1		17.7		18.8		DEGREES C
WELL DEPTH TOTAL		28.72		30.01		30.10		FT
CHEMICAL METHODS & ROBOTICS:								
CHEMICAL OXYGEN DEMAND		30	10.	ND	10.	ND	10.	MG/L
CYANIDE, TOTAL		ND	0.020	ND	0.020	ND	0.020	MG/L
NITROGEN, AMMONIA		0.15	0.020	0.96	0.020	ND	0.020	MG/L
NITROGEN, NITRATE		ND	0.050	ND	0.050	0.40	0.050	MG/L
PH		6.89	0.05	6.87	0.05	7.23	0.05	PH UNITS
PHENOLS		ND	0.050	ND	0.050	ND	0.050	MG/L
SOLIDS, TOTAL DISSOLVED		3180	25.	2380	25.	1040	5.	MG/L
SPECIFIC CONDUCTANCE		4930	1.0	4010	1.0	1920	1.0	UMHOS/CM
TOTAL ORGANIC CARBON		1.4	1.0	1.4	1.0	ND	1.0	MG/L
TOTAL ORGANIC CARBON		1.5	1.0	1.3	1.0	ND	1.0	MG/L
INORGANICS:								
ALKALINITY, BICARBONATE		296	10.	710	10.	393	10.	MG/L
ANTIMONY-TOTAL		ND	100.	ND	100.	ND	100.	UG/L
ARSENIC-TOTAL		17.2	10.0	ND	10.0	ND	10.0	UG/L
BARIUM-TOTAL		ND	200.	ND	200.	ND	200.	UG/L
BERYLLIUM-TOTAL		ND	5.0	ND	5.0	ND	5.0	UG/L
BORON-TOTAL		230	10.0	773	10.0	146	10.0	UG/L
CADMIUM-TOTAL		ND	5.0	ND	5.0	ND	5.0	UG/L
CALCIUM-TOTAL		282000	5000	163000	5000	98400	5000	UG/L
CHLORIDE		1210	5.0	335	2.5	371	0.5	MG/L
CHROMIUM-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L
COBALT-TOTAL		ND	50.0	ND	50.0	ND	50.0	UG/L
COPPER-TOTAL		ND	25.0	ND	25.0	ND	25.0	UG/L
FLUORIDE		0.22	0.050	0.52	0.050	0.49	0.050	MG/L
IRON-TOTAL		3530	100.	2310	100.	2120	100.	UG/L
LEAD-TOTAL		ND	16.0	ND	16.0	ND	5.0	UG/L
MAGNESIUM-TOTAL		117000	5000	57000	5000	40500	5000	UG/L
MANGANESE-TOTAL		2640	15.0	779	15.0	52.3	15.0	UG/L
MERCURY-TOTAL		ND	0.20	ND	0.20	ND	0.20	UG/L
NICKEL-TOTAL		ND	40.0	ND	40.0	ND	40.0	UG/L
POTASSIUM-TOTAL		ND	5000	ND	5000	ND	5000	UG/L
SELENIUM-TOTAL		ND	5.0	ND	16.0	ND	5.0	UG/L
SILVER-TOTAL		ND	25.0	ND	25.0	ND	25.0	UG/L
SODIUM-TOTAL		584000	5000	706000	5000	255000	5000	UG/L
SULFATE		393	50.0	903	25.0	36.5	5.0	MG/L
THALLIUM-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L



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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000ENS: 93-11523
MP: 852931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW02 AH0589 27-APR-1993	EML RL	852-MW02R AH0590 27-APR-1993	EML RL	852-MW03 AH0588 27-APR-1993	EML RL	Units
VANADIUM-TOTAL	ND	50.0	ND	50.0	ND	50.0	UG/L	
ZINC-TOTAL	ND	20.0	ND	20.0	ND	20.0	UG/L	
VOLATILE ORGANICS:								
1,1,1,2-TETRACHLOROETHANE	ND	5.	ND	5.	ND	5.	UG/L	
1,1,1-TRICHLOROETHANE	ND	5.	ND	5.	ND	5.	UG/L	
1,1,2,2-TETRACHLOROETHANE	ND	5.	ND	5.	ND	5.	UG/L	
1,1,2-TRICHLOROETHANE	ND	5.	ND	5.	ND	5.	UG/L	
1,1-DICHLOROETHANE	ND	5.	ND	5.	ND	5.	UG/L	
1,1-DICHLOROETHENE	ND	5.	ND	5.	ND	5.	UG/L	
1,2,3-TRICHLOROPROPANE	ND	10.	ND	10.	ND	10.	UG/L	
1,2-DIBROMO-3-CHLOROPROPANE	ND	10.	ND	10.	ND	10.	UG/L	
1,2-DIBROMOETHANE	ND	10.	ND	10.	ND	10.	UG/L	
1,2-DICHLOROBENZENE	ND	10.	ND	10.	ND	10.	UG/L	
1,2-DICHLOROETHANE	ND	5.	ND	5.	ND	5.	UG/L	
1,2-DICHLOROPROPANE	ND	5.	ND	5.	ND	5.	UG/L	
1,4-DICHLOROBENZENE	ND	10.	ND	10.	ND	10.	UG/L	
2-BUTANONE	ND	10.	ND	10.	ND	10.	UG/L	
2-HEXANONE	ND	10.	ND	10.	ND	10.	UG/L	
4-METHYL-2-PENTANONE	ND	10.	ND	10.	ND	10.	UG/L	
ACETONE	ND	34.	ND	34.	ND	34.	UG/L	
ACRYLONITRILE	ND	100	ND	100	ND	100	UG/L	
BENZENE	ND	5.	ND	5.	ND	5.	UG/L	
BROMOCHLOROMETHANE	ND	10.	ND	10.	ND	10.	UG/L	
BROMODICHLOROMETHANE	ND	5.	ND	5.	ND	5.	UG/L	
BROMOFORM	ND	5.	ND	5.	ND	5.	UG/L	
BROMOMETHANE	ND	10.	ND	10.	ND	10.	UG/L	
CARBON DISULFIDE	ND	5.	ND	5.	ND	5.	UG/L	
CARBON TETRACHLORIDE	ND	5.	ND	5.	ND	5.	UG/L	
CHLOROETHANE	ND	10.	ND	10.	ND	10.	UG/L	
CHLOROETHENE	ND	5.	ND	5.	ND	5.	UG/L	
CHLOROFORM	ND	10.	ND	10.	ND	10.	UG/L	
CHLOROMETHANE	ND	10.	ND	10.	ND	10.	UG/L	
CIS-1,2-DICHLOROETHENE	ND	10.	ND	10.	ND	10.	UG/L	
CIS-1,3-DICHLOROPROPENE	ND	5.	ND	5.	ND	5.	UG/L	
DIBROMOCHLOROMETHANE	ND	5.	ND	5.	ND	5.	UG/L	
DIBROMOMETHANE	ND	10.	ND	10.	ND	10.	UG/L	
ETHYLBENZENE	ND	5.	ND	5.	ND	5.	UG/L	
IODOMETHANE	ND	10.	ND	10.	ND	10.	UG/L	
METHYLENE CHLORIDE	ND	5.	ND	5.	ND	5.	UG/L	
STYRENE	ND	5.	ND	5.	ND	5.	UG/L	
TETRACHLOROETHENE	ND	5.	ND	5.	ND	5.	UG/L	
TOLUENE	ND	5.	ND	5.	ND	5.	UG/L	
TRANS-1,2-DICHLOROETHENE	ND	10.	ND	10.	ND	10.	UG/L	
TRANS-1,3-DICHLOROPROPENE	ND	5.	ND	5.	ND	5.	UG/L	
TRANS-1,4-DICHLORO-2-BUTENE	ND	10.	ND	10.	ND	10.	UG/L	
TRICHLOROETHENE	ND	5.	ND	5.	ND	5.	UG/L	
TRICHLOROFLUOROMETHANE	ND	10.	ND	10.	ND	10.	UG/L	



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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000ENS: 93-11523
MP: 852931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW02 AH0589 27-APR-1993	EML RL	852-MW02R AH0590 27-APR-1993	EML RL	852-MW03 AH0588 27-APR-1993	EML RL	Units
VINYL ACETATE		ND	10.	ND	10.	ND	10.	UG/L
VINYL CHLORIDE		ND	10.	ND	10.	ND	10.	UG/L
XYLENE (TOTAL)		ND	10.	ND	10.	ND	10.	UG/L

NA - Not Analyzed

ND - Not Detected

TBK - Trip Blank

s - EML Subcontract Data



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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000ENS: 93-11523
MP: 852931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW03R AH0586 27-APR-1993	EML RL	852-MW04 AH0583 27-APR-1993	EML RL	852-MW06 AH0584 27-APR-1993	EML RL	Units
FIELD DATA:								
COLOR		CLEAR		CLEAR		CLEAR		
DEPTH TO WATER FROM TOP OF CASING		14.25		4.70		25.28		FT
FIELD DISSOLVED OXYGEN		4.0		2.9		6.2		MG/L
GROUNDWATER ELEV.		629.91		646.67		638.56		FT MSL
ODOR		NONE		NONE		SLIGHT		
PH FIELD		6.75		7.12		6.70		PH UNITS
SPECIFIC CONDUCTANCE FIELD		4100		8150		2810		UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS		15.5		16.0		15.8		DEGREES C
WELL DEPTH TOTAL		40.76		32.50		69.38		FT
CHEMICAL METHODS & ROBOTICS:								
CHEMICAL OXYGEN DEMAND		42	10.	94	10.	ND	10.	MG/L
CYANIDE, TOTAL		ND	0.020	ND	0.020	ND	0.020	MG/L
NITROGEN, AMMONIA		0.96	0.020	ND	0.020	1.16	0.020	MG/L
NITROGEN, NITRATE		ND	0.050	ND	0.050	ND	0.050	MG/L
PH		6.13	0.05	6.78	0.05	6.45	0.05	PH UNITS
PHENOLS		ND	0.050	ND	0.050	ND	0.050	MG/L
SOLIDS, TOTAL DISSOLVED		3920	25.	7950	25.	2140	25.	MG/L
SPECIFIC CONDUCTANCE		4430	1.0	9010	1.0	2900	1.0	UMHOS/CM
TOTAL ORGANIC CARBON		13.3	1.0	21.9	1.0	3.8	1.0	MG/L
TOTAL ORGANIC CARBON		13.1	1.0	21.8	1.0	4.3	1.0	MG/L
INORGANICS:								
ALKALINITY, BICARBONATE		220	10.	1110	10.	490	10.	MG/L
ANTIMONY-TOTAL		ND	500.	ND	100.	ND	100.	UG/L
ARSENIC-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L
BARIUM-TOTAL		ND	200.	ND	200.	ND	200.	UG/L
BERYLLIUM-TOTAL		ND	12.0	ND	5.0	ND	5.0	UG/L
BORON-TOTAL		190	50.0	1700	10.0	282	10.0	UG/L
CADMIUM-TOTAL		ND	25.0	ND	5.0	ND	5.0	UG/L
CALCIUM-TOTAL		421000	5000	633000	5000	148000	5000	UG/L
CHLORIDE		214	5.0	862	0.5	201	2.5	MG/L
CHROMIUM-TOTAL		ND	50.0	12.8	10.0	ND	10.0	UG/L
COBALT-TOTAL		ND	250.	ND	50.0	ND	50.0	UG/L
COPPER-TOTAL		ND	125.	ND	25.0	ND	25.0	UG/L
FLUORIDE		0.43	0.050	0.082	0.050	0.27	0.050	MG/L
IRON-TOTAL		6630	360.	787	100.	5280	100.	UG/L
LEAD-TOTAL		ND	16.0	ND	16.0	51.1	5.0	UG/L
MAGNESIUM-TOTAL		146000	5000	678000	5000	109000	5000	UG/L
MANGANESE-TOTAL		462	56.0	4420	15.0	2040	15.0	UG/L
MERCURY-TOTAL		ND	0.20	ND	0.20	ND	0.20	UG/L
NICKEL-TOTAL		ND	200.	46.3	40.0	ND	40.0	UG/L
POTASSIUM-TOTAL		ND	5000	8020	5000	ND	5000	UG/L
SELENIUM-TOTAL		ND	16.0	ND	16.0	ND	5.0	UG/L
SILVER-TOTAL		ND	125.	ND	25.0	ND	25.0	UG/L
SODIUM-TOTAL		491000	8000	753000	5000	355000	5000	UG/L
SULFATE		2080	50.0	3420	50.0	791	25.0	MG/L
THALLIUM-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L



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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL
2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000

KNS: 93-11523
MP: 052931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW03R AH0586 27-APR-1993	EML RL	852-MW04 AH0583 27-APR-1993	EML RL	852-MW06 AH0584 27-APR-1993	EML RL	Units
VANADIUM-TOTAL		ND	96.0	ND	50.0	ND	50.0	UG/L
ZINC-TOTAL		ND	84.0	ND	20.0	731	20.0	UG/L
VOLATILE ORGANICS:								
1,1,1,2-TETRACHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,1-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2,2-TETRACHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1-DICHLOROETHANE		ND	5.	ND	5.	30.	5.	UG/L
1,1-DICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
1,2,3-TRICHLOROPROPANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DIBROMO-3-CHLOROPROPANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DIBROMOETHANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,2-DICHLOROPROPANE		ND	5.	ND	5.	ND	5.	UG/L
1,4-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
2-BUTANONE		ND	10.	ND	10.	ND	10.	UG/L
2-HEXANONE		ND	10.	ND	10.	ND	10.	UG/L
4-METHYL-2-PENTANONE		ND	10.	ND	10.	ND	10.	UG/L
ACETONE		ND	34.	ND	34.	ND	34.	UG/L
ACRYLONITRILE		ND	100	ND	100	ND	100	UG/L
BENZENE		ND	5.	ND	5.	ND	5.	UG/L
BROMOCHLOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
BROMODICHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
BROMOFORM		ND	5.	ND	5.	ND	5.	UG/L
BROMOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
CARBON DISULFIDE		ND	5.	ND	5.	ND	5.	UG/L
CARBON TETRACHLORIDE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROBENZENE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROETHANE		ND	10.	ND	10.	46.	10.	UG/L
CHLOROFORM		ND	5.	ND	5.	ND	5.	UG/L
CHLOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
CIS-1,2-DICHLOROETHENE		ND	10.	ND	10.	ND	10.	UG/L
CIS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
DIBROMOCHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
DIBROMOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
ETHYLBENZENE		ND	5.	ND	5.	ND	5.	UG/L
IODOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
METHYLENE CHLORIDE		ND	5.	ND	5.	8.	5.	UG/L
STYRENE		ND	5.	ND	5.	ND	5.	UG/L
TETRACHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TOLUENE		ND	5.	ND	5.	ND	5.	UG/L
TRANS-1,2-DICHLOROETHENE		ND	10.	ND	10.	ND	10.	UG/L
TRANS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
TRANS-1,4-DICHLORO-2-BUTENE		ND	10.	ND	10.	ND	10.	UG/L
TRICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TRICHLOROFUOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L



WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL
2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000

ENS: 93-11523
MP: 852931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW03R AH0586 27-APR-1993	EML RL	852-MW04 AH0583 27-APR-1993	EML RL	852-MW06 AH0584 27-APR-1993	EML RL	Units
VINYL ACETATE		ND	10.	ND	10.	ND	10.	UG/L
VINYL CHLORIDE		ND	10.	ND	10.	ND	10.	UG/L
XYLENE (TOTAL)		ND	10.	ND	10.	ND	10.	UG/L

NA - Not Analyzed

ND - Not Detected

TBK - Trip Blank

s - EML Subcontract Data



EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000ENS: 93-11523
MP: 852931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

Analyte	Sample Point: Sample Number: Sampled:	TBK-MW03R AH0586 27-APR-1993	EML RL					Units
FIELD DATA: COLOR DEPTH TO WATER FROM TOP OF CASING FIELD DISSOLVED OXYGEN GROUNDWATER ELEV. ODOR PH FIELD SPECIFIC CONDUCTANCE FIELD WATER TEMPERATURE IN DEGREES CELSIUS WELL DEPTH TOTAL								FT MG/L FT MSL PH UNITS UMHOS/CM DEGREES C FT
CHEMICAL METHODS & ROBOTICS: CHEMICAL OXYGEN DEMAND CYANIDE, TOTAL NITROGEN, AMMONIA NITROGEN, NITRATE PH PHENOLS SOLIDS, TOTAL DISSOLVED SPECIFIC CONDUCTANCE TOTAL ORGANIC CARBON TOTAL ORGANIC CARBON								MG/L MG/L MG/L MG/L PH UNITS MG/L MG/L UMHOS/CM MG/L MG/L
INORGANICS: ALKALINITY, BICARBONATE ANTIMONY-TOTAL ARSENIC-TOTAL BARIUM-TOTAL BERYLLIUM-TOTAL BORON-TOTAL CADMIUM-TOTAL CALCIUM-TOTAL CHLORIDE CHROMIUM-TOTAL COBALT-TOTAL COPPER-TOTAL FLUORIDE IRON-TOTAL LEAD-TOTAL MAGNESIUM-TOTAL MANGANESE-TOTAL MERCURY-TOTAL NICKEL-TOTAL POTASSIUM-TOTAL SELENIUM-TOTAL SILVER-TOTAL SODIUM-TOTAL SULFATE THALLIUM-TOTAL								MG/L UG/L UG/L UG/L UG/L UG/L UG/L UG/L UG/L MG/L UG/L UG/L UG/L UG/L MG/L UG/L UG/L UG/L UG/L UG/L UG/L UG/L UG/L UG/L UG/L



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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000ENS: 93-11523
MP: 852931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

Analyte	Sample Point: Sample Number: Sampled:	TBK-MW03R AH0586 27-APR-1993	EML RL				Units
VANADIUM-TOTAL							UG/L
ZINC-TOTAL							UG/L
VOLATILE ORGANICS:							
1,1,1,2-TETRACHLOROETHANE		ND	5.				UG/L
1,1,1-TRICHLOROETHANE		ND	5.				UG/L
1,1,2,2-TETRACHLOROETHANE		ND	5.				UG/L
1,1,2-TRICHLOROETHANE		ND	5.				UG/L
1,1-DICHLOROETHANE		ND	5.				UG/L
1,1-DICHLOROETHENE		ND	5.				UG/L
1,2,3-TRICHLOROPROPANE		ND	10.				UG/L
1,2-DIBROMO-3-CHLOROPROPANE		ND	10.				UG/L
1,2-DIBROMOETHANE		ND	10.				UG/L
1,2-DICHLOROBENZENE		ND	10.				UG/L
1,2-DICHLOROETHANE		ND	5.				UG/L
1,2-DICHLOROPROPANE		ND	5.				UG/L
1,4-DICHLOROBENZENE		ND	10.				UG/L
2-BUTANONE		ND	10.				UG/L
2-HEXANONE		ND	10.				UG/L
4-METHYL-2-PENTANONE		ND	10.				UG/L
ACETONE		ND	34.				UG/L
ACRYLONITRILE		ND	100				UG/L
BENZENE		ND	5.				UG/L
BROMOCHLOROMETHANE		ND	10.				UG/L
BROMODICHLOROMETHANE		ND	5.				UG/L
BROMOFORM		ND	5.				UG/L
BROMOMETHANE		ND	10.				UG/L
CARBON DISULFIDE		ND	5.				UG/L
CARBON TETRACHLORIDE		ND	5.				UG/L
CHLOROBENZENE		ND	5.				UG/L
CHLOROETHANE		ND	10.				UG/L
CHLOROFORM		ND	5.				UG/L
CHLOROMETHANE		ND	10.				UG/L
CIS-1,2-DICHLOROETHENE		ND	10.				UG/L
CIS-1,3-DICHLOROPROPENE		ND	5.				UG/L
DIBROMOCHLOROMETHANE		ND	5.				UG/L
DIBROMOMETHANE		ND	10.				UG/L
ETHYLBENZENE		ND	5.				UG/L
IODOMETHANE		ND	10.				UG/L
METHYLENE CHLORIDE		ND	5.				UG/L
STYRENE		ND	5.				UG/L
TETRACHLOROETHENE		ND	5.				UG/L
TOLUENE		ND	5.				UG/L
TRANS-1,2-DICHLOROETHENE		ND	10.				UG/L
TRANS-1,3-DICHLOROPROPENE		ND	5.				UG/L
TRANS-1,4-DICHLORO-2-BUTENE		ND	10.				UG/L
TRICHLOROETHENE		ND	5.				UG/L
TRICHLOROFLUOROMETHANE		ND	10.				UG/L

NA = Not Analyzed

ND = Not Detected

TBK = Total Blank

MP = Method Blank



WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000ENS: 93-11523
MP: 852931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

Analyte	Sample Point: Sample Number: Sampled:	TBR-MW03R AH0586 27-APR-1993	EML RL					Units
VINYL ACETATE		ND	10.					UG/L
VINYL CHLORIDE		ND	10.					UG/L
XYLENE (TOTAL)		ND	10.					UG/L

NA - Not Analyzed

ND - Not Detected

TBR - Trip Blank

a - EML Subcontract Data

Muskogee Community Landfill
2801 S. 54th Street W.
Muskogee, Oklahoma 74401
(918) 682-7284
(918) 682-2867 fax



A Waste Management Company

September 28, 1993

Mr. Fenton Rood, Chief
Solid Waste Management Service
Department of Environmental Quality
1000 NE Tenth Street
Oklahoma City, OK 73117-1299

SUBJECT: 3rd Quarter 1993 Groundwater Monitoring
Muskogee Community Landfill & Recycling Center
Permit No. 3551020
Muskogee, Oklahoma

Dear Mr. Rood:

On behalf of Waste Management of Oklahoma, Inc. (WMO), Muskogee Community Landfill & Recycling Center, we are forwarding three (3) copies of the groundwater monitoring report for the sampling conducted on August 17, 1993. WMO monitor wells (MW01R, MW02R and MW03R) and City of Muskogee monitor wells (MW01, MW02, MW03, MW04 and MW06) were sampled.

If you have questions or require additional information, please call me at 918/437-7773 or Mark Daniels at 405/427-6030.

Sincerely,

WASTE MANAGEMENT OF OKLAHOMA, INC.

Dan P. Gibson
Staff Engineer

Enclosure

cc: Larry Cohn, WMNA South
Mark Daniels, East Oak Landfill
Mark Snyder, WMNA South
Mike McCloud - Quarry Landfill
John Wickersham - TCCHD

(MUSK\3093H20.LTR)

N/4 COR
SEC. 6
T 14 N
R 18 E



SOUTH 3972.87'

WEST 1320.0'

WEST 1320.0'

MW02

NE COR
SEC. 6
T 14 N
R 18 E

MUSKOGEE LANDFILL
AND RECYCLING CENTER

WASTE MANAGEMENT OF
OKLAHOMA, INC.

EXISTING
PERMIT AREA

159.00 ACRES

SOUTH 2659.30'

NORTH 2665.74'

MW03

MW01R

MW03R

MW01

CELL 2

CELL 1

MW02R

EAST 1320.0'

⊕ MW01R - MONITORING WELL LOCATION

280.0'
190.0'
280.0'

NORTH 1320.0'

⊕ MW04

⊕ MW06

EAST 2640.0'

NOT TO SCALE

ATTACHMENT

SEC DONOHUE

MUSKOGEE LANDFILL AND
RECYCLING CENTER



WMM ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401ENS: 93-13150
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 8-SEP-1993

Analyte	Sample Point: Sample Number: Sampled:	852-01FB AH8842 17-AUG-1993	EML RL	852-MW01 AH8835 17-AUG-1993	EML RL	852-MW01R AH8838 17-AUG-1993	EML RL	Units
FIELD DATA:								
COLOR		NONE		NONE		LT BROWN		
GROUNDWATER ELEV.		NA		629.73		623.75		FT MSI.
ODOR		NO		NO		NO		
PH FIELD		8.59		6.73		7.32		PH UNITS
SPECIFIC CONDUCTANCE FIELD		7		5330		1579		UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS		36.2		23.1		24.6		DEGREES C
WELL DEPTH TOTAL		NA		43.18		29.25		FT
CHEMICAL METHODS & ROBOTICS:								
CHEMICAL OXYGEN DEMAND		ND	10.	12	10.	ND	10.	MG/L
CYANIDE, TOTAL		ND	0.020	ND	0.020	ND	0.020	MG/L
NITROGEN, AMMONIA		ND	0.020	1.30	0.020	ND	0.020	MG/L
NITROGEN, NITRATE		ND	0.050	ND	0.050	.66	0.050	MG/L
PH		5.89	0.05	6.78	0.05	7.28	0.05	PH UNITS
PHENOLS		ND	0.050	ND	0.050	ND	0.050	MG/L
SOLIDS, TOTAL DISSOLVED		17	5.	4320	25.	1060	5.	MG/L
SPECIFIC CONDUCTANCE		1.4	1.0	5610	1.0	1830	1.0	UMHOS/CM
TOTAL ORGANIC CARBON		ND	1.0	2.8	1.0	ND	1.0	MG/L
TOTAL ORGANIC CARBON		ND	1.0	2.9	1.0	1.0	1.0	MG/L
INORGANICS:								
ALKALINITY		ND	5.0	550	5.0	279	5.0	MG/L
CHLORIDE		ND	0.5	336	5.0	422	0.5	MG/L
FLUORIDE		ND	0.050	.40	0.050	.44	0.050	MG/L
IRON-DISSOLVED		ND	100.	480	100.	460	100.	UG/L
MANGANESE-DISSOLVED		ND	15.0	2340	15.0	40.1	15.0	UG/L
SODIUM-DISSOLVED		ND	5000	602000	5000	181000	5000	UG/L
SULFATE		ND	5.0	2780	50.0	62.8	5.0	MG/L
VOLEATILE ORGANICS:								
1,1,1,2-TETRACHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,1-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2,2-TETRACHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1-DICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1-DICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
1,2,3-TRICHLOROPROPANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DIBROMO-3-CHLOROPROPANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DIBROMOETHANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,2-DICHLOROPROPANE		ND	5.	ND	5.	ND	5.	UG/L
1,3-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
1,4-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
2-BUTANONE		ND	10.	ND	10.	ND	10.	UG/L
2-CHLOROETHYL VINYL ETHER		ND	20.	ND	20.	ND	20.	UG/L
2-HEXANONE		ND	10.	ND	10.	ND	10.	UG/L
4-METHYL-2-PENTANONE		ND	10.	ND	10.	ND	10.	UG/L

NA = Not Analyzed

ND = Not Detected

TRK = Trip Blank

EML Subcontract Data



WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401ENS: 93-13150
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 8-SEP-1993

Analyte	Sample Point: Sample Number: Sampled:	852-01FB AH8842 17-AUG-1993	EML RL	852-MW01 AH8835 17-AUG-1993	EML RL	852-MW01R AH8838 17-AUG-1993	EML RL	Units
ACETONE		ND	34.	ND	34.	ND	34.	UG/L
ACRYLONITRILE		ND	100	ND	100	ND	100	UG/L
BENZENE		ND	5.	ND	5.	ND	5.	UG/L
BROMOCHLOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
BROMODICHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
BROMOFORM		ND	5.	ND	5.	ND	5.	UG/L
BROMOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
CARBON DISULFIDE		ND	5.	ND	5.	ND	5.	UG/L
CARBON TETRACHLORIDE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROBENZENE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROETHANE		ND	10.	ND	10.	ND	10.	UG/L
CHLOROFORM		ND	5.	ND	5.	ND	5.	UG/L
CHLOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
CIS-1,2-DICHLOROETHENE		ND	10.	ND	10.	ND	10.	UG/L
CIS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
DIBROMOCHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
DIBROMOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
ETHYLBENZENE		ND	5.	ND	5.	ND	5.	UG/L
IODOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
METHYLENE CHLORIDE		ND	5.	ND	5.	ND	5.	UG/L
STYRENE		ND	5.	ND	5.	ND	5.	UG/L
TETRACHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TOLUENE		ND	5.	ND	5.	ND	5.	UG/L
TRANS-1,2-DICHLOROETHENE		ND	10.	ND	10.	ND	10.	UG/L
TRANS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
TRANS-1,4-DICHLORO-2-BUTENE		ND	10.	ND	10.	ND	10.	UG/L
TRICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TRICHLOROFLUOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
VINYL ACETATE		ND	10.	ND	10.	ND	10.	UG/L
VINYL CHLORIDE		ND	10.	ND	10.	ND	10.	UG/L
XYLENE (TOTAL)		ND	10.	ND	10.	ND	10.	UG/L

NA = Not Analyzed

ND = Not Detected

TBK = Trip Blank

n = EML Subcontract Data



WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401ENS: 93-13150
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 8-SEP-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW02 AH8840 17-AUG-1993	EML RL	852-MW02R AH8837 17-AUG-1993	EML RL	852-MW03 AH8839 17-AUG-1993	EML RL	Units
FIELD DATA:								
COLOR		LT BROWN		NONE		NONE		
GROUNDWATER ELEV.		615.76		656.23 ←	627.03	623.51		FT MSL
ODOR		NO		NO		NO		
PH FIELD		7.01		6.97	DP6	7.32		PH UNITS
SPECIFIC CONDUCTANCE FIELD		4340		3240	9/27/93	1561		UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS		23.1		25.3		23.5		DEGREES C
WELL DEPTH TOTAL		28.72		30.07		30.10		FT
CHEMICAL METHODS & ROBOTICS:								
CHEMICAL OXYGEN DEMAND		34	10.	10	10.	ND	10.	MG/L
CYANIDE, TOTAL		ND	0.020	ND	0.020	ND	0.020	MG/L
NITROGEN, AMMONIA		.30	0.020	1.05	0.020	ND	0.020	MG/L
NITROGEN, NITRATE		ND	0.050	ND	0.050	.53	0.050	MG/L
PH		6.96	0.05	6.94	0.05	7.25	0.05	PH UNITS
PHENOLS		ND	0.050	ND	0.050	ND	0.050	MG/L
SOLIDS, TOTAL DISSOLVED		3030	25.	2040	25.	1020	5.	MG/L
SPECIFIC CONDUCTANCE		5260	1.0	3710	1.0	1838	1.0	UMHOS/CM
TOTAL ORGANIC CARBON		1.4	1.0	1.5	1.0	ND	1.0	MG/L
TOTAL ORGANIC CARBON		1.5	1.0	1.7	1.0	ND	1.0	MG/L
INORGANICS:								
ALKALINITY		344	5.0	739	5.0	394	5.0	MG/L
CHLORIDE		1460	5.0	377	2.5	372	0.5	MG/L
FLUORIDE		.23	0.050	.59	0.050	.58	0.050	MG/L
IRON-DISSOLVED		8710	100.	475	100.	131	100.	UG/L
MANGANESE-DISSOLVED		3150	15.0	651	15.0	ND	15.0	UG/L
SODIUM-DISSOLVED		576000	5000	678000	5000	238000	5000	UG/L
SULFATE		343	50.0	771	25.0	40.0	5.0	MG/L
VOLATILE ORGANICS:								
1,1,1,2-TETRACHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,1-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2,2-TETRACHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1-DICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1-DICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
1,2,3-TRICHLOROPROPANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DIBROMO-3-CHLOROPROPANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DIBROMOETHANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,2-DICHLOROPROPANE		ND	5.	ND	5.	ND	5.	UG/L
1,3-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
1,4-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
2-BUTANONE		ND	10.	ND	10.	ND	10.	UG/L
2-CHLOROETHYL VINYL ETHER		ND	20.	ND	20.	ND	20.	UG/L
2-HEXANONE		ND	10.	ND	10.	ND	10.	UG/L
4-METHYL-2-PENTANONE		ND	10.	ND	10.	ND	10.	UG/L

NA = Not Analyzed

ND = Not Detected

TRK = Trip Blank

EML = Environmental Monitoring Laboratories, Inc.

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401

ENS: 93-13150
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 8-SEP-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW02 AH8840 17-AUG-1993	EML RL	852-MW02R AH8837 17-AUG-1993	EML RL	852-MW03 AH8839 17-AUG-1993	EML RL	Units
ACETONE		ND	34.	ND	34.	ND	34.	UG/L
ACRYLONITRILE		ND	100	ND	100	ND	100	UG/L
BENZENE		ND	5.	ND	5.	ND	5.	UG/L
BROMOCHLOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
BROMODICHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
BROMOFORM		ND	5.	ND	5.	ND	5.	UG/L
BROMOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
CARBON DISULFIDE		ND	5.	ND	5.	ND	5.	UG/L
CARBON TETRACHLORIDE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROBENZENE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROETHANE		ND	10.	ND	10.	ND	10.	UG/L
CHLOROFORM		ND	5.	ND	5.	ND	5.	UG/L
CHLOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
CIS-1,2-DICHLOROETHENE		ND	10.	ND	10.	ND	10.	UG/L
CIS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
DIBROMOCHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
DIBROMOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
ETHYLBENZENE		ND	5.	ND	5.	ND	5.	UG/L
IODOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
METHYLENE CHLORIDE		ND	5.	ND	5.	ND	5.	UG/L
STYRENE		ND	5.	ND	5.	ND	5.	UG/L
TETRACHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TOLUENE		ND	5.	ND	5.	ND	5.	UG/L
TRANS-1,2-DICHLOROETHENE		ND	10.	ND	10.	ND	10.	UG/L
TRANS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
TRANS-1,4-DICHLORO-2-BUTENE		ND	10.	ND	10.	ND	10.	UG/L
TRICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TRICHLOROFLUOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
VINYL ACETATE		ND	10.	ND	10.	ND	10.	UG/L
VINYL CHLORIDE		ND	10.	ND	10.	ND	10.	UG/L
XYLENE (TOTAL)		ND	10.	ND	10.	ND	10.	UG/L

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ND = Not Detected

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s = EML Subcontract Data



WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401ENS: 93-13150
MP: 852931
Rev / Task: 02 / 01
Sample Type: WEL
Reported: 8-SEP-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW03R AH8836 17-AUG-1993	EML RL	852-MW04 AH8834 17-AUG-1993	EML RL	852-MW06 AH8841 17-AUG-1993	EML RL	Units
FIELD DATA:								
COLOR		NONE		NONE		NONE		
GROUNDWATER ELEV.		631.16		657.04		638.62		FT MSL
ODOR		NO		NO		NO		
PH FIELD		6.31		6.45		6.83		PH UNITS
SPECIFIC CONDUCTANCE FIELD		3910		7540		2560		UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS		23.5		21.9		24.8		DEGREES C
WELL DEPTH TOTAL		40.76		32.50		69.38		FT
CHEMICAL METHODS & ROBOTICS:								
CHEMICAL OXYGEN DEMAND		51	10.	89	10.	12	10.	MG/L
CYANIDE, TOTAL		ND	0.020	ND	0.020	ND	0.020	MG/L
NITROGEN, AMMONIA		.98	0.020	ND	0.020	1.19	0.020	MG/L
NITROGEN, NITRATE		ND	0.050	ND	0.050	.13	0.050	MG/L
PH		6.01	0.05	6.98	0.05	6.76	0.05	PH UNITS
PHENOLS		ND	0.050	ND	0.050	ND	0.050	MG/L
SOLIDS, TOTAL DISSOLVED		2750	25.	7130	25.	2030	10.	MG/L
SPECIFIC CONDUCTANCE		4120	1.0	8180	1.0	2980	1.0	UMHOS/CM
TOTAL ORGANIC CARBON		15.0	1.0	22.1	1.0	2.2	1.0	MG/L
TOTAL ORGANIC CARBON		15.6	1.0	22.4	1.0	2.2	1.0	MG/L
INORGANICS:								
ALKALINITY		229	5.0	1140	5.0	529	5.0	MG/L
CHLORIDE		245	2.5	877	5.0	233	2.5	MG/L
FLUORIDE		.48	0.050	.085	0.050	.34	0.050	MG/L
IRON-DISSOLVED		2350	360.	259	100.	2770	100.	UG/L
MANGANESE-DISSOLVED		767	56.0	4410	15.0	2220	15.0	UG/L
SODIUM-DISSOLVED		424000	8000	734000	5000	382000	5000	UG/L
SULFATE		1950	25.0	3340	50.0	864	25.0	MG/L
VOIATILE ORGANICS:								
1,1,1,2-TETRACHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,1-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2,2-TETRACHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1-DICHLOROETHANE		ND	5.	ND	5.	25.	5.	UG/L
1,1-DICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
1,2,3-TRICHLOROPROPANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DIBROMO-3-CHLOROPROPANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DIBROMOETHANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,2-DICHLOROPROPANE		ND	5.	ND	5.	ND	5.	UG/L
1,3-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
1,4-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
2-BUTANONE		ND	10.	ND	10.	ND	10.	UG/L
2-CHLOROETHYL VINYL ETHER		ND	20.	ND	20.	ND	20.	UG/L
2-HEXANONE		ND	10.	ND	10.	ND	10.	UG/L
4-METHYL-2-PENTANONE		ND	10.	ND	10.	ND	10.	UG/L

NA = Not Analyzed

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ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401ENS: 93-13150
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 8-SEP-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW03R AH8836 17-AUG-1993	EML RL	852-MW04 AH8834 17-AUG-1993	EML RL	852-MW06 AH8841 17-AUG-1993	EML RL	Units
ACETONE		ND	34.	ND	34.	ND	34.	UG/L
ACRYLONITRILE		ND	100	ND	100	ND	100	UG/L
BENZENE		ND	5.	ND	5.	ND	5.	UG/L
BROMOCHLOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
BROMODICHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
BROMOFORM		ND	5.	ND	5.	ND	5.	UG/L
BROMOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
CARBON DISULFIDE		ND	5.	ND	5.	ND	5.	UG/L
CARBON TETRACHLORIDE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROBENZENE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROETHANE		ND	10.	ND	10.	28.	10.	UG/L
CHLOROFORM		ND	5.	ND	5.	ND	5.	UG/L
CHLOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
CIS-1,2-DICHLOROETHENE		ND	10.	ND	10.	ND	10.	UG/L
CIS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
DIBROMOCHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
DIBROMOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
ETHYLBENZENE		ND	5.	ND	5.	ND	5.	UG/L
IODOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
METHYLENE CHLORIDE		ND	5.	ND	5.	ND	5.	UG/L
STYRENE		ND	5.	ND	5.	ND	5.	UG/L
TETRACHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TOLUENE		ND	5.	ND	5.	ND	5.	UG/L
TRANS-1,2-DICHLOROETHENE		ND	10.	ND	10.	ND	10.	UG/L
TRANS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
TRANS-1,4-DICHLORO-2-BUTENE		ND	10.	ND	10.	ND	10.	UG/L
TRICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TRICHLOROFLUOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
VINYL ACETATE		ND	10.	ND	10.	ND	10.	UG/L
VINYL CHLORIDE		ND	10.	ND	10.	10.	10.	UG/L
XYLENE (TOTAL)		ND	10.	ND	10.	ND	10.	UG/L

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WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401ENS: 93-13150
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 8-SEP-1993

Analyte	Sample Point: Sample Number: Sampled:	TBK-MW02R AH8837 17-AUG-1993	EML RL					Units
FIELD DATA:								
COLOR								
GROUNDWATER ELEV.								FT MSI.
ODOR								
PH FIELD								PH UNITS
SPECIFIC CONDUCTANCE FIELD								UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS								DEGREES C
WELL DEPTH TOTAL								FT
CHEMICAL METHODS & ROBOTICS:								
CHEMICAL OXYGEN DEMAND								MG/L
CYANIDE, TOTAL								MG/L
NITROGEN, AMMONIA								MG/L
NITROGEN, NITRATE								MG/L
PH								PH UNITS
PHENOLS								MG/L
SOLIDS, TOTAL DISSOLVED								MG/L
SPECIFIC CONDUCTANCE								UMHOS/CM
TOTAL ORGANIC CARBON								MG/L
TOTAL ORGANIC CARBON								MG/L
INORGANICS:								
ALKALINITY								MG/L
CHLORIDE								MG/L
FLUORIDE								MG/L
IRON-DISSOLVED								UG/L
MANGANESE-DISSOLVED								UG/L
SODIUM-DISSOLVED								UG/L
SULFATE								MG/L
VOIATILE ORGANICS:								
1,1,1,2-TETRACHLOROETHANE	ND		5.					UG/L
1,1,1-TRICHLOROETHANE	ND		5.					UG/L
1,1,2,2-TETRACHLOROETHANE	ND		5.					UG/L
1,1,2-TRICHLOROETHANE	ND		5.					UG/L
1,1-DICHLOROETHANE	ND		5.					UG/L
1,1-DICHLOROETHENE	ND		5.					UG/L
1,2,3-TRICHLOROPROPANE	ND		10.					UG/L
1,2-DIBROMO-3-CHLOROPROPANE	ND		10.					UG/L
1,2-DIBROMOETHANE	ND		10.					UG/L
1,2-DICHLOROBENZENE	ND		10.					UG/L
1,2-DICHLOROETHANE	ND		5.					UG/L
1,2-DICHLOROPROPANE	ND		5.					UG/L
1,3-DICHLOROBENZENE	ND		10.					UG/L
1,4-DICHLOROBENZENE	ND		10.					UG/L
2-BUTANONE	ND		10.					UG/L
2-CHLOROETHYL VINYL ETHER	ND		20.					UG/L
2-HEXANONE	ND		10.					UG/L
4-METHYL-2-PENTANONE	ND		10.					UG/L

NA = Not Analyzed

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EML Subcontract Data



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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401ENS: 93-13150
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 8-SEP-1993

Analyte	Sample Point: Sample Number: Sampled:	TBK-MW02R AH8837 17-AUG-1993	EML RL					Units
ACETONE		ND	34.					UG/L
ACRYLONITRILE		ND	100					UG/L
BENZENE		ND	5.					UG/L
BROMOCHLOROMETHANE		ND	10.					UG/L
BROMODICHLOROMETHANE		ND	5.					UG/L
BROMOFORM		ND	5.					UG/L
BROMOMETHANE		ND	10.					UG/L
CARBON DISULFIDE		ND	5.					UG/L
CARBON TETRACHLORIDE		ND	5.					UG/L
CHLOROBENZENE		ND	5.					UG/L
CHLOROETHANE		ND	10.					UG/L
CHLOROFORM		ND	5.					UG/L
CHLOROMETHANE		ND	10.					UG/L
CIS-1,2-DICHLOROETHENE		ND	10.					UG/L
CIS-1,3-DICHLOROPROPENE		ND	5.					UG/L
DIBROMOCHLOROMETHANE		ND	5.					UG/L
DIBROMOMETHANE		ND	10.					UG/L
ETHYLBENZENE		ND	5.					UG/L
IODOMETHANE		ND	10.					UG/L
METHYLENE CHLORIDE		ND	5.					UG/L
STYRENE		ND	5.					UG/L
TETRACHLOROETHENE		ND	5.					UG/L
TOLUENE		ND	5.					UG/L
TRANS-1,2-DICHLOROETHENE		ND	10.					UG/L
TRANS-1,3-DICHLOROPROPENE		ND	5.					UG/L
TRANS-1,4-DICHLORO-2-BUTENE		ND	10.					UG/L
TRICHLOROETHENE		ND	5.					UG/L
TRICHLOROFLUOROMETHANE		ND	10.					UG/L
VINYL ACETATE		ND	10.					UG/L
VINYL CHLORIDE		ND	10.					UG/L
XYLENE (TOTAL)		ND	10.					UG/L

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ND = Not Detected

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WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401ENS: 93-13151
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 17-SEP-1993

Analyte	Sample Point: Sample Number: Sampled:	852-01FB AH8843 17-AUG-1993	EML RL	852-MW01 AH8849 17-AUG-1993	EML RL	852-MW01R AH8847 17-AUG-1993	EML RL	Units
INORGANICS:								
ANTIMONY-TOTAL	ND	300.		ND	300.	ND	300.	UG/L
ARSENIC-TOTAL	ND	10.0		ND	14.0	ND	10.0	UG/L
BARIUM-TOTAL	ND	200.		ND	200.	ND	200.	UG/L
BERYLLIUM-TOTAL	ND	5.0		ND	5.0	ND	5.0	UG/L
CADMIUM-TOTAL	ND	5.0		ND	5.0	ND	5.0	UG/L
CHROMIUM-TOTAL	ND	10.0		ND	10.0	14.4	10.0	UG/L
COBALT-TOTAL	ND	50.0		ND	50.0	ND	50.0	UG/L
COPPER-TOTAL	202	25.0		ND	25.0	ND	25.0	UG/L
LEAD-TOTAL	ND	5.0		ND	16.0	11.1	5.0	UG/L
NICKEL-TOTAL	ND	40.0		ND	40.0	101	40.0	UG/L
SELENIUM-TOTAL	ND	5.0		ND	16.0	ND	5.0	UG/L
SILVER-TOTAL	ND	25.0		ND	25.0	ND	25.0	UG/L
THALLIUM-TOTAL	ND	10.0		ND	10.0	ND	10.0	UG/L
VANADIUM-TOTAL	ND	50.0		ND	50.0	ND	50.0	UG/L
ZINC-TOTAL	ND	20.0		ND	20.0	55.8	20.0	UG/L

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WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401ENS: 93-13151
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 17-SEP-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW02 AH8845 17-AUG-1993	EML RL	852-MW02R AH8848 17-AUG-1993	EML RL	852-MW03 AH8846 17-AUG-1993	EML RL	Units
INORGANICS:								
ANTIMONY-TOTAL		ND	300.	ND	300.	ND	300.	UG/L
ARSENIC-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L
BARIUM-TOTAL		527	200.	ND	200.	ND	200.	UG/L
BERYLLIUM-TOTAL		ND	5.0	ND	5.0	ND	5.0	UG/L
CAESIUM-TOTAL		ND	5.0	ND	5.0	ND	5.0	UG/L
CHROMIUM-TOTAL		18.0	10.0	ND	10.0	ND	10.0	UG/L
COBALT-TOTAL		ND	50.0	ND	50.0	ND	50.0	UG/L
COPPER-TOTAL		ND	25.0	ND	25.0	ND	25.0	UG/L
LEAD-TOTAL		ND	16.0	ND	16.0	ND	5.0	UG/L
NICKEL-TOTAL		ND	40.0	111	40.0	ND	40.0	UG/L
SELENIUM-TOTAL		ND	5.0	ND	5.0	ND	5.0	UG/L
SILVER-TOTAL		ND	25.0	ND	25.0	ND	25.0	UG/L
THALLIUM-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L
VANADIUM-TOTAL		ND	50.0	ND	50.0	ND	50.0	UG/L
ZINC-TOTAL		64.3	20.0	53.3	20.0	ND	20.0	UG/L

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WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

Page 3

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401ENS: 93-13151
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 17-SEP-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW03R AH8850 17-AUG-1993	EML RL	852-MW04 AH8851 17-AUG-1993	EML RL	852-MW06 AH8844 17-AUG-1993	EML RL	Units
INORGANICS:								
ANTIMONY-TOTAL		ND	300.	ND	1000	ND	300.	UG/L
ARSENIC-TOTAL		ND	10.0	ND	14.0	ND	10.0	UG/L
BARIUM-TOTAL		262	200.	ND	200.	ND	200.	UG/L
BERYLLIUM-TOTAL		ND	5.0	ND	5.0	ND	5.0	UG/L
CADMIUM-TOTAL		ND	5.0	ND	5.0	ND	5.0	UG/L
CHROMIUM-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L
COBALT-TOTAL		ND	50.0	ND	50.0	ND	50.0	UG/L
COPPER-TOTAL		29.9	25.0	ND	25.0	ND	25.0	UG/L
LEAD-TOTAL		ND	16.0	ND	16.0	41.0	16.0	UG/L
NICKEL-TOTAL		ND	40.0	ND	40.0	ND	40.0	UG/L
SELENIUM-TOTAL		ND	16.0	ND	16.0	ND	5.0	UG/L
SILVER-TOTAL		ND	25.0	ND	25.0	ND	25.0	UG/L
THALLIUM-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L
VANADIUM-TOTAL		ND	50.0	ND	50.0	ND	50.0	UG/L
ZINC-TOTAL		392	20.0	ND	20.0	529	20.0	UG/L

NA - Not Analyzed

ND - Not Detected

TBK - Trip Blank

s - EML Subcontract Data

Muskogee Community Landfill
2801 S. 54th Street W.
Muskogee, Oklahoma 74401
(918) 662-7284
(918) 662-2867 fax



A Waste Management Company

December 17, 1993

Mr. Fenton Rood, Chief
Solid Waste Management
Department of Environmental Quality
1000 NE Tenth Street
Oklahoma City, OK 73117-1212

SUBJECT: 4th Quarter 1993 Groundwater Monitoring
Muskogee Community Landfill & Recycling Center
Permit No. 3551020
Muskogee, Oklahoma

Dear Mr. Rood:

On behalf of Waste Management of Oklahoma, Inc. (WMO), Muskogee Community Landfill & Recycling Center, we are forwarding three (3) copies of the groundwater monitoring report for the sampling conducted on November 9, 1993. WMO monitor wells (MW01R, MW02R and MW03R) and City of Muskogee monitor wells (MW02, MW04 and MW06) were sampled. City of Muskogee monitor wells MW01 and MW03 were recently plugged by WMO after obtaining approval from the ODEQ.

By copy of this letter, the analytical results for City of Muskogee monitor wells MW02, MW04 and MW06 are being sent to Mr. Walter Beckham, City Manager for the City of Muskogee, for submittal to the ODEQ. If you have questions or require additional information, please call me at 918/437-7773 or Mark Daniels at 405/427-6030.

Sincerely,

WASTE MANAGEMENT OF OKLAHOMA, INC.

Dan P. Gibson
Staff Engineer

Enclosure

cc: Larry Cohn
Mark Daniels
Mike McCloud
John Wickersham, TCCHD
Walter Beckham, City of Muskogee

(MUSK\4093N20.LTR)

N/4 COR
SEC. 6
T 14 N
R 18 E



NE 1/4
SEC. 6
T 14 N
R 18 E

EXISTING
PERMIT AREA
159.00 ACRES

MUSKOGEE LANDFILL
AND RECYCLING CENTER

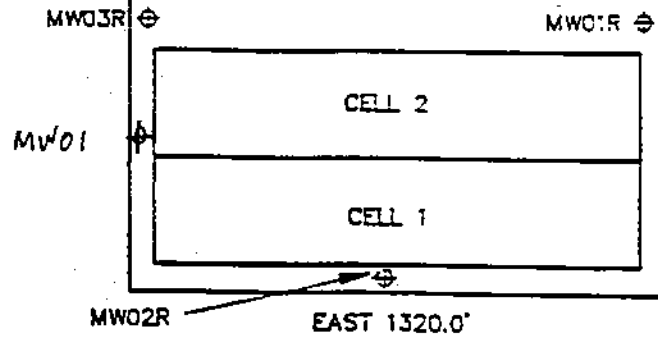
WASTE MANAGEMENT OF
OKLAHOMA, INC.

SOUTH 3972.87'

SOUTH 2659.30'

NORTH 2665.74'

NORTH 1320.0'



⊕ MW01R - MONITORING WELL LOCATION

280.0'
190.0'
280.0'

⊕ MW04

⊕ MW06

EAST 2640.0'

NOT TO SCALE

ATTACHMENT



MUSKOGEE LANDFILL AND
RECYCLING CENTER
MONITORING WELL LOCATION MAP



WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401ENS: 93-14416
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 6-DEC-1993

Analyte	Sample Point: Sample Number: Sampled:	852-01FB A15684 09-NOV-1993	EML RL	852-MW01R A15682 09-NOV-1993	EML RL	852-MW02 A15681 09-NOV-1993	EML RL	Units
FIELD DATA:								
GROUNDWATER ELEV.	NA			621.34		615.52		FT MSL
PH FIELD	7.96			7.20		6.78		PH UNITS
SPECIFIC CONDUCTANCE FIELD	3			1255		3880		UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS	14.5			16.3		16.3		DEGREES C
WELL DEPTH TOTAL	NA			29.25		28.72		FT
CHEMICAL METHODS & ROBOTICS:								
CHEMICAL OXYGEN DEMAND	ND	10.	ND	10.	37	10.	MG/L	
NITROGEN, AMMONIA	ND	0.020	ND	0.020	0.40	0.020	MG/L	
NITROGEN, NITRATE	ND	0.050	0.61	0.050	ND	0.050	MG/L	
PHENOLS	ND	0.050	ND	0.050	ND	0.050	MG/L	
SOLIDS, TOTAL DISSOLVED	7	5.	978	5.	3480	25.	MG/L	
INORGANICS:								
CHLORIDE	ND	0.5	417	0.5	1750	2.5	MG/L	
IRON-DISSOLVED	ND	100.	ND	100.	3690	100.	UG/L	
MANGANESE-DISSOLVED	ND	15.0	ND	15.0	2720	15.0	UG/L	
SODIUM-DISSOLVED	ND	5000	194000	5000	681000	5000	UG/L	
SULFATE	ND	5.0	60.1	5.0	274	25.0	MG/L	
VOLATILE ORGANICS:								
1,1,1-TRICHLOROETHANE	ND	5.	ND	5.	ND	5.	UG/L	
1,1,2,2-TETRACHLOROETHANE	ND	5.	ND	5.	ND	5.	UG/L	
1,1,2-TRICHLOROETHANE	ND	5.	ND	5.	ND	5.	UG/L	
1,1-DICHLOROETHANE	ND	5.	ND	5.	ND	5.	UG/L	
1,1-DICHLOROETHENE	ND	5.	ND	5.	ND	5.	UG/L	
1,2-DICHLOROBENZENE	ND	5.	ND	5.	ND	5.	UG/L	
1,2-DICHLOROETHANE	ND	10.	ND	10.	ND	10.	UG/L	
1,2-DICHLOROPROPANE	ND	5.	ND	5.	ND	5.	UG/L	
1,3-DICHLOROBENZENE	ND	5.	ND	5.	ND	5.	UG/L	
1,4-DICHLOROBENZENE	ND	10.	ND	10.	ND	10.	UG/L	
2-CHLOROETHYL VINYL ETHER	ND	10.	ND	10.	ND	10.	UG/L	
BENZENE	ND	20.	ND	20.	ND	20.	UG/L	
BROMODICHLOROMETHANE	ND	5.	ND	5.	ND	5.	UG/L	
BROMOFORM	ND	5.	ND	5.	ND	5.	UG/L	
BROMOMETHANE	ND	5.	ND	5.	ND	5.	UG/L	
CARBON TETRACHLORIDE	ND	10.	ND	10.	ND	10.	UG/L	
CHLOROBENZENE	ND	5.	ND	5.	ND	5.	UG/L	
CHLOROETHANE	ND	5.	ND	5.	ND	5.	UG/L	
CHLOROFORM	ND	10.	ND	10.	ND	10.	UG/L	
CHLOROMETHANE	ND	5.	ND	5.	ND	5.	UG/L	
CIS-1,3-DICHLOROPROPENE	ND	10.	ND	10.	ND	10.	UG/L	
DIBROMOCHLOROMETHANE	ND	5.	ND	5.	ND	5.	UG/L	
ETHYLBENZENE	ND	5.	ND	5.	ND	5.	UG/L	
METHYLENE CHLORIDE	ND	5.	ND	5.	ND	5.	UG/L	
TETRACHLOROETHENE	ND	5.	ND	5.	ND	5.	UG/L	
TOLUENE	ND	5.	ND	5.	ND	5.	UG/L	
TRANS-1,2-DICHLOROETHENE	ND	5.	ND	5.	ND	5.	UG/L	



WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401

ENS: 93-14416
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 6-DEC-1993

Analyte	Sample Point: Sample Number: Sampled:	852-01FB A15684 09-NOV-1993	EML RL	852-MW01R A15682 09-NOV-1993	EML RL	852-MW02 A15681 09-NOV-1993	EMI RL	Units
TRANS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
TRICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TRICHLOROFLUOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
VINYL CHLORIDE		ND	10.	ND	10.	ND	10.	UG/L

NA = Not Analyzed

ND = Not Detected

TBK = Trip Blank

s = EML Subcontract Data



WAX ENVIRONMENTAL MONITORING LABORATORIES, INC.

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL
2801 S. 54TH STREET WEST
MUSKOGEE OK 74401

ENS: 93-14416
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 6-DEC-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW02R A15683 09-NOV-1993	EML RL	852-MW03R A15680 09-NOV-1993	EML RL	852-MW04 A15679 09-NOV-1993	EML RL	Units
FIELD DATA:								
GROUNDWATER ELEV.		657.24	6.28.64	631.83		645.14		FT MSL
PH FIELD		6.95		6.06		6.66		PH UNITS
SPECIFIC CONDUCTANCE FIELD		2480	1) 6.28.64	2700		5340		UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS		17.1		15.8		16.6		DEGREES C
WELL DEPTH TOTAL		30.01		40.76		32.50		FT
CHEMICAL METHODS & ROBOTICS:								
CHEMICAL OXYGEN DEMAND		11	10.	54	10.	84	10.	MG/L
NITROGEN, AMMONIA		1.06	0.020	1.05	0.020	ND	0.020	MG/L
NITROGEN, NITRATE		ND	0.050	ND	0.050	ND	0.050	MG/L
PHENOLS		ND	0.050	ND	0.050	ND	0.050	MG/L
SOLIDS, TOTAL DISSOLVED		2100	25.	2870	25.	6450	25.	MG/L
INORGANICS:								
CHLORIDE		377	2.5	258	2.5	848	5.0	MG/L
IRON-DISSOLVED		ND	100.	1580	100.	ND	100.	UG/L
MANGANESE-DISSOLVED		529	15.0	344	15.0	4560	15.0	UG/L
SODIUM-DISSOLVED		662000	5000	402000	5000	702000	5000	UG/L
SULFATE		745	25.0	1990	50.0	3590	50.0	MG/L
VOLATILE ORGANICS:								
1,1,1-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2,2-TETRACHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1-DICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1-DICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
1,2-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,2-DICHLOROPROPANE		ND	5.	ND	5.	ND	5.	UG/L
1,3-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
1,4-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
2-CHLOROETHYL VINYL ETHER		ND	10.	ND	10.	ND	10.	UG/L
BENZENE		ND	20.	ND	20.	ND	20.	UG/L
BROMODICHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
BROMOFORM		ND	5.	ND	5.	ND	5.	UG/L
BROMOMETHANE		ND	5.	ND	5.	ND	5.	UG/L
CARBON TETRACHLORIDE		ND	10.	ND	10.	ND	10.	UG/L
CHLOROBENZENE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROFORM		ND	10.	ND	10.	ND	10.	UG/L
CHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
CIS-1,3-DICHLOROPROPENE		ND	10.	ND	10.	ND	10.	UG/L
DIBROMOCHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
ETHYLBENZENE		ND	5.	ND	5.	ND	5.	UG/L
METHYLENE CHLORIDE		ND	5.	ND	5.	ND	5.	UG/L
TETRACHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TOLUENE		ND	5.	ND	5.	ND	5.	UG/L
TRANS-1,2-DICHLOROETHENE		ND	10.	ND	10.	ND	10.	UG/L



WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401

ENS: 93-14416
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 6-DEC-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW02R A15683 09-NOV-1993	EMI RL	852-MW03R A15680 09-NOV-1993	EMI RL	852-MW04 A15679 09-NOV-1993	EMI RL	Units
TRANS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
TRICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TRICHLOROFLUOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
VINYL CHLORIDE		ND	10.	ND	10.	ND	10.	UG/L

NA = Not Analyzed ND = Not Detected TBK = Trip Blank ca = EMI Subcontract Data



WMM ENVIRONMENTAL MONITORING LABORATORIES, INC.

5

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401ENS: 93-14416
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 6-DEC-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW06 A15678 09-NOV-1993	EML RL	TBK-MW02 A15681 09-NOV-1993	EML RL			Units
FIELD DATA:								
GROUNDWATER ELEV.		638.62						FT MSL
PH FIELD		6.43						PH UNITS
SPECIFIC CONDUCTANCE FIELD		2370						UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS		14.3						DEGREES C
WELL DEPTH TOTAL		69.38						FT
CHEMICAL METHODS & ROBOTICS:								
CHEMICAL OXYGEN DEMAND		11	10.					MG/L
NITROGEN, AMMONIA		1.05	0.020					MG/L
NITROGEN, NITRATE		0.31	0.050					MG/L
PHENOLS		ND	0.050					MG/L
SOLIDS, TOTAL DISSOLVED		2170	10.					MG/L
INORGANICS:								
CHLORIDE		243	2.5					MG/L
IRON-DISSOLVED		247	100.					UG/L
MANGANESE-DISSOLVED		2080	15.0					UG/L
SODIUM-DISSOLVED		379000	5000					UG/L
SULFATE		1050	25.0					MG/L
VOIATILE ORGANICS:								
1,1,1-TRICHLOROETHANE		ND	5.	ND	5.			UG/L
1,1,2,2-TETRACHLOROETHANE		ND	5.	ND	5.			UG/L
1,1,2-TRICHLOROETHANE		ND	5.	ND	5.			UG/L
1,1-DICHLOROETHANE		35	5.	ND	5.			UG/L
1,1-DICHLOROETHENE		ND	5.	ND	5.			UG/L
1,2-DICHLOROBENZENE		ND	10.	ND	10.			UG/L
1,2-DICHLOROETHANE		ND	5.	ND	5.			UG/L
1,2-DICHLOROPROPANE		ND	5.	ND	5.			UG/L
1,3-DICHLOROBENZENE		ND	10.	ND	10.			UG/L
1,4-DICHLOROBENZENE		ND	10.	ND	10.			UG/L
2-CHLOROETHYL VINYL ETHER		ND	20.	ND	20.			UG/L
BENZENE		ND	5.	ND	5.			UG/L
BROMODICHLOROMETHANE		ND	5.	ND	5.			UG/L
BROMOFORM		ND	5.	ND	5.			UG/L
BROMOMETHANE		ND	10.	ND	10.			UG/L
CARBON TETRACHLORIDE		ND	5.	ND	5.			UG/L
CHLOROBENZENE		ND	5.	ND	5.			UG/L
CHLOROETHANE		64	10.	ND	10.			UG/L
CHLOROFORM		ND	5.	ND	5.			UG/L
CHLOROMETHANE		ND	10.	ND	10.			UG/L
CIS-1,3-DICHLOROPROPENE		ND	5.	ND	5.			UG/L
DIBROMOCHLOROMETHANE		ND	5.	ND	5.			UG/L
ETHYLBENZENE		ND	5.	ND	5.			UG/L
METHYLENE CHLORIDE		7.9	5.	ND	5.			UG/L
TETRACHLOROETHENE		8.3	5.	ND	5.			UG/L
TOLUENE		ND	5.	ND	5.			UG/L
TRANS-1,2-DICHLOROETHENE		ND	10.	ND	10.			UG/L

NA = Not Analyzed

ND = Not Detected

TOL

E-8-313



WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

: 6

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401

ENS: 93-14416
MP: 85293J
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 6-DEC-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW06 A15678 09-NOV-1993	EML RL	TBK-MW02 A15681 09-NOV-1993	EML RL			Units
TRANS-1,3-DICHLOROPROPENE		ND	5.	ND	5.			UG/L
TRICHLOROETHENE		ND	5.	ND	5.			UG/L
TRICHLOROFLUOROMETHANE		ND	10.	ND	10.			UG/L
VINYL CHLORIDE		17	10.	ND	10.			UG/L

NA = Not Analyzed

ND = Not Detected

TBK = Trip Blank

• = EML Subcontract Data



WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

e: 1

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL
2801 S. 54TH STREET WEST
MUSKOGEE OK 74401

ENS: 93-14417
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELLS
Reported: 8-DEC-1993

Analyte	Sample Point: Sample Number: Sampled:	852-01FB A15691 09-NOV-1993	EMI RL	852-MW01R A15689 09-NOV-1993	EMI RL	852-MW02 A15688 09-NOV-1993	EMI RL	Units
INORGANICS:								
ANTIMONY-DISSOLVED		ND	300.	ND	300.	ND	300.	UG/L
ANTIMONY-TOTAL		ND	300.	ND	300.	ND	300.	UG/L
ARSENIC-DISSOLVED		ND	10.0	ND	10.0	22.0	10.0	UG/L
ARSENIC-TOTAL		ND	10.0	ND	10.0	17.6	10.0	UG/L
BARIUM-DISSOLVED		ND	200.	ND	200.	ND	200.	UG/L
BARIUM-TOTAL		ND	200.	ND	200.	ND	200.	UG/L
BERYLLIUM-DISSOLVED		ND	5.0	ND	5.0	ND	5.0	UG/L
BERYLLIUM-TOTAL		ND	5.0	ND	5.0	ND	5.0	UG/L
CADMIUM-DISSOLVED		ND	5.0	ND	5.0	ND	5.0	UG/L
CADMIUM-TOTAL		ND	5.0	ND	5.0	ND	5.0	UG/L
CHROMIUM-DISSOLVED		ND	10.0	ND	10.0	ND	10.0	UG/L
CHROMIUM-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L
COBALT-DISSOLVED		ND	50.0	ND	50.0	ND	50.0	UG/L
COBALT-TOTAL		ND	50.0	ND	50.0	ND	50.0	UG/L
COPPER-DISSOLVED		228	25.0	ND	25.0	ND	25.0	UG/L
COPPER-TOTAL		237	25.0	ND	25.0	ND	25.0	UG/L
LEAD-DISSOLVED		ND	5.0	ND	5.0	ND	5.0	UG/L
LEAD-TOTAL		ND	5.0	6.1	5.0	ND	16.0	UG/L
NICKEL-DISSOLVED		ND	40.0	55.4	40.0	ND	40.0	UG/L
NICKEL-TOTAL		ND	40.0	65.1	40.0	ND	40.0	UG/L
SELENIUM-DISSOLVED		ND	5.0	ND	5.0	ND	5.0	UG/L
SELENIUM-TOTAL		ND	5.0	ND	5.0	ND	5.0	UG/L
SILVER-DISSOLVED		ND	25.0	ND	25.0	ND	25.0	UG/L
SILVER-TOTAL		ND	25.0	ND	25.0	ND	25.0	UG/L
THALLIUM-DISSOLVED		ND	10.0	ND	10.0	ND	10.0	UG/L
THALLIUM-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L
VANADIUM-DISSOLVED		ND	50.0	ND	50.0	ND	50.0	UG/L
VANADIUM-TOTAL		ND	50.0	ND	50.0	ND	50.0	UG/L
ZINC-DISSOLVED		ND	20.0	20.3	20.0	ND	20.0	UG/L
ZINC-TOTAL		ND	20.0	30.7	20.0	ND	20.0	UG/L
VOLATILE ORGANICS:								
1,1,1,2-TETRACHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,1-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2,2-TETRACHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1-DICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1-DICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
1,2,3-TRICHLOROPROPANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DIBROMO-3-CHLOROPROPANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DIBROMOETHANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,2-DICHLOROPROPANE		ND	5.	ND	5.	ND	5.	UG/L
1,4-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
2-BUTANONE		ND	10.	ND	10.	ND	10.	UG/L
2-HEXANONE		ND	10.	ND	10.	ND	10.	UG/L
4-METHYL-2-PENTANONE		ND	10.	ND	10.	ND	10.	UG/L



WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

e: 2

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401ENS: 93-14417
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 8-DEC-1993

Analyte	Sample Point: Sample Number: Sampled:	852-01FB A15691 09-NOV-1993	EML RL	852-MW01R A15689 09-NOV-1993	EML RL	852-MW02 A15688 09-NOV-1993	EML RL	Units
ACETONE		ND	34.	ND	34.	ND	34.	UG/L
ACRYLONITRILE		ND	100.	ND	100.	ND	100.	UG/L
BENZENE		ND	5.	ND	5.	ND	5.	UG/L
BROMOCHLOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
BROMODICHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
BROMOFORM		ND	5.	ND	5.	ND	5.	UG/L
BROMOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
CARBON DISULFIDE		ND	5.	ND	5.	ND	5.	UG/L
CARBON TETRACHLORIDE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROBEZENE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROETHANE		ND	10.	ND	10.	ND	10.	UG/L
CHLOROFORM		7.73	5.	ND	10.	ND	10.	UG/L
CHLOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
CIS-1,2-DICHLOROETHENE		ND	10.	ND	10.	ND	10.	UG/L
CIS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
DIBROMOCHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
DIBROMOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
ETHYLBENZENE		ND	5.	ND	5.	ND	5.	UG/L
IODOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
METHYLENE CHLORIDE		ND	5.	ND	5.	ND	5.	UG/L
STYRENE		ND	5.	ND	5.	ND	5.	UG/L
TETRACHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TOLUENE		ND	5.	ND	5.	ND	5.	UG/L
TRANS-1,2-DICHLOROETHENE		ND	10.	ND	10.	ND	10.	UG/L
TRANS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
TRANS-1,4-DICHLORO-2-BUTENE		ND	10.	ND	10.	ND	10.	UG/L
TRICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TRICHLOROFLUOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
VINYL ACETATE		ND	10.	ND	10.	ND	10.	UG/L
VINYL CHLORIDE		ND	10.	ND	10.	ND	10.	UG/L
XYLENE (TOTAL)		ND	10.	ND	10.	ND	10.	UG/L

NA = Not Analyzed

ND = Not Detected

TDB = Trip Blank

u = EML Subcontract Data



WMS ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401FNS: 93-14417
MP: B52931
Rev / Task: 02 / 01
Sample Type: WELLS
Reported: 8-DEC-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW02R A15690 09-NOV-1993	EMI RL	052-MW03R A15687 09-NOV-1993	EMI RL	852-MW04 A15686 09-NOV-1993	EMI RL	Units
INORGANICS:								
ANTIMONY-DISSOLVED		ND	300.	ND	1000	ND	1000	UG/L
ANTIMONY-TOTAL		ND	300.	ND	300.	ND	300.	UG/L
ARSENIC-DISSOLVED		ND	10.0	ND	10.0	ND	10.0	UG/L
ARSENIC-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L
BARIUM-DISSOLVED		ND	200.	ND	200.	ND	200.	UG/L
BARIUM-TOTAL		ND	200.	ND	200.	ND	200.	UG/L
BERYLLIUM-DISSOLVED		ND	5.0	ND	12.0	ND	5.0	UG/L
BERYLLIUM-TOTAL		ND	5.0	ND	5.0	ND	5.0	UG/L
CADMIUM-DISSOLVED		ND	5.0	ND	25.0	ND	5.0	UG/L
CADMIUM-TOTAL		ND	5.0	ND	5.0	ND	5.0	UG/L
CHROMIUM-DISSOLVED		ND	10.0	ND	50.0	ND	10.0	UG/L
CHROMIUM-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L
COBALT-DISSOLVED		ND	50.0	ND	250.	ND	50.0	UG/L
COBALT-TOTAL		ND	50.0	ND	50.0	ND	50.0	UG/L
COPPER-DISSOLVED		ND	25.0	ND	125.	ND	25.0	UG/L
COPPER-TOTAL		ND	25.0	ND	25.0	ND	25.0	UG/L
LEAD-DISSOLVED		ND	16.0	ND	16.0	ND	16.0	UG/L
LEAD-TOTAL		ND	16.0	ND	16.0	ND	16.0	UG/L
NICKEL-DISSOLVED		42.7	40.0	ND	200.	41.2	40.0	UG/L
NICKEL-TOTAL		174	40.0	ND	40.0	ND	40.0	UG/L
SELENIUM-DISSOLVED		ND	16.0	ND	16.0	ND	16.0	UG/L
SELENIUM-TOTAL		ND	16.0	ND	16.0	ND	16.0	UG/L
SILVER-DISSOLVED		ND	25.0	ND	125.	ND	125.	UG/L
SILVER-TOTAL		ND	25.0	ND	25.0	ND	25.0	UG/L
THALLIUM-DISSOLVED		ND	10.0	ND	10.0	ND	10.0	UG/L
THALLIUM-TOTAL		ND	16.0	ND	16.0	ND	16.0	UG/L
VANADIUM-DISSOLVED		ND	50.0	ND	96.0	ND	50.0	UG/L
VANADIUM-TOTAL		ND	50.0	ND	50.0	ND	50.0	UG/L
ZINC-DISSOLVED		ND	20.0	ND	84.0	ND	20.0	UG/L
ZINC-TOTAL		28.8	20.0	33.8	20.0	ND	20.0	UG/L
VOLATILE ORGANICS:								
1,1,1,2-TETRACHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,1-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2,2-TETRACHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1-DICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1-DICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
1,2,3-TRICHLOROPROPANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DIBROMO-3-CHLOROPROPANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DIBROMOETHANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,2-DICHLOROPROPANE		ND	5.	ND	5.	ND	5.	UG/L
1,4-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
2-BUTANONE		ND	10.	ND	10.	ND	10.	UG/L
2-HEXANONE		ND	10.	ND	10.	ND	10.	UG/L
4-METHYL-2-PENTANONE		ND	10.	ND	10.	ND	10.	UG/L



WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401ENS: 93-14417
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 8-DEC-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW02R A15690 09-NOV-1993	EML RL	852-MW03R A15687 09-NOV-1993	EML RL	852-MW04 A15686 09-NOV-1993	EML RL	Units
ACETONE		ND	34.	ND	34.	ND	34.	UG/L
ACRYLONITRILE		ND	100	ND	100	ND	100	UG/L
BENZENE		ND	5.	ND	5.	ND	5.	UG/L
BROMOCHLOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
BROMODICHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
BROMOFORM		ND	5.	ND	5.	ND	5.	UG/L
BROMOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
CARBON DISULFIDE		ND	5.	ND	5.	ND	5.	UG/L
CARBON TETRACHLORIDE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROBENZENE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROETHANE		ND	10.	ND	10.	ND	10.	UG/L
CHLOROFORM		ND	5.	ND	5.	ND	5.	UG/L
CHLOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
CIS-1,2-DICHLOROETHENE		ND	10.	ND	10.	ND	10.	UG/L
CIS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
DIBROMOCHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
DIBROMOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
ETHYLBENZENE		ND	5.	ND	5.	ND	5.	UG/L
IODOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
METHYLENE CHLORIDE		ND	5.	ND	5.	ND	5.	UG/L
STYRENE		ND	5.	ND	5.	ND	5.	UG/L
TETRACHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TOLUENE		ND	5.	ND	5.	ND	5.	UG/L
TRANS-1,2-DICHLOROETHENE		ND	10.	ND	10.	ND	10.	UG/L
TRANS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
TRANS-1,4-DICHLORO-2-BUTENE		ND	10.	ND	10.	ND	10.	UG/L
TRICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TRICHLOROFLUOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
VINYL ACETATE		ND	10.	ND	10.	ND	10.	UG/L
VINYL CHLORIDE		ND	10.	ND	10.	ND	10.	UG/L
XYLENE (TOTAL)		ND	10.	ND	10.	ND	10.	UG/L

NA = Not Analyzed

ND = Not Detected

TBL = Trip Blank

S = EML Subcontract Data



WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401ENS: 93-14417
MP: 852911
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 8-DEC-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW06 A15685 09-NOV-1993	EML RL					Units
INORGANICS:								
ANTIMONY-DISSOLVED		ND	300.					UG/L
ANTIMONY-TOTAL		ND	300.					UG/L
ARSENIC-DISSOLVED		ND	10.0					UG/L
ARSENIC-TOTAL		ND	10.0					UG/L
BARIUM-DISSOLVED		ND	200.					UG/L
BARIUM-TOTAL		ND	200.					UG/L
BERYLLIUM-DISSOLVED		ND	5.0					UG/L
BERYLLIUM-TOTAL		ND	5.0					UG/L
CADMIUM-DISSOLVED		ND	5.0					UG/L
CADMIUM-TOTAL		ND	5.0					UG/L
CHROMIUM-DISSOLVED		ND	10.0					UG/L
CHROMIUM-TOTAL		ND	10.0					UG/L
COBALT-DISSOLVED		ND	50.0					UG/L
COBALT-TOTAL		ND	50.0					UG/L
COPPER-DISSOLVED		ND	25.0					UG/L
COPPER-TOTAL		ND	25.0					UG/L
LEAD-DISSOLVED		ND	5.0					UG/L
LEAD-TOTAL		43.5	16.0					UG/L
NICKEL-DISSOLVED		ND	40.0					UG/L
NICKEL-TOTAL		ND	40.0					UG/L
SELENIUM-DISSOLVED		ND	5.0					UG/L
SELENIUM-TOTAL		ND	16.0					UG/L
SILVER-DISSOLVED		ND	25.0					UG/L
SILVER-TOTAL		ND	25.0					UG/L
THALLIUM-DISSOLVED		ND	10.0					UG/L
THALLIUM-TOTAL		ND	10.0					UG/L
VANADIUM-DISSOLVED		ND	50.0					UG/L
VANADIUM-TOTAL		ND	50.0					UG/L
ZINC-DISSOLVED		142	20.0					UG/L
ZINC-TOTAL		370	20.0					UG/L
VOLATILE ORGANICS:								
1,1,1,2-TETRACHLOROETHANE		ND	5.					UG/L
1,1,1-TRICHLOROETHANE		ND	5.					UG/L
1,1,2,2-TETRACHLOROETHANE		ND	5.					UG/L
1,1,2-TRICHLOROETHANE		ND	5.					UG/L
1,1-DICHLOROETHANE		22.8	5.					UG/L
1,1-DICHLOROETHENE		ND	5.					UG/L
1,2,3-TRICHLOROPROPANE		ND	10.					UG/L
1,2-DIBROMO-3-CHLOROPROPANE		ND	10.					UG/L
1,2-DIBROMOETHANE		ND	10.					UG/L
1,2-DICHLOROBENZENE		ND	10.					UG/L
1,2-DICHLOROETHANE		ND	5.					UG/L
1,2-DICHLOROPROPANE		ND	5.					UG/L
1,4-DICHLOROBENZENE		ND	10.					UG/L
2-BUTANONE		ND	10.					UG/L
2-HEXANONE		ND	10.					UG/L
4-METHYL-2-PENTANONE		ND	10.					UG/L



WME ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 74401ENS: 93-14417
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 8-DEC-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW06 A15685 09-NOV-1993	EML RL					Units
ACETONE		ND	34.					UG/L
ACRYLONITRILE		ND	100					UG/L
BENZENE		ND	5.					UG/L
BROMOCHLOROMETHANE		ND	10.					UG/L
BROMODICHLOROMETHANE		ND	5.					UG/L
BROMOFORM		ND	5.					UG/L
BROMOMETHANE		ND	10.					UG/L
CARBON DISULFIDE		ND	5.					UG/L
CARBON TETRACHLORIDE		ND	5.					UG/L
CHLOROBENZENE		ND	5.					UG/L
CHLOROETHANE		103	10.					UG/L
CHLOROFORM		ND	5.					UG/L
CHLOROMETHANE		ND	10.					UG/L
CIS-1,2-DICHLOROETHENE		13.4	10.					UG/L
CIS-1,3-DICHLOROPROPENE		ND	5.					UG/L
DIBROMOCHLOROMETHANE		ND	5.					UG/L
DIBROMOMETHANE		ND	10.					UG/L
ETHYLBENZENE		ND	5.					UG/L
IODOMETHANE		ND	10.					UG/L
METHYLENE CHLORIDE		ND	5.					UG/L
STYRENE		ND	5.					UG/L
TETRACHLOROETHENE		7.86	5.					UG/L
TOLUENE		ND	5.					UG/L
TRANS-1,2-DICHLOROETHENE		ND	10.					UG/L
TRANS-1,3-DICHLOROPROPENE		ND	5.					UG/L
TRANS-1,4-DICHLORO-2-BUTENE		ND	10.					UG/L
TRICHLOROETHENE		ND	5.					UG/L
TRICHLOROFLUOROMETHANE		ND	10.					UG/L
VINYL ACETATE		ND	10.					UG/L
VINYL CHLORIDE		17.4	10.					UG/L
XYLENE (TOTAL)		ND	10.					UG/L

NA = Not Analyzed

ND = Not Detected

TDB = Trip Blank

s = EML Subcontract Data

APPENDIX J
GEOTECHNICAL LABORATORY DATA

Muskogee\B6251dp2.3rd

LAW ENGINEERING, INC.

SUMMARY OF TEST DATA
TRACT A

RUST E & I MUSKOGEE LANDFILL

Sample Identification		Material Description	Moisture Content %	Organics %	Compression ksf	% Strain	Cation Exchange Meq Na/100g	Dry Density pcf	pH	Pocket pen.	ATTENBERG LIMIT		
Hole #	Depth										Liquid Limit	Plastic Limit	Plastic Index
B-1	0-1	Light Brown Silty Clay	20.2										
B-1	3-5	Tan Silty Clay	21.8		3.14	5.85		101.67					
B-1	8-10	Tan Silty Clay w/Fe Nodules	19.6		4.50	4.79		106.88	7.05				
B-1	13-15	Yellow Brown Silty Clay w/Fe Stains	18.9										
B-1	18-20	Light Brown Clayey Shale	17.3								52	25	27
B-2	0-2	Light Brown Silty Clay	19.3	7.6									
B-2	2-4	Brown Silty Clay	16.8								47	16	31
B-2	4-6	Br Mottled Silty Clay w/Fe Nodules	17.8										
B-2	6-8	Tan Silty Clay	18.5				6.26				46	14	32
B-2	13-15	Yellow Brown Silty Clay w/Fe Nodules	16.8		6.70	3.21		113.77					
B-2	18-20	Brown & Gray Clayey Shale	14.7								44	23	21
B-2	23-25	Light Brown Clayey Shale	10.9										
B-3	0-2	Lt Reddish Brown & Tan Silty Clay	21.7	3.3									
B-3	2-4	Lt Br & Yellow Br Silty Clay w/Fe Nodule	21.1										
B-3	6-8	Yellow Brown Mottled Sl Cl w/Fe Stains	21.2										
B-3	8-10	Yellowish Br & Dk Gr Fat Cl w/Fe Nodul	17.5						7.1		38	15	23
B-3	10-12	Light Brown & Yellow Brown Silty Clay	19.1										
B-3	12-14	Brown Clayey Shale w/Fe Nodules	16.9								44	24	20
B-3	18-20	Tan & Gray Weathered Shale	11.7								43	24	19
B-3	23-24	Gray Weathered Shale	11.8										
B-4	0-2	Light Brown Silty Clay	19.1	3.4									
B-4	2-4	Br & Yellow Br Silty Clay w/Fe Nodules	22.2										
B-4	4-6	Yellow Brown Silty Clay w/Fe Nodules	21.4								40	15	25
B-4	8-10	Yellowish Br & Lt Gr Stiff Fat Clay	22.2										
B-4	13-15	Yellowish Br & Lt Gr Stiff Fat Clay	16.8		5.00	2.68		115.39					
B-4	18-20	Brown Clayey Shale	14.7								44	24	20
B-5	#4	Gray Shale Rock Core	4.86		252.09			138.02			29	19	10
B-5	0-2	Light Brown Silty Clay	23.5	3.3									
B-5	2-4	Light Brown Silty Clay w/Fe Nodules					12.8						
B-5	4-6	Lt Brown Mottled Silty Clay w/Fe Stains	20.8								47	18	29
B-5	8-10	Tan Silty Clay w/Fe Nodules	19.1		3.63	3.82		106.50	7.25				
B-5	18-20	Light Brown Clayey Shale	11.6										
B-6	1-2	Tan & Gray Silty Clay	18.4							3.75			
B-6	2-4	Tan Slightly Sandy Clay	23.1	4.0									
B-6	4-6	Tan Silty Clay	24.2							2.75			
B-6	6-7	Tan & Light Brown Silty Clay	20.5							2.5			

LAW ENGINEERING, INC.

SUMMARY OF TEST DATA
TRACT A

RUST E & I MUSKOGEE LANDFILL

Sample Identification		Material Description	Moisture Content %	Organics %	Compression ksf	% Strain	Cation Exchange Meq Na/100g	Dry Density pcf	pH	Pocket pen.	ATTERBERG LIMIT		
Hole #	Depth										Liquid Limit	Plastic Limit	Plastic Index
B-6	7-9	Tan Silty Clay	21.3							2.0	46	16	30
B-6	9-11	Tan Silty Clay with Ferrous Nodules	17.2							2.0			
B-6	12-13	Tan Silty Clay with Ferrous Seams	32.8							3.25			
B-6	16-17	Tan Slightly Sandy Clayey Shale	11.9								42	16	26
B-6	17-18	Light Brown Shaley Silty Clay	12.9							1.5			
B-6	22-23	Dark Brown Shaley Silty Clay	18.7								44	24	20
B-7	#1	Gray Shale Rock Core	1.23		456.22			141.16			20	19	1
B-7	0-2	Lt Br Mottled Silty Clay w/Fe Nodules	25.6	1.8									
B-7	2-4	Yellow Brown Silty Clay w/Fe Streaks	20.5								48	16	32
B-7	6-8	Yellow Br & Lt Br Silty Clay w/Fe Nodule	20.2								46	15	31
B-7	8-10	Tan Shaley Silty Clay w/Fe Seams	12.1		5.36	6.72		115.73		4.5+			
B-7	13-14	Light Brown Clayey Shale	11.7				11.0						
B-7	18-20	Light Brown Clayey Shale	11.7						7.4				
B-8	#3	Gray Shale Rock Core	6.16		69.24			144.69			34	22	12
B-8	2-4	Light Brown & Brown Silty Clay	20.2								49	17	32
B-8	4-6	Light Brown & Yellow Brown Silty Clay	16.5										
B-8	6-8	Lt Br w/Yellow Br Silty Clay w/Fe Nodules	21.4										
B-8	13-14	Light Brown & Yellow Brown Shaley Clay	16.8										
B-8	18-19	Brown Clayey Shale	14.2										
B-9	#6	Gray Shale Rock Core	2.10		297.38			161.32			24	18	6
B-9	0-2	Yellow Br & Lt Br Silty Clay w/Fe Nodule	21.8										
B-9	2-4	Br & Yellow Br Silty Clay w/Fe Nodules	21.9	4.4									
B-9	4-6	Tan Brown Silty Clay w/Fe Nodules	19.6										
B-9	6-8	Tan & Brown Silty Clay	15.0		4.06	6.00	14.1	115.05					
B-10	0-2	Brown & Light Brown Silty Clay	22.9										
B-10	2-4	Tan Silty Clay	18.3						6.7		41	15	26
B-10	4-6	Light Brown Silty Clay	21.1	7.2									
B-10	6-8	Yellow Br & Lt Br Silty Clay w/Fe Nodule	18.0										
B-10	8-10	Tan Silty Clay w/Fe Nodules	19.0		5.03	3.31		113.19					
B-10	13-15	Tan & Gray Silty Clay	16.9								46	16	30
B-10	18-20	Brown Highly Weathered Shale	18.6										
B-11	2-4	Light Brown Silty Clay w/Fe Nodules	20.1								46	18	28
B-11	6-8	Yellow Brown Silty Clay w/Fe Nodules	19.3		3.90	3.44		109.19	7.3	4.5+			
B-11	18-19	Gray Shaley Silty Clay	5.8								40	21	19
B-12	0-2	Tan & Gray Silty Clay w/Fe Stains	21.4							4.5			
B-12	2-4	Lt Tan & Gr Silty Clay w/Fe Nodules & Stains	20.1							4.5	48	16	32
B-12	6-8	Yellow Brown Silty Clay w/Fe Nodules	18.7		7.29	4.25		112.83		4.5+			

LAW ENGINEERING, INC.

SUMMARY OF TEST DATA
TRACT A

RUST E & I MUSKOGEE LANDFILL

Sample Identification		Material Description	Moisture Content %	Organics %	Compression ksf	% Strain	Cation Exchange Meq Na/100g	Dry Density pcf	pH	Pocket pen.	ATTERBERG LIMIT		
Hole #	Depth										Liquid Limit	Plastic Limit	Plastic Index
B-12	8-10	Tan & Gray Silty Clay w/Fe Nodules	16.9							4.5+			
B-12	13-15		11.3	2.8									
B-12	18-20	Tan Shaley Silty Clay	11.6							4.5			
B-13	0-2	Light Brown Clay	23.6							3.25	58	21	37
B-13	4-6	Tan & Gray Silty Clay w/Fe Nodules	19.2	2.5									
B-13	6-8	Tan & Gray Silty Clay w/Fe Nodules	18.9				11.8			4.25			
B-13	8-10	Yellow Br & Gr Silty Clay w/Fe Nodules	23.5		2.97	2.18		103.28		3.5			
B-13	13-15	Tan Slightly Shaley Silty Clay	12.3						7.4		32	20	12
B-14	1-2	Brown Silty Clay w/Organics	14.9										
B-14	2-4	Tan Clay	17.4								50	16	34
B-14	4-6	Tan & Gray Silty Clay	17.1	2.7									
B-14	11-12	Tan & Gray Silty Clay	18.0										
B-14	12-14	Lt. Tan Silty Clay, Slightly Shaley	28.4										
B-14	14-16	Tan & Gray Shaley Silty Clay	13.1								35	21	14
B-14	19-21	Tan Shaley Silty Clay	14.3										
B-14	22-24	Gray Shaley Silty Clay	11.9										
B-14	27-29	Dark Gray Shale	15.4										
B-15	#4	Gray Shale Rock Core	4.72		211.23			138.78			30	20	10
B-15	0-2	Lt Brown Slightly Clayey Silt w/Organics	15.4							2.0			
B-15	2-4	Light Brown & Tan Clay	16.4							4.5+	54	17	37
B-15	4-5	Tan & Gray Silty Clay	14.8							4.5+			
B-15	6-8	Light Brown Silty Clay w/Fe Stains	18.8	3.9	6.51	5.00		105.16		4.5+			
B-15	8-10	Yellowish Br Stiff Fat Clay	19.9							3.75			
B-15	13-14	Lt Brown & Tan Slightly Shaley Silty Clay	13.7								43	25	18
B-16	0-2	Tan & Brown Silty Clay	19.8							4.5+			
B-16	2-4	Tan & Gray Silty Clay							7.5				
B-16	4-6	Yellowish Br & Lt Gr Stiff Fat Clay	21.7							2.75	47	15	32
B-16	6-8	Tan Silty Clay	26.4				13.2						
B-16	8-10	Tan Silty Clay w/Shale Fragments	18.8	5.1	Sample too short to test			109.79		4.25			
B-17	#1	Gray Shale Rock Core	9.34		37.58			117.15			39	22	17
B-17	0-2	Light Brown Silty Clay	20.6							4.5+			
B-17	2-4	Brown Clay	25.6							2.25	55	18	37
B-17	4-6	Lt Br Silty Clay w/Fe Stains & Nodules	22.2		3.72	6.15		102.32		2.5			
B-17	8-10	Tan and Gray Silty Clay	20.7							4.25			
B-17	13-15	Tan & Gray Clay	21.3							3.5	52	17	35
B-17	18-19	Light Tan Silty Clay	12.0							3.25			
B-18	#5	Gray Shale Rock Core	4.13		215.93			140.39			30	18	12
B-18	0-2	Yellowish Tan Silty Clay	14.3							4.5+	42	14	28
B-18	2-4	Tan & Gray Silty Clay w/Fe Nodules	19.7										
B-18	4-6	Yellow & Brown Silty Clay w/Fe Nodules	19.0		3.80	3.47		107.55		4.5	47	16	31
B-18	8-10	Tan Silty Clay w/Fe Pockets	20.5							2.25	34	14	20
B-18	13-15	Tan Silty Clay	18.6	3.7			18.4						

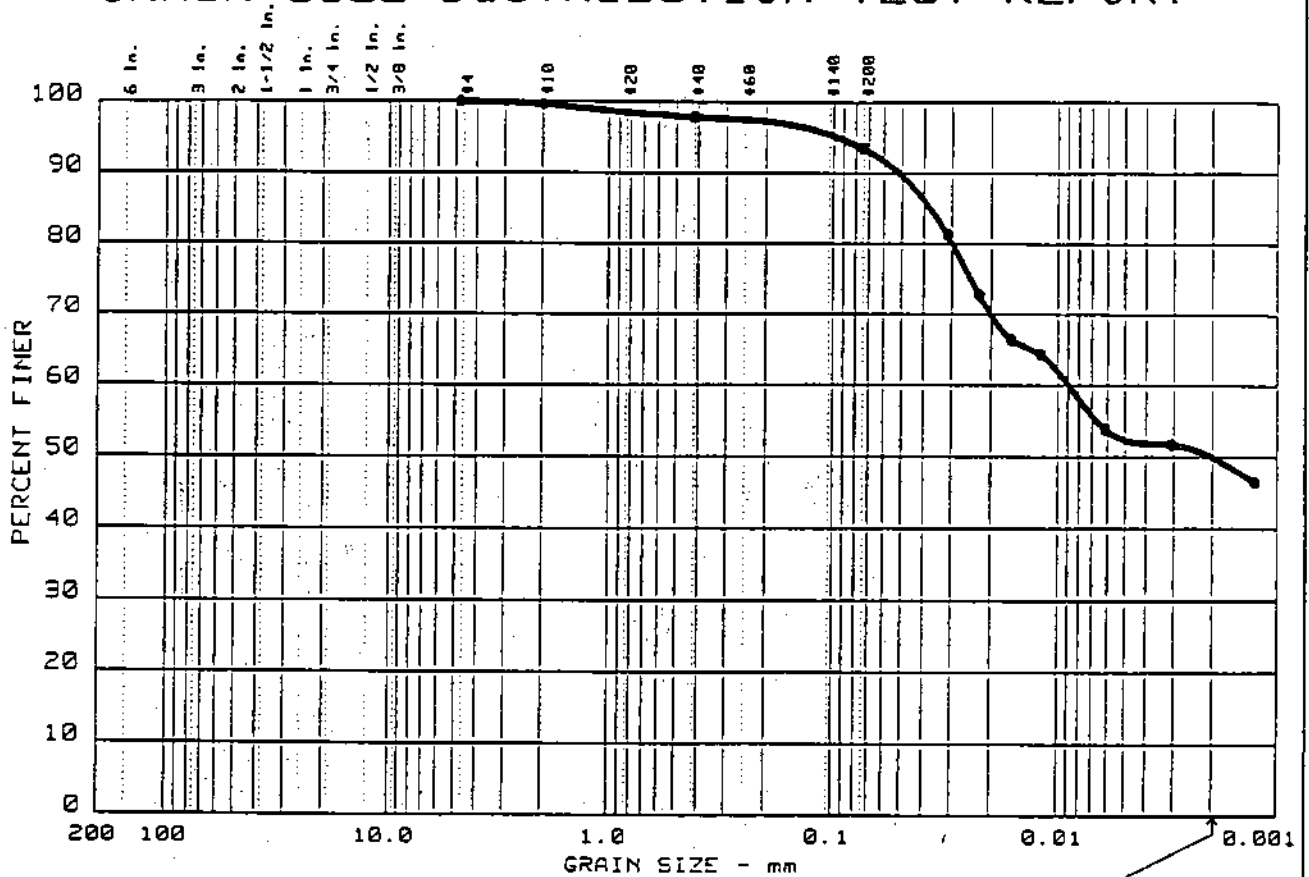
LAW ENGINEERING, INC.

SUMMARY OF TEST DATA
TRACT A

RUST E & I MUSKOGEE LANDFILL

Sample Identification		Material Description	Moisture Content %	Organics %	Compression ksf	% Strain	Cation Exchange Meq Na/100g	Dry Density pcf	pH	Pocket pen.	ATTERBERG LIMIT		
Hole #	Depth										Liquid Limit	Plastic Limit	Plastic Index
B-18	18-19	Tan Silty Clayey Shale	10.8						6.8				
B-19	20-22	Tan & Gray Silty Clay	22.1										
B-19	22-24	Tan Silty Clay with Ferrous Nodules	21.5		3.05	9.20		103.59		2.75			
B-20	0-2	Tan & Gray Silty Clay w/Fe Nodules	14.0				12.3			4.5+			
B-20	2-4	Tan & Gray Clay w/Fe Pockets	18.6							4.5+	54	17	37
B-20	4-6	Yellow & Brown Silty Clay w/Fe Nodules	21.5		1.48	6.08		111.40	6.8	1.75			
B-20	8-10	Tan Silty Clay	19.6	3.3									
B-20	23-25	Gray Silty Clay	19.6							2.5			
B-20	28-29	Gray Slightly Shaley Silty Clay	17.7							0.75			
B-21	17-19	Tan & Gray Silty Clayey Shale	19.2								49	16	33
B-21	19-21	Tan & Gray Silty Clay w/Fe Nodules	18	4.0									
B-21	21-22	Tan Silty Clay with Ferrous Nodules	19.1							4.5			
B-21	22-24	Tan Silty Clay with Fe Nodules & Seams	19.3							4.25			
B-21	24-26	Tan & Gray Silty Clay	22.0							1.75			
B-21	29-31	Dark Gray Silty Clayey Shale	21.3							1.75	51	17	34

GRAIN SIZE DISTRIBUTION TEST REPORT



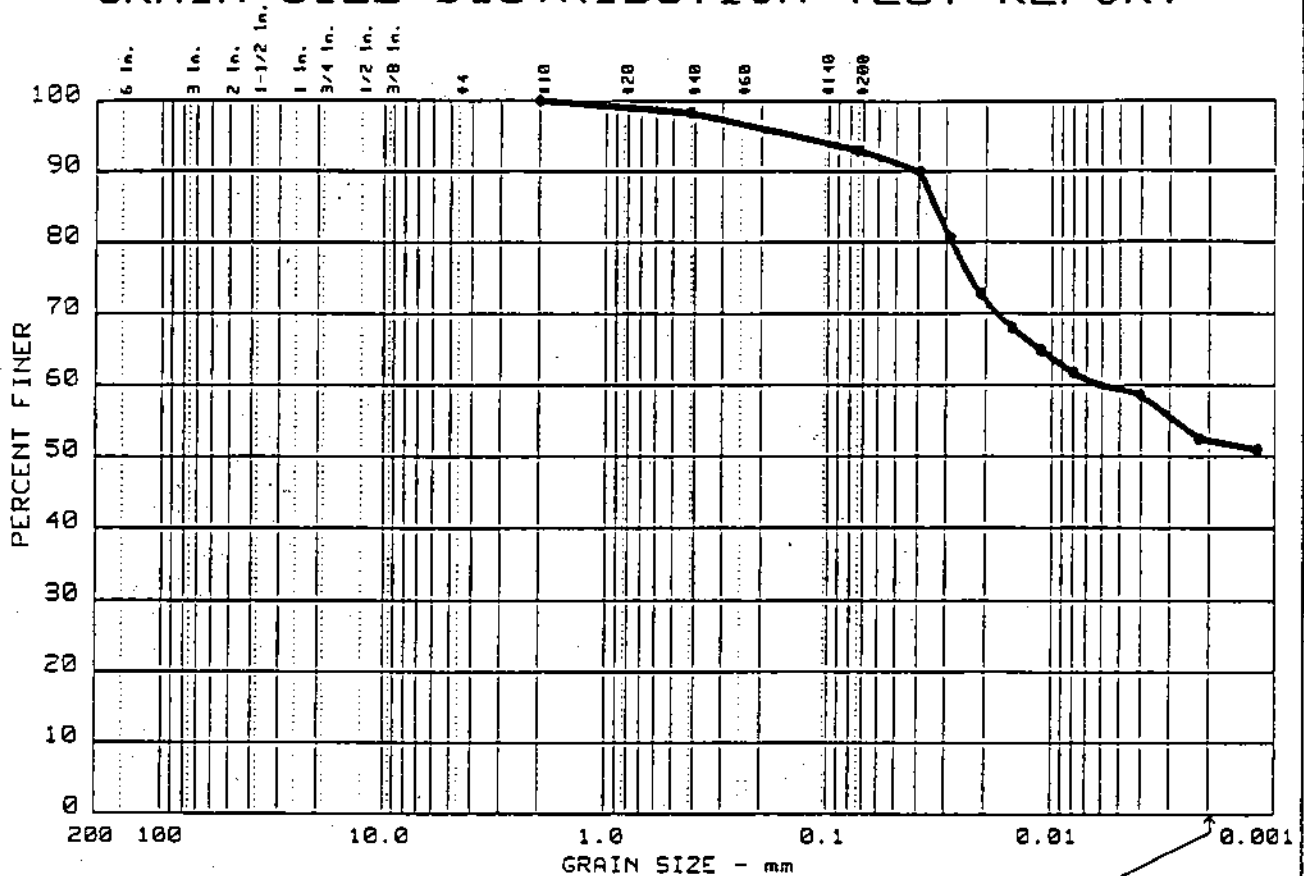
Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
• 15	0.0	0.0	6.5	43.5	50.0

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
•				0.00					

MATERIAL DESCRIPTION	USCS	AASHTO
• LT. BROWN SILTY CLAY		

Project No.: 396-01402-01 Project: RUST ENVIRONMENTAL MUSKOGEE LANDFILL • Location: HOLE NO. B-3 0.0'-2.0' TRACT A Date: 01-09-94 GRAIN SIZE DISTRIBUTION TEST REPORT LAW ENGINEERING, INC.	Remarks: SPECIFIC GRAVITY ASSUMED Figure No.
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GRAIN SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
• 10	0.0	0.0	7.0	40.6	52.2

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
•									

MATERIAL DESCRIPTION	USCS	AASHTO
• TAN SILTY CLAY		

Project No.: 396-01402-01
 Project: RUST ENVIRONMENTAL MUSKOGEE LANDFILL
 • Location: HOLE NO. B-6 4.0'-6.0' TRACT A

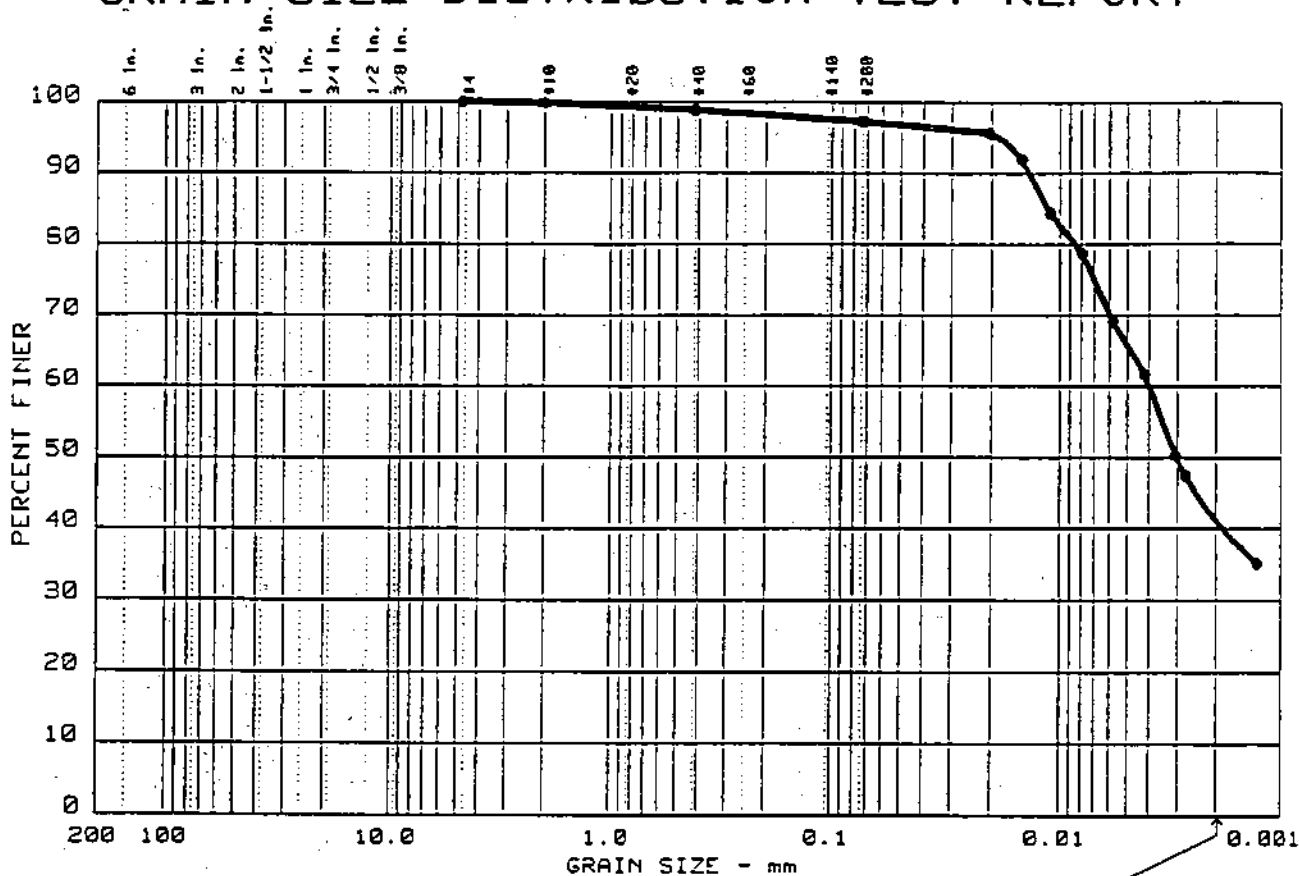
Date: 01-09-94

GRAIN SIZE DISTRIBUTION TEST REPORT
 LAW ENGINEERING, INC.

Remarks:
 SPECIFIC GRAVITY ASSUMED

Figure No.

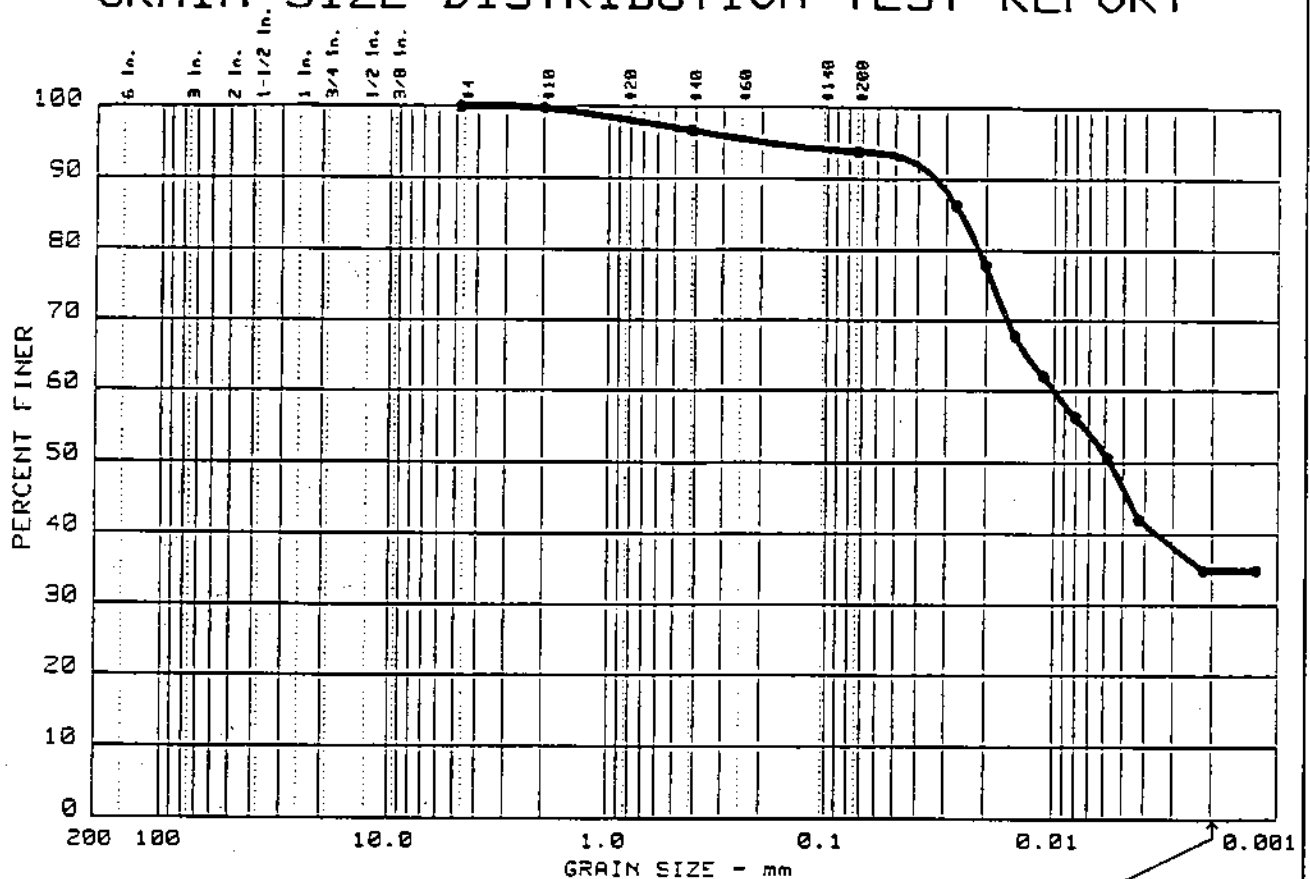
GRAIN SIZE DISTRIBUTION TEST REPORT



[illegible]

Project No.: 396-01402-01 Project: RUST ENVIRONMENTAL MUSKOGEE LANDFILL • Location: HOLE NO. B-11 4.0'-6.0' TRACT A	Remarks: SPECIFIC GRAVITY ASSUMED
Date: 01-09-94 GRAIN SIZE DISTRIBUTION TEST REPORT LAW ENGINEERING, INC.	Figure No.

GRAIN SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
• 5	0.0	0.0	6.1	59.0	34.9

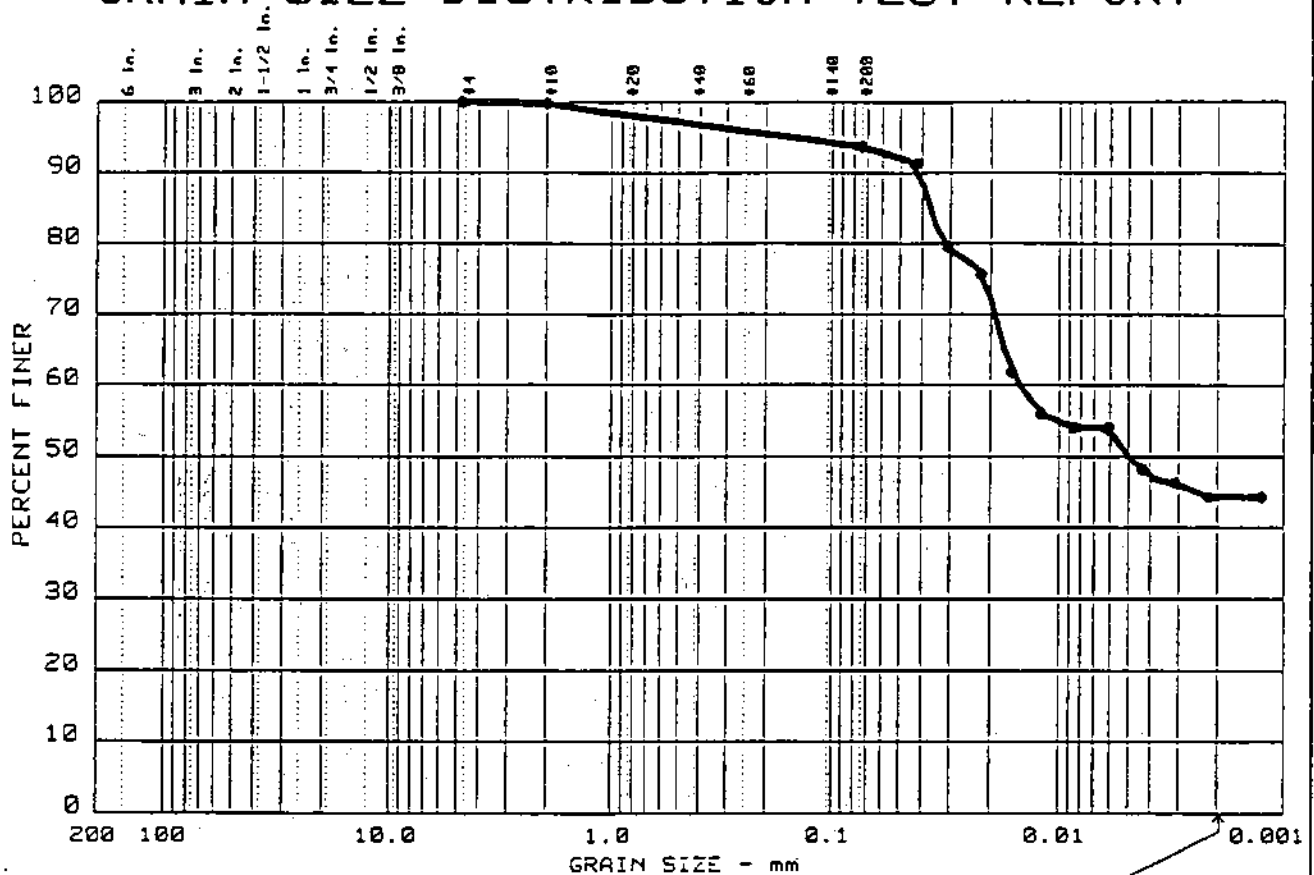
LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
•				0.01					

MATERIAL DESCRIPTION	USCS	AASHTO
• TAN & GRAY SHALEY SILTY CLAY		

Project No.: 396-01402-01 Project: RUST ENVIRONMENTAL MUSKOGEE LANDFILL • Location: HOLE NO. B-12 13.0'-15.0' TRACT A Date: 01-09-94	Remarks: SPECIFIC GRAVITY ASSUMED Figure No.
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GRAIN SIZE DISTRIBUTION TEST REPORT LAW ENGINEERING, INC.
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GRAIN SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
7	0.0	0.0	6.3	49.5	44.2

LL	PI	D ₂₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
				0.00					

MATERIAL DESCRIPTION	USCS	AASHTO
TAN & GRAY SILTY CLAY w/FERROUS NODULES		

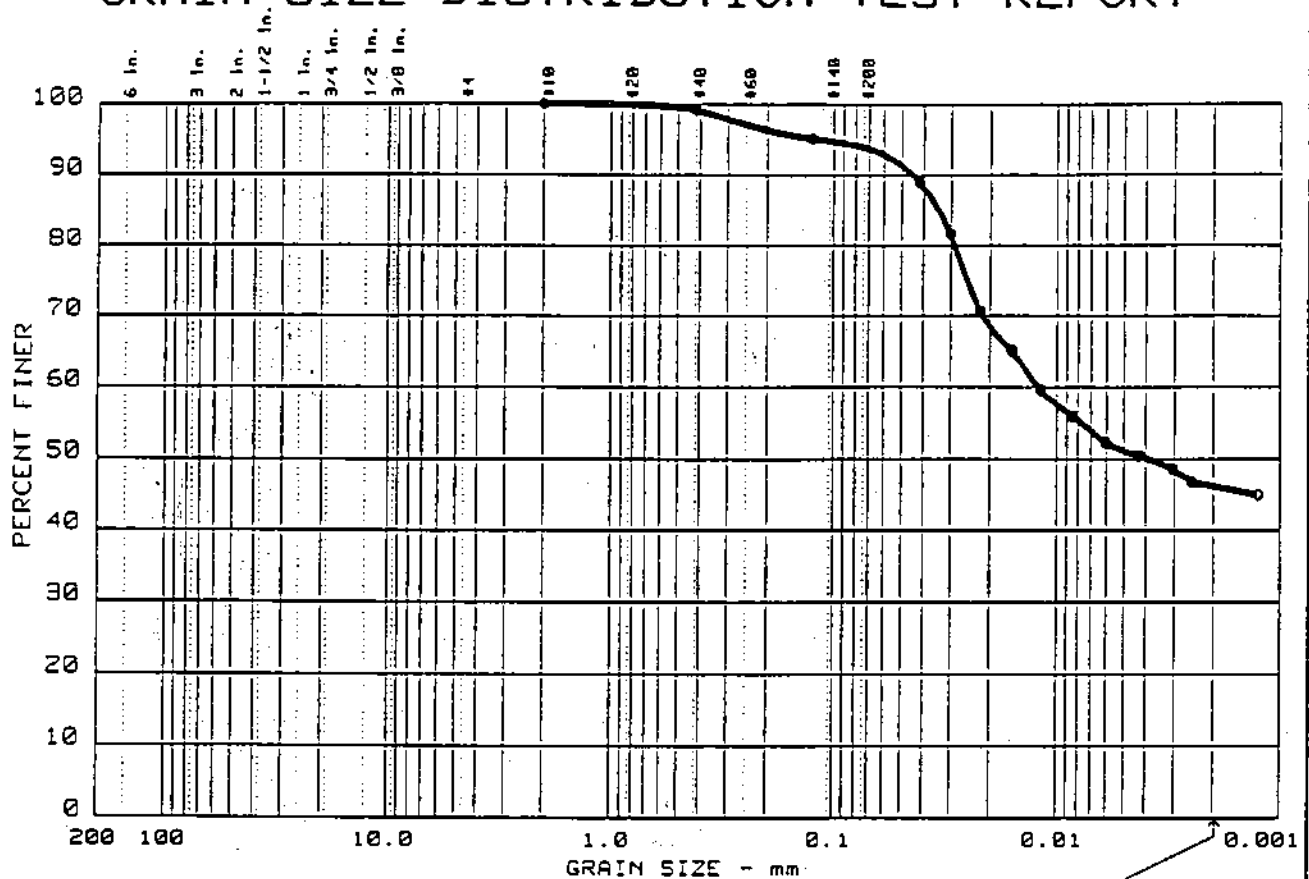
Project No.: 396-01402-01
 Project: RUST ENVIRONMENTAL MUSKOGEE LANDFILL
 Location: HOLE NO. B-13 4.0'-6.0' TRACT A
 Date: 01-09-94

Remarks:
 SPECIFIC GRAVITY ASSUMED

GRAIN SIZE DISTRIBUTION TEST REPORT
 LAW ENGINEERING, INC.

Figure No.

GRAIN SIZE DISTRIBUTION TEST REPORT



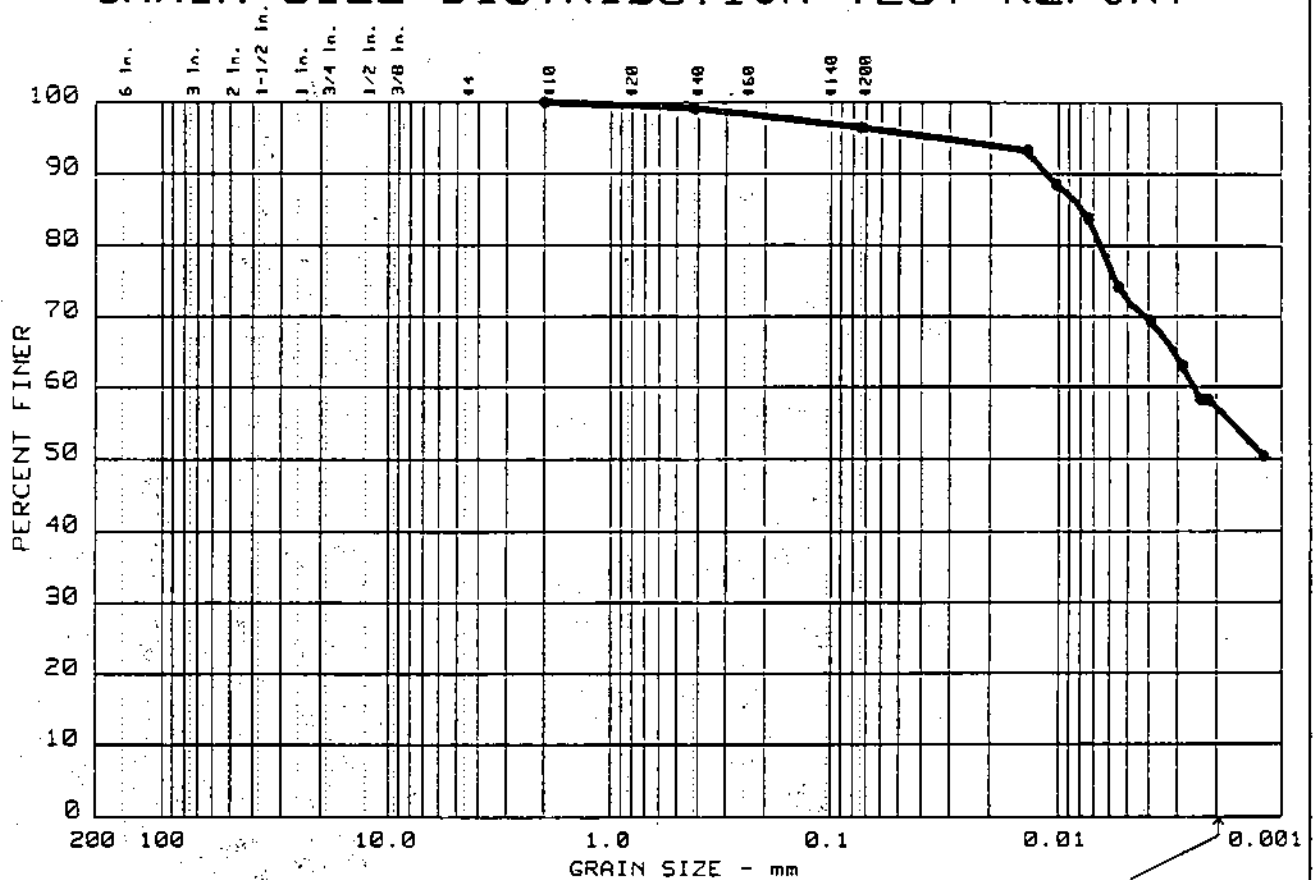
Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
• 13	0.0	0.0	6.0	47.7	46.3

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
•				0.00					

MATERIAL DESCRIPTION	USCS	AASHTO
• BROWN SILTY CLAY w/ ORGANICS		

Project No.: 396-01402-01 Project: RUST ENVIRONMENTAL MUSKOGEE LANDFILL • Location: HOLE NO. B-14 1.0'-2.0' TRACT A Date: 01-09-94 GRAIN SIZE DISTRIBUTION TEST REPORT LAW ENGINEERING, INC.	Remarks: SPECIFIC GRAVITY ASSUMED Figure No.
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GRAIN SIZE DISTRIBUTION TEST REPORT



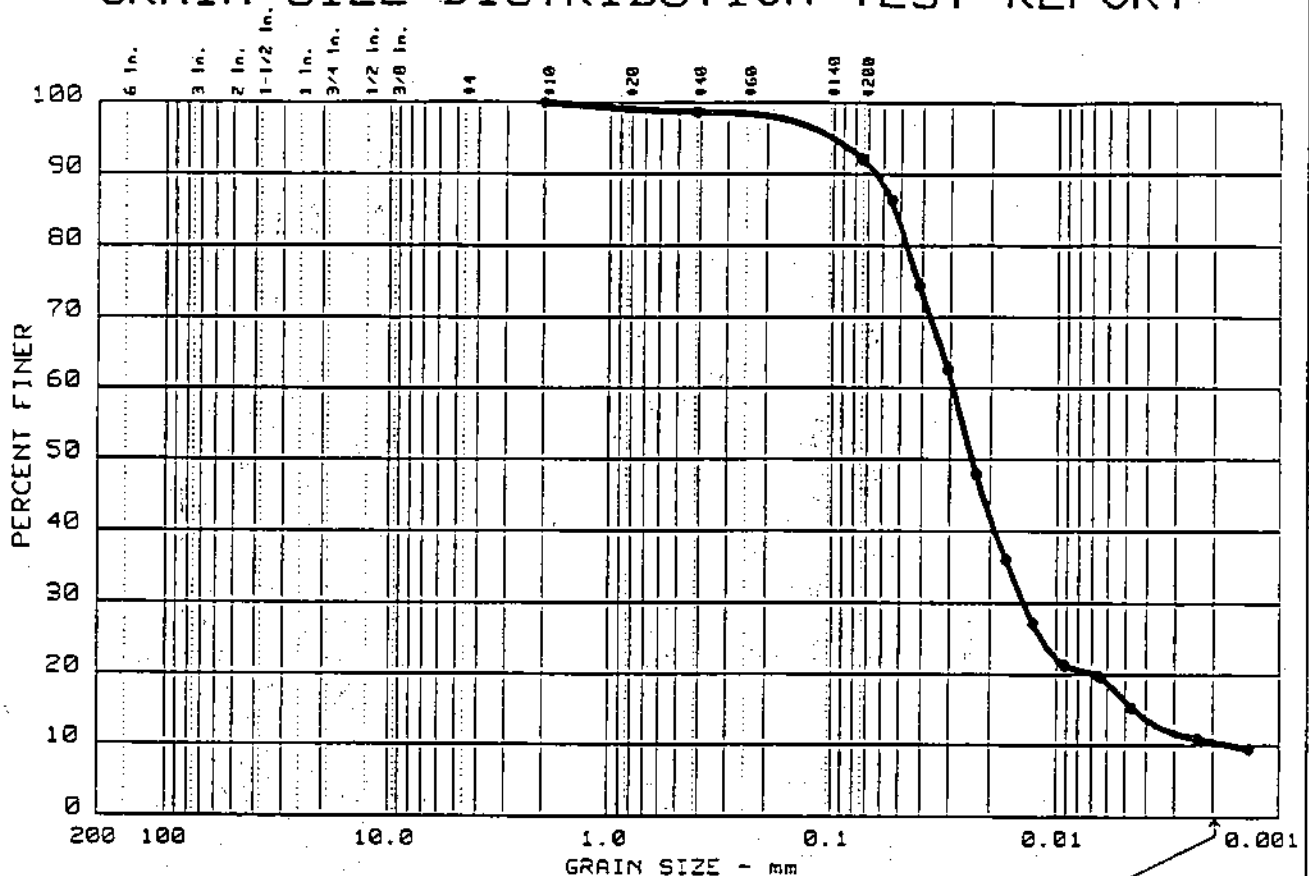
Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
• 12	0.0	0.0	3.5	39.4	57.1

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
•									

MATERIAL DESCRIPTION	USCS	AASHTO
• LT. TAN SLIGHTLY SHALEY SILTY CLAY		

Project No.: 396-01402-01 Project: RUST ENVIRONMENTAL MUSKOGEE LANDFILL • Location: HOLE NO. B-14 12.0'-14.0' TRACT A Date: 01-09-94	Remarks: SPECIFIC GRAVITY ASSUMED Figure No.
GRAIN SIZE DISTRIBUTION TEST REPORT LAW ENGINEERING, INC.	

GRAIN SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
• 3	0.0	0.0	8.0	81.5	10.5

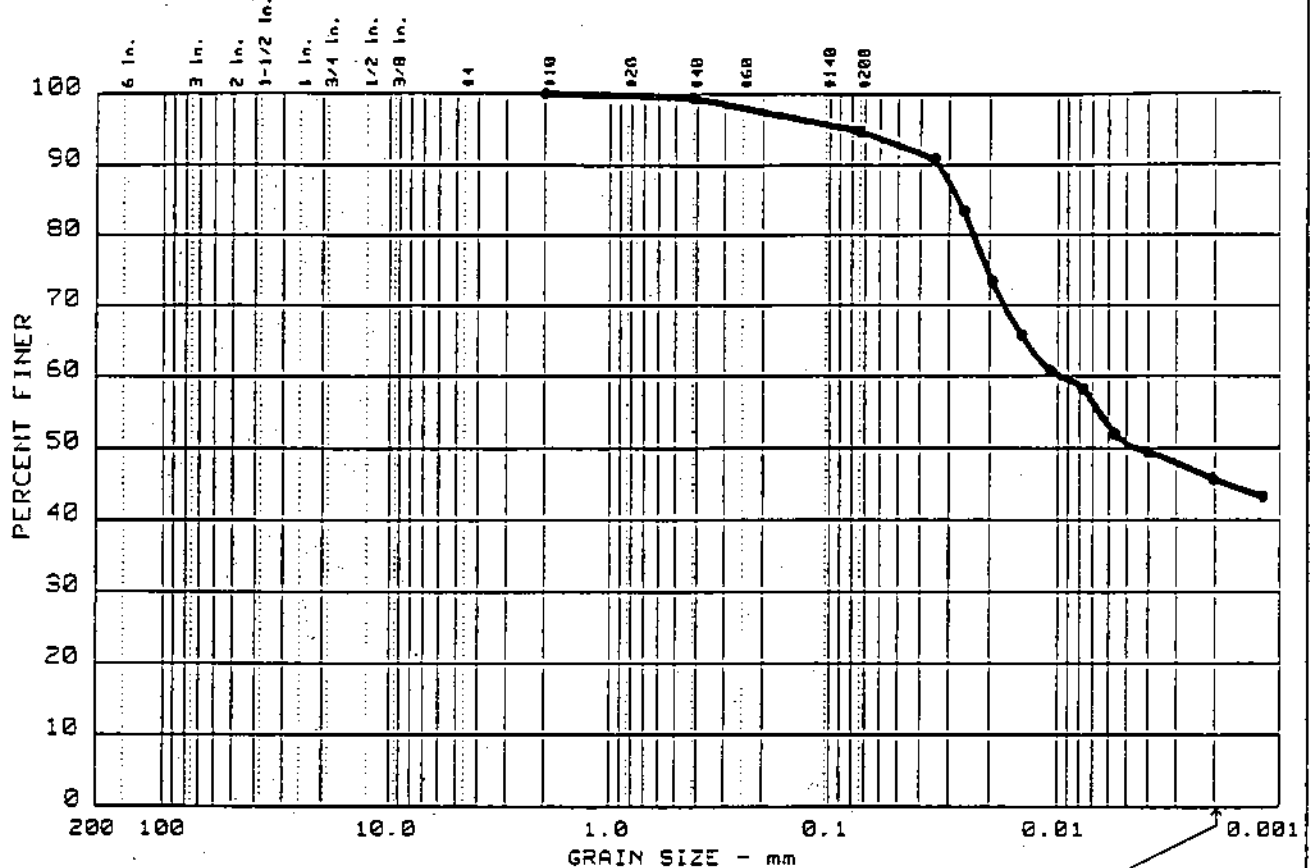
LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
•				0.02	0.014	0.0045	0.0017	4.07	17.4

MATERIAL DESCRIPTION	USCS	AASHTO
• LT. BROWN SLIGHTLY CLAYEY SILT w/ORGANICS		

Project No.: 396-01402-01 Project: RUST ENVIRONMENTAL MUSKOGEE LANDFILL • Location: HOLE NO. B-15 0.0'-2.0' TRACT A Date: 01-09-94	Remarks: SPECIFIC GRAVITY ASSUMED Figure No.
GRAIN SIZE DISTRIBUTION TEST REPORT LAW ENGINEERING, INC.	

[illegible]Figure No.

GRAIN SIZE DISTRIBUTION TEST REPORT



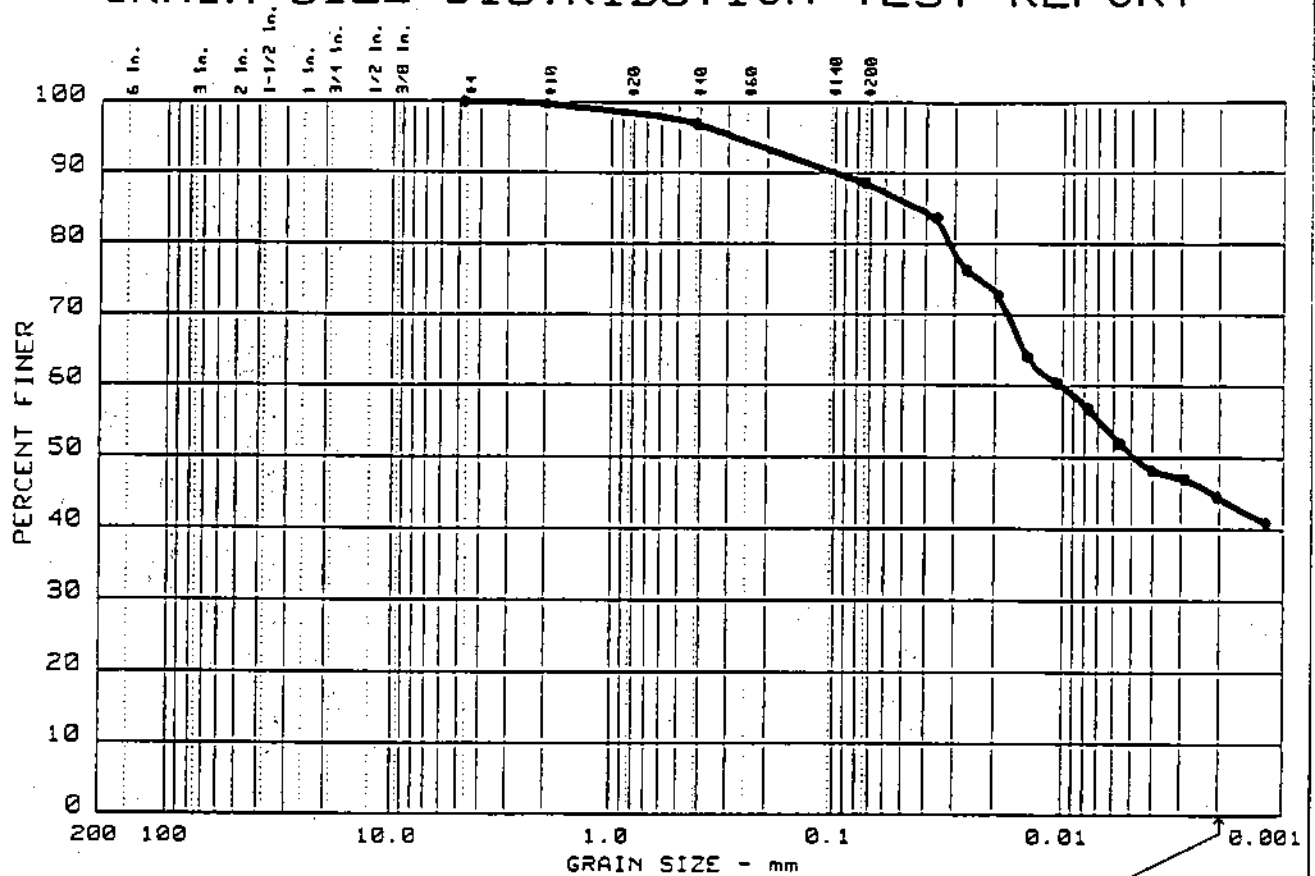
Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
• 4	0.0	0.0	5.1	49.3	45.6

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
•				0.00					

MATERIAL DESCRIPTION	USCS	AASHTO
• TAN & GRAY SILTY CLAY w/FERROUS POCKETS		

Project No.: 396-01402-01 Project: RUST ENVIRONMENTAL MUSKOGEE LANDFILL • Location: HOLE NO. B-17 6.0'-8.0' TRACT A Date: 01-09-94 GRAIN SIZE DISTRIBUTION TEST REPORT LAW ENGINEERING, INC.	Remarks: SPECIFIC GRAVITY ASSUMED Figure No.
--	--

GRAIN SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
• 6	0.0	0.0	11.4	44.2	44.4

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
•				0.00					

MATERIAL DESCRIPTION	USCS	AASHTO
• TAN & GRAY SILTY CLAY w/FERROUS NODULES	CL	

Project No.: 396-01402-01 Project: RUST ENVIRONMENTAL MUSKOGEE LANDFILL • Location: HOLE NO. B-1B 2.0'-4.0' TRACT A Date: 01-09-94	Remarks: SPECIFIC GRAVITY ASSUMED Figure No.
GRAIN SIZE DISTRIBUTION TEST REPORT LAW ENGINEERING, INC.	

Grain size distribution curve for Test Report No. 1. The graph plots Percent Finer (0 to 100) against Grain Size in mm (200 to 0.001). The curve shows a sharp drop in percent finer between 0.075 mm and 0.06 mm, indicating a fine sand material.

Grain Size (mm)	Percent Finer (%)
200	100
100	100
60	100
42.5	100
30	100
25	100
20	100
15	100
12.5	100
10	100
7.5	100
6	100
4.75	100
3.75	100
3.0	100
2.5	100
2.0	100
1.5	100
1.18	100
0.85	100
0.75	100
0.6	100
0.425	100
0.3	100
0.25	100
0.2	100
0.15	100
0.125	100
0.106	100
0.075	100
0.06	88
0.05	80
0.0425	75
0.0375	70
0.03	65
0.025	60
0.02	55
0.015	50
0.0125	48
0.0106	45
0.0085	42
0.0075	40
0.006	38
0.00425	35
0.003	32
0.0025	30
0.002	28
0.0015	25
0.00125	22
0.00106	20
0.00085	18
0.00075	15
0.0006	12
0.000425	10
0.0003	8
0.00025	6
0.0002	4
0.00015	2
0.000125	1
0.000106	0
0.000085	0
0.000075	0
0.00006	0
0.0000425	0
0.00003	0
0.000025	0
0.00002	0
0.000015	0
0.0000125	0
0.0000106	0
0.0000085	0
0.0000075	0
0.000006	0
0.00000425	0
0.000003	0
0.0000025	0
0.000002	0
0.0000015	0
0.00000125	0
0.00000106	0
0.00000085	0
0.00000075	0
0.0000006	0
0.000000425	0
0.0000003	0
0.00000025	0
0.0000002	0
0.00000015	0
0.000000125	0
0.000000106	0
0.000000085	0
0.000000075	0
0.00000006	0
0.0000000425	0
0.00000003	0
0.000000025	0
0.00000002	0
0.000000015	0
0.0000000125	0
0.0000000106	0
0.0000000085	0
0.0000000075	0
0.000000006	0
0.00000000425	0
0.000000003	0
0.0000000025	0
0.000000002	0
0.0000000015	0
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0.000000000425	0
0.0000000003	0
0.00000000025	0
0.0000000002	0
0.00000000015	0
0.000000000125	0
0.000000000106	0
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0.000000000003	

[illegible]

Project No.: 396-01402-01
Project: RUST ENVIRONMENTAL MUSKOGEE LANDFILL
• Location: HOLE NO. B-20 8.0'-10.0' TRACT A
Date: 01-09-94

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Figure No.

[illegible][illegible]

Project No.: 396-01402-01
Project: RUST ENVIRONMENTAL MUSKOGEE LANDFILL
● Location: HOLE NO. B-21 17.0'-19.0' TRACT A

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Figure No.

**LAW ENGINEERING**GEOTECHNICAL ENVIRONMENTAL
& CONSTRUCTION MATERIALS
CONSULTANTS1540 NORTH 107TH EAST AVENUE
TULSA, OKLAHOMA 74116
PHONE: 918-834-4700
FAX: 918-835-2545

REPORT NO. _____

DATE: 11-08-93

396-01402-01

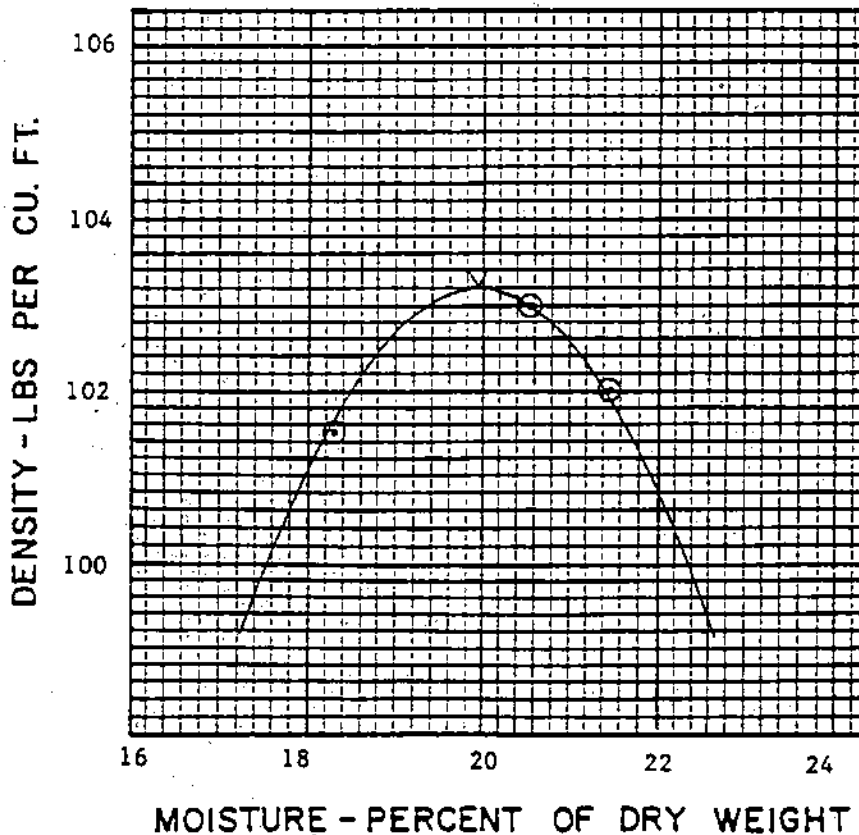
MOISTURE - DENSITY CURVE

CLIENT: Rust Environmental

PROJECT: Muskogee Landfill

MATERIAL: Light reddish brown and tan silty clay

MATERIAL SOURCE: Tract A B-3 0'-2'

TEST RESULTSMETHOD OF TEST ASTM D-698MAXIMUM DRY DENSITY = 103.2 LBS PER CU. FT.OPTIMUM MOISTURE CONTENT = 20.0 %**PHYSICAL
PROPERTIES**LIQUID LIMIT = 52 %PLASTIC LIMIT = 16 %PLASTICITY INDEX = 36 %

CLASSIFICATION = _____

**LAW ENGINEERING**GEOTECHNICAL, ENVIRONMENTAL
& CONSTRUCTION MATERIALS
CONSULTANTS1540 NORTH 107TH EAST AVENUE
TULSA, OKLAHOMA 74116
PHONE: 918-834-4700
FAX: 918-835-2545

REPORT NO. _____

DATE: 11-08-93

396-01402-01

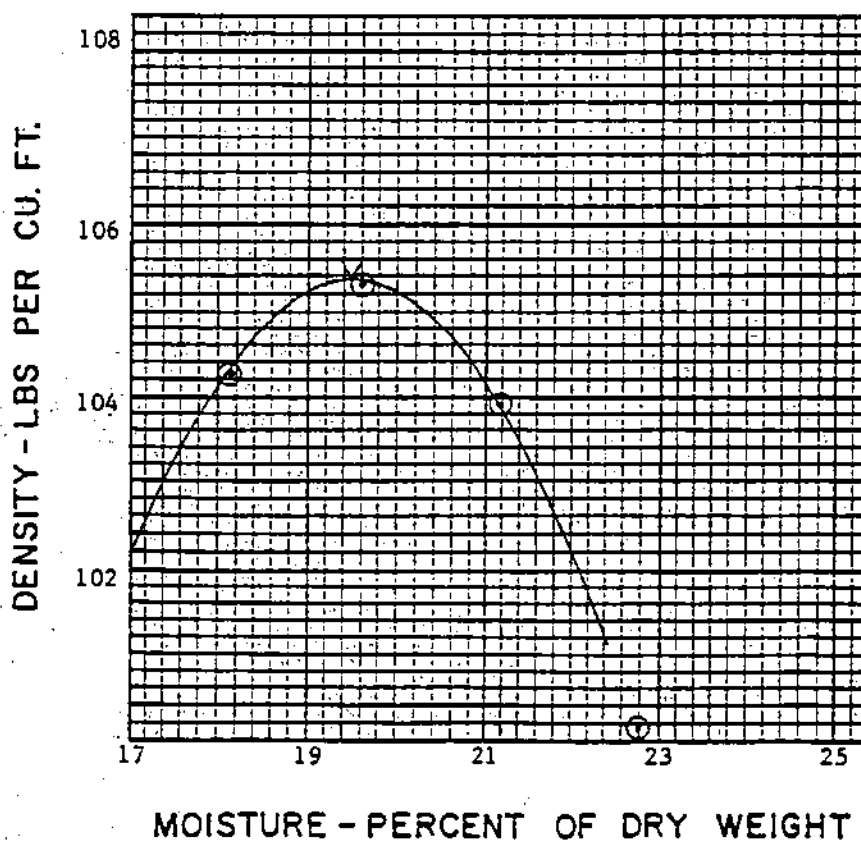
MOISTURE - DENSITY CURVE

CLIENT: Rust Environmental

PROJECT: Muskogee Landfill

MATERIAL: Tan and brown silty clay

MATERIAL SOURCE: Tract A B-16 0'-2'

TEST RESULTSMETHOD OF TEST ASTM D-698MAXIMUM DRY DENSITY = 105.4 LBS PER CU. FT.OPTIMUM MOISTURE CONTENT = 19.5 %**PHYSICAL
PROPERTIES**LIQUID
LIMIT = 51 %PLASTIC
LIMIT = 17 %PLASTICITY
INDEX = 34 %

CLASSIFICATION = _____

**LAW ENGINEERING**GEOTECHNICAL, ENVIRONMENTAL
& CONSTRUCTION MATERIALS
CONSULTANTS1540 NORTH 107TH EAST AVENUE
TULSA, OKLAHOMA 74116
PHONE: 918-834-4700
FAX: 918-835-2545REPORT NO. _____
DATE: 11-29-93

396-01402-02

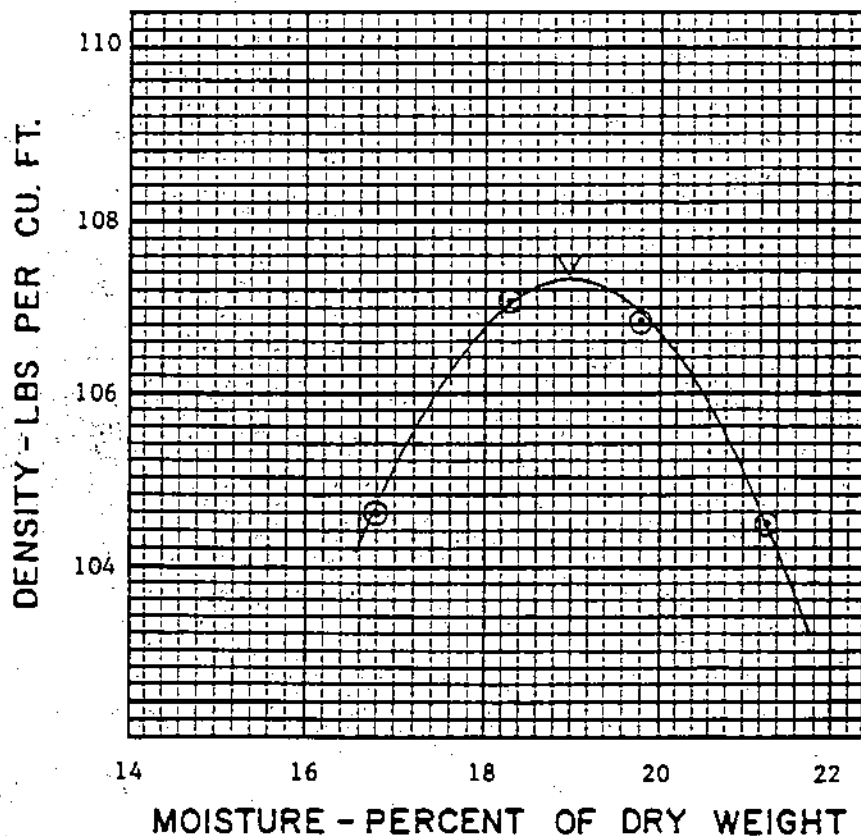
MOISTURE - DENSITY CURVE

CLIENT: Rust Environmental

PROJECT: Muskogee Landfill

MATERIAL: Yellowish tan silty clay

MATERIAL SOURCE: Tract A B-18 0'-2'

TEST RESULTSMETHOD OF TEST ASTM D-698MAXIMUM DRY DENSITY = 107.4 LBS PER CU. FT.OPTIMUM MOISTURE CONTENT = 19.0 %**PHYSICAL
PROPERTIES**LIQUID
LIMIT = 46 %PLASTIC
LIMIT = 16 %PLASTICITY
INDEX = 30 %

CLASSIFICATION = _____

**LAW ENGINEERING**GEOTECHNICAL ENVIRONMENTAL
& CONSTRUCTION MATERIALS
CONSULTANTS1540 NORTH 107TH EAST AVENUE
TULSA, OKLAHOMA 74116
PHONE: 918-834-4700
FAX: 918-835-2545

REPORT NO. _____

DATE: 11-08-93

396-01402-01

MOISTURE - DENSITY CURVE

CLIENT: Rust Environmental

PROJECT: Muskogee Landfill

MATERIAL: Tan and light brown silty clay

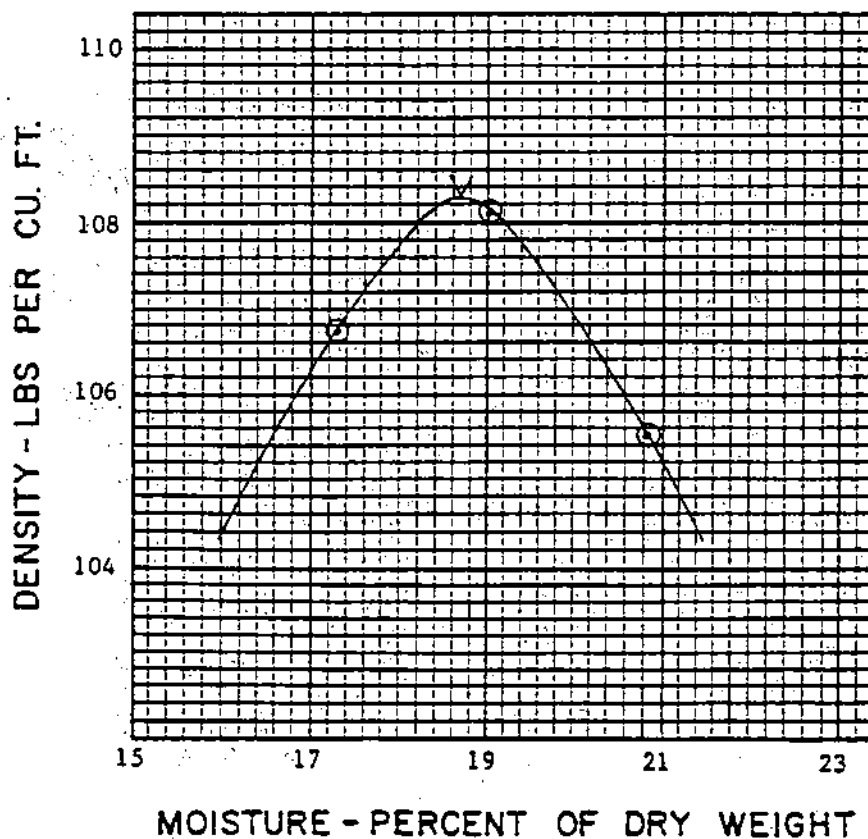
MATERIAL SOURCE: Tract A P-11 0'-2'

TEST RESULTS

METHOD OF TEST ASTM D-698

MAXIMUM DRY DENSITY = 108.2 LBS PER CU. FT.

OPTIMUM MOISTURE CONTENT = 18.7 %

**PHYSICAL
PROPERTIES**LIQUID
LIMIT = 48 %PLASTIC
LIMIT = 16 %PLASTICITY
INDEX = 32 %

CLASSIFICATION = _____

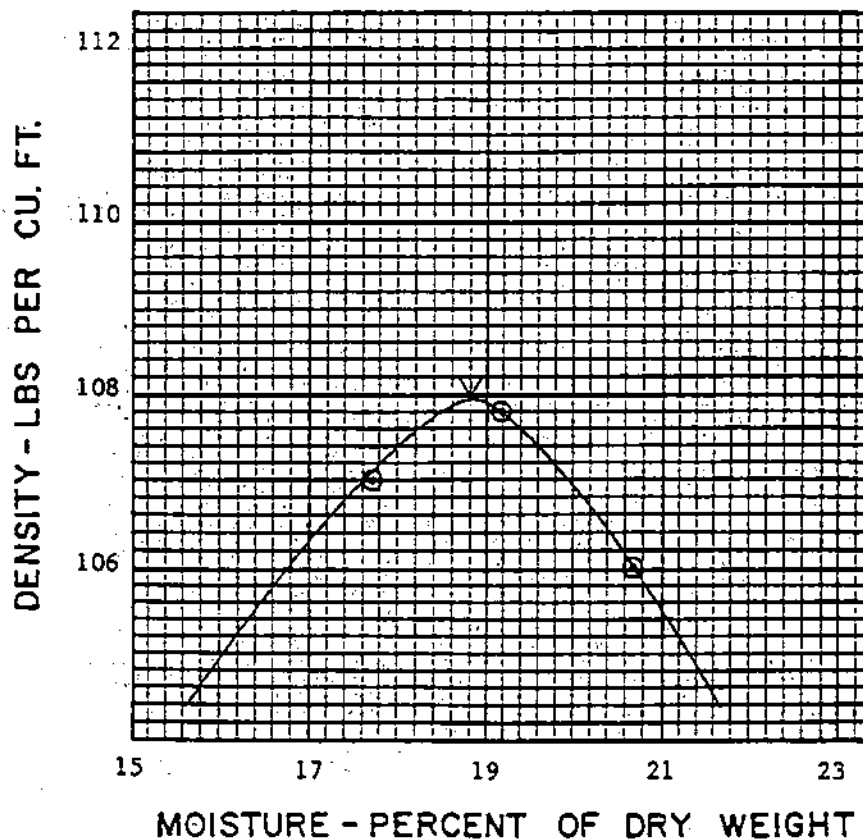
**LAW ENGINEERING**GEOTECHNICAL, ENVIRONMENTAL
& CONSTRUCTION MATERIALS
CONSULTANTS1540 NORTH 107TH EAST AVENUE
TULSA, OKLAHOMA 74116
PHONE: 918-834-4700
FAX: 918-835-2545REPORT NO. _____
DATE: November 8, 1991
396-01402-01**MOISTURE - DENSITY CURVE**

CLIENT: Rust Environmental

PROJECT: Muskogee Landfill

MATERIAL: Tan and light brown silty clay

MATERIAL SOURCE: Tract A P-12 0'-2'

TEST RESULTSMETHOD OF TEST ASTM D-698MAXIMUM DRY DENSITY = 108.0 LBS PER CU. FT.OPTIMUM MOISTURE CONTENT = 18.8 %**PHYSICAL PROPERTIES**LIQUID LIMIT = 41 %PLASTIC LIMIT = 16 %PLASTICITY INDEX = 25 %

CLASSIFICATION = _____

**LAW ENGINEERING**GEOTECHNICAL, ENVIRONMENTAL
& CONSTRUCTION MATERIALS
CONSULTANTS1540 NORTH 107TH EAST AVENUE
TULSA, OKLAHOMA 74116
PHONE: 918-834-4700
FAX: 918-835-2545

REPORT NO. _____

DATE: 11-08-93

396-01402-01

MOISTURE - DENSITY CURVE

CLIENT: Rust Environmental

PROJECT: Muskogee Landfill

MATERIAL: Tan and light brown silty clay

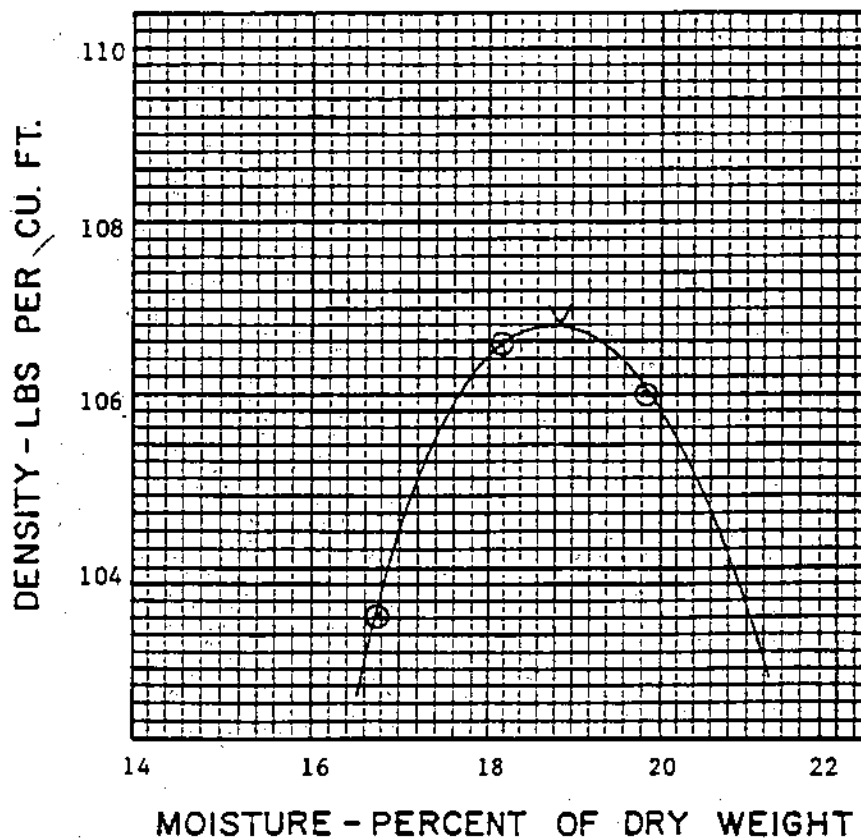
MATERIAL SOURCE: Tract A P-15 2'-7'

TEST RESULTS

METHOD OF TEST ASTM D-698

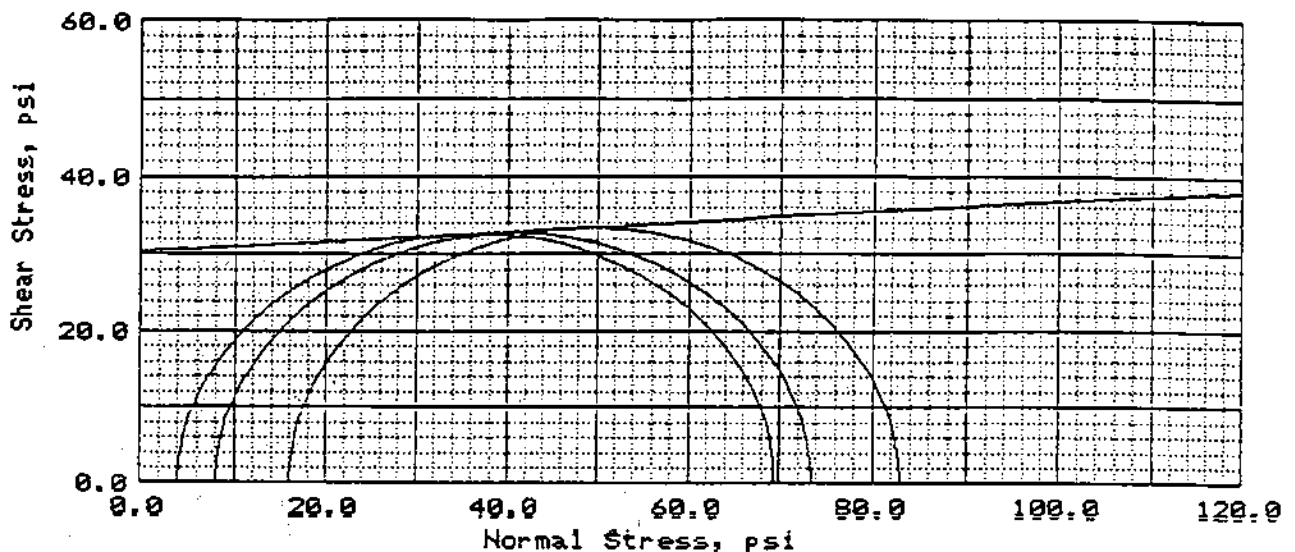
MAXIMUM DRY DENSITY = 106.8 LBS PER CU. FT.

OPTIMUM MOISTURE CONTENT = 18.8 %

**PHYSICAL
PROPERTIES**LIQUID
LIMIT = 48 %PLASTIC
LIMIT = 15 %PLASTICITY
INDEX = 33 %

CLASSIFICATION = _____

TRIAXIAL SHEAR TEST REPORT



Type of Test: Unconsolidated undrained Sample Type: UNDISTURBED

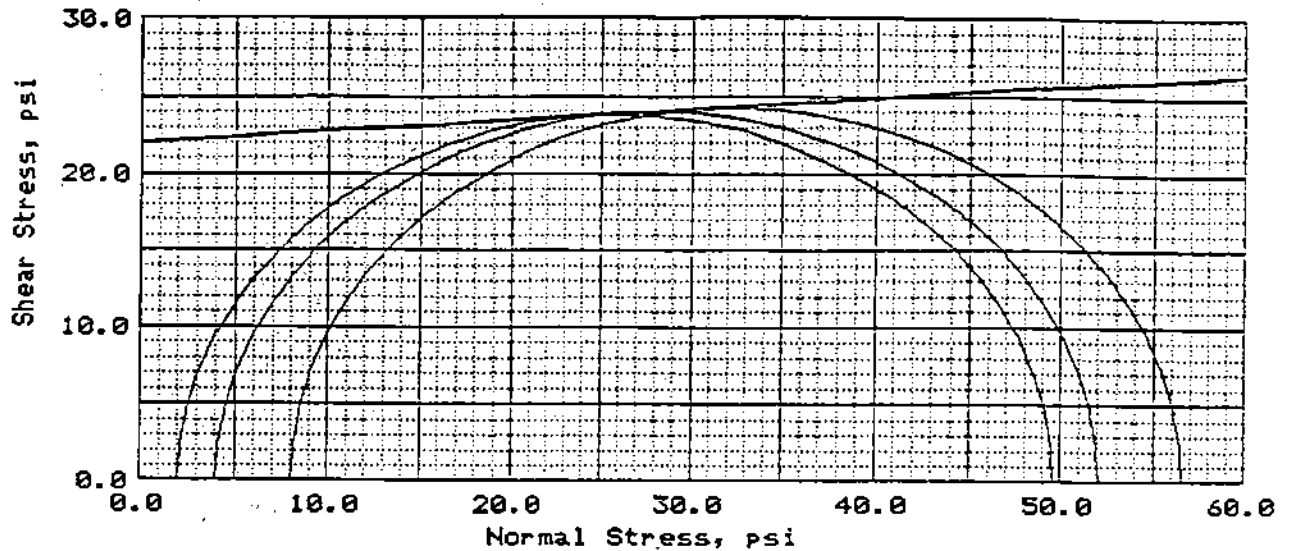
No.	FLUID PRESS. psi		MAX. STRENGTH psi		ULT. STRENGTH psi		PRINCIPAL STRESSES AT FAILURE psi	
	Cell	Back	Deviator	Pore	Deviator	Pore	σ_1	σ_3
1	4	0	65.4	0.0			69.4	4.0
2	8	0	65.5	0.0			73.5	8.0
3	16	0	66.9	0.0			82.9	16.0

SAMPLE PARAMETERS							
No.	% Water Content	Dry Dens. pcf	Satur-ation	Void Ratio	Diameter in	Height in	Strain rate in/min.
1	19.5	110.6	100.6 %	0.5246	2.70	5.83	0.030
2	19.5	110.6	100.6 %	0.5246	2.70	5.83	0.030
3	19.5	110.6	100.6 %	0.5246	2.70	5.83	0.030

MOHR-COULOMB STRENGTH PARAMETERS	MATERIAL DESCRIPTION
Total Strength intercept, $c = 30.3$ psi Friction angle, $\phi = 3.7$ deg Tangent $\phi = 0.06$	TAN & GRAY SILTY CLAY LL= PI=

CLIENT: RUST ENVIRONMENT AND INFRASTRUCTURE PROJECT: MUSKOGEE LANDFILL TRACT A LOCATION: HOLE NO. B-5 6.0'-8.0'	DATE: 01-14-94 File: RUST56-8 REMARKS: RUN BY J.ALEXANDER MULTIPLE-STAGE Proj. No.: 3960140201 Fig. No. 2
TRIAXIAL SHEAR TEST REPORT LAW ENGINEERING, INC.	

TRIAXIAL SHEAR TEST REPORT



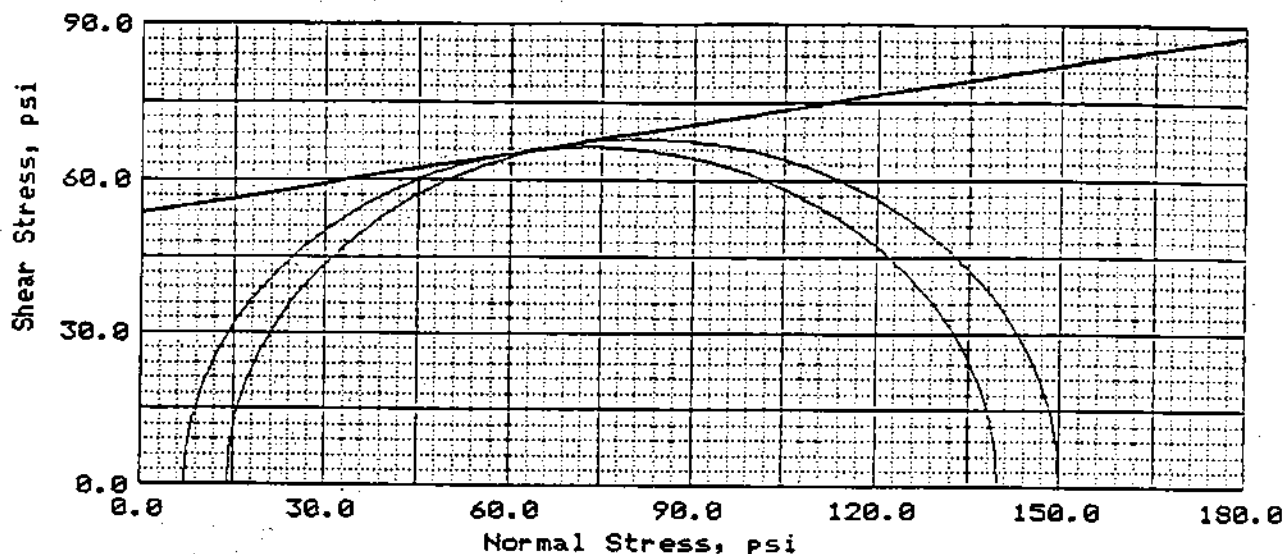
Type of Test: Unconsolidated undrained Sample Type: INDISTURBED

No.	FLUID PRESS. psi		MAX. STRENGTH psi		ULT. STRENGTH psi		PRINCIPAL STRESSES AT FAILURE psi	
	Cell	Back	Deviator	Pore	Deviator	Pore	σ_1	σ_3
1	2	0	47.6	0.0			49.6	2.0
2	4	0	48.0	0.0			52.0	4.0
3	8	0	48.5	0.0			56.5	8.0

SAMPLE PARAMETERS							
No.	% Water Content	Dry Dens. pcf	Saturation	Void Ratio	Diameter in	Height in	Strain rate in/min.
1	20.0	109.2	99.3 %	0.5430	2.71	5.78	0.030
2	20.0	109.2	99.3 %	0.5430	2.71	5.78	0.030
3	20.0	109.2	99.3 %	0.5430	2.71	5.78	0.030

MOHR-COULOMB STRENGTH PARAMETERS				MATERIAL DESCRIPTION			
Total				TAN & GRAY SILTY			
Strength intercept, $c = 22.0$ psi				CLAY			
Friction angle, $\phi = 4.2$ deg				LL= PI=			
Tangent $\phi = 0.07$							
CLIENT: RUST ENVIRONMENT AND INFRASTRUCTURE					DATE: 01-14-94		
PROJECT: MUSKOGEE LANDFILL TRACT A					File: RUST74-6		
LOCATION: HOLE NO. B-7 4.0'-6.0'					REMARKS:		
					RUN BY J.ALEXANDER		
					MULTIPLE-STAGE		
TRIAXIAL SHEAR TEST REPORT					Proj. No.: 3960140201		
LAW ENGINEERING, INC.					Fig. No. 4		

TRIAXIAL SHEAR TEST REPORT



Type of Test: Unconsolidated undrained Sample Type: UNDISTURBED

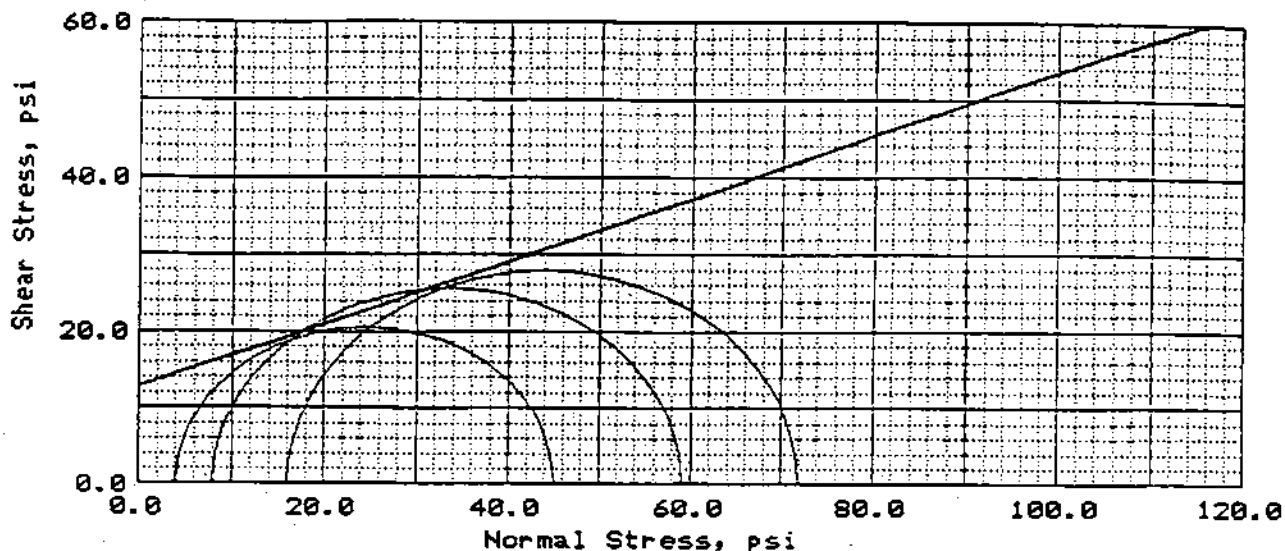
No.	FLUID PRESS. psi		MAX. STRENGTH psi		ULT. STRENGTH psi		PRINCIPAL STRESSES AT FAILURE psi	
	Cell	Back	Deviator	Pore	Deviator	Pore	σ_1	σ_3
1	7	0	132.8	0.0			139.8	7.0
2	14	0	136.0	0.0			150.0	14.0

No.	SAMPLE PARAMETERS						
	% Water Content	Dry Dens. pcf	Satur-ation	Void Ratio	Diameter in	Height in	Strain rate in/min.
1	15.6	116.3	93.6 %	0.4494	2.68	5.81	0.030
2	15.6	116.3	93.6 %	0.4494	2.68	5.81	0.030

MOHR-COULOMB STRENGTH PARAMETERS	MATERIAL DESCRIPTION
Total Strength intercept, $c = 53.6$ psi Friction angle, $\phi = 10.8$ deg Tangent $\phi = 0.19$	TAN & GRAY SILTY CLAY LL= PI=

CLIENT: RUST ENVIRONMENT AND INFRASTRUCTURE PROJECT: MUSKOGEE LANDFILL TRACT A LOCATION: HOLE NO. B-16 13.0'-14.0'	DATE: 01-14-94 File: RUST16 REMARKS: RUN BY J.ALEXANDER MULTIPLE-STAGE Proj. No.: 3960140201 Fig. No. 3
TRIAXIAL SHEAR TEST REPORT LAW ENGINEERING, INC.	

TRIAXIAL SHEAR TEST REPORT

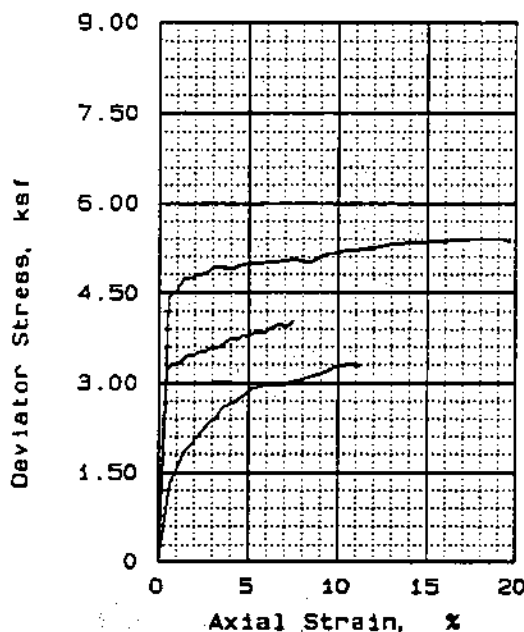
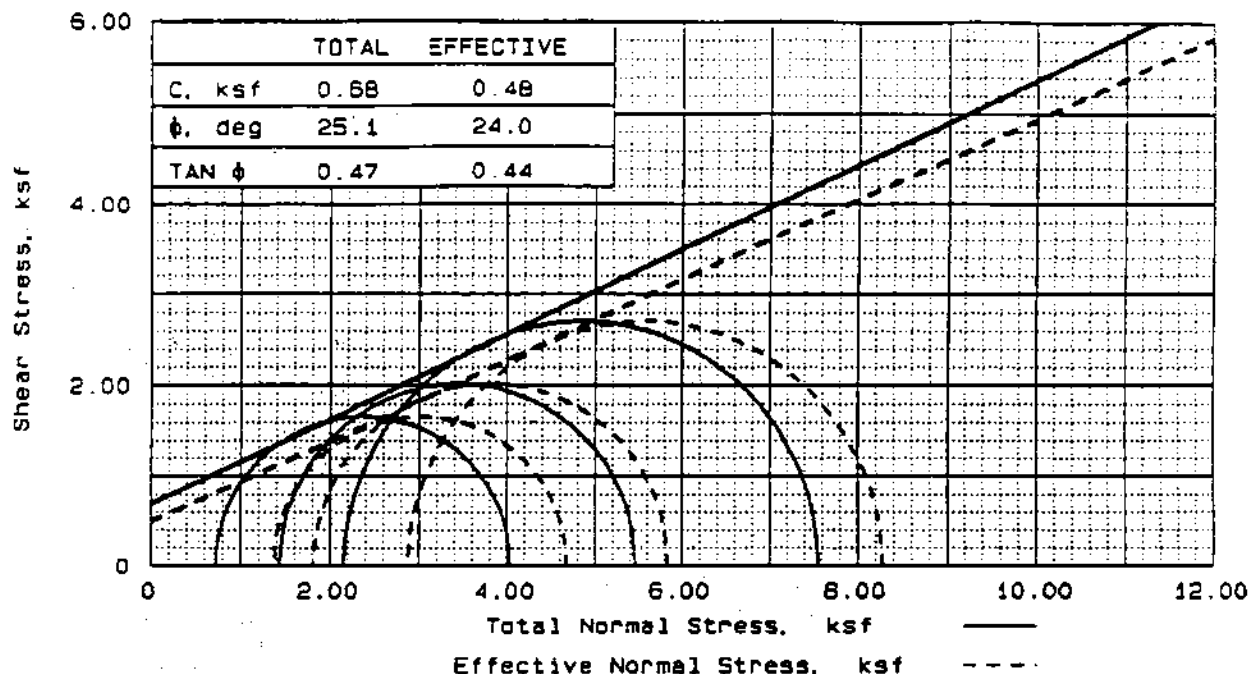


Type of Test: Unconsolidated undrained Sample Type: SHELBY TUBE

No.	FLUID PRESS. psi		MAX. STRENGTH psi		ULT. STRENGTH psi		PRINCIPAL STRESSES AT FAILURE psi	
	Cell	Back	Deviator	Pore	Deviator	Pore	σ_1	σ_3
1	4	0	41.1	0.0			45.1	4.0
2	8	0	51.1	0.0			59.1	8.0
3	16	0	55.8	0.0			71.8	16.0

SAMPLE PARAMETERS							
No.	% Water Content	Dry Dens. pcf	Satur-ation	Void Ratio	Diameter in	Height in	Strain rate in/min.
1	19.5	107.2	93.3 %	0.5610	2.73	5.91	0.030
2	19.5	107.2	93.3 %	0.5610	2.73	5.91	0.030
3	19.5	107.2	93.3 %	0.5610	2.73	5.91	0.030

MOHR-COULOMB STRENGTH PARAMETERS				MATERIAL DESCRIPTION			
Total Strength intercept, $c = 12.8$ psi Friction angle, $\phi = 22.2$ deg Tangent $\phi = 0.41$				TAN & GRAY SILTY CLAY w/FERROUS NODULES LL= PI=			
CLIENT: RUST ENVIRONMENT AND INFRASTRUCTURE PROJECT: MUSKOGEE LANDFILL TRACT A LOCATION: HOLE NO. B-20 6.0'-9.0'				DATE: 01-13-94 File: RUSTB20 REMARKS: RUN BY J.ALEXANDER MULTIPLE-STAGE			
TRIAXIAL SHEAR TEST REPORT LAW ENGINEERING, INC.				Proj. No.: 3960140201 Fig. No. 1			



SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	18.4	18.4	18.4
	DRY DENSITY, pcf	110.4	110.4	110.4
	SATURATION, %	93.0	93.0	93.0
	VOID RATIO	0.539	0.539	0.539
	DIAMETER, in	1.41	1.41	1.41
AT TEST	HEIGHT, in	2.84	2.84	2.84
	WATER CONTENT, %	19.5	19.5	19.5
	DRY DENSITY, pcf	110.4	110.4	110.4
	SATURATION, %	98.7	98.7	98.7
	VOID RATIO	0.539	0.539	0.539
	DIAMETER, in	1.41	1.41	1.41
	HEIGHT, in	2.84	2.84	2.84
	Strain rate, in/min	0.001	0.001	0.001
	BACK PRESSURE, ksf	9.79	9.79	9.79
	CELL PRESSURE, ksf	10.51	11.23	11.95
	FAILURE STRESS, ksf	3.32	4.03	5.41
	PORE PRESSURE, ksf	9.14	9.42	9.07
	ULTIMATE STRESS, ksf	3.32	4.03	5.40
	PORE PRESSURE, ksf	9.14	9.42	9.01
	$\bar{\sigma}_1$ FAILURE, ksf	4.68	5.85	8.29
	$\bar{\sigma}_3$ FAILURE, ksf	1.37	1.81	2.88

TYPE OF TEST: CU with pore pressures

SAMPLE TYPE: UNDISTURBED

DESCRIPTION: YELLOWISH BROWN
LEAN CLAY W/FERROUS

LL= PL= PI=

SPECIFIC GRAVITY=.2.72

REMARKS: IN GENERAL ACCORDANCE
W/ASTM D4767

ASSUMED SPECIFIC GRAVITY

CLIENT: RUST E&I

PROJECT: MUSKOGEE COMMUNITY LANDFILL - TRACT A

SAMPLE LOCATION: BH2

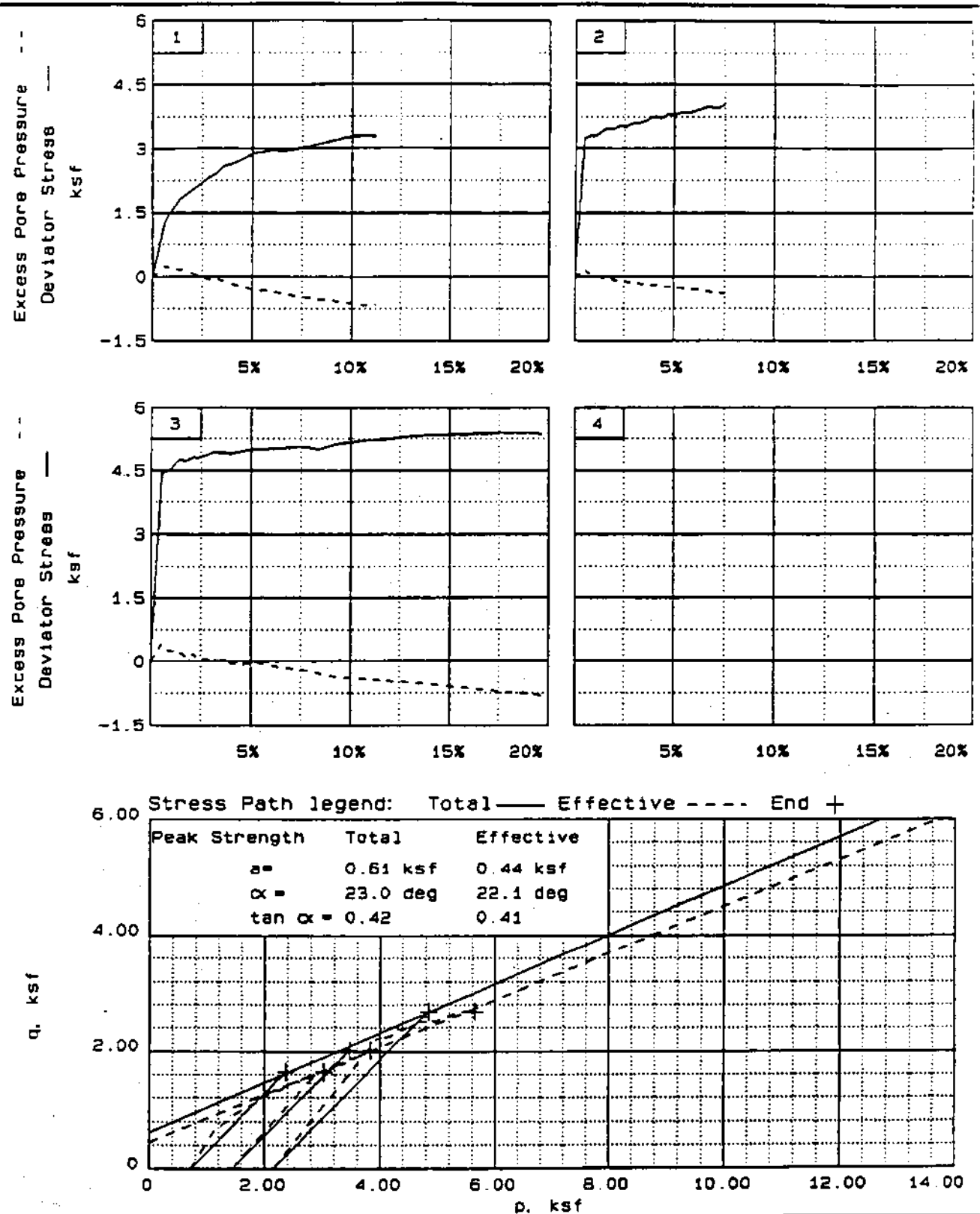
DEPTH: 8.0 - 10.0 FEET

PROJ. NO.: 3070576201 DATE: 11/05/93

TRIAxIAL SHEAR TEST REPORT

LAW ENGINEERING, INC.

FIG. NO.:



Client: RUST E&I

Project: MUSKOGEE COMMUNITY LANDFILL - TRACT A

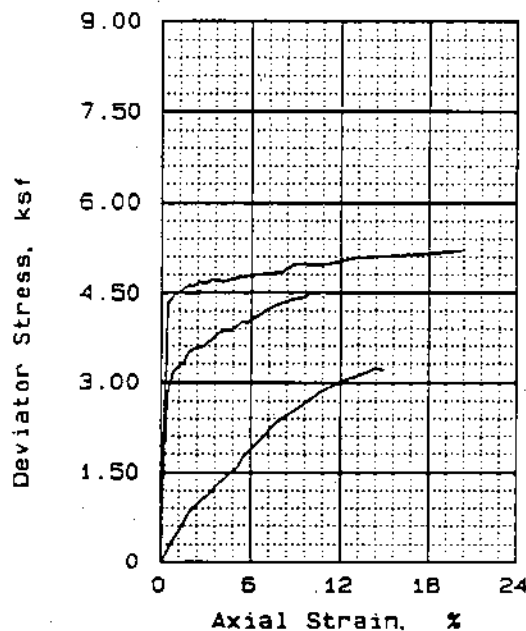
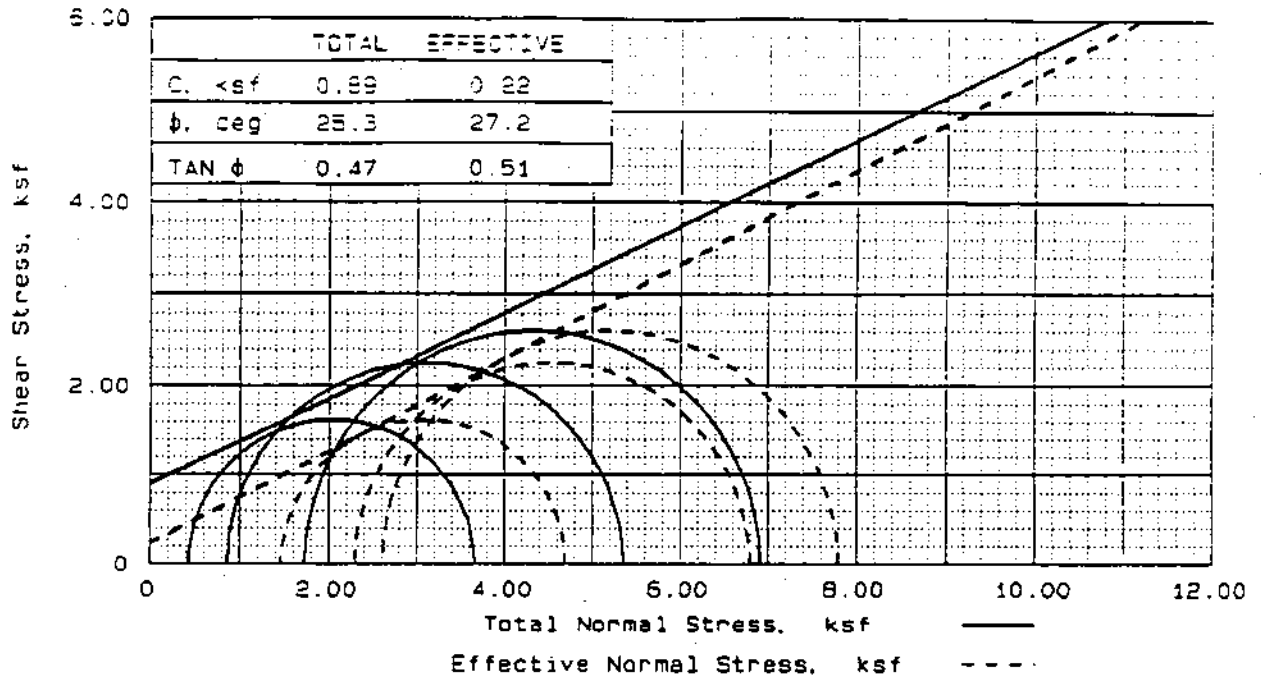
Location: BH2 DEPTH: 8.0 - 10.0 FEET

File: 5762CUP3

Project No.: 3070576201

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Fig. No. _____



SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	13.9	13.9	13.9
	DRY DENSITY, pcf	119.5	119.5	119.5
	SATURATION, %	90.0	90.0	90.0
	VOID RATIO	0.421	0.421	0.421
	DIAMETER, in	1.40	1.40	1.40
	HEIGHT, in	2.72	2.72	2.72
AT TEST	WATER CONTENT, %	14.8	14.8	14.8
	DRY DENSITY, pcf	119.5	119.5	119.5
	SATURATION, %	95.6	95.6	95.6
	VOID RATIO	0.421	0.421	0.421
	DIAMETER, in	1.40	1.40	1.40
	HEIGHT, in	2.72	2.72	2.72
Strain rate, in/min		0.001	0.001	0.001
BACK PRESSURE, ksf		8.41	8.41	8.41
CELL PRESSURE, ksf		8.84	9.27	10.14
FAILURE STRESS, ksf		3.23	4.50	5.19
PORE PRESSURE, ksf		7.37	6.97	7.53
ULTIMATE STRESS, ksf		3.23	4.50	5.19
PORE PRESSURE, ksf		7.37	6.97	7.53
$\bar{\sigma}_1$ FAILURE, ksf		4.70	6.80	7.80
$\bar{\sigma}_3$ FAILURE, ksf		1.47	2.3	2.61

TYPE OF TEST:

CU with pore pressures

SAMPLE TYPE: UNDISTURBED

DESCRIPTION: YELLOW & GRAYISH

BROWN LEAN CLAY W/FERROUS

LL= PL= PI=

SPECIFIC GRAVITY= 2.72

REMARKS: IN GENERAL ACCORDANCE

W/ASTM D4767

ASSUMED SPECIFIC GRAVITY

CLIENT: RUST E&I

PROJECT: MUSKOGEE COMMUNITY LANDFILL - TRACT A

SAMPLE LOCATION: BM10

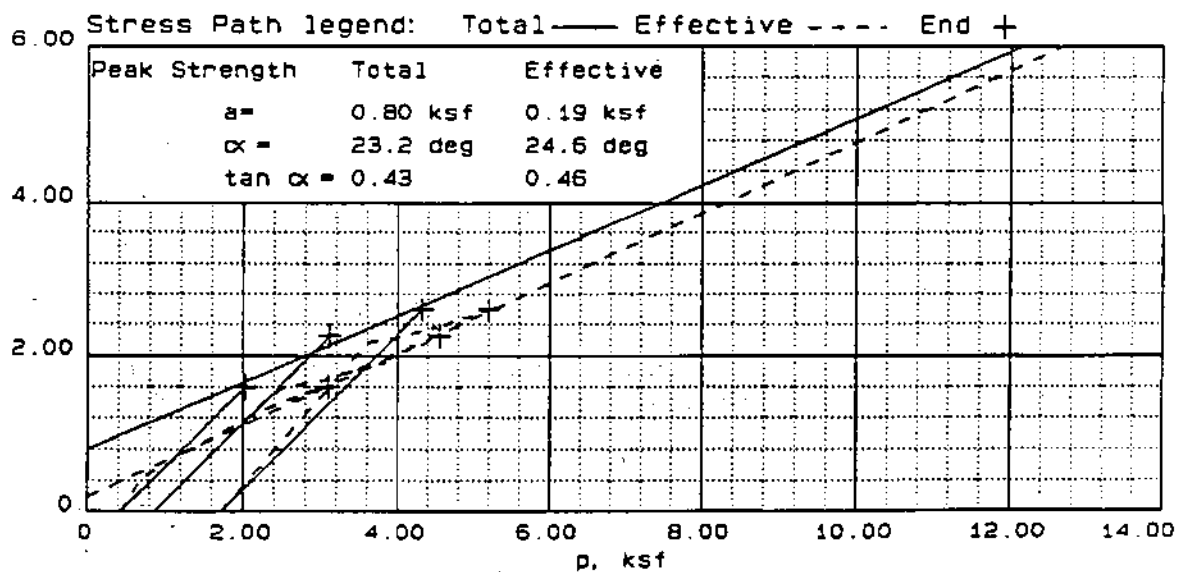
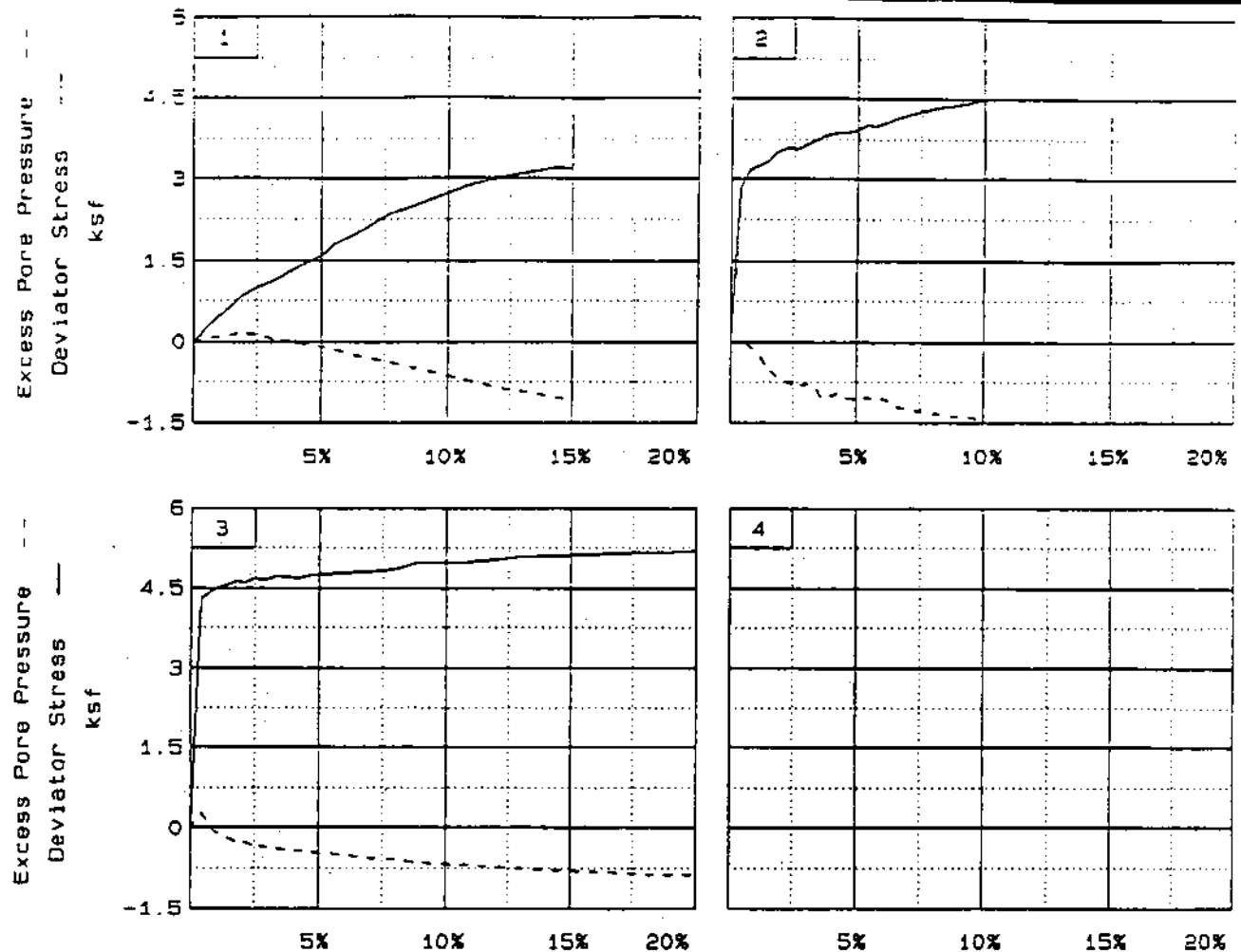
DEPTH: 4.0 - 6.0 FEET

PROJ. NO.: 3070576201 DATE: 11/05/93

TRIAXIAL SHEAR TEST REPORT

LAW ENGINEERING, INC.

FIG. NO. 1



Client: RUST E&I

Project: MUSKOGEE COMMUNITY LANDFILL - TRACT A

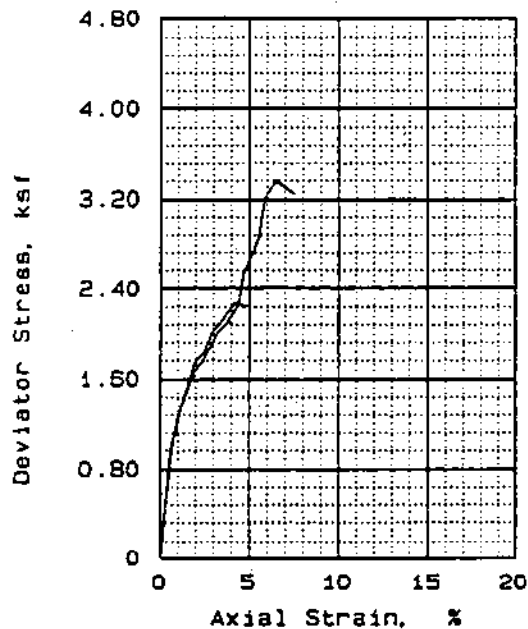
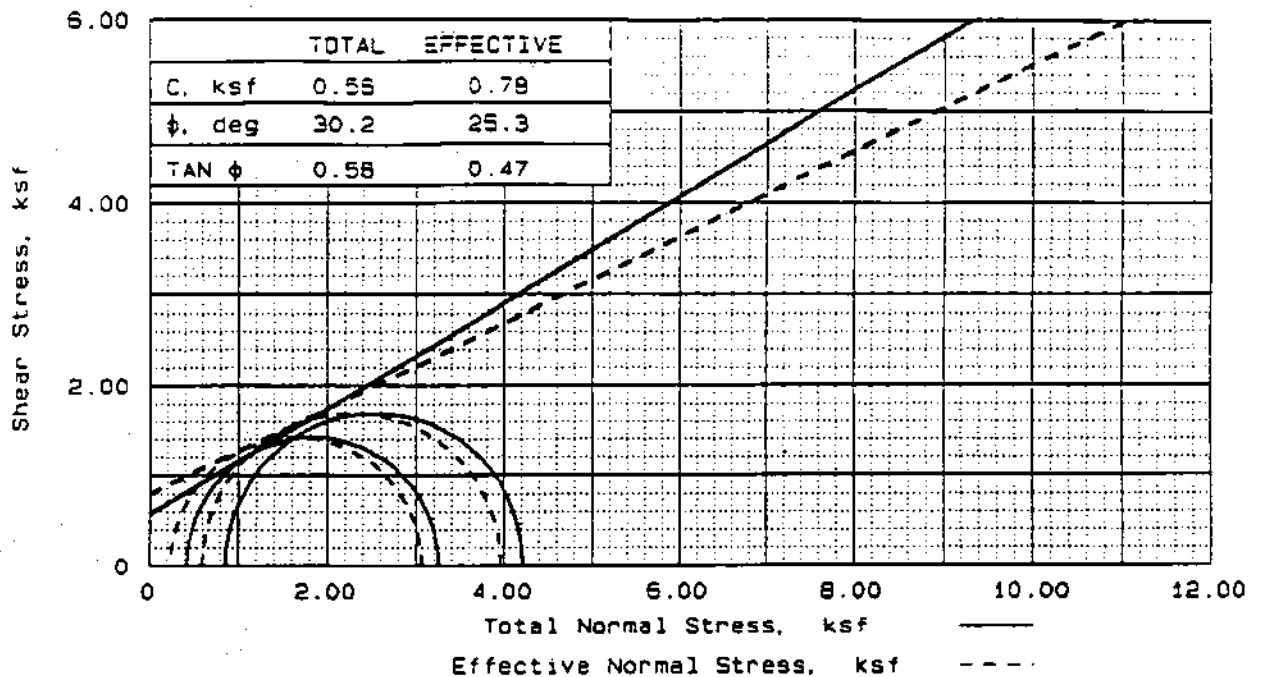
Location: BH10 DEPTH: 4.0 - 6.0 FEET

File: 5762CU4

Project No.: 3070576201

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Fig. No. _____



SAMPLE NO.		1	2
INITIAL	WATER CONTENT, %	16.4	16.4
	DRY DENSITY, pcf	113.4	113.4
	SATURATION, %	89.9	89.9
	VOID RATIO	0.497	0.497
	DIAMETER, in	1.39	1.39
AT TEST	HEIGHT, in	2.81	2.81
	WATER CONTENT, %	17.6	17.6
	DRY DENSITY, pcf	113.4	113.4
	SATURATION, %	96.5	96.5
	VOID RATIO	0.497	0.497
	DIAMETER, in	1.39	1.39
	HEIGHT, in	2.81	2.81
Strain rate, in/min		0.001	0.001
BACK PRESSURE, ksf		9.84	9.84
CELL PRESSURE, ksf		10.27	10.70
FAILURE STRESS, ksf		2.83	3.36
PORE PRESSURE, ksf		10.02	10.09
ULTIMATE STRESS, ksf		2.27	3.36
PORE PRESSURE, ksf		10.02	10.09
$\bar{\sigma}_1$ FAILURE, ksf		3.07	3.97
$\bar{\sigma}_3$ FAILURE, ksf		0.24	0.6

TYPE OF TEST:

CU with pore pressures

SAMPLE TYPE: UNDISTURBED

DESCRIPTION: YELLOWISH BROWN &
LT. GRAY FAT CLAY

LL= PL= PI=

SPECIFIC GRAVITY= 2.72

REMARKS: IN GENERAL ACCORDANCE

W/ASTM D4767

ASSUMED SPECIFIC GRAVITY

CLIENT: RUST E&I

PROJECT: MUSKOGEE COMMUNITY LANDFILL - TRACT A

SAMPLE LOCATION: BH12

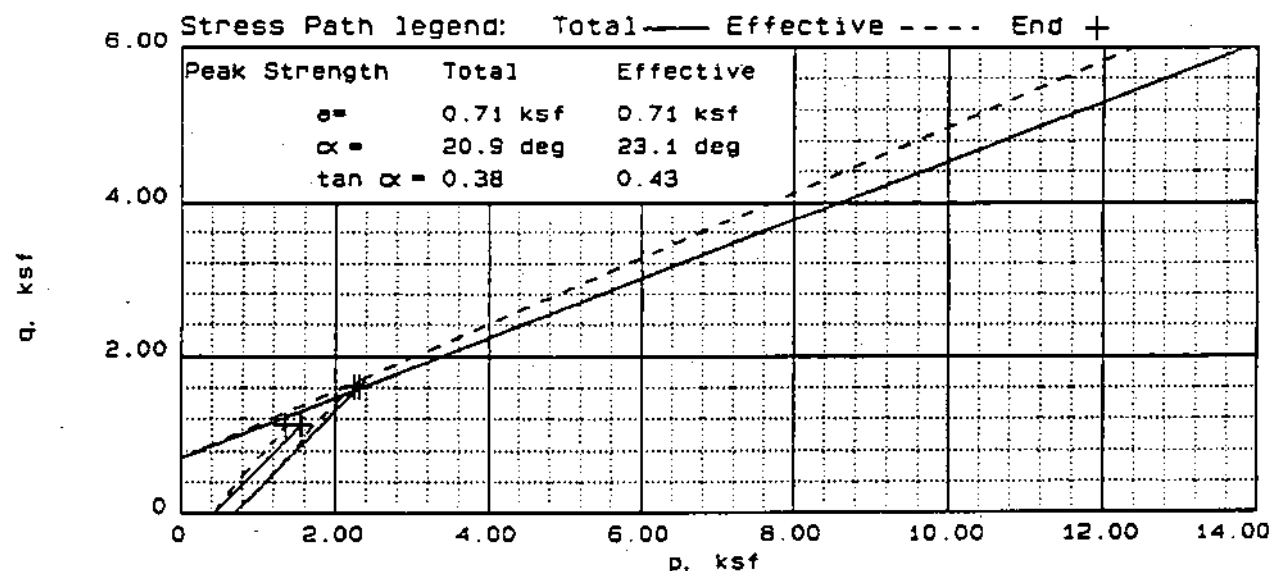
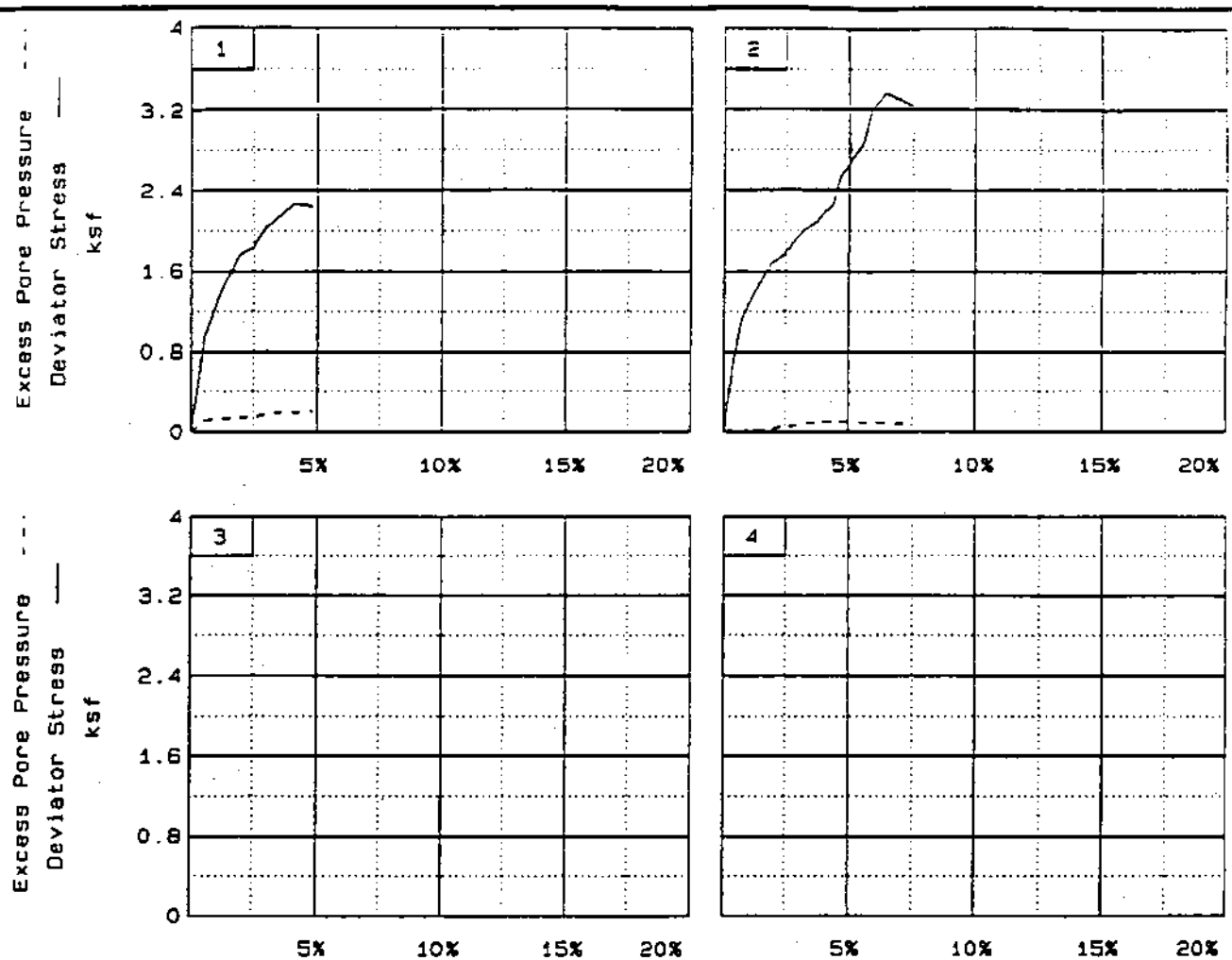
DEPTH: 4.0 - 6.0 FEET

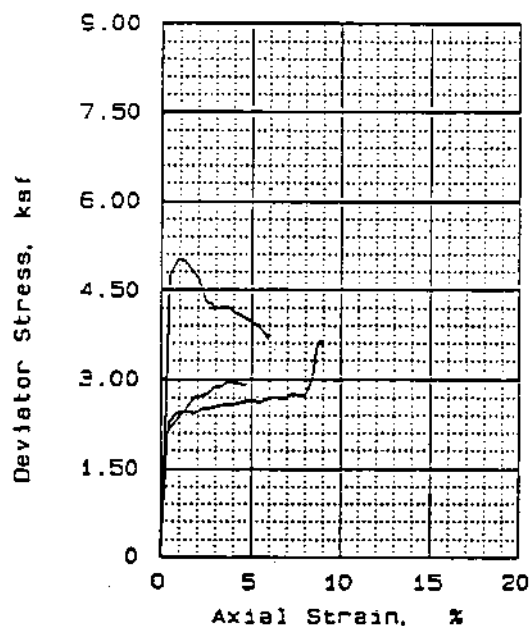
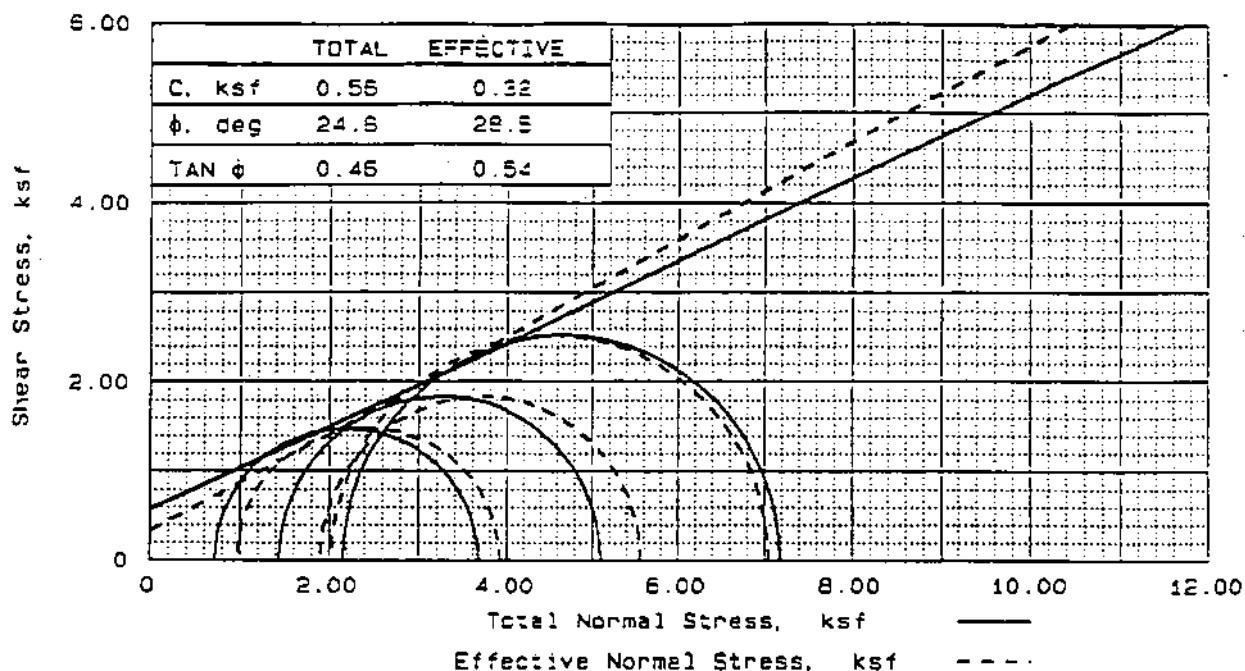
PROJ. NO.: 3070576201 DATE: 11/17/93

TRIAXIAL SHEAR TEST REPORT

LAW ENGINEERING, INC.

FIG. NO.





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	16.2	16.2	16.2
	DRY DENSITY, pcf	112.0	112.0	112.0
	SATURATION, %	83.9	83.9	83.9
	VOID RATIO	0.532	0.532	0.532
	DIAMETER, in	1.39	1.39	1.39
AT TEST	HEIGHT, in	2.80	2.80	2.80
	WATER CONTENT, %	21.3	21.3	21.3
	DRY DENSITY, pcf	113.3	113.3	113.3
	SATURATION, %	113.3	113.3	113.3
	VOID RATIO	0.516	0.516	0.516
	DIAMETER, in	1.38	1.38	1.38
	HEIGHT, in	2.79	2.79	2.79
Strain rate, in/min		0.001	0.001	0.001
BACK PRESSURE, ksf		9.79	9.79	9.79
CELL PRESSURE, ksf		10.51	11.23	11.95
FAILURE STRESS, ksf		2.95	3.67	5.03
PORE PRESSURE, ksf		9.55	9.33	9.92
ULTIMATE STRESS, ksf		2.95	3.67	5.03
PORE PRESSURE, ksf		9.55	9.35	9.92
σ_1 FAILURE, ksf		3.92	5.57	7.06
σ_3 FAILURE, ksf		0.96	1.9	2.03

TYPE OF TEST:

CU with pore pressures

SAMPLE TYPE: UNDISTURBED

DESCRIPTION:

LL= PL= PI=

SPECIFIC GRAVITY= 2.75

REMARKS: IN GENERAL ACCORDANCE

W/ASTM D4767

ASSUMED SPECIFIC GRAVITY

FIG. NO.

CLIENT: RUST E&I

PROJECT: MUSKOGEE COMM. LANDFILL

SAMPLE LOCATION: BORING BH-18

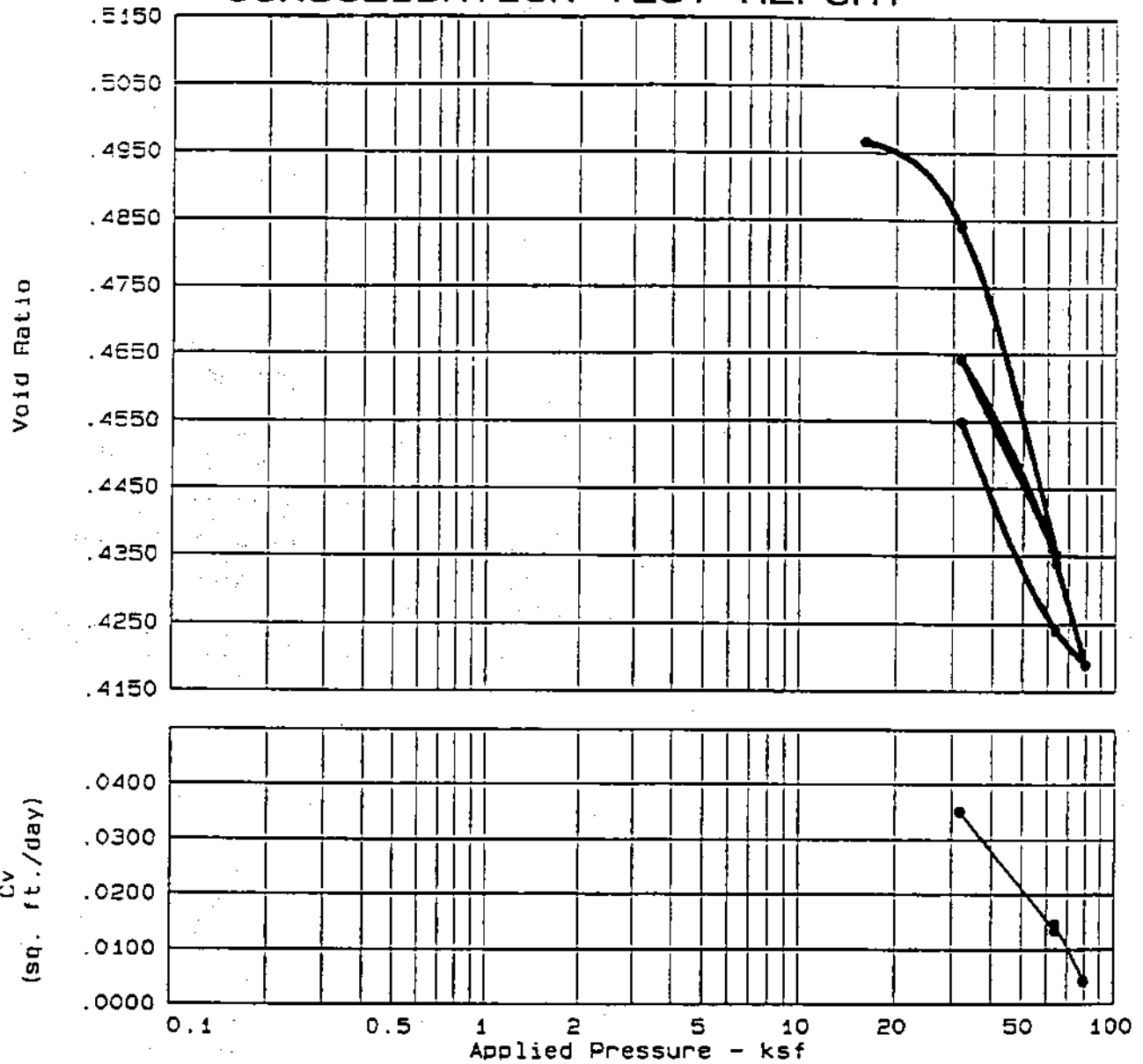
DEPTH: 13.0 - 14.0 FEET

PROJ. NO.: 3960140201 DATE: 01/13/94

TRIAXIAL SHEAR TEST REPORT

LAW ENGINEERING, INC.

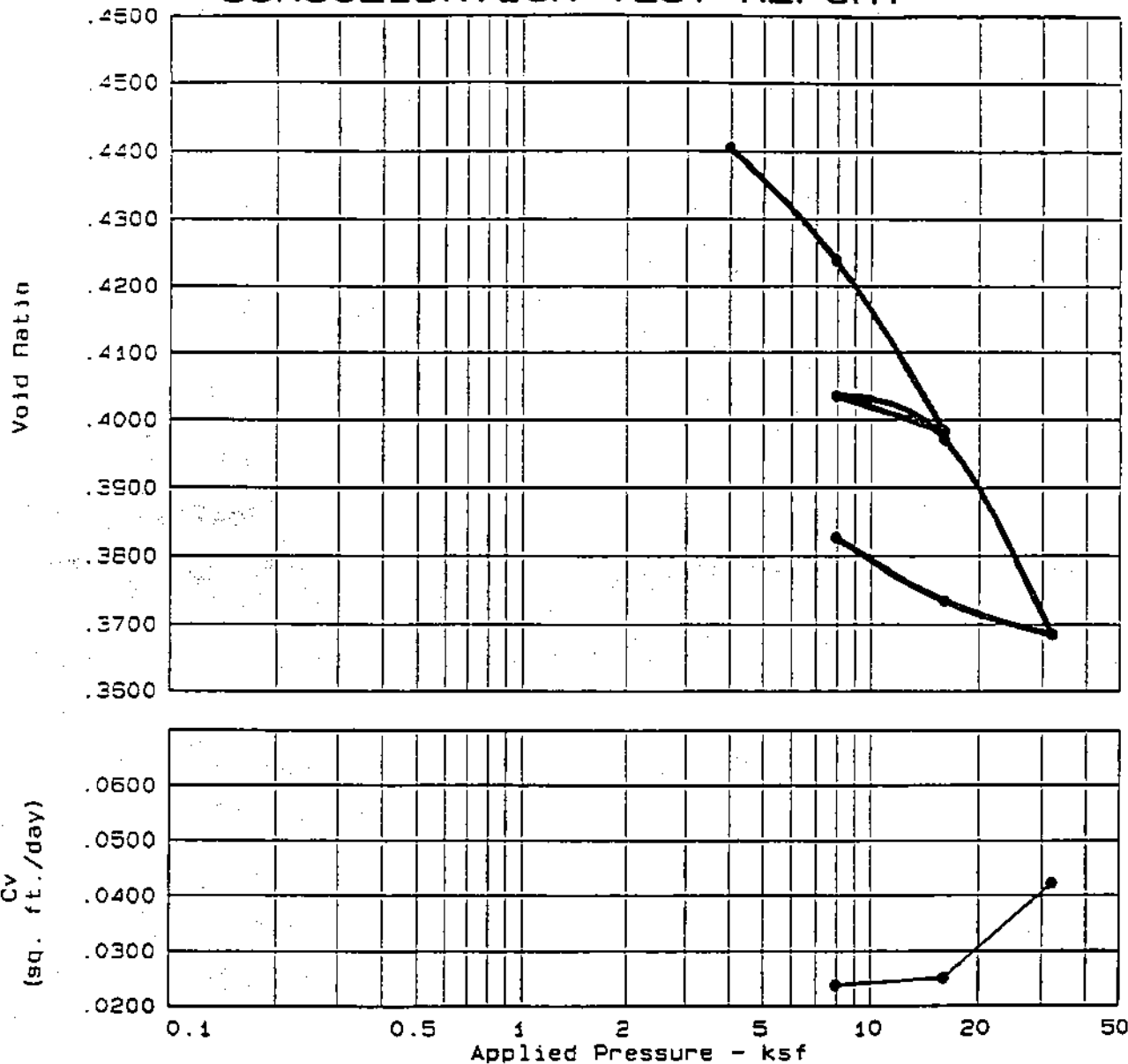
CONSOLIDATION TEST REPORT



Swell press.	Nat. Sat.	Nat. Moist.	Dry Density	LL	PI	Sp. Gr.	Precons. press.	C _c	e ₀
	87.4 %	15.7	116.3			2.75	32.04	0.17	0.4945

TEST RESULTS	MATERIAL DESCRIPTION
Compression Index = 0.17	
Project No.: 307-05762-01 (39601402-01) Project: LAW - TULSA (MUSKOGEE COMM. LANDFILL) Location: BORING NO. B-5 DEPTH: 13.0 - 15.0 FEET Date: 01/14/94	Remarks: IN GENERAL ACCORDANCE W/ASTM D2435 ASSUMED SPEC. GRAVITY Cr = 0.097 Fig. No. _____
CONSOLIDATION TEST REPORT LAW ENGINEERING, INC.	

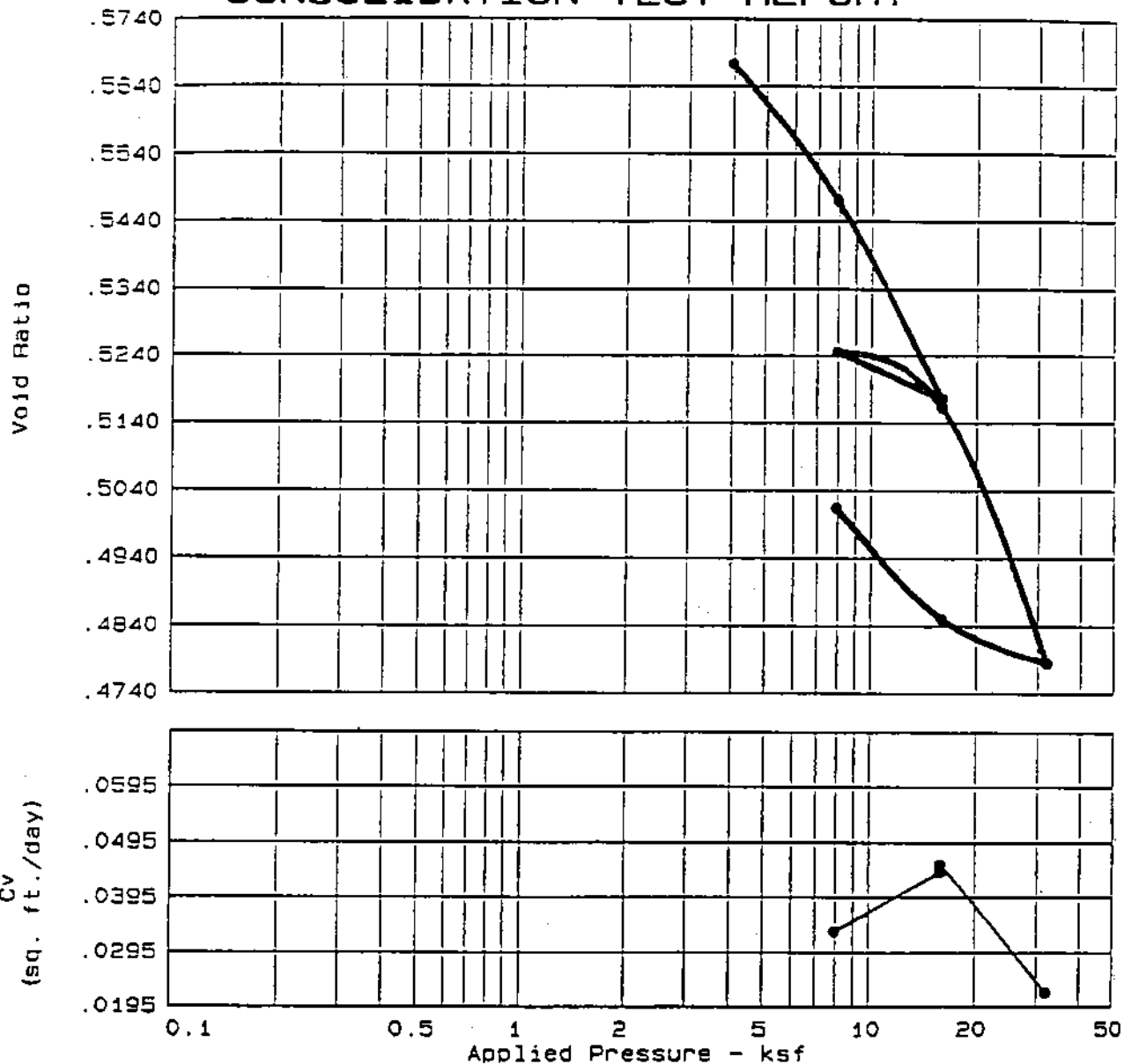
CONSOLIDATION TEST REPORT



Swell press.	Nat. Sat.	Nat. Moist.	Dry Density	LL	PI	Sp. Gr.	Precons. press.	C _c	e ₀
	67.3 %	11.4	117.2			2.75	10.94	0.10	0.4647

TEST RESULTS	MATERIAL DESCRIPTION
Compression Index = 0.10	
Project No.: 307-05762-01 (396-01402-01) Project: LAW TULSA (MUSKOGEE COMM. LANDFILL) Location: BORING NO. B-7 DEPTH: 8.0 - 9.0 FEET Date: 01/14/94	Remarks: IN GENERAL ACCORDANCE W/ASTM D2435 ASSUMED SPEC. GRAVITY Cr = 0.018 Fig. No. _____
CONSOLIDATION TEST REPORT LAW ENGINEERING, INC.	

CONSOLIDATION TEST REPORT



Swell press.	Nat. Sat.	Nat. Moist.	Dry Density	LL	PI	Sp.Gr.	Precons. press.	C _c	e ₀
	84.3 %	17.7	111.7			2.75	11.06	0.12	0.5781

TEST RESULTS

Compression Index = 0.12

Project No.: 307-05762-01 (36901402-01)
 Project: LAW - TULSA (MUSKOGEE COMM. LANDFILL)
 Location: BORING NO. B-16
 DEPTH: 13.0 - 15.0 FEET
 Date: 01/14/94

CONSOLIDATION TEST REPORT

LAW ENGINEERING, INC.

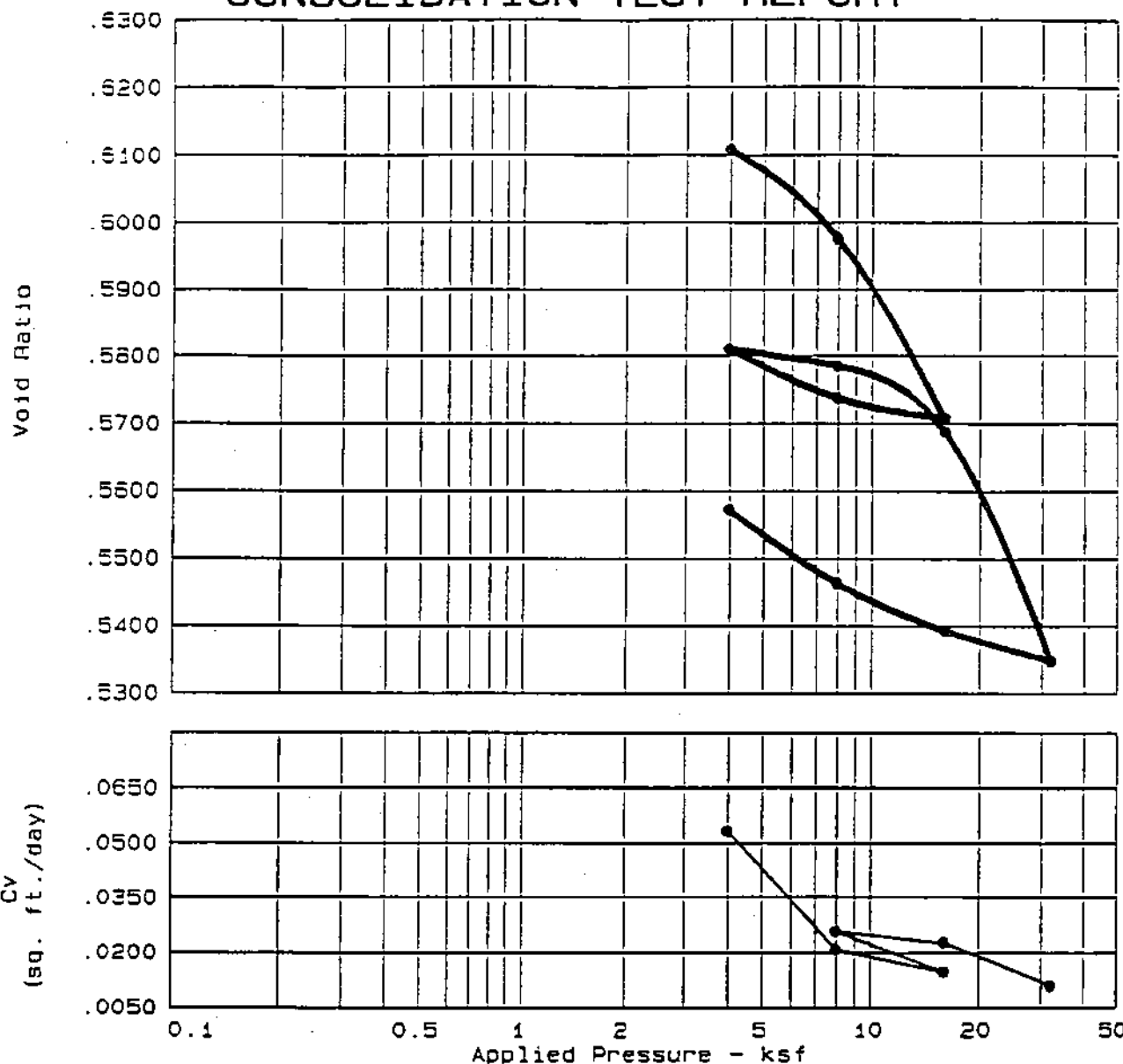
MATERIAL DESCRIPTION

Remarks:
 IN GENERAL ACCORDANCE
 W/ASTM D2435
 ASSUMED SPEC. GRAVITY

Cr = 0.023

Fig. No. _____

CONSOLIDATION TEST REPORT



Swell press.	Nat. Sat.	Nat. Moist.	Dry Density	LL	PI	Sp. Gr.	Precons. press.	C _c	e ₀
	87.9 %	19.7	106.3			2.75	11.03	0.11	0.6162

TEST RESULTS	MATERIAL DESCRIPTION
Compression Index = 0.11	
Project No.: 307-05762-01 (396-01402-01) Project: LAW - TULSA (MUSKOGEE COMM. LANDFILL) Location: BORING NO. B-B DEPTH: 8.0 - 10.0 FEET Date: 01/14/94	Remarks: IN GENERAL ACCORDANCE W/ASTM D2435 ASSUMED SPEC. GRAVITY Cr = 0.017 Fig. No. _____
CONSOLIDATION TEST REPORT LAW ENGINEERING, INC.	

LAW ENGINEERING
HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

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PROJECT NAME:	LAW - TULSA (RUST E & I)
PROJECT NUMBER:	307-05762-01 (396-01384-01) LAB NO.: 05
SAMPLE LOCATION:	TRACT "A", B-3, 0-2 FT.
DESCRIPTION OF SOIL:	LIGHT REDDISH-BROWN AND TAN, SILTY CLAY
TYPE OF SPECIMEN:	UNDISTURBED ☐ REMOLDED ☒ ASTM D698
PERMEANT:	DE-AIRED TAP WATER

SAMPLE DATA		
	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	7.20	7.23
AREA OF SAMPLE(cm ²),A	41.63	41.10
LENGTH OF SAMPLE(cm),L	9.05	9.01
MOISTURE CONTENT(%)	21.0	25.2
DRY DENSITY(pcf)	98.9	99.1
SATURATION(%)		97.2

HYDRAULIC CONDUCTIVITY OF SOIL (average of last four k ₂₀ readings)	
k ₂₀ =	<u>2.4 E-09 cm/sec</u>
(or)	
k ₂₀ =	<u>2.4 E-11 m/sec</u>

$$k = (aL/2At) \ln(h_1/h_2)$$

$$\text{pipette length} = 25.380 \text{ cm}$$

$$k_{20} = kRt$$

$$\text{pipette volume} = 25.0 \text{ cm}^3$$

$$Rt = (-0.02452T \text{ CELSIUS} + 1.495)$$

$$a = a_{in} = a_{out} = 0.985 \text{ cm}^2$$

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PROJECT NAME: LAW - TULSA (RUST E & I)
PROJECT NUMBER: 307-05762-01 (396-01384-01) LAB NO.: 05

BACK PRESSURE SATURATION CONDITIONS

EFFECTIVE STRESS (psi): 2.0 1) B COEFFICIENT $b = 0.95$
SATURATION METHOD: 1 2) FINAL SATURATION CALCULATED $100 - b = 5\%$
3) VOLUME CHANGE DURING TEST

CONSOLIDATION CONDITIONS

CONFINING PRESSURE(psi): 56.0
CONSOLIDATION PRESSURE(psi): 48.0
EFFECTIVE STRESS(psi): 8.0

PERMEATION CONDITIONS

CONFINING PRESSURE(psi): 62.0
INFLUENT PRESSURE(psi): 52.0 $\text{psi} \times 70.34 = \text{cm}$
EFFLUENT PRESSURE(psi): 50.0
HYDRAULIC GRADIENT, i: 17

FALLING HEAD HYDRAULIC CONDUCTIVITY READINGS						
ELAPSED TIME		V ₁ (cm ³ /20)	V ₂ (cm ³ /20)	head loss (cm)	R	Q (cm/sec)
min	sec					
1075	64500	4.30	21.30			
1430	85800	4.35	21.25	0.102	0.88	2.9 E-09 cm/sec
2540	152400	4.45	21.15	0.203	0.90	1.8 E-09 cm/sec
3870	232200	4.60	21.00	0.305	0.91	2.4 E-09 cm/sec
5380	322800	4.80	20.85	0.355	0.92	2.5 E-09 cm/sec

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DATE: 1/31/94

PROJECT NAME:	LAW - TULSA (RUST E & I)	
PROJECT NUMBER:	307-05762-01	LAB NO.: 14
SAMPLE LOCATION:	B-3, 8 - 10 FT. TRACT "A"	
DESCRIPTION OF SOIL:	YELLOWISH BROWN & DK GRAY FAT CLAY W/ FER. NOI	
TYPE OF SPECIMEN:	UNDISTURBED ☒ VERTICAL AXIS ☒	
PERMEANT:	DE-AIRED TAP WATER	

SAMPLE DATA		
	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	6.96	6.99
AREA OF SAMPLE(cm ²), A	38.05	39.37
LENGTH OF SAMPLE(cm), L	4.04	4.06
MOISTURE CONTENT(%)	18.0	18.6
DRY DENSITY(pcf)	113.8	112.6
SATURATION(%)		97.6

HYDRAULIC CONDUCTIVITY OF SOIL (average of last four k20 readings)	
k20 =	<u>2.1 E-08 cm/sec</u>
	(or)
k20 =	<u>2.1 E-10 m/sec</u>

$$k = (aL/2At) \cdot \ln(h_1/h_2)$$

$$\text{pipette length} = 28.542 \text{ cm}$$

$$k_{20} = k_{Rt}$$

$$\text{pipette volume} = 25.0 \text{ cm}^3$$

$$R_t = (-0.02452T \text{ CELSIUS} + 1.495)$$

$$a = a_{in} = a_{out} = 0.876 \text{ cm}^2$$

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DATE: 1/31/94

PROJECT NAME: LAW - TULSA
PROJECT NUMBER: 307-05762-01 LAB NO.: 14

BACK PRESSURE SATURATION CONDITIONS:

EFFECTIVE STRESS (psi): 2.0 1) α COEFFICIENT $\geq \alpha_T = 0.95$
SATURATION METHOD: 1 2) FINAL SATURATION CALCULATED $100 + \alpha_T - 5\%$
3) VOLUME CHANGE DURING TEST

CONSOLIDATION CONDITIONS:

CONFINING PRESSURE(psi): 86.0
CONSOLIDATION PRESSURE(psi): 78.0
EFFECTIVE STRESS(psi): 8.0

PERMEATION CONDITIONS:

CONFINING PRESSURE(psi): 86.0
INFLUENT PRESSURE(psi): 79.5 $\text{psi} \times 70.34 = \text{cm}$
EFFLUENT PRESSURE(psi): 78.0
HYDRAULIC GRADIENT, i : 25

LAST FIVE HYDRAULIC CONDUCTIVITY READINGS						
ELAPSED TIME, t		V_{in}	V_{out}	head loss	Pt	k_{20} cm/sec
min	sec	(cm ³ /h ₂ O)	(cm ³ /h ₂ O)	(cm)		
0	0	12.00	12.00			
480	28800	12.60	11.40	1.370	0.94	1.9 E-08 cm/sec
1560	93600	14.00	10.00	3.197	0.94	2.1 E-08 cm/sec
1920	115200	14.30	9.50	1.142	0.94	2.3 E-08 cm/sec
2820	169200	15.50	8.50	2.283	0.94	1.8 E-08 cm/sec

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DATE: 1/31/94

PROJECT NAME:	LAW - TULSA (RUST E & I)	
PROJECT NUMBER:	307-05762-01	LAB NO.: 15
SAMPLE LOCATION:	B-4, 8 - 10 FT. TRACT "A"	
DESCRIPTION OF SOIL:	YELLOWISH BROWN & LIGHT GRAY STIFF FAT CLAY	
TYPE OF SPECIMEN:	UNDISTURBED ☒ VERTICAL AXIS ☒	
PERMEANT:	DE-AIRED TAP WATER	

SAMPLE DATA		
	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	6.91	6.93
AREA OF SAMPLE(cm ²), A	37.50	37.72
LENGTH OF SAMPLE(cm), L	3.96	3.99
MOISTURE CONTENT(%)	18.2	22.1
DRY DENSITY(pcf)	110.9	107.0
SATURATION(%)		100.7

HYDRAULIC CONDUCTIVITY OF SOIL (average of last four k20 readings)	
k20 =	<u>1.2 E-08 cm/sec</u>
(or)	
k20 =	<u>1.2 E-10 m/sec</u>

$$k = (aL/2At) \cdot \ln(b1/h2)$$

$$\text{pipette length} = 25.400 \text{ cm}$$

$$k20 = kRt$$

$$\text{pipette volume} = 25.0 \text{ cm}^3$$

$$Rt = (-0.02452T \text{ CELSIUS} + 1.495)$$

$$a = a_{in} = a_{out} = 0.984 \text{ cm}^2$$

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DATE: 1/31/94

PROJECT NAME: LAW - TULSA
PROJECT NUMBER: 307-05762-01

LAB NO.: 15

BACK PRESSURE SATURATION CONDITIONS:

EFFECTIVE STRESS (psi): 2.0

1) B COEFFICIENT $> \text{or} = 0.93$

SATURATION METHOD: 1

2) FINAL SATURATION CALCULATED $100 \pm \text{or} = 2\%$

3) VOLUME CHANGE DURING TEST

CONSOLIDATION CONDITIONS:

CONFINING PRESSURE(psi): 86.0

CONSOLIDATION PRESSURE(psi): 78.0

EFFECTIVE STRESS(psi): 8.0

PERMEATION CONDITIONS:

CONFINING PRESSURE(psi): 86.0

INFLUENT PRESSURE(psi): 79.5

psi x 70.34 = cm

EFFLUENT PRESSURE(psi): 78.0

HYDRAULIC GRADIENT, i: 26

LAST FIVE HYDRAULIC CONDUCTIVITY READINGS						
ELAPSED TIME t		V _{in}	V _{out}	head loss	R _t	k ₂₀ , cm/sec
min	sec	(cm h ₂ O)	(cm h ₂ O)	(cm)		
0	0	12.00	12.00			
480	28800	12.20	11.80	0.406	0.94	9.2 E-09 cm/sec
1560	93600	12.90	11.10	1.422	0.94	1.4 E-08 cm/sec
1920	115200	13.10	10.90	0.406	0.94	1.3 E-08 cm/sec
2820	169200	13.50	10.50	0.813	0.94	1.0 E-08 cm/sec

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PROJECT NAME:	LAW - TULSA (RUST E & I)	
PROJECT NUMBER:	307-05762-01	LAB NO.: 16
SAMPLE LOCATION:	B-15, 8 - 10 FT. TRACT "A"	
DESCRIPTION OF SOIL:	YELLOWISH BROWN STIFF FAT CLAY	
TYPE OF SPECIMEN:	UNDISTURBED ☒ VERTICAL AXIS ☒	
PERMEANT:	DE-AIRED TAP WATER	

SAMPLE DATA		
	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	6.86	3.88
AREA OF SAMPLE(cm ²),A	36.96	37.18
LENGTH OF SAMPLE(cm),L	4.09	4.11
MOISTURE CONTENT(%)	16.3	23.2
DRY DENSITY(pcf)	113.4	106.7
SATURATION(%)		104.9

HYDRAULIC CONDUCTIVITY OF SOIL (average of last four k20 readings)	
k20 =	<u>4.9 E-09 cm/sec</u>
(or)	
k20 =	<u>4.9 E-11 m/sec</u>

$$k = (aL/2At) \cdot \ln(h_1/h_2)$$

$$\text{pipette length} = 25.400 \text{ cm}$$

$$k_{20} = kR_t$$

$$\text{pipette volume} = 25.0 \text{ cm}^3$$

$$R_t = (-0.02452T \text{ CELSIUS} + 1.495)$$

$$a = a_{in} = a_{out} = 0.984 \text{ cm}^2$$

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DATE: 1/31/94

PROJECT NAME: LAW - TULSA
PROJECT NUMBER: 307-05762-01

LAB NO.: 16

BACK PRESSURE SATURATION CONDITIONS:

EFFECTIVE STRESS (psi): 2.0

1) B COEFFICIENT ≥ 0.95

SATURATION METHOD: 1

2) FINAL SATURATION CALCULATED $100 - 0.1 - 5\%$

3) VOLUME CHANGE DURING TEST

CONSOLIDATION CONDITIONS:

CONFINING PRESSURE(psi): 86.0

CONSOLIDATION PRESSURE(psi): 78.0

EFFECTIVE STRESS(psi): 8.0

PERMEATION CONDITIONS:

CONFINING PRESSURE(psi): 86.0

INFLUENT PRESSURE(psi): 79.5

psi x 70.34 = cm

EFFLUENT PRESSURE(psi): 78.0

HYDRAULIC GRADIENT, i: 25

LAST FIVE HYDRAULIC CONDUCTIVITY READINGS						
ELAPSED TIME, t		V _{in}	V _{out}	head loss	Rt	k ₂₀ , cm/sec
min.	sec.	(cm ³ /20)	(cm ³ /20)	(cm)		
0	0	12.00	12.00			
480	28800	12.20	11.80	0.406	0.94	6.8 E-09 cm/sec
1560	93600	12.50	11.50	0.610	0.94	4.6 E-09 cm/sec
1920	115200	12.60	11.40	0.203	0.94	4.6 E-09 cm/sec
2820	169200	12.80	11.20	0.406	0.94	3.7 E-09 cm/sec

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PROJECT NAME:	LAW - TULSA (RUST E & I)
PROJECT NUMBER:	307-05762-01 (396-01384-01) LAB NO.: 04
SAMPLE LOCATION:	TRACT "A", B-16 0-2 FT.
DESCRIPTION OF SOIL:	TAN AND BROWN SILTY CLAY
TYPE OF SPECIMEN:	UNDISTURBED ☐ REMOLDED ☒ ASTM D698
PERMEANT:	DE-AIRED TAP WATER

SAMPLE DATA		
	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	7.23	7.23
AREA OF SAMPLE(cm ²), A	41.04	41.01
LENGTH OF SAMPLE(cm), L	9.19	9.08
MOISTURE CONTENT (%)	21.5	24.9
DRY DENSITY(pcf)	101.0	100.1
SATURATION (%)		97.4

HYDRAULIC CONDUCTIVITY OF SOIL (average of last four k20 readings)	
k20 =	<u>2.7 E-09 cm/sec</u>
(or)	
k20 =	<u>2.7 E-11 m/sec</u>

$$k = (aL/2At) \ln(h_1/h_2)$$

$$\text{pipette length} = 28.600 \text{ cm}$$

$$k20 = kRt$$

$$\text{pipette volume} = 25.0 \text{ cm}^3$$

$$Rt = (-0.02452T \text{ CELSIUS} + 1.495)$$

$$a = a_{in} = a_{out} = 0.874 \text{ cm}^2$$

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PROJECT NAME: LAW - TULSA (RUST E & I)
PROJECT NUMBER: 307-05762-01 (396-01384-01) LAB NO.: 04

BACK PRESSURE SATURATION CONDITIONS

EFFECTIVE STRESS (psi): 2.0 1) α COEFFICIENT $\geq \alpha = 0.93$
SATURATION METHOD: 1 2) FINAL SATURATION CALCULATED $100 - \alpha = 3\%$
3) VOLUME CHANGE DURING TEST

CONSOLIDATION CONDITIONS

CONFINING PRESSURE(psi): 56.0
CONSOLIDATION PRESSURE(psi): 45.0
EFFECTIVE STRESS(psi): 11.0

PERMEATION CONDITIONS

CONFINING PRESSURE(psi): 62.0
INFLUENT PRESSURE(psi): 52.0 $\text{psi} \times 70.34 = \text{cm}$
EFFLUENT PRESSURE(psi): 50.0
HYDRAULIC GRADIENT, i: 17

LAST FIVE HYDRAULIC CONDUCTIVITY READINGS						
ELAPSED TIME	VT	VOUT	head loss	R	K20 cm/sec	
min	sec	cm ³ /120	cm			
1500	90000	5.95	22.05			
2575	154500	6.10	21.90	0.343	0.88	2.8 E-09 cm/sec
4040	242400	6.25	21.75	0.343	0.88	2.0 E-09 cm/sec
4400	264000	6.30	21.70	0.114	0.88	2.8 E-09 cm/sec
5455	327300	6.45	21.55	0.343	0.92	3.0 E-09 cm/sec

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DATE: 1/31/94

PROJECT NAME:	LAW - TULSA (RUST E & I)	
PROJECT NUMBER:	307-05762-01	LAB NO.: 13
SAMPLE LOCATION:	B-16, 4 - 6 FT. TRACT "A"	
DESCRIPTION OF SOIL:	YELLOWISH BROWN AND LIGHT GRAY STIFF FAT CLAY	
TYPE OF SPECIMEN:	UNDISTURBED ☒ VERTICAL AXIS ☒	
PERMEANT:	DE-AIRED TAP WATER	

SAMPLE DATA		
	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	6.86	6.88
AREA OF SAMPLE(cm ²),A	36.96	37.18
LENGTH OF SAMPLE(cm),L	4.06	4.09
MOISTURE CONTENT(%)	20.6	22.9
DRY DENSITY(pcf)	106.9	105.1
SATURATION(%)		99.5

HYDRAULIC CONDUCTIVITY OF SOIL (average of last four k ₂₀ readings)	
k ₂₀ =	2.6 E-09 cm/sec
(or)	
k ₂₀ =	2.6 E-11 m/sec

$$k = (aL/2At) \ln(h_1/h_2)$$

$$\text{pipette length} = 28.542 \text{ cm}$$

$$k_{20} = kRt$$

$$\text{pipette volume} = 25.0 \text{ cm}^3$$

$$Rt = (-0.02452T \text{ CELSIUS} + 1.495)$$

$$a = a_{in} = a_{out} = 0.876 \text{ cm}^2$$

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PROJECT NAME: LAW - TULSA
PROJECT NUMBER: 307-05762-01

LAB NO.: 13

BACK PRESSURE SATURATION CONDITIONS:

EFFECTIVE STRESS (psi): 2.0

1) B COEFFICIENT $\geq$ or = 0.95

SATURATION METHOD: 1

2) FINAL SATURATION CALCULATED 100 $\pm$ or $\pm$ 5%

3) VOLUME CHANGE DURING TEST

CONSOLIDATION CONDITIONS:

CONFINING PRESSURE(psi): 86.0

CONSOLIDATION PRESSURE(psi): 78.0

EFFECTIVE STRESS(psi): 8.0

PERMEATION CONDITIONS:

CONFINING PRESSURE(psi): 86.0

INFLUENT PRESSURE(psi): 79.5

psi x 70.34 = cm

EFFLUENT PRESSURE(psi): 78.0

HYDRAULIC GRADIENT, i: 26

LAST FIVE HYDRAULIC CONDUCTIVITY READINGS						
ELAPSED TIME (t)		V_{in}	V_{out}	head loss	RI	k_{20} , cm/sec
min.	sec.	(cm ³ /h ₂ O)	(cm ³ /h ₂ O)	(cm)		
0	0	12.00	12.00			
480	28800	12.10	11.90	0.228	0.94	3.4 E-09 cm/sec
1560	93600	12.30	11.70	0.457	0.94	3.0 E-09 cm/sec
1920	115200	12.35	11.65	0.114	0.94	2.3 E-09 cm/sec
2820	169200	12.45	11.55	0.228	0.94	1.8 E-09 cm/sec

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PROJECT NAME:	LAW - TULSA (RUST E & I)
PROJECT NUMBER:	307-05762-01 (396-01402-01) LAB NO.: 16
SAMPLE LOCATION:	TRACT "A", B-18 0-2 FT.
DESCRIPTION OF SOIL:	YELLOWISH TAN SILTY CLAY
TYPE OF SPECIMEN:	UNDISTURBED [] REMOLDED [X] ASTM D698
PERMEANT:	DE-AIRED TAP WATER

	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	7.52	7.32
AREA OF SAMPLE(cm ²),A	41.31	42.06
LENGTH OF SAMPLE(cm),L	8.99	9.05
MOISTURE CONTENT(%)	21.1	24.1
DRY DENSITY(pcf)	102.7	101.5
SATURATION(%)		98.8

$k_{20} = \underline{5.0 \text{ E}-09 \text{ cm/sec}}$ (or) $k_{20} = \underline{5.0 \text{ E}-11 \text{ m/sec}}$

$k = (aL/2At) \cdot \ln(h_1/h_2)$ pipette length = 25.40 cm
 $k_{20} = k_{Rt}$ pipette volume = 25.0 cm³
 $Rt = (-0.02452T \text{ CELSIUS} + 1.495)a = a_{in} = a_{out} = 0.095 \text{ cm}^2$

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PROJECT NAME: LAW - TULSA (RUST E & I)
PROJECT NUMBER: 307-05762-01 (396-01402-01) LAB NO.: 16

TEST CONDITIONS

EFFECTIVE STRESS (psf): 2.0 1) α COEFFICIENT $> \alpha = 0.95$
SATURATION METHOD: 1 2) FINAL SATURATION CALCULATED $100 + \alpha - 5\%$
3) VOLUME CHANGE DURING TEST

CONSOLIDATION CONDITIONS

CONFINING PRESSURE (psf): 53.5
CONSOLIDATION PRESSURE (psf): 50.0
EFFECTIVE STRESS (psf): 3.5

PERMEABILITY CONDITIONS

CONFINING PRESSURE (psf): 54.5
INFLUENT PRESSURE (psf): 52
EFFLUENT PRESSURE (psf): 50
HYDRAULIC GRADIENT, i : 17
 $\text{psf} \times 70.34 = \text{cm}$

Time (min)	Head (in)	Head (cm)	Head (ft)	Head (m)	Head (cm)	Head (ft)
294	17640	2.40	14.65			
1374	82440	2.80	14.30	0.762	0.95	7.7 E-09 cm/sec
1886	113160	2.90	14.20	0.203	0.90	4.1 E-09 cm/sec
2756	165360	3.10	14.05	0.356	0.92	4.4 E-09 cm/sec
3031	181860	3.15	14.00	0.102	0.91	3.9 E-09 cm/sec

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PROJECT NAME:	LAW - TULSA (RUST E & I)
PROJECT NUMBER:	307-05762-01 (396-01384-01) LAB NO.: 06
SAMPLE LOCATION:	TRACT "A", P-11 0-2 FT.
DESCRIPTION OF SOIL:	TAN AND LIGHT BROWN, SILTY CLAY
TYPE OF SPECIMEN:	UNDISTURBED ☐ REMOLDED ☒ ASTM D698
PERMEANT:	DE-AIRED TAP WATER

SAMPLE DATA		
	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	7.21	7.21
AREA OF SAMPLE(cm ²), A	40.84	40.87
LENGTH OF SAMPLE(cm), L	9.15	9.09
MOISTURE CONTENT (%)	22.3	21.9
DRY DENSITY(pcf)	102.4	102.9
SATURATION (%)		95.5

HYDRAULIC CONDUCTIVITY OF SOIL (average of last four (20) readings)	
k ₂₀ = 1.9 E-09 cm/sec	
(or)	
k ₂₀ = 1.9 E-11 m/sec	

$$k = (aL/2At) \ln(h_1/h_2)$$

$$\text{pipette length} = 25.484 \text{ cm}$$

$$k_{20} = kRt$$

$$\text{pipette volume} = 25.0 \text{ cm}^3$$

$$Rt = (-0.02452T \text{ CELSIUS} + 1.495)$$

$$a = a_{in} = a_{out} = 0.981 \text{ cm}^2$$

THIS REPORT RELATES ONLY TO THE ITEMS TESTED AND SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT APPROVAL OF LAW ENGINEERING.

LAW ENGINEERING
HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

PAGE NO. 2 of 2
DATE: 12/29/93

PROJECT NAME: LAW - TULSA (RUST E & I)
PROJECT NUMBER: 307-05762-01 (396-01384-01) LAB NO.: 06

BACK PRESSURE SATURATION CONDITIONS

EFFECTIVE STRESS (psi): 2.0 1) α COEFFICIENT $\geq \alpha = 0.95$
SATURATION METHOD: 1 2) FINAL SATURATION CALCULATED $100 - \alpha = 5\%$
3) VOLUME CHANGE DURING TEST

CONSOLIDATION CONDITIONS

CONFINING PRESSURE (psi): 36.0
CONSOLIDATION PRESSURE (psi): 30.0
EFFECTIVE STRESS (psi): 6.0

PERMEATION CONDITIONS

CONFINING PRESSURE (psi): 71.0
INFLUENT PRESSURE (psi): 63.0 psi x 70.34 = cm
EFFLUENT PRESSURE (psi): 60.0
HYDRAULIC GRADIENT, i: 25

LAST FIVE HYDRAULIC CONDUCTIVITY READINGS						
ELAPSED TIME min	TIME sec	IN cm/20	OUT cm/20	HEAD LOSS cm	PK	20 cm/sec
2741	164460	5.25	19.25			
4274	256440	5.40	19.10	0.306	0.93	1.5 E-09 cm/sec
4895	293700	5.50	19.00	0.204	0.93	2.5 E-09 cm/sec
5722	343320	5.60	18.90	0.204	0.93	1.9 E-09 cm/sec
7250	435000	5.75	18.75	0.306	0.94	1.5 E-09 cm/sec

LAW ENGINEERING
HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

PAGE NO. 1 of 2
DATE: 12/29/93

PROJECT NAME:	LAW - TULSA (RUST E & I)
PROJECT NUMBER:	307-05762-01 (396-01384-01) LAB NO.: 02
SAMPLE LOCATION:	TRACT "A", P-12 0-2 FT.
DESCRIPTION OF SOIL:	TAN AND LIGHT BROWN, SILTY CLAY
TYPE OF SPECIMEN:	UNDISTURBED ☐ REMOLDED ☒ ASTM D698
PERMEANT:	DE-AIRED TAP WATER

SAMPLE DATA		
	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	7.26	7.24
AREA OF SAMPLE(cm ²),A	41.44	41.19
LENGTH OF SAMPLE(cm),L	9.06	8.95
MOISTURE CONTENT(%)	20.8	23.5
DRY DENSITY(pcf)	102.1	103.0
SATURATION(%)		99.8

HYDRAULIC CONDUCTIVITY OF SOIL (average of last four k20 readings)	
k20 =	<u>2.3 E-09 cm/sec</u>
(or)	
k20 =	<u>2.3 E-11 m/sec</u>

$$k = (aL/2At) \cdot \ln(h_1/h_2)$$

$$k20 = kRt$$

$$Rt = (-0.02452T \text{ CELSIUS} + 1.495) \quad a = a_{in} = a_{out} = 0.118 \text{ cm}^2$$

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LAW ENGINEERING
HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

PAGE NO. 2 of 2
DATE: 12/29/93

PROJECT NAME: LAW - TULSA (RUST E & I)
PROJECT NUMBER: 307-05762-01 (396-01384-01) LAB NO.: 02

BACK PRESSURE SATURATION CONDITIONS:

EFFECTIVE STRESS (psi): 2.0 1) α COEFFICIENT $\alpha = 0.93$
SATURATION METHOD: 1 2) FINAL SATURATION CALCULATED $100 - \alpha = 1\%$
3) VOLUME CHANGE DURING TEST

CONSOLIDATION CONDITIONS:

CONFINING PRESSURE(psi): 68.0
CONSOLIDATION PRESSURE(psi): 60.0
EFFECTIVE STRESS(psi): 10.0

PERMEATION CONDITIONS:

CONFINING PRESSURE(psi): 71.0
INFLUENT PRESSURE(psi): 62.0 $\text{psi} \times 70.34 = \text{cm}$
EFFLUENT PRESSURE(psi): 60.0
HYDRAULIC GRADIENT, i : 16

LAST FIVE HYDRAULIC CONDUCTIVITY READINGS						
ELAPSED TIME		V_{in}	V_{out}	head loss	h_c	K 20 cm/sec
min	sec	(cm ³ /20)	(cm ³ /20)	(cm)		
1720	103200	0.36	1.31			
2680	160800	0.47	1.22	1.689	0.93	2.4 E-09 cm/sec
3190	191400	0.52	1.16	0.929	0.88	2.4 E-09 cm/sec
4048	242880	0.61	1.08	1.435	0.92	2.3 E-09 cm/sec
4330	259800	0.64	1.06	0.422	0.92	2.0 E-09 cm/sec

LAW ENGINEERING
HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

PAGE NO. 1 of 2
DATE: 12/29/93

PROJECT NAME:	LAW - TULSA (RUST E & I)
PROJECT NUMBER:	307-05762-01 (396-01384-01) LAB NO.: 03
SAMPLE LOCATION:	TRACT "A", P-15 2-7 FT.
DESCRIPTION OF SOIL:	TAN AND LIGHT BROWN, SILTY CLAY
TYPE OF SPECIMEN:	UNDISTURBED ☐ REMOLDED ☒ ASTM D698
PERMEANT:	DE-AIRED TAP WATER

SAMPLE DATA		
	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	7.20	7.26
AREA OF SAMPLE(cm ²),A	40.73	41.39
LENGTH OF SAMPLE(cm),L	9.26	9.16
MOISTURE CONTENT(%)	22.6	26.1
DRY DENSITY(pcf)	100.4	97.8
SATURATION(%)		96.6

HYDRAULIC CONDUCTIVITY OF SOIL (average of last four k ₂₀ readings)	
k ₂₀ =	<u>3.3 E-09 cm/sec</u>
(or)	
k ₂₀ =	<u>3.3 E-11 m/sec</u>

$$k = (aL/2At) \ln(h_1/h_2)$$

$$k_{20} = kR_t$$

$$R_t = (-0.02452T \text{ CELSIUS} + 1.495) \quad a = a_{in} = a_{out} = 0.118 \text{ cm}^2$$

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LAW ENGINEERING
HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

PAGE NO. 2 of 2
DATE: 12/29/93

PROJECT NAME: LAW - TULSA (RUST E & I)
PROJECT NUMBER: 307-05762-01 (396-01384-01) LAB NO.: 03

BACK PRESSURE SATURATION CONDITIONS

EFFECTIVE STRESS (psi): 2.0 1) α COEFFICIENT $> \alpha = 0.95$
SATURATION METHOD: 1 2) FINAL SATURATION CALCULATED $100 + \alpha = 98$
3) VOLUME CHANGE DURING TEST

CONSOLIDATION CONDITIONS

CONFINING PRESSURE(psi): 56.0
CONSOLIDATION PRESSURE(psi): 47.0
EFFECTIVE STRESS(psi): 9.0

PERMEATION CONDITIONS

CONFINING PRESSURE(psi): 60.0
INFLUENT PRESSURE(psi): 52.0 $\text{psi} \times 70.34 = \text{cm}$
EFFLUENT PRESSURE(psi): 50.0
HYDRAULIC GRADIENT, i: 16

LAST FIVE HYDRAULIC CONDUCTIVITY READINGS						
ELAPSED TIME	V_f	V_{eff}	ΔV	R	$K_{20} \text{ cm/sec}$	
min	sec	(cm ³ /2s)	(cm ³ /2s)	(cm)		
1473	88380	0.43	1.37			
1878	112680	0.49	1.31	1.013	0.91	3.3 E-09 cm/sec
2988	179280	0.64	1.15	2.617	0.91	3.2 E-09 cm/sec
3383	202980	0.69	1.09	0.929	0.91	3.2 E-09 cm/sec
4393	263580	0.84	0.93	2.617	0.92	3.6 E-09 cm/sec

**RUST
HYDROGEOLOGICAL STUDY REPORT
(1993)**

An aerial photograph of a rural landscape, likely in Oklahoma, showing a grid of land parcels. The terrain is a mix of dark, wooded areas and lighter, cleared or agricultural land. A network of roads and possibly a railway line is visible, crisscrossing the grid. The overall image has a high-contrast, black-and-white appearance.

HYDROGEOLOGICAL STUDY
FOR
MUSKOGEE COMMUNITY LANDFILL AND RECYCLING CENTER
MUSKOGEE, OKLAHOMA

Prepared For:
WASTE MANAGEMENT OF OKLAHOMA
TULSA, OKLAHOMA

Prepared By:
RUST ENVIRONMENT & INFRASTRUCTURE
HOUSTON, TEXAS

JULY, 1993

MARK S. COLEMAN
Executive Director



*Letter picked up
by M. Daniels*
DAVID WALTERS
Governor

State of Oklahoma
DEPARTMENT OF ENVIRONMENTAL QUALITY

August 24, 1993

Mr. Mark Daniels
Waste Management of Oklahoma, Inc.
Route 4, Box 310
Oklahoma City, Oklahoma 73111

Re: Hydrogeological Study
DEQ Log Number 93-140
Muskogee Community Landfill & Recycling Center
Muskogee County

Dear Mr. Daniels:

Pursuant to "Procedures of the Department of Environmental Quality", Oklahoma Administrative Code (OAC) 310:360-9-3, the above referenced report was submitted on July 28, 1993. We conducted a thorough technical review and subsequently determined the proposed hydrogeological investigative activities are deficient with respect to OAC 310:360-9-3.

The following is a list of review comments and deficiencies found in the referenced report sections:

5.4.2 Potentiometric Surface Map

Determining the minimum distance between waste placement and ground water as specified in OAC 310:360-5-1(27), requires collection of monthly ground water elevation data. Based on the collected data, OAC 310:360-9-3(19)(D) and (E) require the construction of a contour map identifying the highest measured water levels or potentiometric surface, depending on whether the aquifer is unconfined or confined, respectively. Therefore, Phase II shall provide said map prior to determining the minimum elevation for the placement of waste.

Mr. Mark Daniels

August 24, 1993

Page 2 of 2

7.1.2 Geotechnical Boring Procedure

Pursuant to OAC 310:360-9-3(10) the elevation of ground water, if encountered, shall be measured in ALL boreholes. Furthermore, if the elevation of the saturated zone is above the depth where ground water was anticipated, then drilling shall be halted, a piezometer installed and screened in the shallow zone and a new boring, located within ten feet of the piezometer, shall be drilled to the original proposed total depth.

8.0 Conclusions

The Department agrees with recommendations to install nested piezometers on the hill south of the site and gather information on existing private wells in the vicinity to better define the aquifer system.

If there are any questions concerning the hydrogeological report or the Muskogee Community Landfill and Recycling Center, please do not hesitate to contact me at (405) 271-8135.

Sincerely,



James Warram

Environmental Engineer

Solid Waste Permitting Section

- c: Carey Bell, R.S., Muskogee County Department of Environmental Quality
David Freede, R.S., District Sanitarian
Penny Carpenter, Rust Environment & Infrastructure

PROPOSAL FOR
HYDROGEO STUDY WITH LANDFILL DESIGN

MUSKOGEE LANDILL

PRESENTED TO:
WASTE MANAGEMENT OF OKLAHOMA
OKLAHOMA CITY, OKLAHOMA

PRESENTED BY:
RUST ENVIRONMENT & INFRASTRUCTURE
HOUSTON, TEXAS

RUST E & I PROPOSAL NO. 0403M.H3

FEBRUARY 23, 1993

1.0 Introduction

RUST Environmental and Infrastructure (RUST E & I) is submitting a proposal to perform a hydrogeological study for Waste Management of Oklahoma (WMO) on a Type I-B municipal solid waste landfill in Muskogee, Oklahoma. The proposed project site is located in southwest Muskogee, Muskogee County, Oklahoma, south of Hancock Road and west of 51st Street. The purpose is to develop geotechnical and hydrogeological information sufficiently detailed to meet the Oklahoma State Department of Health (OSDH) site characterization standards, be in general accordance with the Waste Management, Inc. Site Assessment Manual (SAM) and to support the following requirements:

- Preparation of landfill design plans to upgrade the currently permitted 80 acre site owned by WMO (Permit No. 1057020). The study must allow preparation of a permit application for a Type I-B landfill that will be acceptable to the OSDH in accordance with Solid Waste Management Regulations shown as provided.
- Evaluation of two adjacent 80 acre tracts (City of Muskogee Permit Nos. 1057008 and 1057009) currently owned by the city and previously utilized for landfilling by the trench method below existing grade. WMO desires to ascertain if these tracts may be economically developed as future landfill areas by WMO.
- Evaluation of an adjacent 225 acre site as a soil borrow area and possible future landfill site.
- The final product will be a hydrogeological study suitable for submission to and permitting by the Solid Waste Management Service (SWMS) at the OSDH.

2.0 Scope of Work

The following proposal is based on a detailed scope of work which addresses the various activities as separate task items. The scope of work for this project is broken into the following tasks.

- Task 1: Review of existing, available data and preparation of a boring plan for submission to the SWMS; a trip to the OSDH to present the plan will likely be required.
- Task 2: Field and laboratory investigations of the site(s) to include evaluation of soils for suitability as liner construction material and installation of piezometers in accordance with the approved boring plan.
- Task 3: Evaluation of the existing city-owned permitted sites with a recommendation as to which areas, if any, might be purchased from the city for future landfilling.
- Task 4: Preparation of a draft version of the hydrogeologic study to justify to the SWMS locations of new monitoring wells.
- Task 5: Preparation of the final version of the hydrogeologic study to be included in the permit application.

2.1 Task 1 - Phase I Investigation and Preparation of Boring Plan

Task 1 will be divided into two parts: a Phase I investigation and the preparation of a boring plan. A Phase I investigation is designed to provide a comprehensive overview of available information concerning a site. A boring plan is required by the OSDH and must be submitted to the SWMS and approved prior to beginning a field investigation.

2.1.1 Phase I Investigation

A Phase I investigation is considered an important planning action that summarizes any available information, including the basic geologic and hydrogeologic factors. This review will be supplemented by a site reconnaissance to document the available data and ascertain additional information, if possible.

2.1.1.1 Literature Review

The literature review will identify hydrogeologic complexities and contingencies that may require further analyses in later phased investigations and provide a basis for the development of the field investigation. The following topics will be covered in the literature review:

- Land use, including topographic maps and air photographs.
- Climatology, determining ten-year-average annual temperature and precipitation, seasonal variations, landfill water balance.
- Surface water hydrology, determining drainage patterns, runoff volumes, delineation of the 100-year floodplain.
- Geology, obtaining soils maps, geologic maps, and stratigraphic columns.
- Hydrogeology, obtaining and/or generating regional cross sections, isopachs of the uppermost aquifer and confining units, regional and previously defined site-specific hydraulic conductivity, transmissivity, storage coefficient or specific yield, thickness of uppermost aquifer and confining unit(s), gradient, flow direction, recharge source, discharge areas, general water quality and surface water/groundwater relationships.

2.1.1.2 Site Reconnaissance

RUST E & I will conduct a site reconnaissance to identify significant surface characteristics, structural features, surface drainage, erosional conditions, and vegetation.

2.1.1.3 Well Inventory

RUST E & I will develop a preliminary conceptual model of the hydrogeologic system. Such a model is useful in understanding potential ground-water flow paths and will enable RUST E & I to fine-tune the field investigation program.

2.1.2 Boring Plan

RUST E & I will develop a boring plan and submit it to SWMS as required by the OSDH site characterization standards. Elements of the boring plan will include a regional hydrogeological study composed of the following parts:

- Narrative information on the regional hydrogeology of the proposed site
- A regional surface geological map
- Illustrations of the regional stratigraphic column and geologic or hydrogeologic cross-sections
- Description of regional ground-water quality and identification of underground drinking water sources
- References indicating the source of information

Drilling activities will not begin until the boring plan is received by the SWMS and RUST E & I receives written authorization to proceed.

2.2 Task 2 - Phase II Field Investigation

Subsurface hydrogeologic investigations must be of sufficient intensity to determine the conditions that may influence the design and construction of both the landfill and the ground-water monitoring system. The exploration program proposed by RUST E & I consists of:

- Determining and interpreting subsurface conditions
- Taking samples of soil and rock for analysis, and
- Preparation of a final report with recommendations of monitoring well locations

RUST E & I will use the subdivisions as delineated by WMO at the Muskogee Landfill.

- Tract A, WMO's currently permitted 80-acre site (Permit No. 1057020).
- Tract B, City of Muskogee's 80-acre tract, west of Tract A (Permit No. 1057008).
- Tract C, City of Muskogee's 80-acre tract, south of Tract A (Permit No. 1057009).
- Borrow Area, 225 acres west of Tracts A, B, and C.

2.2.1 Tract A Investigation

RUST E & I has developed a field investigation program for Tract A that meets OSDH site characterization standards and is in general accordance with the Waste Management, Inc. SAM. The Tract A investigation contains tasks ranging from deep stratigraphic borings to engineering evaluation concerning the suitability of soils for liner and borrow material.

2.2.1.1 *Deep Stratigraphic Borings*

The subsurface investigation is designed to detect all saturated zones encountered while drilling. The goal of this investigation is to determine the uppermost saturated zone that can be monitored for ground-water contaminants. The OSDH site characteristic standards from the Oklahoma Administrative Code (OAC) 310:360-9-3 (3) (E) indicates at least three borings shall be drilled a minimum of 10 feet into the uppermost saturated zone or to a depth of 250 feet, whichever is less. The OAC also indicates regardless of the depth at which ground water is encountered, at least one of the borings shall be drilled to a depth to determine the saturated thickness of all underground drinking water sources underlying the proposed sites, or 100 feet, whichever is less. Shallow saturated conditions are expected to be encountered 16 to 30 feet below ground surface based on the boring logs from three ground-water monitoring wells installed in November 1992.

To meet this requirement, RUST E & I proposes to drill six deep stratigraphic borings to a depth of 100 feet. Four of the boreholes will be located at the approximate corners of Tract A. Two additional borings will be placed in the middle of the tract, within the proposed disposal area. The borings will be continuously sampled and logged, paying particular attention to the presence of shallow ground water. The upper portions of the deep

stratigraphic borings will be selected for the collection of samples for geotechnical analysis. Each boring will be logged continuously, for its entire depth, using visual classification techniques. Lithologic sample logs will be made of each borehole drilled and will include the following items:

- Geotechnical information about drilling, such as penetration rates and drill bit changes.
- Identification of all soil and rock layers encountered during drilling describing:
 - color, texture, thickness, degree of compaction or consolidation and amount of moisture present in each layer.
 - soil classifications based on the Unified Soil Classification System.
 - rock classifications as defined in the Dictionary of Geological Terms.
- The depths at which ground water was encountered and stabilized ground water elevations.

The boreholes will be advanced to a depth of 10 feet into bedrock. Thereafter, two of the six borings will use wet rotary techniques while continuously sampling with a rock core barrel to depths of 100 feet.

Percentage recovery of the rock core and the Rock Quality Designation (RQD) will be calculated for every core run. The RQD is a modified core recovery measurement used to characterize the quality of the rock mass. To calculate RQD, all pieces of a core run over 4-inches in length of the core run are added together and divided by the total length that is recovered, and is expressed as a percent. Listed below is a table showing the relationship of RQD and rock quality.

<u>RQD %</u>	<u>Description of Rock Quality</u>
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

The lower the RQD value a rock unit has, the easier the rock unit will be to open pit mine.

The remaining four borings will be advanced to the 100-foot termination depth with air rotary techniques. Samples will be collected and logged using the standard penetration test and/or examination of drilling cuttings. (Note: based on the drilling contractor's experience, rock coring with air rotary is difficult. Water must be used to collect sufficient rock cores for lithologic examination.) Upon completion of drilling and sampling, all deep stratigraphic borings will be grouted with bentonite grout using a tremie line.

2.2.1.2 Downhole Geophysical Logging

The six deep stratigraphic borings will be logged with geophysical logging tools consisting of spontaneous potential, single-point resistance, and natural gamma tools in the two deep borings drilled with wet rotary techniques. Only the natural gamma tool will be able to be used in the air rotary borings and in the steel casing of the hollow stem augers. The following table summarizes the aspects of the downhole geophysical logging:

<u>Technique/Application</u>	Water Filled Hole, Saturated Zone		Dry Hole, Unsaturated Zone	
	<u>Uncased</u>	<u>Steel</u>	<u>Uncased</u>	<u>Steel</u>
<u>Natural Gamma</u> soil & rock identification, geologic correlation	Yes	Yes	Yes	Yes
<u>Spontaneous Potential</u> soil & rock identification, geologic correlation	Yes	No	No	No
<u>Single-Point Resistance</u> soil & rock identification, geologic correlation, resistive rock fracture detection	Yes	No	No	No

2.2.1.3 *Geotechnical Borings*

RUST E & I proposes to drill an additional 14 borings at Tract A; thus raising the total number of borings to 20, as required in OAC 310: 360-9-3 (3)(c). The borings shall be located so as to give complete coverage to the entire 80 acres. All borings shall be drilled a minimum of 30 feet below the deepest proposed excavation. Geotechnical borings are expected to be 50 to 60 feet in depth. The borings will be continuously sampled and advanced with hollowstem augers to total depth, paying particularly close attention to the presence of shallow ground water.

All drilling activities will cease upon encountering shallow ground water. The rise of water within the borehole will then be measured in five-minute increments until equilibrium is reached or for a maximum period of 30 minutes, whichever is less. Drilling activities will continue upon completing the water-level readings. The borings will be logged and classified as previously described in Section 2.2.1.1. All geotechnical borings will be grouted with a bentonite grout, using a tremie line.

2.2.1.4 *Piezometer Installation*

The placement of piezometers in the Phase II Field Investigation provide an opportunity to address the site-specific hydrogeology. The following items can be determined:

- In-place permeability of geologic units
- Direction of ground-water flow
- Rates of ground-water flow
- Maximum high elevation of piezometric surfaces
- Ground-water recharge and discharge areas
- Background water quality

The piezometer program for Tract A requires six piezometers to be installed in the shallow saturated zone, and six piezometers to be installed in the residual soils above the saturated zone. There will be six nested piezometer locations that will be pre-selected and distributed evenly throughout the northern three-quarters of the 80 acres.

Three ground-water monitoring wells in the southern one-quarter of the tract will provide sufficient hydrogeological information in that area. Four of the nested piezometer locations will be along the periphery of the tract; the two other locations will be within the disposal area.

Each nested piezometer location will be within a 10-foot diameter area of a geotechnical boring and within 10-feet of each other. At each location the screened portion of one piezometer will extend 5-feet into the shallow saturated zone from the first noted occurrence of ground water. The hollowstem augers will be advanced approximately 5-feet into the saturated zone. If the surrounding material is competent, the augers will then be raised 5-feet, and if conditions warrant, backflushed with potable water through a tremie line. This will clear the annulus of turbid water and facilitate development. The piezometer screen and casing will be set, and the 20-40 graded filter pack sand will be poured through the top of the augers. In accordance with the SAM, no more than 10-feet of augers will be pulled if in competent material.

The filter pack will extend two-feet above the top of the screen, followed by a 3 to 5-foot bentonite pellet seal, hydrated if needed, and tamped into place. The remainder of the annulus will be grouted to the surface with a bentonite grout tremied into place. The piezometer material will consist of 1 1/4-inch, schedule 40 PVC with flush-threaded joints. The screened portion of each piezometer will consist of the same PVC material, 5-feet in length, with 0.010-inch slots. The second piezometer at each nested location will be constructed to the same standards as the first, but the bottom of the screen will be set 5-feet above the first piezometer filter pack. Due to anticipated dry conditions, the annulus will not be backflushed with water. Potable water, however, will be used to hydrate the bentonite pellet seal. The piezometer borings will not be sampled and logged for lithology due to the proximity to each geotechnical boring. Three nested piezometer locations will be selected for potential analysis for background water quality. The piezometers and equipment used for installation will be decontaminated with a high pressure washer/steam cleaner.

The first piezometer of each nested location will be used to gather data concerning the shallow saturated zone. The second piezometer will be used to document that the residual

clay soils above the shallow ground water act as a confining unit. Thus, shallow ground water will not impact the landfill operations if the bottom of the excavation is below or near the piezometric surface, assuming adequate thickness of clay soils between shallow ground water and the liner to prevent hydraulic pressure buildup and liner blow out.

2.2.1.5 Piezometer Development

All piezometers yielding shallow ground water will be developed by ASTM standards to help restore the natural hydraulic properties of the transmissive unit. The piezometers will be allowed to reach static water level prior to development. A minimum of two days upon completion of the installation will be allowed for the water levels to reach equilibrium in each piezometer. Multiple water level readings will be taken during this interim period to ascertain static levels.

Once static conditions are reached the water level will be determined and recorded immediately prior to development. The amount of one well volume will be determined, and development will proceed using a Waterra® inertial hand pump until a minimum of three well volumes are removed. Piezometers for background water quality will be developed by pumping until a minimum of three well volumes are removed and when field measurements of pH, specific conductance, and temperature have stabilized.

If fine sediments are a problem, development will continue to an appropriately low level of suspended material in the water.

2.2.1.6 Surveying

Upon completion of all the piezometers, the location of the wells and top of PVC casing will be surveyed by licensed professional surveyor in the State of Oklahoma. The elevations will be surveyed to the nearest 0.01 foot above mean sea level; the location will be given in terms of latitude and longitude of the piezometer at least to the nearest tenth of a second.

2.2.1.7 *In-Situ Permeability Testing*

Hydraulic conductivity tests will be performed for all six piezometers measuring the piezometric surface of the shallow ground water of Tract A. Hydraulic conductivity will be evaluated using rising-head slug tests, and will commence after development, once the hydraulic properties of the transmissive zone has been restored. RUSTE & I will wait for a time period in which the static water level have been attained. The following sequence of events will occur during each slug test:

1. Determine the static water level.
2. Lower the Waterra® hand pump into place and remove a known volume (slug) of water from the piezometer. The analysis assumes an instantaneous change in volume when the slug is removed. The elapsed time equal to zero will be recorded immediately upon cessation of pumping. The pump will be removed and an electric water-level meter will determine the rise of water within the piezometer.
3. Water levels in the piezometer will be recorded every 30-seconds for five minutes, then every minute until 15 minutes have elapsed. Measurements will then continue with water levels taken every five minutes until 30 minutes have elapsed; whereafter, water levels will be taken every 10 minutes until one hour has elapsed.
4. Successive time-depth measurements will proceed on an hourly basis until the static water level has met 95% recovery.

Transmissivity and hydraulic conductivity will be evaluated using the Copper et. al. Method for a confined ground-water system.

2.2.1.8 *Geotechnical Laboratory Analysis*

Geotechnical analyses of the soils are designed to provide information on the quantity and physical characteristics of both borrow and landfill cut areas. Soil samples will be evaluated by performing the following analyses:

- Particle-Size Analysis
- Atterburg Limits
- Standard Proctor
- Organic Content
- Falling-Head Test
- Test for Unconsolidated, Undrained Strength of Cohesive Soils in Triaxial Compression
- Consolidation Tests
- Cation Exchange Capacity
- Soil pH

The underlying shale formation will be evaluated by measuring the hydraulic conductivity of rock plugs. RUST E & I will detail the results of the geotechnical analysis and how the soil and rock impact landfill design.

2.2.1.9 Testing of Background Water Quality

Characterizing existing quality of ground water establishes the baseline conditions of evaluating risks to human health and the environment throughout the operational and post-closure periods of the landfill. In addition, existing ground-water quality, in part, determines current uses and affects future uses. Both the shallow ground water and deep ground water from drinking water sources will be evaluated.

As part of the Phase II field investigation of Tract A, RUST E & I will preselect and designate three piezometers as potential sampling points for background water quality and use construction standards equivalent with monitoring well standards. At the end of the Phase II field investigation of Tracts A, B, C, and the borrow area, water level measurements of all the piezometers and monitoring wells within the study area will be taken within a 24-hour time period. A potentiometric map of the shallow ground water will be constructed. Hydraulic parameters of shallow ground water such as direction of ground-water flow will be determined. If the three sampling points exist in an area upgradient of a potential source of contamination, RUST E & I will sample the three piezometers for the following ground-water parameters:

pH
Chemical Oxygen Demand (COD)
Specific Conductance
Chlorides
Total Dissolved Solids

Ground-water sampling will be conducted in accordance with the Waste Management, Inc. Manual for Groundwater Sampling. The shallow ground water will be evaluated with respect to the classification of ground waters and protection levels, as detailed in OAC 310:360-3.2. During development and purging, RUST E & I will document the withdrawal rate from all piezometers in order to evaluate the ground water based on OSDH production criteria. RUST E & I will note the maximum pumping rate of the Waterra® inertial hand pump.

2.3 Tract B and Tract C Field Investigation

Tract B and Tract C are located west and south of Tract A, respectively. Both are previously permitted landfilling areas owned by the City of Muskogee. WMO is interested in determining the potential of both tracts for future landfilling. The focus of the field investigation is primarily on Tract B, and to a limited degree, Tract C. RUST E & I will also determine the impact of both tracts on ground-water flow and rate of flow.

2.3.1 Piezometer Installations

RUST E & I will install six piezometers around Tracts B and C to measure the potentiometric surface of the shallow ground water. The piezometers will be installed using hollowstem auger techniques. The residual soils will be continuously sampled to determine the first occurrence of the shallow ground water. The piezometers will be screened in the 5-foot interval beyond the first occurrence of shallow ground water.

The standards for the construction of the piezometers will be the same as those previously detailed in Section 2.2.1.4. Piezometer development will occur as detailed in Section 2.2.1.5. The piezometers will be surveyed as detailed in Section 2.2.1.6. The location of the six piezometers are as follows:

- | <u>Tract B</u> | <u>Tract C</u> |
|---|----------------------------|
| • Center of the west side | • Southeast Corner |
| • Center of northern one-quarter of the tract | • Center of the south side |
| | • Southwest Corner |
| | • Northwest Corner |

2.3.2 Geophysical Survey

RUST E & I will retain the services of a contractor to perform a geophysical survey of Tract B, and to a small extent, Tract C, in order to define the areal and vertical extent of previously placed refuse. The survey will employ electromagnetic (EM) methods to determine the conductivity of the overlying terrain. A 100-foot grid will be established for Tract B, and EM 34 geophysical unit will read the conductivity of each intersection point of the grid. A similar survey will be conducted over the western one-quarter of Tract C. The contractor will produce a contour map showing the ground conductivity for the two areas, and interpret the location and size of specific anomalous sites consistent with refuse burial.

In addition, the contractor will define the vertical extent of specific refuse areas found on Tract B and as defined by the EM survey. Seismic refraction will be used to define the base of the refuse area on Tract B. Seismic refraction will not be used on Tract C. The contractor proposes to use standard compression wave refraction data to evaluate the depth of the refuse. Shear wave refraction data will be used if complications arise from water saturation in the refuse pits.

2.4. Borrow Area Investigation

RUST E & I proposes to install 10 piezometers and conduct geotechnical testing of collected samples to evaluate the borrow area as a potential landfill area and borrow source. Ten piezometers will be spread evenly throughout the 225-acre property, and will measure the potentiometric surface of the shallow ground water. The borings will be continuously sampled and logged. Soil samples will be tested in a geotechnical laboratory using only those tests suitable to evaluate potential borrow material. Three piezometers will be constructed using the same standards used in ground-water monitoring wells. Upon

completion of the installation of the Phase II field investigation, RUST E & I will measure the water levels of all piezometers and construct a potentiometric map of the shallow ground water. If the upgradient area of a potential source of contamination exists within the borrow area, the three specially-designated piezometers will be sampled in accordance with WMI standards in order to determine background water quality. The testing parameters will be those mentioned in Section 2.2.1.9. The shallow ground-water will be characterized in accordance with OAC 310: 360-3.2.

3.0 Task 3 - Evaluation of Tracts B and C as Future Landfill Areas

RUST E & I will evaluate the existing city-owned permitted site with a recommendation as to which areas, if any, might be purchased from the City of Muskogee for future landfilling. Potential options range from capping the existing refuse to excavation of shallow refuse and construction of new cells. The recommended options(s) will be based on the geophysical survey, standard and acceptable landfill design practices in the State of Oklahoma, and economic considerations.

4.0 Preparation of Hydrogeological Report

A draft report of the Hydrogeological Study performed will be prepared. The report will be an assimilation of all the data obtained in the Phase I and Phase II investigations described in this proposal. The report will include, but not be limited to, the following information:

- A description of the depositional history in the area.
- Delineation of the uppermost aquifer and significant confining units in cross sections or fence diagrams.
- Estimates of ground-water flow paths, gradient and potential direction.
- A description of all field activities and summaries of the data obtained for each tract.
- Description and conclusions of the geophysical survey.
- An assessment of the site hydrogeology and the hydraulic analysis including a description of the potential for contaminant migration from the waste facility.
- Development of a preliminary conceptual model of the hydrogeologic regime.

The draft report will be written in accordance with the Waste Management SAM. The draft report will be submitted to WMO for review and comments. Upon receipt of comments, the report will be finalized.

5.0 Task 5 - Final Report

The comments from the draft report will be addressed. Once the report has been finalized, it will then be submitted to OSDH with Waste Management approval. If WMO so desires, all field data, conclusions and recommendations for Tracts B and C will be written up as a separate letter report.

**Waste Management of Oklahoma
Muskogee Landfill
RUST E & I Proposal No. 0403M.H3**

TASK 1

A. Phase I Studies

ES III	56 hours x \$63/hour	\$3,528
Roundtrip Airfare	1 trip x \$300/trip	\$300
Per Diem	2 days x \$85/day	\$170
Car Rental	2 days x \$40/day	\$80
Misc. (phone calls, copies, faxes, film, etc.)		\$50

B. Boring Plan for OSDH

ES VI	12 hours x \$83/hour	\$996
ES IV	40 hours x \$70/hour	\$2,800
Word Processor	8 hours x \$35/hour	\$280
CADD	8 hours x \$73/hour	\$584
Misc. (copies, phone, Federal Express, etc.)		\$100
Roundtrip Airfare	2 persons x \$300/each	\$600
Per Diem	2 persons x 1 day x \$85/day	\$170
Car Rental	1 day x \$40/day	\$40

Subtotal Task 1 **\$9,698**

TASK 2

A. Tract A

ES IV	200 hours x \$70/hour	\$14,000
ES III	60/hours x \$63/hour	\$3,780
Airfare	2 persons x \$300/each	\$600
Per Diem	30 days x \$85/day	\$2,550
Car Rental	30 days x \$40/day	\$1,200
Misc. (phone, copies, etc.)		\$200

Subcontractors:

Surveyor		\$1,045
Driller		\$30,478
Equipment Rental		\$200
Logging Tools & Computer:		
7 days x \$190/day		\$1,880
\$250 set-up fee + \$300 shipping		
Consumable Supplies		\$200

Subtotal Task 2A **\$56,133**

B. Tracts B and C

ES IV	48 hours x \$70/hour	\$3,360
Per Diem	1 person x 6 days x \$85/day	\$510
Car Rental	6 days x \$40/day	\$240

Subcontractors:

Geophysical Study		\$15,400
Drillers		\$4,257
Equipment Rental		<u>\$200</u>

Subtotal Task 2B		\$20,607
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C. Borrow Area

ES IV	64 hours x \$63/hour	\$4,480
Roundtrip Airfare		\$300
Per Diem	8 days x \$85/day	\$680
Car Rental	8 days x \$40/day	\$320

Subcontractors:

Driller		\$6,930
Equipment Rental		<u>\$300</u>

Subtotal Task 2C		\$13,010
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TOTAL TASK 2A - 2C		\$89,750
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TASK 3

ES IV	16 hours x \$70/hour	\$1,120
ES III	4 hours x \$63/hour	\$252
Word Processor	4 hours x \$35/hour	\$140
Misc. (computer time)		<u>\$50</u>

TOTAL TASK 3		\$1,562
--------------	--	---------

TASK 4

ES VI	24 hours x \$83/hour	\$1,992
ES IV	40 hours x \$70/hour	\$2,800
ES IV	80 hours x \$70/hour	\$5,600
ES III	80 hours x \$63/hour	\$5,040
Word Processor	32 hours x \$35/hour	\$1,120
CADD	40 hours x \$73/hour	\$2,920
Misc. (copies, binders, phone, faxes, etc.)		\$300

TOTAL TASK 4 **\$19,772**

TASK 5

ES VI	16 hours x \$83/hour	\$1,328
ES IV	24 hours x \$70/hour	\$1,680
ES III	24 hours x \$63/hour	\$1,512
CADD	24 hours x \$73/hour	\$1,752
Word Processing	16 hours x \$35/hour	\$560
Misc. (copies, etc.)		\$300

TOTAL TASK 5 **\$7,132**

GRAND TOTAL **\$118,216**
(without Geotechnical laboratory costs)

GRAND TOTAL **\$143,390**
(with Geotechnical laboratory costs)

COST ESTIMATE FOR GEOTECHNICAL TESTING

<u>Geotechnical Test</u>	<u>Number of Tests</u>		<u>Unit Cost</u>	<u>Total</u>
	<u>Tract A</u>	<u>Borrow Area</u>		
Particle Size Analysis	60	20	\$40	\$3,200
Aterburg Limits	60	20	\$35	\$2,800
Standard Proctor	15	10	\$150	\$3,750
Organic Content	10	5	\$25	\$375
Permeability Test (Falling Head)	15	10	\$230	\$5,750
Triaxial Test	10	0	\$450	\$4,500
Consolidation Test	10	0	\$250	\$2,500
Cation Exchange Capacity	10		\$90	\$900
Soil pH	10		\$20	<u>\$200</u>
TOTAL, PLUS 5% MARKUP				\$25,174

DEC 8 1974

DEC 8 1974

**PHASE I - HYDROGEOLOGICAL STUDY
FOR
MUSKOGEE COMMUNITY LANDFILL AND RECYCLING CENTER
MUSKOGEE, OKLAHOMA**

**Prepared For:
WASTE MANAGEMENT OF OKLAHOMA
TULSA, OKLAHOMA**

**Prepared By:
RUST ENVIRONMENT & INFRASTRUCTURE
100 GLENBOROUGH, SUITE 300
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Marty Sara, Rust
Peter Walls, Rust
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Mark Daniels, WMO
Theresa Talty, WMNA**

PROJECT NO. 86251.100

93-140
1 of 3

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Section 1

1.0 INTRODUCTION

Rust Environment and Infrastructure (RUST E&I) is presenting the results of the Phase I Hydrogeological Investigation for Muskogee Community Landfill and Recycling Center (Muskogee Community Landfill) in Muskogee, Oklahoma. Muskogee Community Landfill is owned and operated by Waste Management of Oklahoma, Inc. (WMO). This report was prepared in response to WMO's acceptance of RUST E&I's proposal for a hydrogeological study with landfill design, dated April, 1993. Authorization to proceed was given by Mr. Lawrence R. Cohn, P.E., Environmental Engineering Manager for Waste Management of North America - South (WMNA) on May 5, 1993.

1.1 Purpose and Scope

The Phase I Hydrogeological Investigation for Muskogee Community Landfill summarizes the available data for this facility and the surrounding region, identifies current data gaps and provides recommendations on required hydrogeologic activities. This report incorporates the original geotechnical studies which were a part of the permit application and subsequent information. The scope of this report includes:

- A thorough review of existing literature and technical information;
- Preliminary site reconnaissance;
- Development of the regional and site-specific geology and hydrogeology as understood by the existing literature;
- Development of initial regional and site-specific hydrogeologic conceptual models;
- Use of the acquired information to establish target monitoring zones and identify limiting design criteria;
- Development of a geotechnical boring plan to meet WMO engineering design practices and Oklahoma State Department of Health regulations; and,

- Development of piezometer installation plan to monitor the piezometric surface underlying the site.

The scope of this report represents the first phase of the project; the second phase is the field investigation. The goals of the project are to:

- Establish potentiometric surfaces for landfill design purposes and the ground-water monitoring plan.
- Establish a new geotechnical data, geological data, and hydrogeological data base.
- Design a ground-water monitoring plan for Tract A.
- Determine if the landfills on Tracts B and C are impacting Tract A.
- Use the geotechnical analyses to aid in the landfill design.

1.2 Previous Investigations

An investigation was conducted on Tract A by Poe and Associates, Inc. in 1984. The two reports written were similarly entitled: Geotechnical and Hydrogeological Evaluation of Proposed Muskogee Landfill Update, Revised October, 1984, and Geotechnical and Hydrogeological Evaluation of Muskogee Landfill Update, Revised October, 1984. The first report was included in the City of Muskogee Sanitary Landfill Permit Application, also prepared by Poe and Associates, Inc. in May, 1985. The second report was prepared after the permit application was accepted. The original reports to the Poe & Associates "Updates" were not available for review.

The information from the Poe and Associates' investigation was reviewed, validated, and used to aid in this hydrogeological investigation. The investigation, herein, fills the gaps of the Poe and Associates' reports with the available information necessary to develop a preliminary hydrogeological conceptual model for the landfill.

Both geotechnical and hydrogeological evaluations by Poe and Associates summarize the regional geology coupled with a site-specific soils investigation. Sixteen soil borings on Tract A, ranging in depth from 20 to 50 feet below land surface, were evaluated for geotechnical properties. The depths of the borings were insufficient to define the deep stratigraphy and hydrogeologic units underneath Tract A and also fulfill the current OSDH regulations. The borings were able to roughly define the residual soils underlying the site, though lacking detailed descriptions. As a result, the information obtained from the Poe and Associates' reports is used to aid in the development of a boring plan for Tract A, further discussed in Section 7.0.

1.3 Sources of Information

The sources of information obtained for this study were acquired from the local files at Muskogee Community Landfill, the Oklahoma Geological Survey (OGS), the United States Geological Survey (USGS), the Oklahoma Water Resources Board, the Oklahoma Corporation Commission, Sooner Well Service, and Ace Aerials. Geosource Inc. in Austin, Texas was subcontracted to assist in gathering all the historical aerials and maps for the facility and surrounding areas.

Section 2

2.0 SITE CONDITIONS

This section describes site-specific conditions including location, history, aerial photography, physiography, topography, climate and previous investigations.

2.1 Location

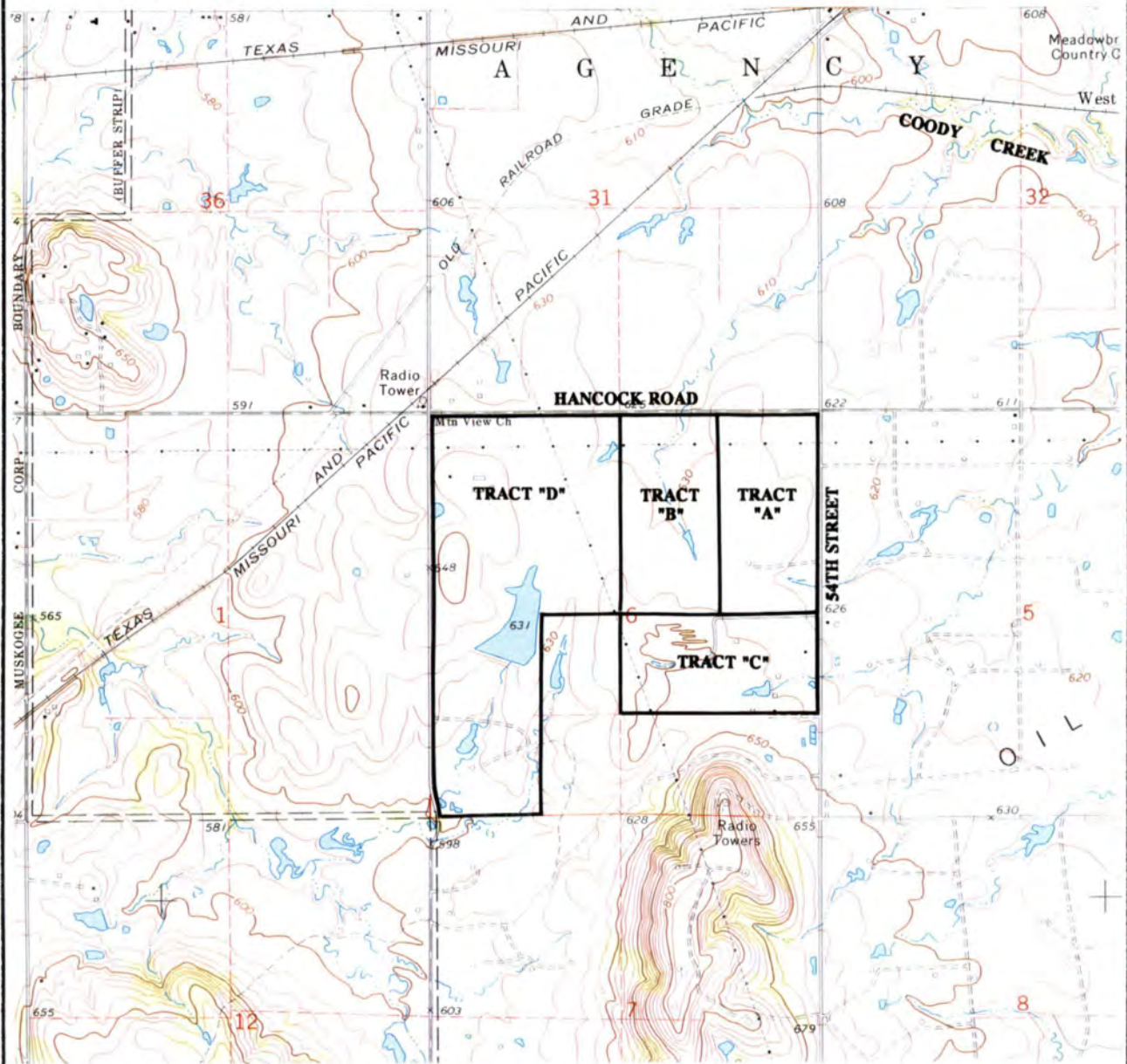
Muskogee Community Landfill, located southwest of the City of Muskogee in Muskogee County, Oklahoma, south of Hancock Road and west of 54th Street, is identified as Tract A in Figure 2-1. Reference to the "facility" in this report refers only to Tract A. The northeast corner of the facility is approximately 1.5 miles west of Highway 69 and one-half mile south of the Texas-Pacific and Missouri-Pacific Rail lines. The entrance is off 54th Street, one-half mile south of the intersection with Hancock Road. The facility is located in Lot 1 and the SE ¼ of the NE ¼ of Section 6, Township 14 North, Range 18 East.

Also shown in Figure 2-1, Tract B is located directly to the west of Tract A; Tract C is located directly to the south. Both of these tracts are Type I-B municipal solid waste facilities. Tract D, located west of Tract B, is a potential borrow source and is currently owned by James M. and Eileen R. Hewgley.

The land use of the surrounding area includes a residential neighborhood three-quarters mile to the west just north of Hancock Road, another neighborhood about one mile to the north, undeveloped pasture and farmland north, east and west, and a public animal shelter and additional undeveloped property to the south. There are several oil wells around and within the property.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

SOUTHWEST MUSKOGEE QUADRANGLE
OKLAHOMA—MUSKOGEE CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)



UTM GRID AND 1974 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

LEGEND:

TRACT "A" Owned by WMO 80 acres
TRACT "B" Owned by City 80 acres
TRACT "C" Owned by City 80 acres
TRACT "D" Privately Owned 225 acres



PROJECT LOCATION MAP, 1993

RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 2-1

2.2 Landfill History

The original permits for landfill operations for Tracts A, B, and C were all initially issued to the City of Muskogee by the Oklahoma State Department of Health (OSDH). Permit No. 3551020 for Tract A was issued on April 4, 1987. Permit No. 3551009 for Tract B was issued on August 18, 1976. Permit No. 3551002 for Tract C was issued on February 16, 1972.

The City of Muskogee excavated, filled with trash, and covered a single trench in the southwest corner of Tract A in the winter of 1983. Additional excavation was also carried out in the southern portion but no landfill operations took place. In December, 1992 the name of the owner/operator was changed/transferred to Waste Management of Oklahoma, Inc. (WMO) and the name of the facility was changed to Muskogee Community Landfill and Recycling Center. The Muskogee Community Landfill is a Type I-B municipal solid waste facility which, according to OSDH regulations, is approved to receive non-hazardous commercial residential and industrial solid waste. The currently permitted area of the facility encompasses approximately 80 acres, 69.5 acres of which will be used for landfill operations. A population equivalent of about 60,000 is being served.

During a recent 12-month period, the landfill received a monthly waste volume of 23,100 yd³ on average. The estimated life of the facility was approximately 2.8 years prior to approval of a permit amendment by OSDH in December, 1992, which allowed an increase in height of fill by an average of 10 feet over the facility. Under this scenario, the current life of the facility is approximately 7.5 years based on a total available waste volume of 2,070,000 yd³.

Operation of Tracts B and C began shortly after the permits were issued using the trench landfilling method. Operations on Tract B ceased by the early 1980s. Approximately 20 acres in the northern part of Tract B were never filled.

Operations for Tract C started in the western half of the tract. The City of Muskogee is currently filling the southeastern corner with construction debris.

2.3 Aerial Photographs

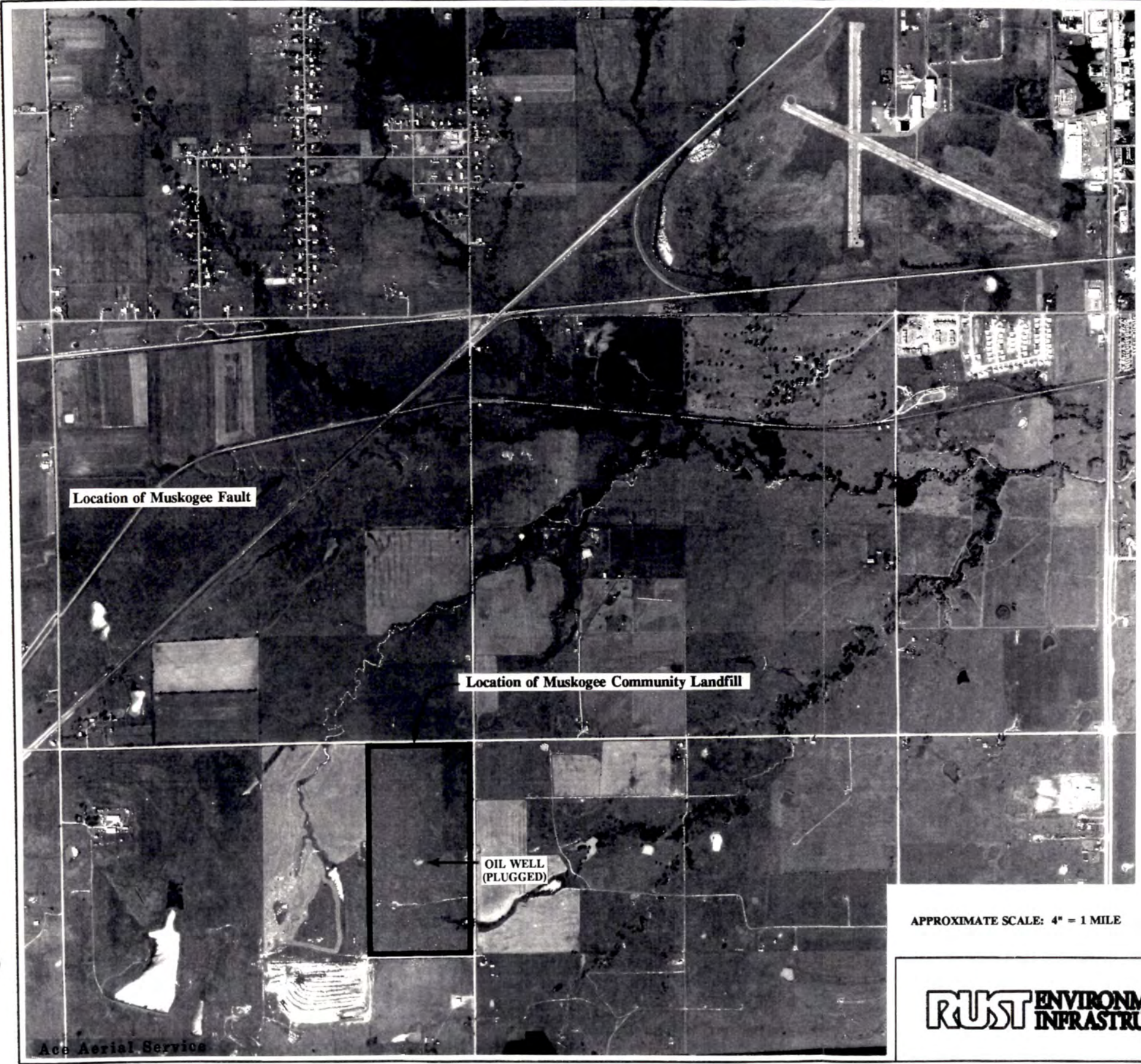
Aerial photographs were reviewed for the years 1973, 1980, 1991, and 1992. There were no aerial photographs available prior to 1973, and the most recent aerial photograph available was from June, 1992.

On September, 28, 1973, Tracts A, B, and D were undeveloped land, as shown on Figure 2-2. The small light spot in the center of the Tract A shows an area of dead vegetation. The vegetation was reportedly killed due to brine water seeping from a poorly plugged oil well. This issue is addressed in Section 4.6, Petroleum Geology, later in this report.

Tract B has a small pond which was connected to an intermittent stream. The stream was a tributary of Coody Creek located to the northeast. The western half of Tract C was being landfilled by the trench landfilling method. Tract D is farmland surrounding a lake and a small pond.

As indicated, on the October 8, 1980 photograph, Tract A was still undeveloped, and the dead vegetation due to the flowing brine water had radially expanded (Figure 2-3). The southern third and western half of Tracts B and C were being landfilled. The stream which was connected to the pond on Tract B appears to have been obstructed by the landfill. It also appears that the excavation of Tract B had reached the pond, and the pond was being filled in. Tract D was still undeveloped.

By April, 1991, the southern-most part of Tract A had been excavated. The trench in the southwestern corner had been filled and covered by the City of Muskogee. The area of dead vegetation was still present.

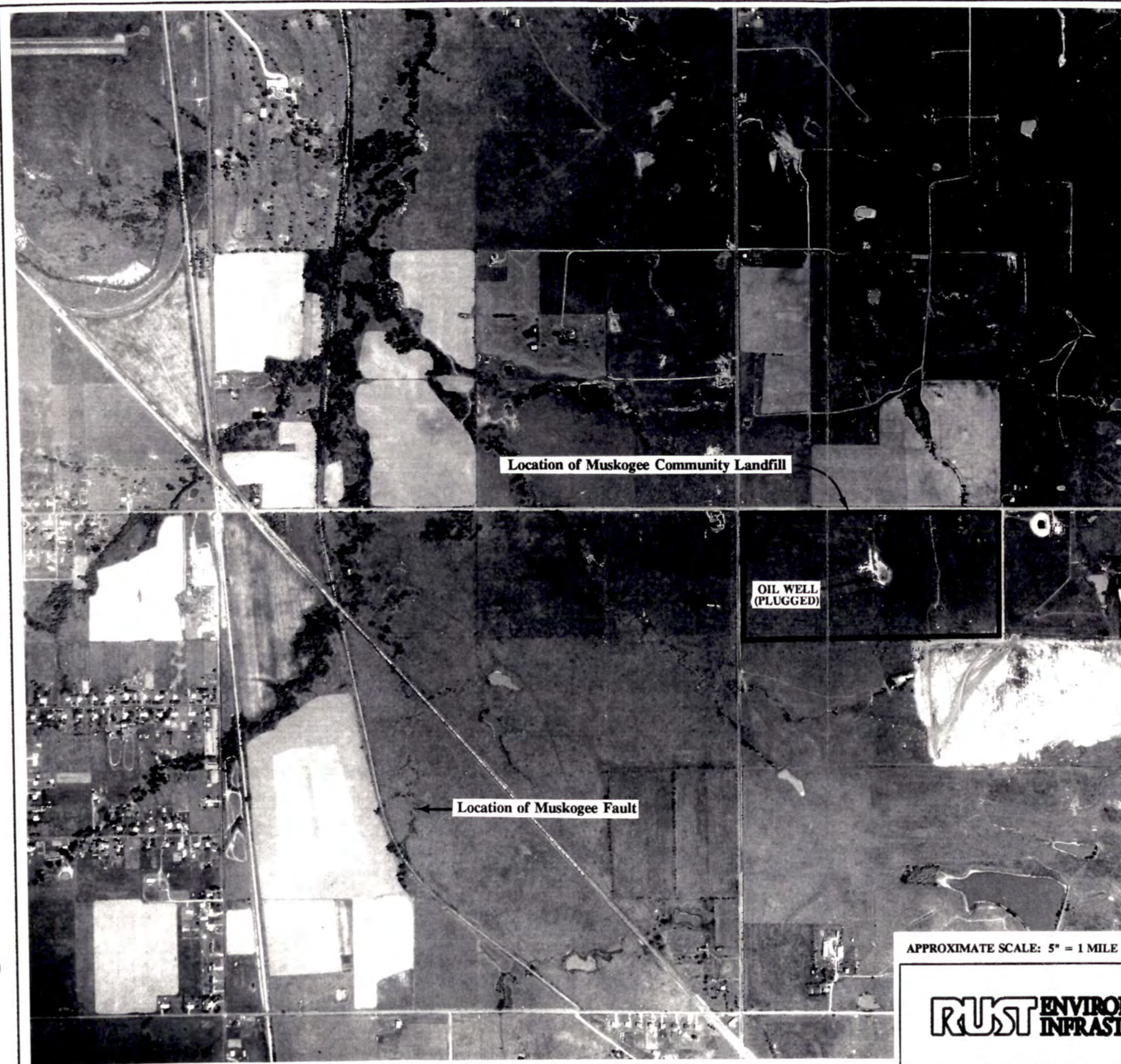


APPROXIMATE SCALE: 4" = 1 MILE

RUST ENVIRONMENT & INFRASTRUCTURE

AERIAL PHOTO - 1973

FIGURE 2-2



Location of Muskogee Community Landfill

OIL WELL
(PLUGGED)

Location of Muskogee Fault

APPROXIMATE SCALE: 5" = 1 MILE

RUST ENVIRONMENT &
INFRASTRUCTURE

AERIAL PHOTO - 1980

FIGURE 2-3

Landfill operations had ceased in Tract B with trenches filled and covered. Most of the western portion of Tract C appeared to be finished and covered with vegetation. Part of the eastern half was also covered with vegetation.

The June, 1992 aerial photograph showed that Tract A remained basically unchanged. The area of dead vegetation was still present. Tract B appeared the same. Landfilling operations for Tract C were active in the southeastern part of the landfill.

2.4 Physiography and Topography

Muskogee County is mainly in the Arkansas Valley section of the Ouachita Province and in the Osage Plains section of the Central Lowlands Province. The Arkansas River forms the northern border of the county then flows south through the eastern third of the county. The Canadian River flows northeast-southwest to the south of the county. The general drainage is towards these rivers and the overall slope of the county is to the south and east. Topographic differences across the county range from moderately steep slopes in the northeast corner to nearly level floodplains along the Arkansas River. Elevations range from about 1,100 feet mean sea level (msl) in the northeast to about 450 feet msl in the south.

The local topography for the area around the landfill is shown in Figure 2-1. The land surface slopes toward the northeast across Tract A, B, and C. There is a prominent topographic high about one-half mile to the south of Tract A.

Figure 2-4 shows the site-specific topography for Tract A as existing on June 22, 1992. The highest elevation on Tract A is 639.8 feet msl located on top of a mound of trash near the southwest corner of the tract. This mound is full of trash deposited by the City of Muskogee prior to the transfer of ownership to WMO. The mound is approximately 100 feet wide at its widest point with steep slopes to a base elevation of approximately 620 feet msl. The lowest elevation in the

excavation area of Cell 1 is about 621 feet msl. The topography of the undeveloped portion of Tract A slopes to the northeast, ranging in elevation from approximately 639 feet msl on the west side of the property to an elevation of 621 feet msl on the northeast side of the property.

2.5 Climate

Table 2-1 gives historical averages on temperature and precipitation for the Muskogee area as recorded by the National Oceanic and Atmospheric Association for the last 30 years. In winter, the average temperature is 40.8 degrees Fahrenheit (F), and the average daily minimum is 31 degrees F. The lowest temperature of -9 degrees F occurred on January 10, 1977. In summer the average temperature is 80.6 degrees F, and the average daily maximum temperature is 92 degrees F. The highest recorded temperature, which occurred at Muskogee on July 13, 1954 is 114 degrees F.

The average annual precipitation for the past 30 years is 40.00 inches. Of this, 24.46 inches, or 61 percent, usually falls from April through September. The growing season for most crops occurs within this period. In two years out of ten, the rainfall in April through September is less than 19 inches. Table 2-2 is a histogram representation of the monthly averages for temperature and precipitation. The largest amount of rainfall occurs during the spring and fall with a moderate decrease in the summertime. The least amount of rainfall occurs during the winter months. Thunderstorms occur on about 50 days each year and most occur in the summer.

The average relative humidity in mid-afternoon is about 50 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in the summer and 55 percent in winter. The prevailing wind is from the south. The average windspeed is 12 miles per hour with the highest winds occurring in the spring (Soil Conservation Services, 1988).

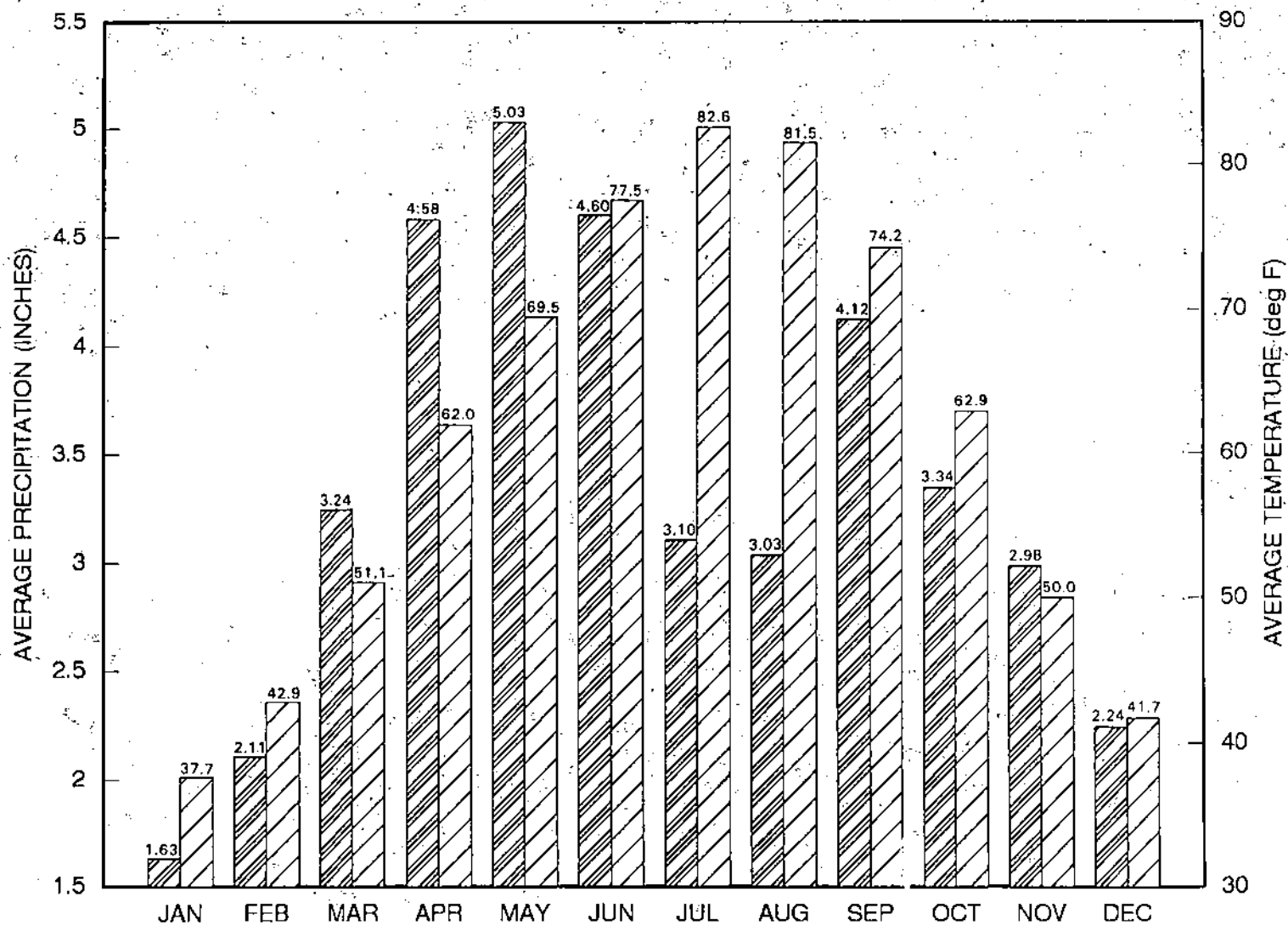
TABLE 2-1
TEMPERATURE AND PRECIPITATION

MONTH	AVERAGE TEMPERATURE (°F)	AVERAGE PRECIPITATION (inches)
January	37.7	1.63
February	42.9	2.11
March	51.1	3.24
April	62.0	4.58
May	69.5	5.03
June	77.5	4.60
July	82.6	3.10
August	81.5	3.03
September	74.2	4.12
October	62.9	3.34
November	50.0	2.98
December	41.7	2.24
YEARLY AVERAGE	61.2°F	40.00 inches

Note: All data are averaged for the years 1962 through 1991. National Oceanic and Atmospheric Administration, Climatological Data Annual Summary, Oklahoma 1991, Volume 100, Number 13.

HISTOGRAM OF AVERAGE TEMPERATURE AND PRECIPITATION

TABLE 2-2



Section 3

3.0 SOILS AND VEGETATIVE COVER

The following section describes the general soils of the region, site-specific soils, and vegetative cover and erosion potential of the study area. This section gives information about soil types, general physiography and drainage, and soil management.

3.1 General Soil Types

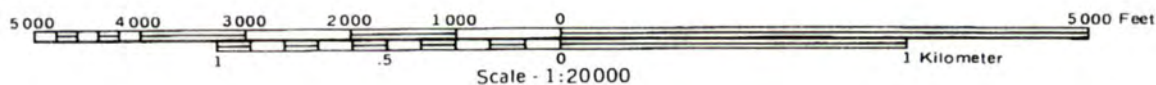
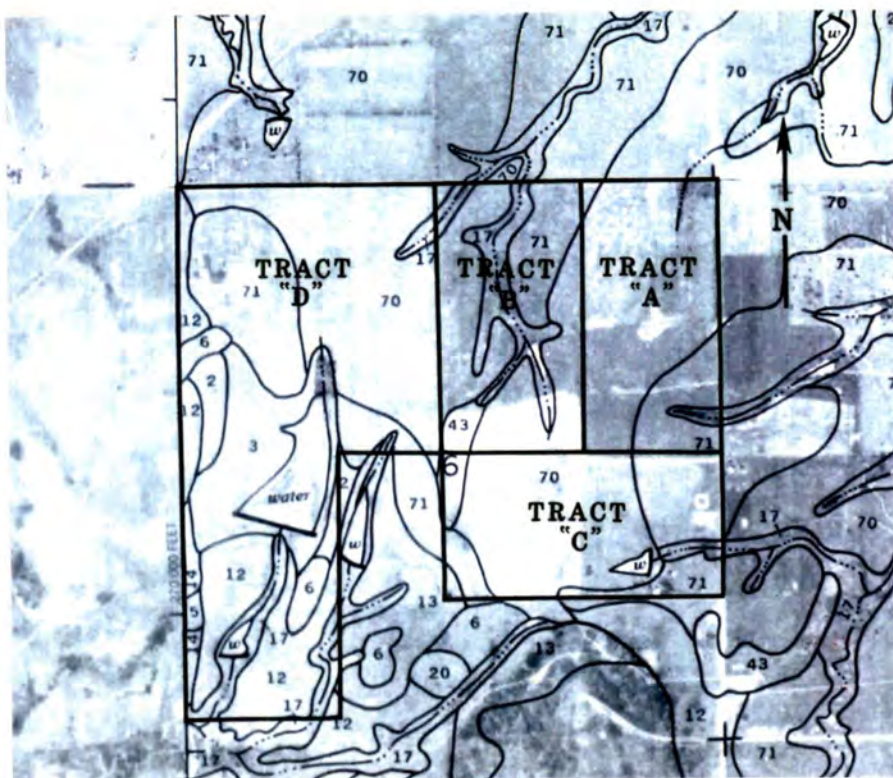
The general soils of the region consist mainly of two types: the Taloka-Parsons-Stigler soils and the Dennis-Bates-Coweta soils (Figure 3-1). Approximately 28 percent of Muskogee County consists of this soil series. It is about 32 percent Taloka soils, 22 percent Parsons soils, 21 percent Stigler soils, and 25 percent soils of minor extent (Soil Conservation Service, 1988). About 36 percent of the region is made up of Dennis-Bates-Coweta soils. Approximately 44 percent of this map unit consists of the Dennis soils, 24 percent of the Bates soils, 9 percent Coweta soils, and 23 percent soils of minor extent.

3.1.1 Taloka-Parsons-Stigler Soils

The Taloka-Parsons-Stigler map unit consists of soils that are nearly level to very gently sloping. The slopes range from zero to three percent. The soils are formed on broad, smooth uplands and high terraces or prairies. There are no prominent landforms in this unit. The water features in the area are farm ponds and scattered drainageways.

These soils are deep, somewhat poorly drained, and have low permeability. They have a loamy surface layer and a clayey subsoil.

Concerns in management for these soils include preventing erosion, maintaining soil tilth and fertility, and improving water intake. Terraces are needed for these soils to decrease soil erosion where slopes



Legend of Soil Units:

2	Bates Loam (1 - 3% slope)
3	Bates Loam (3 - 5% slope)
5	Bates-Coweta Fine Sandy Loams (1 - 3% slope)
6	Bates - Coweta Fine Sandy Loams (3 - 5% slope)
12	Dennis Silt Loam (1 - 3% slope)
13	Dennis Silt Loam (3 - 5% slope)
14	Dennis Silt Loam (2 - 5% eroded slope)
17	Dennis-Verdigris Complex
43	Oil-Waste Land
70	Taloka Silt Loam (0 - 1% slope)
71	Taloka Silt Loam (1 - 3% slope)

Modified from Soil Conservation Service, 1988.

RUST ENVIRONMENT & INFRASTRUCTURE

LOCAL SOILS MAP

FIGURE 3-1

exceed one percent. These soils have low potential for most urban uses. Low strength, wetness, and the high shrink-swell potential are the main limitations (Soil Conservation Service, 1988).

3.1.2 Dennis-Bates-Coweta Soils

This unit is very gently sloping to moderately steep, and is on moderately long, smooth slopes on uplands with occasional sandstone outcrops. The slope ranges from one to 15 percent and is drained by small streams. Soils from this unit, particularly Coweta soils, are present approximately one-half mile to the south of Tract A. Water features consists of farm ponds and streams that are major drainageways. Other land uses are oil and gas production, coal strip mining, and flagstone production.

Dennis soils are on smooth, convex side slopes of uplands. These soils are deep, sloping, moderately well drained, and slowly permeable. They have a loamy surface layer and a clayey subsoil.

Bates soils are in higher positions than Dennis soils on smooth, slightly convex side slopes. Bates soils are moderately deep, very gently to gently sloping, well drained, and moderately permeable. They also have a loamy surface layer and a loamy subsoil. These soils formed in residuum weathered from sandstone and thin layers of shale.

Coweta soils are on convex ridges and side slopes of uplands. These soils are shallow, very gently sloping to strongly sloping, well drained and somewhat excessively drained, and moderately permeable. They have a loamy surface layer and subsoil underlain by soft sandstone. The soils of this map unit are used mainly for native grasses or tame pasture. The main concerns are erosion control and maintenance of

soil tilth and fertility. Terraces and residue management are used to help control erosion. These soils have low potential for most urban uses. (Soil Conservation Service, 1988).

3.2 Site-Specific Soil Types

The site-specific soil types are described by the Poe and Associates' investigation and the information available from the Muskogee County Soil Conservation Service.

3.2.1 Soils Investigation by Poe and Associates

During the geotechnical evaluation performed by Poe and Associates, residual clay soils were identified to overlie the majority of the site. It was determined that within this clay unit exists two soil types. The upper two feet consists of a highly weathered and leached topsoil zone. Clay subsoil thickness ranges from 11 to 19 feet. The subsoils have developed as a result of in-situ physio-chemical weathering processes acting on the silty shales of the Savanna Formation (described in Section 4.1) for the past 10,000 years or more. In the field, the soil was described as a brown and gray mottled clay, containing numerous iron-manganese stains and nodules. These characteristics indicated the internal soil drainage is very slow and the soil remains moist during most of the year. It should be emphasized that the subsurface clay is continuous across Tract A. Minor changes in thickness are to be expected but the physical properties show very little variation across the existing landfill site.

3.2.2 Soil Conservation Services Soil Survey

According to the Muskogee County Soil Survey, Tract A consists of approximately 75 percent Taloka silt loam (zero to one percent slope) with the remaining 25 percent Taloka silt loam (one to three percent slope).

Taloka silt loam (zero to one percent slope) is deep, nearly level, and a somewhat poorly drained soil. Typically, the surface layer and subsurface layer are very dark, grayish brown silt loam. The subsoil is clay (Soil Conservation Service, 1988).

This soil is medium in natural fertility, and the organic matter content is low. The surface layer is slightly acid to strongly acid. Permeability is very low, and the available water capacity is high. The soil has good tilth and can be worked throughout a moderate range of moisture content.

The remaining 25 percent of Tract A consists of Taloka silt loam (one to three percent slope). This type of soil is much like the soils described above, with only slight variations in thicknesses of the loam and subsurface layers (Soil Conservation Service, 1988).

3.3. Vegetation Cover and Erosion Potential

The vegetative cover for the Taloka silt loam soils is used for tame pasture or for native range or hayland. This soil has a high potential for native grasses and tame pasture (a combination of Bermuda grass or tall fescue and clover). Soil erosion is considered a major concern, and erosion is decreased with fertility and tilth maintenance of vegetative cover. Control of erosion is also aided by controlling storm-water runoff from the facility.

Section 4

4.0 GEOLOGIC SETTING

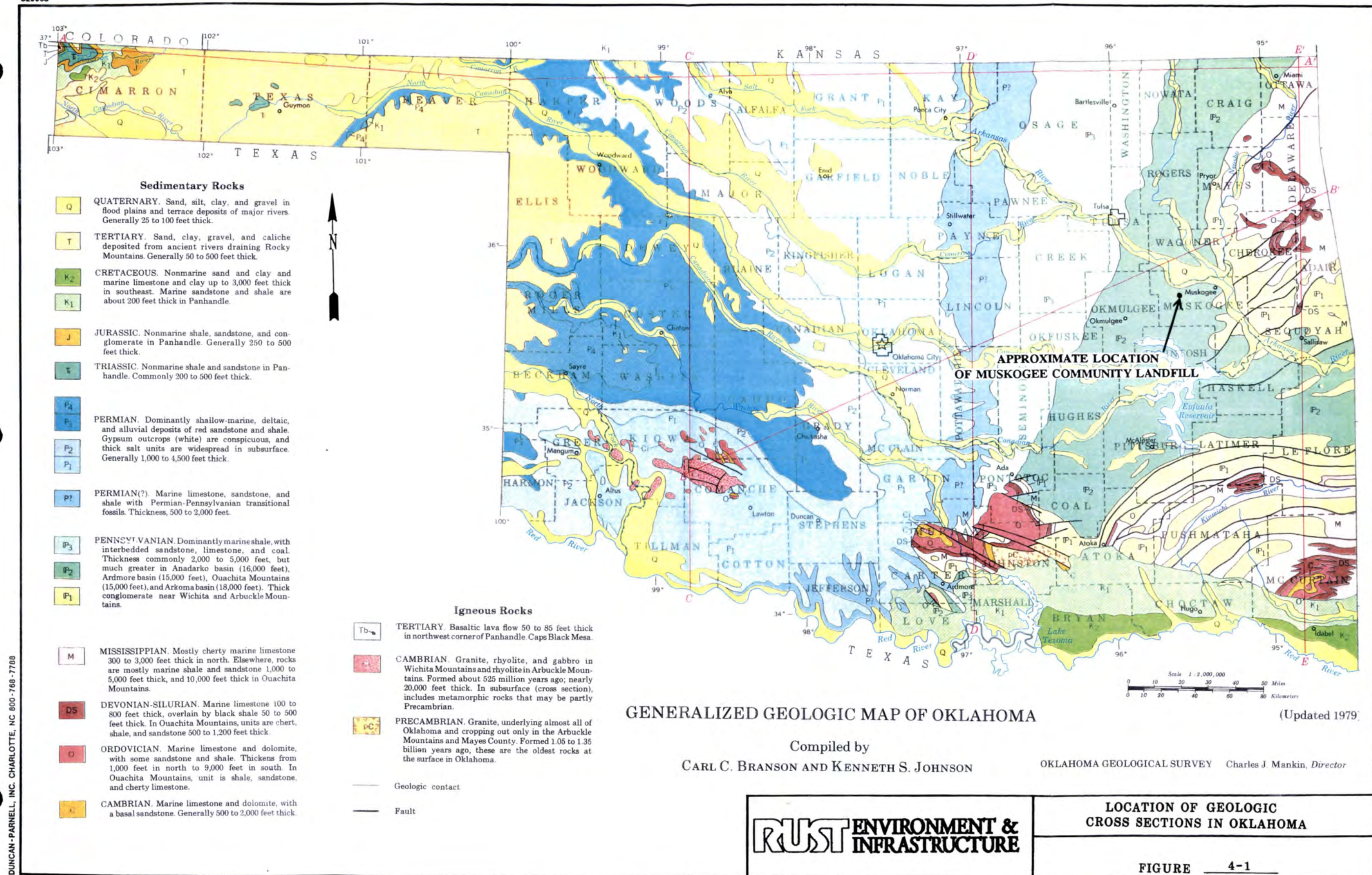
The following section describes the setting of surface and subsurface geologic units across the region and at the facility. The following topics will be discussed: regional geology, stratigraphy, structural features, geologic history and environment of deposition, site geology, and petroleum geology.

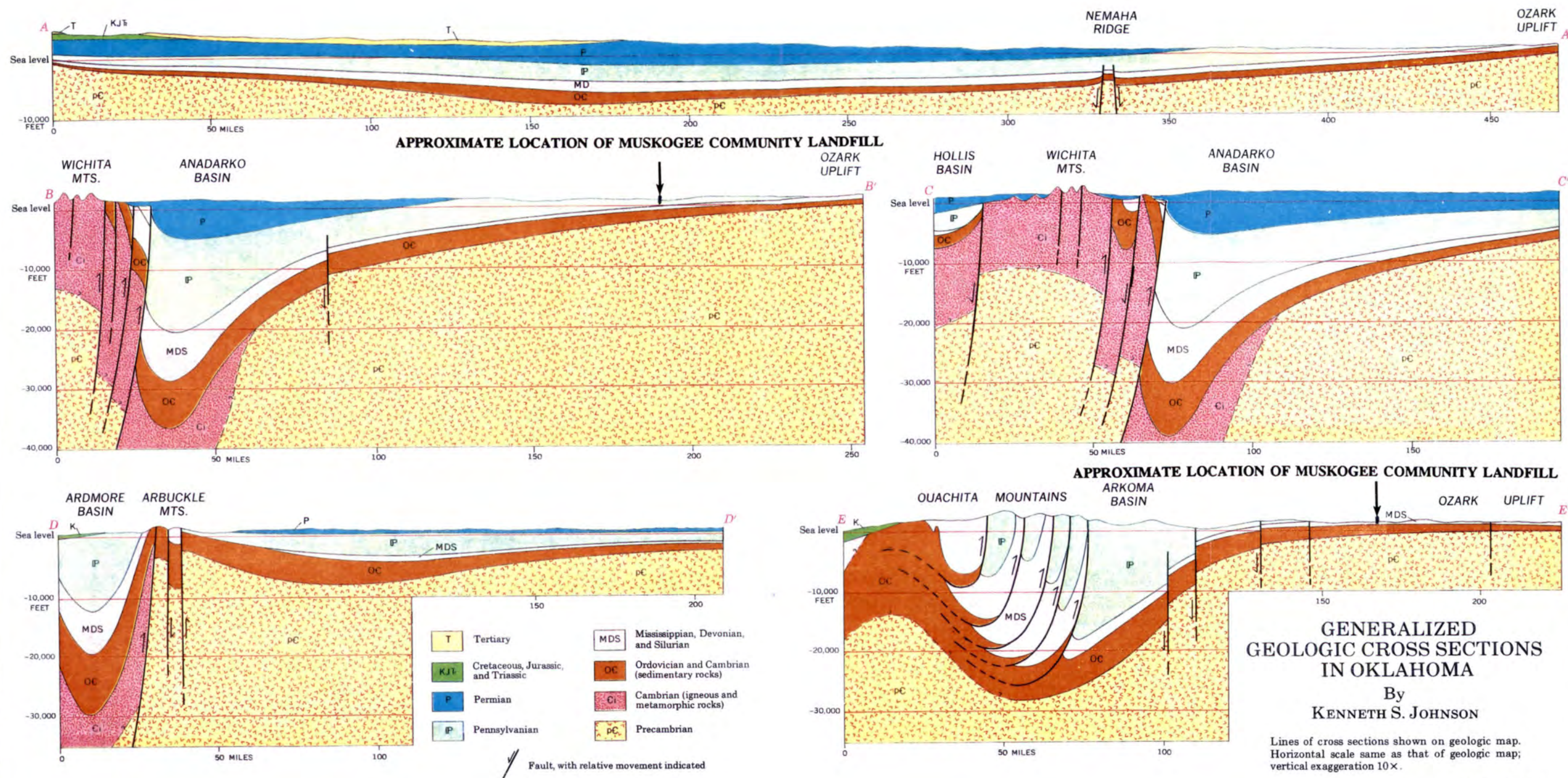
4.1 Regional Geology

The regional geology of the area consists of sedimentary rocks ranging in age from the Quaternary period to the Mississippian period. Quaternary alluvium and terrace deposits are located along the Arkansas River and along portions of Coody Creek and Pecan Creek. Pennsylvanian marine shales, interbedded with sandstone, limestone, and coal are found adjacent to the alluvium and terrace deposits of the Arkansas River. Mississippian shales, limestones, and cherts are located northwest of Muskogee County, while additional Pennsylvanian rocks are found north, east and south of Muskogee County. Figure 4-1 presents the surface geology of Oklahoma and Figure 4-2 presents the generalized subsurface stratigraphy and structural features of Oklahoma. Note that cross sections B-B' and E-E' show the stratigraphy closest to the study area.

4.2 Stratigraphy

The facility sits atop the transition zone of the Arkoma Basin and the Northern Shelf near the Ozark Uplift. Figure 4-3 shows the locations of the Arkoma Basin, Northern Shelf and Ozark Uplift throughout northeastern and central Oklahoma. The Arkoma Basin consists of the Desmoinesian, Atokan and Morrowan series as it developed through the Pennsylvanian period. Table 4-1 shows the geologic framework of the Arkoma Basin. The Desmoinesian series is made up of the Boggy, Savanna, McAlester, and Hartshorne Formations. As shown in Figure 4-4, the Savanna Formation underlies the facility with the Boggy Formation cropping





GENERALIZED GEOLOGIC CROSS SECTIONS IN OKLAHOMA

By
KENNETH S. JOHNSON

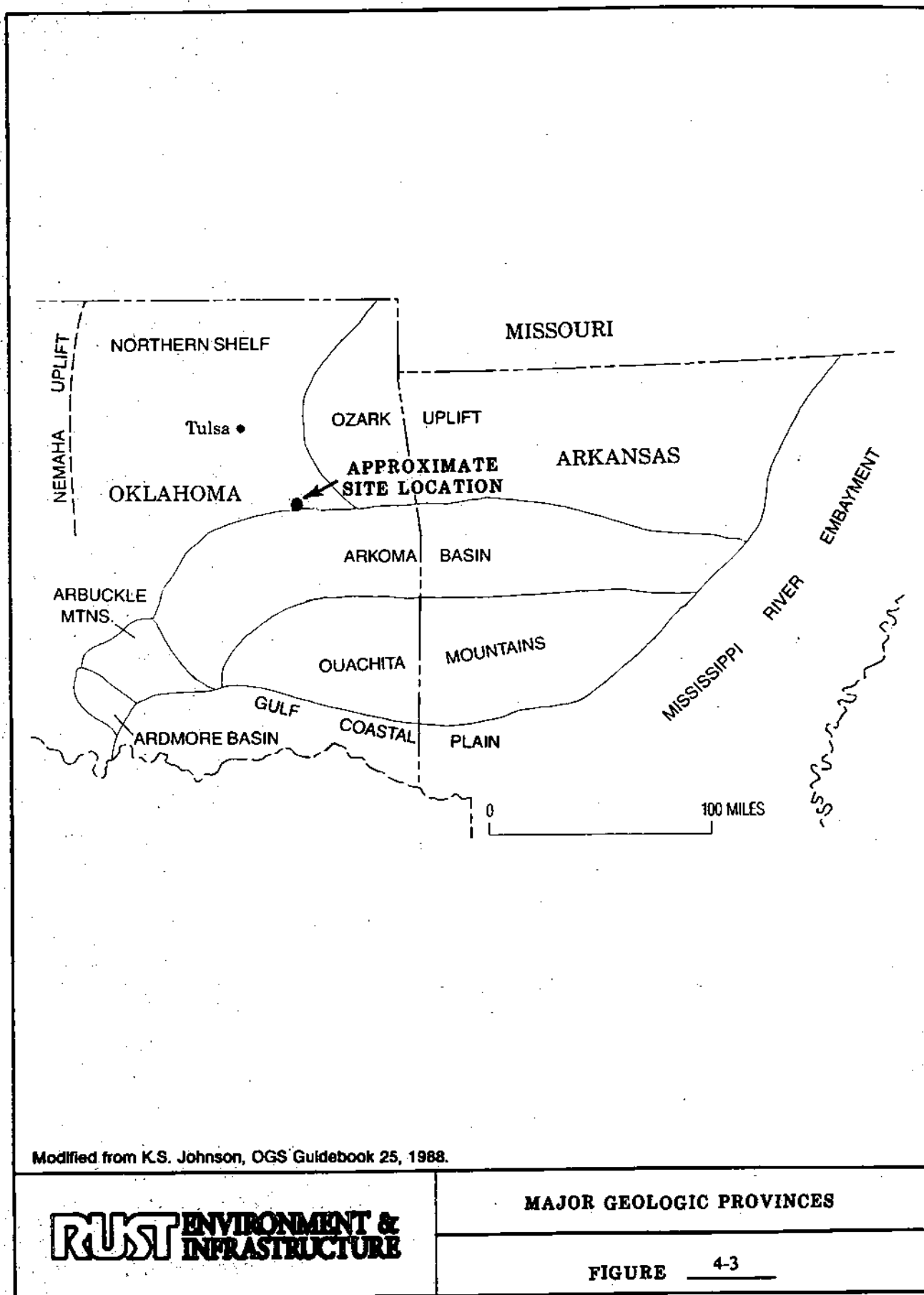
Lines of cross sections shown on geologic map.
Horizontal scale same as that of geologic map;
vertical exaggeration 10×.

(Updated 1979)

RUST ENVIRONMENT & INFRASTRUCTURE

GENERALIZED GEOLOGIC
CROSS SECTIONS IN OKLAHOHMA

FIGURE 4-2



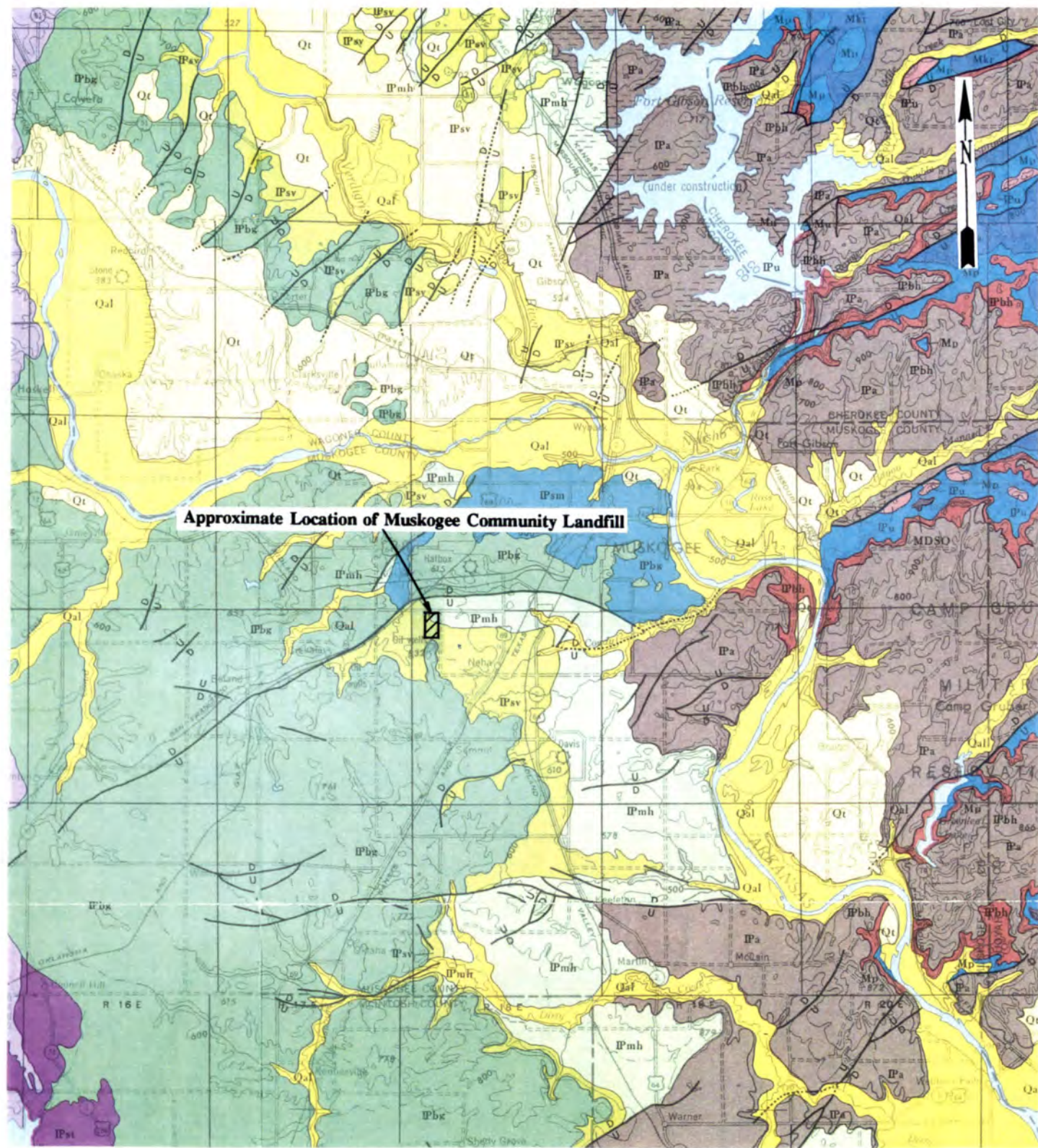
SERIES		ARKOMA BASIN		
PENNSYLVANIAN	Desmoinesian	Krebs Gp.	Boggy Fm.	Pbg
			Savanna Fm.	Psv
			McAlester Fm.	Pma
			Hartshorne Fm.	Upper Lower Phs
	Atokan		Atoka Fm.	Pa
	Morrowan		Wapanucka Ls. Union Valley Ls. Cromwell ss.	Pm
MISSISSIPPIAN	Chesterian	"Caney" Sh.		MD
	Meramecian			
	Osagean			
	Kinderhookian			
DEVONIAN	Upper	Woodford Sh.		DSOhs
	Lower	Hunton Gp.	Frisco Ls. Bois d'Arc Ls. Haragan Ls.	
SILURIAN	Upper		Henryhouse Fm.	
	Lower	Chimneyhill Subgroup		
ORDOVICIAN	Upper	Viola Gp.	Sylvan Sh.	Ovs
	Middle		Welling Fm. Viola Springs Fm.	
		Simpson Gp.	Bromide Fm. Tulip Creek Fm. McLish Fm. Oil Creek Fm. Joins Fm.	
CAMBRIAN	Lower	Arbuckle Gp.	West Spring Creek Fm. Kindblade Fm. Cool Creek Fm. McKenzie Hill Fm. Butterfly Dol.	OCa
	Upper		Signal Mountain Ls. Royer Dol. Fort Sill Ls.	
		Timbered Hills Gp.	Honey Creek Ls. Reagan Ss.	
PRECAMBRIAN		Granite and rhyolite		pC

Modified from
K.S. Johnson, OGS
Guidebook 25, 1988.

RUST ENVIRONMENT &
INFRASTRUCTURE

STRATIGRAPHIC CHART FOR THE ARKOMA BASIN

TABLE 4-1



Scale 1:250,000

Contour interval: 100 feet

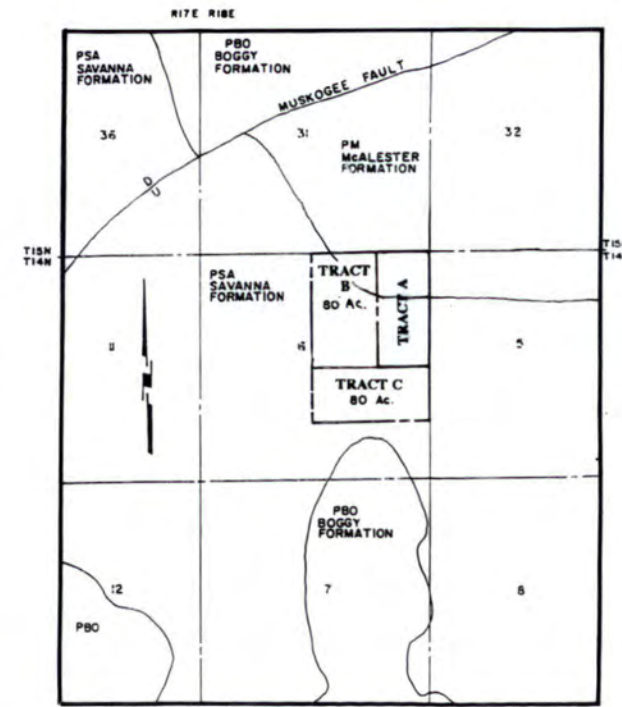
Datum: Mean sea level

U.S. Geological Survey, 1967.

EXPLANATION

- QUATERNARY**
- Qal**
ALLUVIUM
Gravel, sand, silt, and clay. Yields large amounts of water of good quality along the Arkansas River and probably will yield moderate to large amounts along the Canadian River.
 - Qt**
TERRACE DEPOSITS
Gravel, sand, silt, and clay. Yield moderate to large amounts of water of good quality locally along the Arkansas River; smaller amounts elsewhere.
- MISSISSIPPIAN, DEVONIAN, SILURIAN, AND ORDOVICIAN**
- Ip**
STUART SHALE
Shale and minor sandstones. Probably will yield only limited amounts of water of poor quality.
 - Is**
THURMAN SANDSTONE
Sandstone and shale. Probably will yield only limited amounts of water of poor quality.
 - Ipbg**
BOGGY FORMATION
Shale, sandstone, and coal; includes Bluejacket Sandstone Member at base. Yields limited amounts of water of poor quality.
- PENNSYLVANIAN**
- IPsm** **IPsv**
SAVANNA, McALESTER, AND HARTSHORNE FORMATIONS
 - IPsv** Savanna Formation, shale, sandstone, and coal. Yields limited amounts of water of poor quality.
 - IPmh** McAlester and Hartshorne Formations (undifferentiated), shale, sandstone, and coal. Yield limited amounts of water of poor quality.
 - IPsm** Savanna and McAlester Formations (undifferentiated; T. 15 N., Rs. 18, 19 E.), shale and minor sandstones. Yield limited amounts of water of poor quality.
 - IPa** **IPb**
ATOKA, BLOYD, AND HALE FORMATIONS
 - IPu** Undifferentiated.
 - IPa** Atoka Formation, shale and sandstone. Yields limited amounts of water of poor quality.
 - IPbh** Boyd Formation, shale and limestone; and Hale Formation, limestone and sandstone. Probably will yield only small amounts of water of fair to poor quality.

- MISSISSIPPIAN**
- Mu**
MISSISSIPPIAN ROCKS ABOVE CHATTANOOGA SHALE
Undifferentiated.
 - Mp** Pitkin Formation, limestone; Fayetteville Formation, shale and limestone; Hindsville Formation, limestone and shale; and Moorefield Formation, limestone.
 - Mkr** Keokuk Formation, chert; Reeds Spring Formation, chert and limestone; and St. Joe "Group," limestone and marlstone. Yield small to moderate amounts of water of fair to good quality.
- MISSISSIPPIAN, DEVONIAN, SILURIAN, AND ORDOVICIAN**
- MDSO**
MISSISSIPPIAN, DEVONIAN, SILURIAN, AND ORDOVICIAN ROCKS, UNDIFFERENTIATED
Mississippian and Devonian. Chattanooga Shale, shale.
Devonian. Sallisaw Formation, limestone, sandstone, and chert; and Frisco Formation, limestone.
Silurian. Quarry Mountain Formation, limestone; Tenkiller Formation, limestone; and Blackgun Formation, limestone and dolomite.
Ordovician. Sylvan Shale, shale; Fernvale Limestone, limestone; Fite Limestone, limestone; Tyner Formation, shale, sandstone, dolomite, and limestone; Burgen Sandstone, sandstone and minor shales and limestones; and Catter Dolomite, dolomite.
Limestone, dolomite, and sandstone units may yield small to moderate amounts of water of fair to good quality; shale units probably will yield only limited amounts of water of poor to fair quality.



Vicinity Map

REGIONAL GEOLOGIC MAP

FIGURE 4-4

RUST ENVIRONMENT & INFRASTRUCTURE

out directly to the south; the McAlester and Hartshorne Formations are located on the northeastern corner of the property.

The Savanna Formation consists of shales, silty shales and sandstones, with discontinuous limestone beds and coal seams. The silty shales and shales are highly variable in thickness and character; in this portion of Muskogee County, the Savanna Formation has been determined to be about 170 feet thick (Poe and Associates, 1988). The outcrops trend in a northwest-southeast direction, and as with other Pennsylvanian formations in the area, the Savanna becomes thinner to the north and dips gently to the west-southwest, except where it intercepts structural features.

There are seven coal beds which have been identified by the OGS within the Savanna Formation. Of the seven, four are of sufficient thicknesses to be named. Thickness of these beds ranges from 0.1 to 3.0 feet. The four beds are the Drywood coal, the Rowe coal, the Sam Creek coal, and the Tallahassee coal (OGS Guidebook 25, 1988). The Rowe coal has been encountered in previous drilling activities at the facility.

Located directly to south of the facility is a topographic feature with an elevation of approximately 800 feet msl. This feature is made up of the Boggy Formation which is the youngest of the Pennsylvanian shales, sandstones, and coal beds. The formation includes the Bluejacket Sandstone Member at the base which yields limited amounts of water of poor quality. This sandstone unit forms resistant ridges which are common in Muskogee County (Oklahoma Geological Society, 1988). Three coal beds -- an unnamed coal, the Secor coal, and the Secor rider coal -- have been identified with confidence in the lower Boggy Formation in this part of the Arkoma Basin. The Secor coal occurs almost immediately above the Bluejacket Sandstone in the area. It is generally overlain by a shale or siltstone unit (OGS Guidebook 25, 1988).

The McAlester and Hartshorne Formations are located on the northeast corner of Tract A. The two formations are undifferentiated and consist of shale, sandstone, and coal. These formations yield limited amounts of poor quality water (OGS, 1988).

4.3 Structural Features

Two important geological structures exist near the site. The first is the Muskogee Fault, a northeast trending normal fault with about 600 feet of vertical displacement (Figure 4-4). The upthrown block occurs on the south side of the fault trace and the surface expression is 1.5 miles north of the site. At the present time, it is unknown whether the fault is active or has been active in recent years. A seismicity study is currently being conducted as part of the Subtitle D Siting Criteria. Geologic maps prepared by the Oklahoma Geologic Survey document this fault and the fault can be identified on aerial photographs. The section of the Muskogee fault, seen in Figure 2-2, is trending east-west approximately three-quarter mile (following Coody Creek) north of Tract A. The fault trace can be seen in the area northwest of Tract A between the railroad tracks. The creeks running both northwest and southeast off Coody Creek are very linear and may represent splays running off the main fault.

The second geologic structure is a broad, gentle, northward plunging anticline with the axis one-half mile east of the site. This feature is suggested by local outcrop mapping, strike and dip measurements, attitude of coal seams, and the position of the Muskogee Oil Field to the east. This anticline is not documented on maps but appears in cross sections from oil and gas surveys from the OGS.

The Oklahoma Geologic Survey indicates two additional faults approximately five miles east of the site (Figure 4-4). One fault trends in a west-southwest to east-northeast direction and the surface expression is concealed in the Quaternary alluvium of Coody Creek. The second fault is in the McAlester Formation and

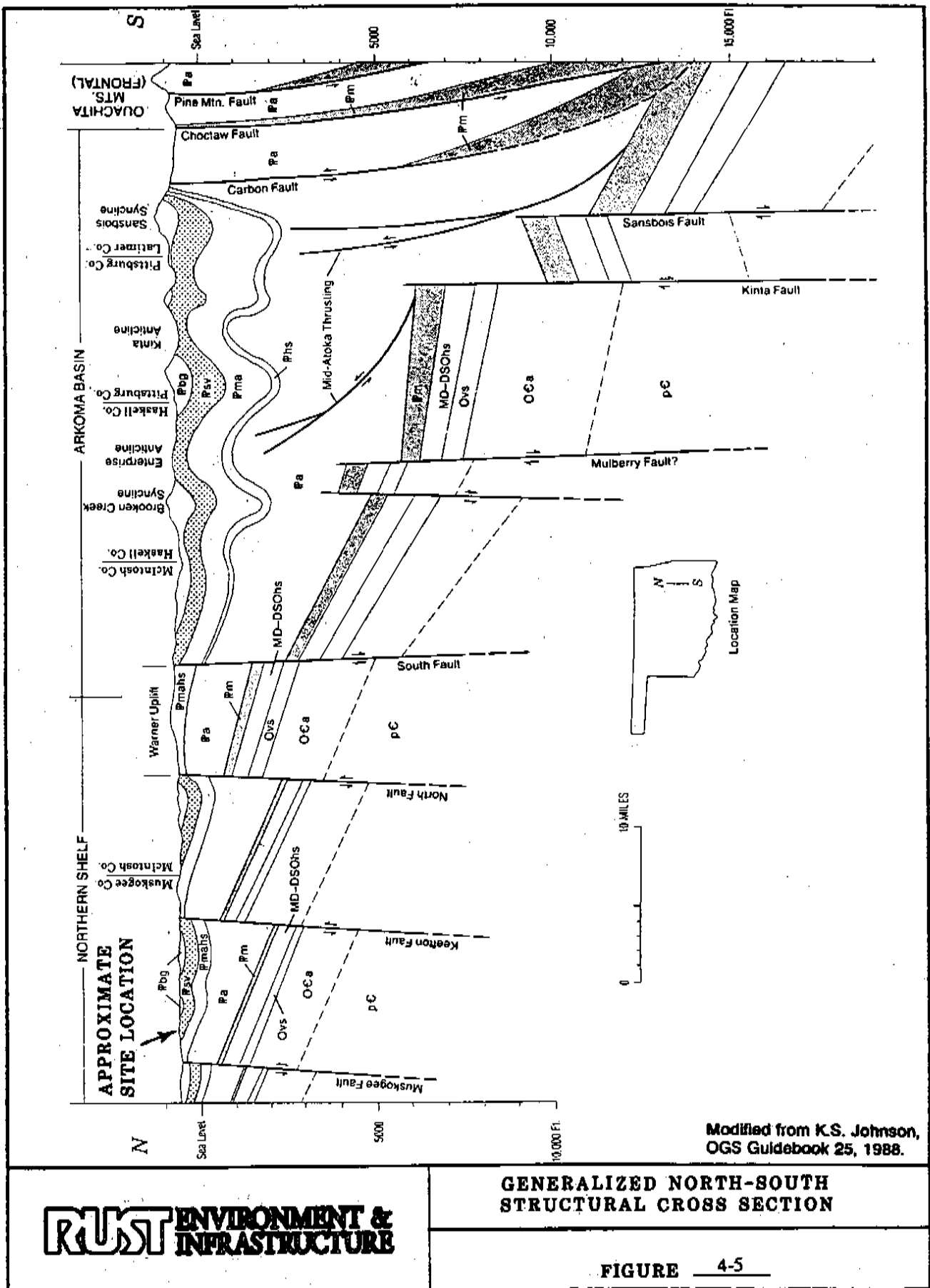
trends south-southwest to north-northeast, masked by the alluvial deposits of Coody Creek and tributaries. Figure 4-5 presents the generalized geologic cross section in Oklahoma.

4.4 Geologic History and Environment of Deposition

The facility is located on the transition of the Arkoma Basin Province and the Northern Shelf Province. The Arkoma Basin is a major tectonic province geographically located in eastern Oklahoma and central and western Arkansas (Figure 4-3). The Arkoma Basin is bounded to the north by the Ozark Uplift and grades northwestward onto the Northern Shelf Province. To the southwest, the basin is bound by the Arbuckle Mountains, and to the south by the Ouachita Mountains. The development of the Arkoma Basin is tied closely to that of the Ouachita Province. Both tectonic features were most active during the Early and Middle Pennsylvanian periods.

During the pre-Pennsylvanian times, the Arkoma Basin consisted of a broad epicontinental shelf that received shallow-water carbonates and clastics deposited during the Cambrian through Mississippian periods. These sediments graded southward into a deep-water basins consisting of black shales and cherts that accumulated in the Ouachita geosyncline. Morrowan and early Atokan sediments were deposited in a similar fashion of shelf sedimentation in the Arkoma Basin and deep-water sedimentation in the Ouachita trough. Deposition of the Atokan Series strata were through meandering fluvial and deltaic process with their source areas being to the north and northwest.

These processes continued through the late Atokan time, in which the Ouachita Trough experienced orogenic activity, including folding, thrusting, and marked uplift of the Ouachita facies. This uplift, called the Ouachita orogeny, resulted from the collision of the South American plate into the North American Craton and the resultant destruction of the Ouachita Trough.

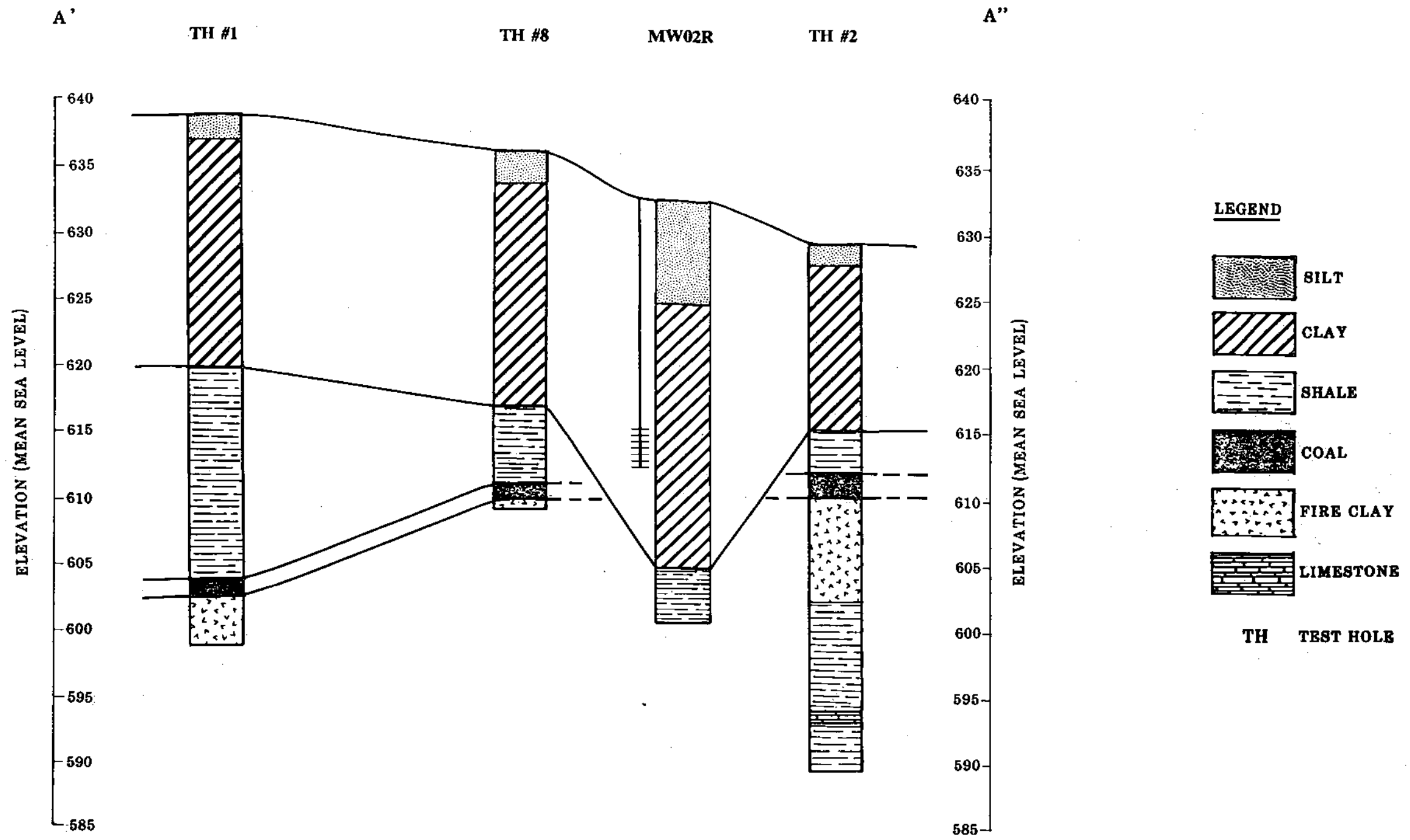


With the destruction of the Ouachita Trough, the center of deposition was shifted northwest in the Arkoma Basin. The derivation of sediments continued from northern sources, and the basin continued to intermittently subside through Desmoinesian time. Early Desmoinesian formations, like the Savannah and Boggy Formations, were formed as the depositional environments passed through transgressive marine sedimentation, deltaic sedimentation, and into fluvial sedimentation, in which coal swamps developed during episodes of marine regression (OGS Guidebook 25, 1988).

4.5 Site Geology

As documented by the geotechnical report by Poe and Associates, and the soils boring logs of three ground-water monitoring wells installed by RUST E&I in November, 1992, the subsurface conditions of the site consist of residual clay soils underlain by shale. These sediments are primarily part of the Savannah Formation. The location of all the previous borings, ground-water monitoring well, and orientation of cross section lines are presented in Figure 4-6. The residual soils are continuous across Tract A, as shown in Figures 4-7 through 4-14 which demonstrate cross sections of the borings performed by Poe and Associates across Tract A.

The Poe and Associates report differentiates between weathered shale and unweathered shale. The shale logged in the RUST E&I borings corresponds closely to the unweathered shale as picked by Poe and Associates. The weathered shale zone ranges from eight to 20 feet in thickness. Other encountered lithologies include coal seams, sandstone and siltstone layers, and limestone beds. Figure 4-15 presents a composite stratigraphic section for Tract A. Appendix A presents all soil borehole logs. It is important to note the convention used in the presentation of borehole logs 1 through 15. The depths marked indicate the base of the bed, not the top of the bed.



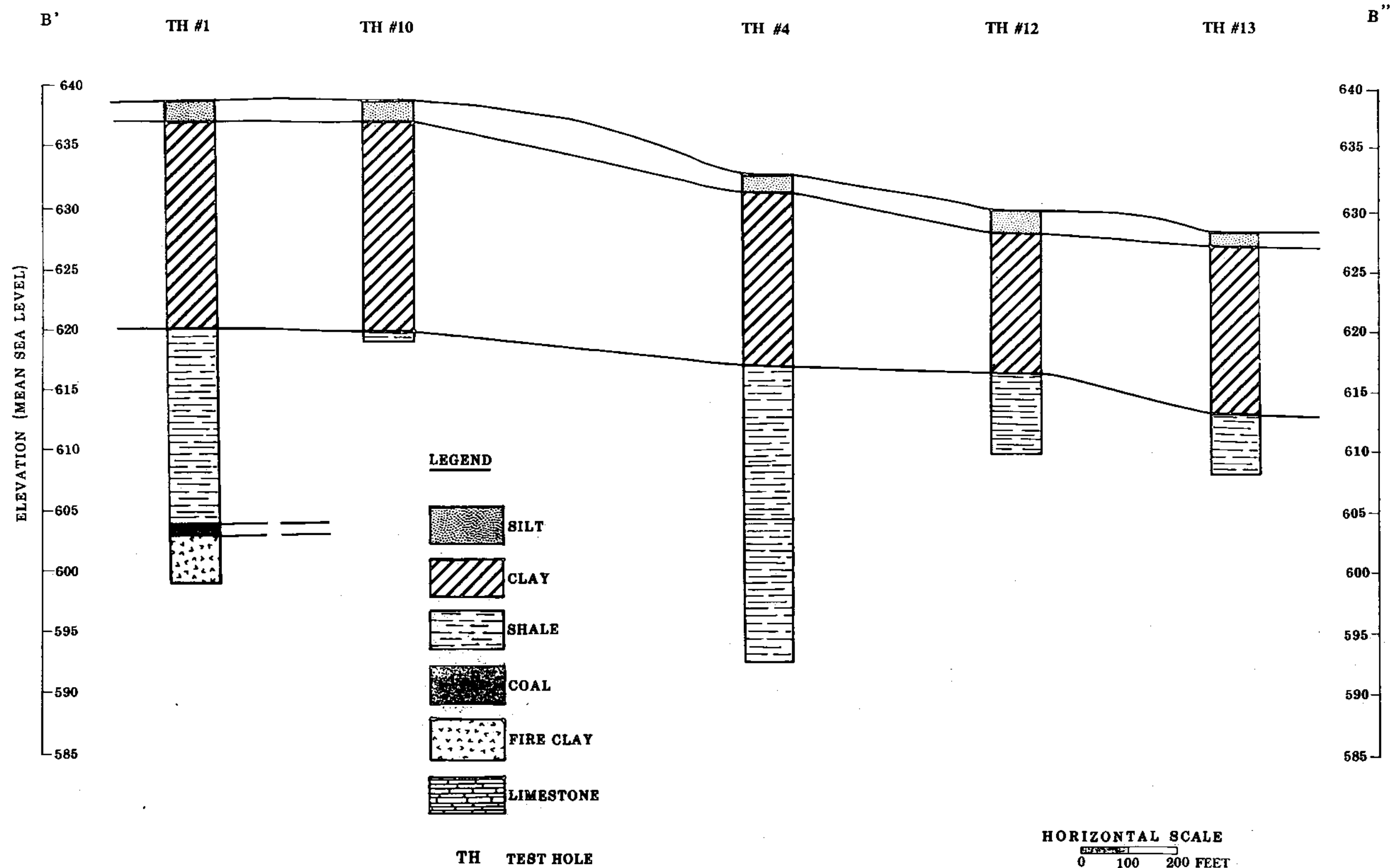
NOTE: THE ELEVATION OF MW02R IS BASED ON CURRENT SURVEYED ELEVATIONS. THE REMAINING TEST HOLE ELEVATIONS ARE BASED ON DATA PROVIDED BY POE AND ASSOCIATES.

HORIZONTAL SCALE
0 100 200 FEET

RUST ENVIRONMENT & INFRASTRUCTURE

CROSS SECTION A'-A''

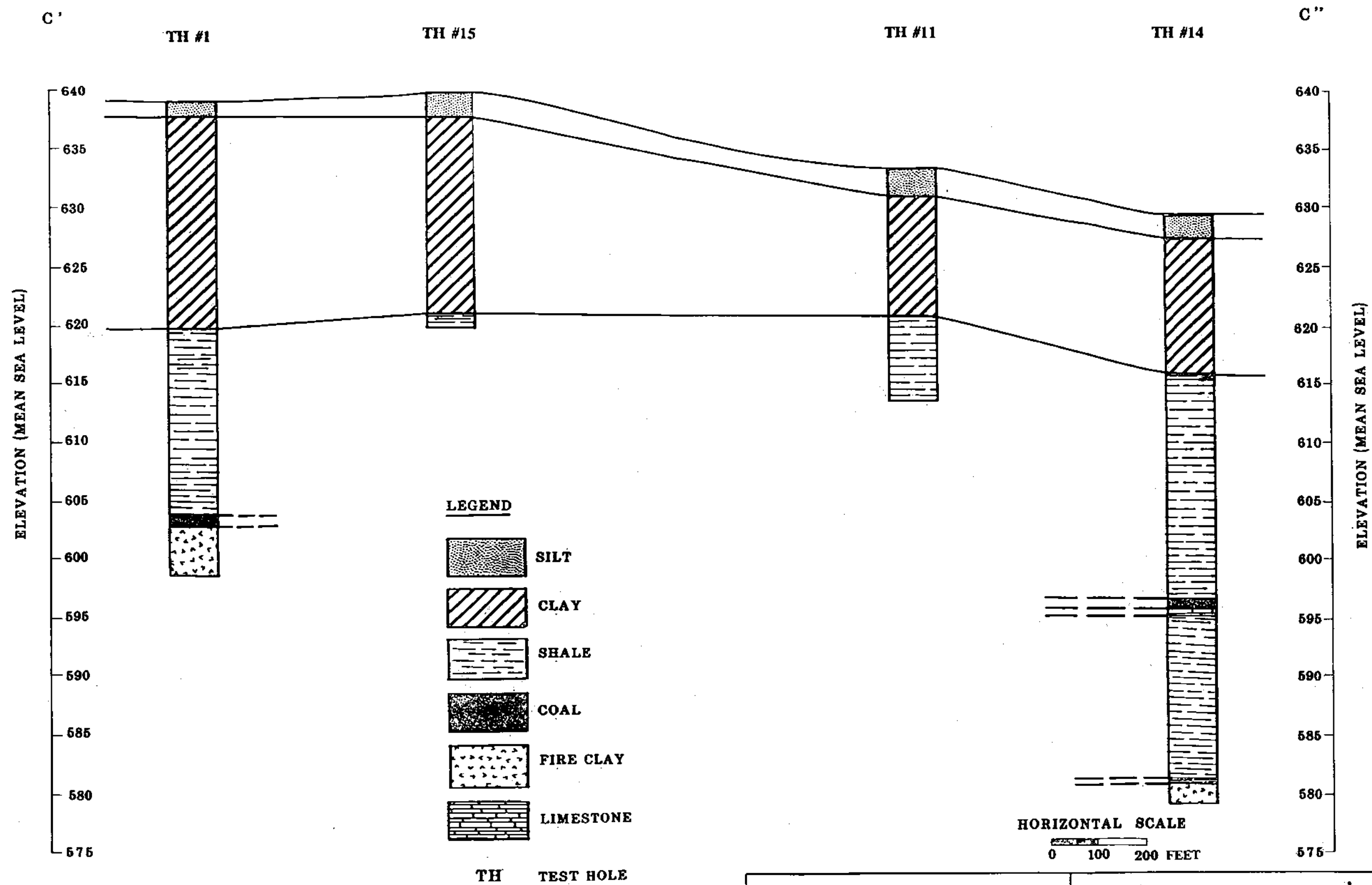
FIGURE 4-7



RUST ENVIRONMENT & INFRASTRUCTURE

CROSS SECTION B'-B''

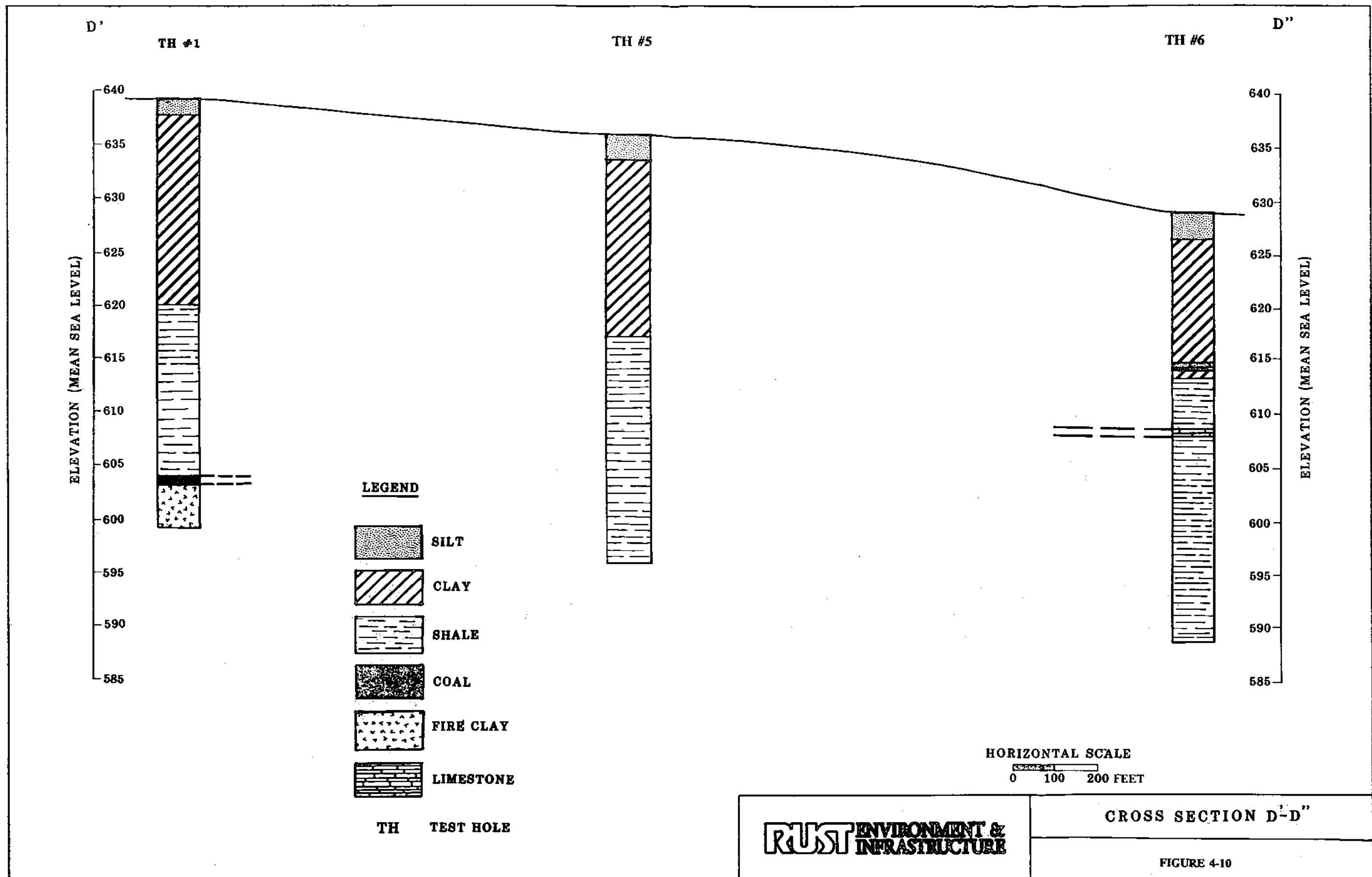
FIGURE 4-8

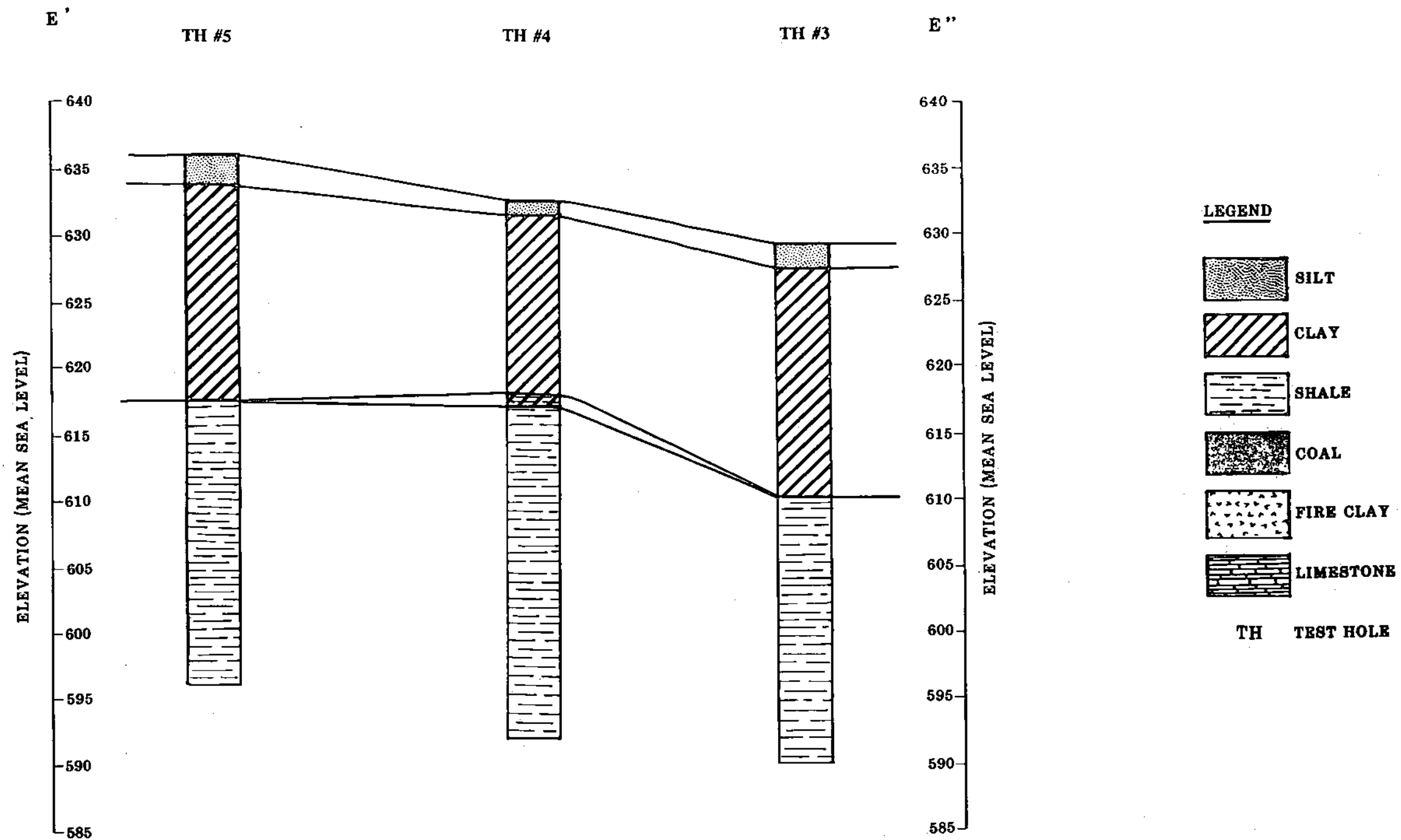


RUST ENVIRONMENT & INFRASTRUCTURE

CROSS SECTION C'-C''

FIGURE 4-9

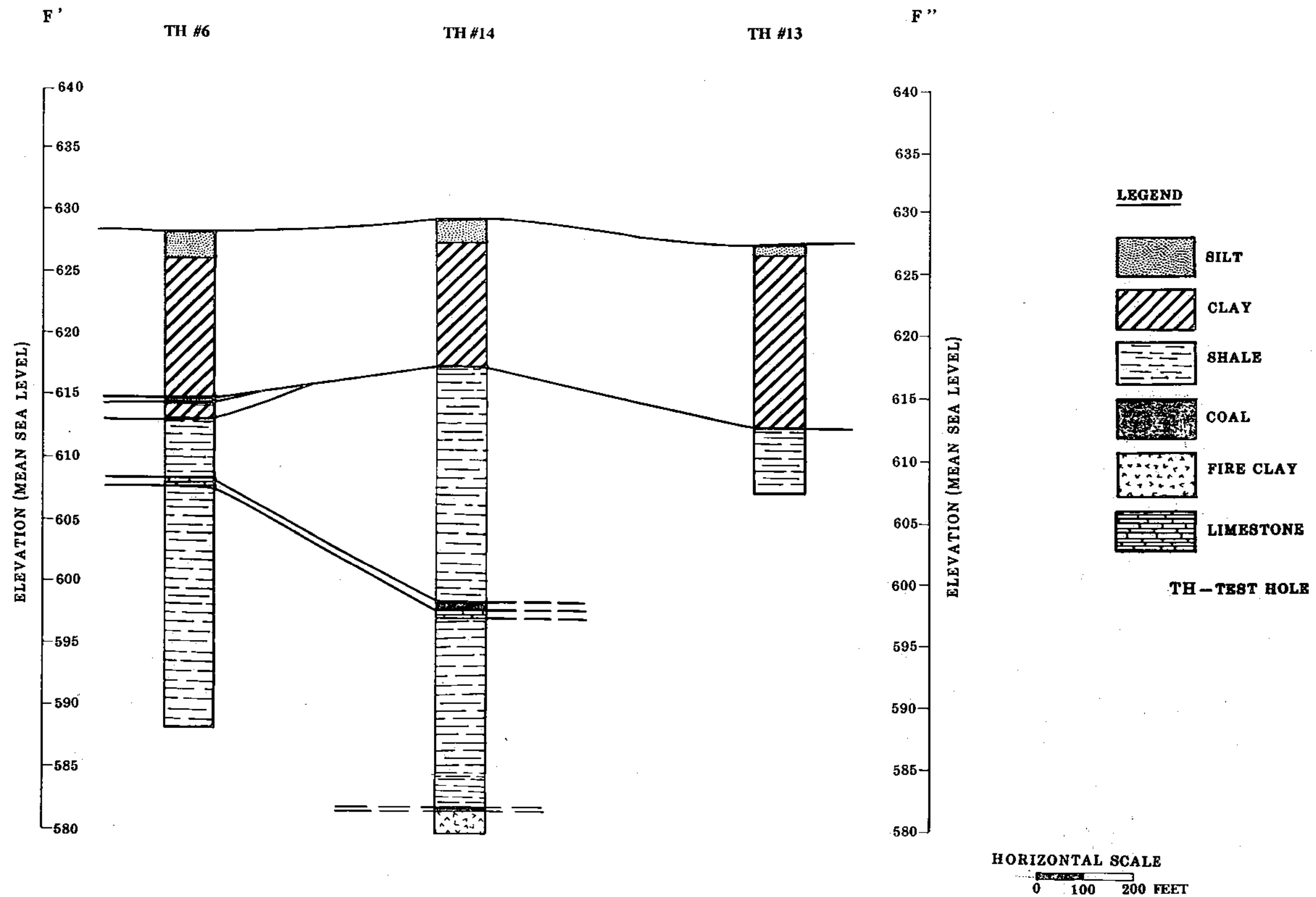




RUST ENVIRONMENT & INFRASTRUCTURE

CROSS SECTION E'-E''

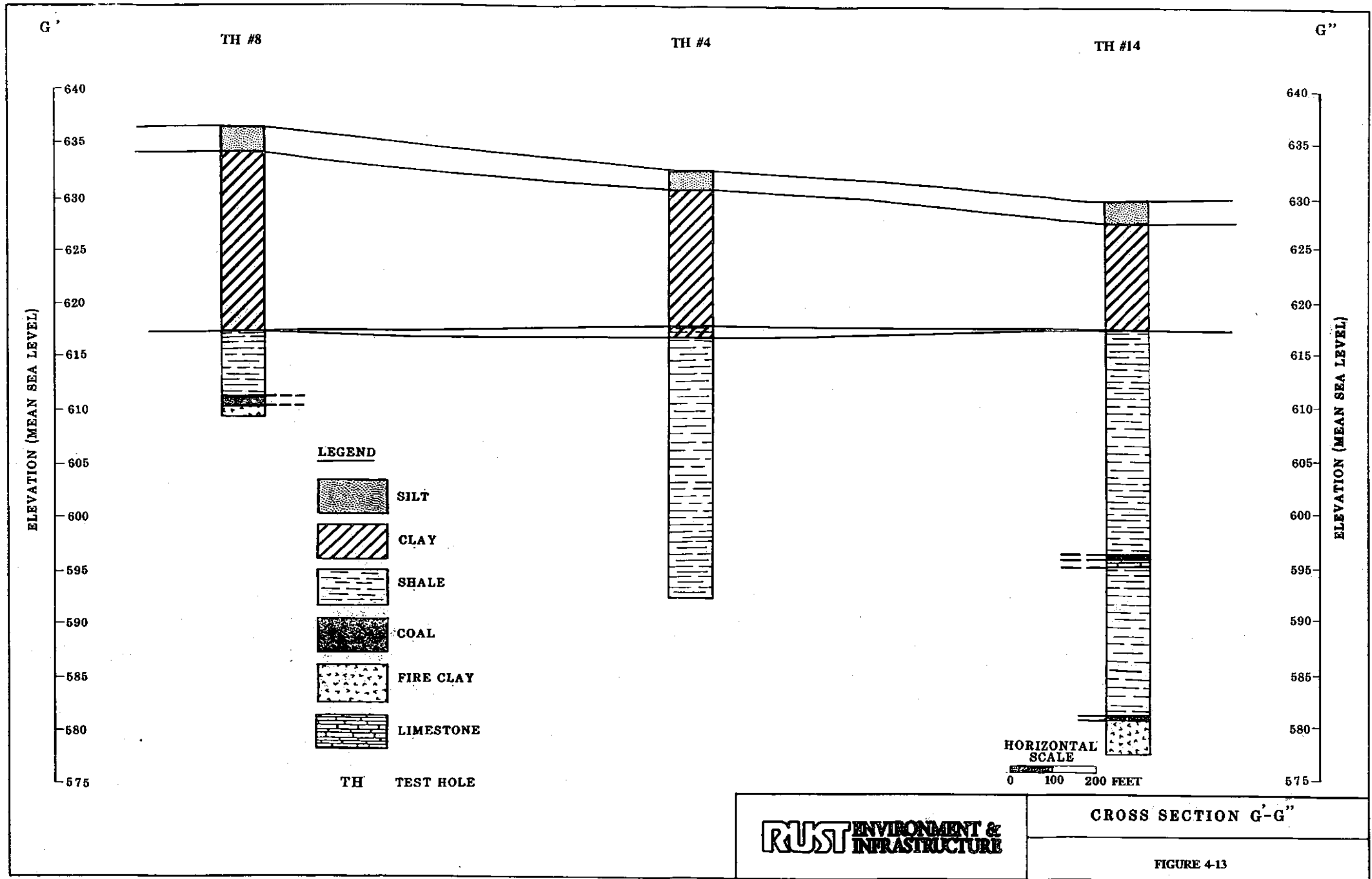
FIGURE 4-11

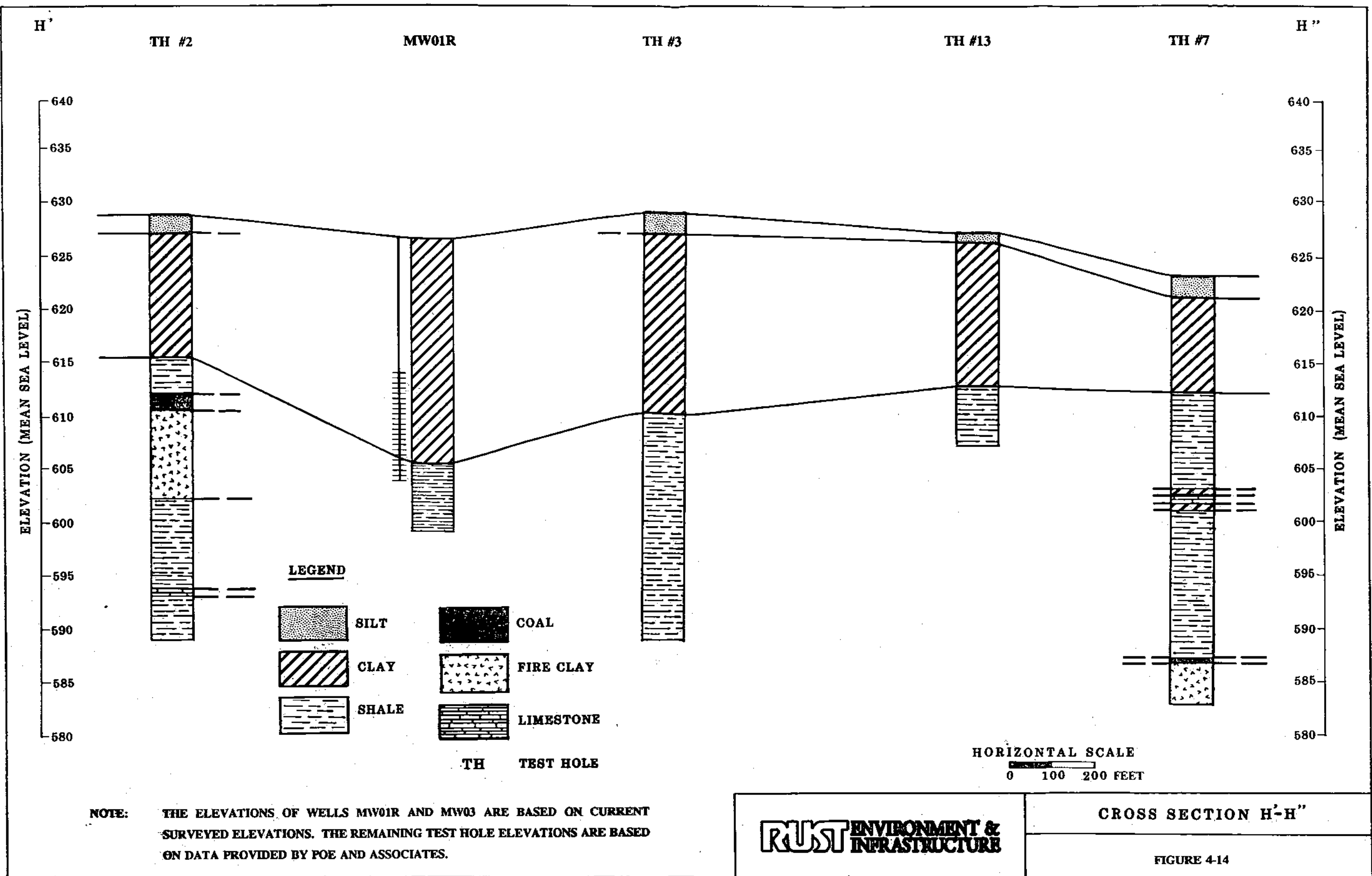


RUST ENVIRONMENT & INFRASTRUCTURE

CROSS SECTION F'-F''

FIGURE 4-12





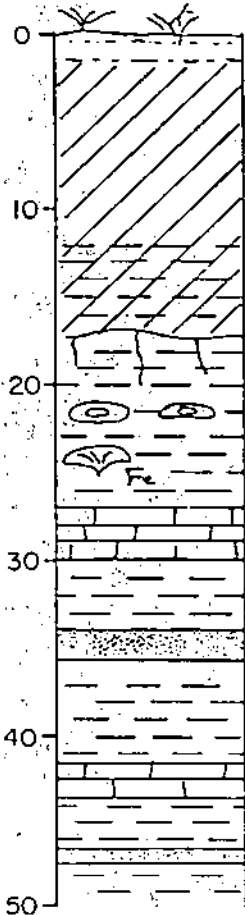
COMPOSITE TYPE SECTION PROPOSED

MUSKOGEE LANDFILL

AGE FORMATION LITHOLOGIC DESCRIPTION

PENNSYLVANIAN

Savanna Formation



Light brown silt,
Brown clay mottled with
Gray zones, numerous
Fe-Mn stains and Fe-Mn nodules
Olive gray weathered shale
Ferruginous concretions
Fossiliferous limonite beds
Fossiliferous limestone (Donley limestone)
Coal bed (Rowe coal)
Dark gray shale, interbedded
with lenticular fossiliferous
limestone and coal seams, unweathered

RUST ENVIRONMENT & INFRASTRUCTURE

COMPOSITE STATIGRAPHIC SECTION

POE & ASSOCIATES, INC.

DATE

10820 EAST 45TH ST. TULSA, OKLAHOMA 74146

665-8800

11-8-83

FIGURE 4-15

The composite stratigraphic section shows iron-rich concretions and fossiliferous limonite beds which in most cases marks the contact between the clay soil and the weathered shale (Poe and Associates). Figure 4-16, taken from the Poe and Associates report, shows the depth to the top of the weathered shale. The map suggests the surface is undulatory and dips very gently to the east with a northeastern dip becoming more dominant in the northern third of the site.

Coal seams which range in thickness from 0.1 to 1.0 foot, are found in seven borings. In both the Poe and Associates and RUST E&I investigations, the bituminous grade coal appeared highly fractured and yielded water quite readily when encountered during drilling operations. The seams appear discontinuous across the site and more than one unit is probably present. The Rowe coal is most likely represented in the section. Test holes No. 7 and 14 both encountered thin coal stringers near fossiliferous limestone beds fairly deep in the borings within the unweathered shale.

4.5.1 Site Geotechnical Data

Geotechnical testing data by Poe and Associates is summarized in Table 4-2. The test hole and test pit locations can be found on Figure 4-6.

Geotechnical laboratory testing by Poe and Associates reveals falling-head permeabilities of Shelby tube samples to be 9.7×10^{-9} cm/sec and 3.2×10^{-9} cm/sec at eight feet (TH10) and 10 feet (TH11), respectively. Poe and Associates also reported field test results for falling-head permeabilities at five feet and 10 feet according to ASTM STP 74 6C. The results indicate permeabilities of 3.0×10^{-7} cm/sec at a depth of five feet (Test Pit 1), 2.9×10^{-6} cm/sec at a depth of 10 feet (Test Pit 1), and 1.4×10^{-6} cm/sec at a depth of 10 feet (Test Pit 2).

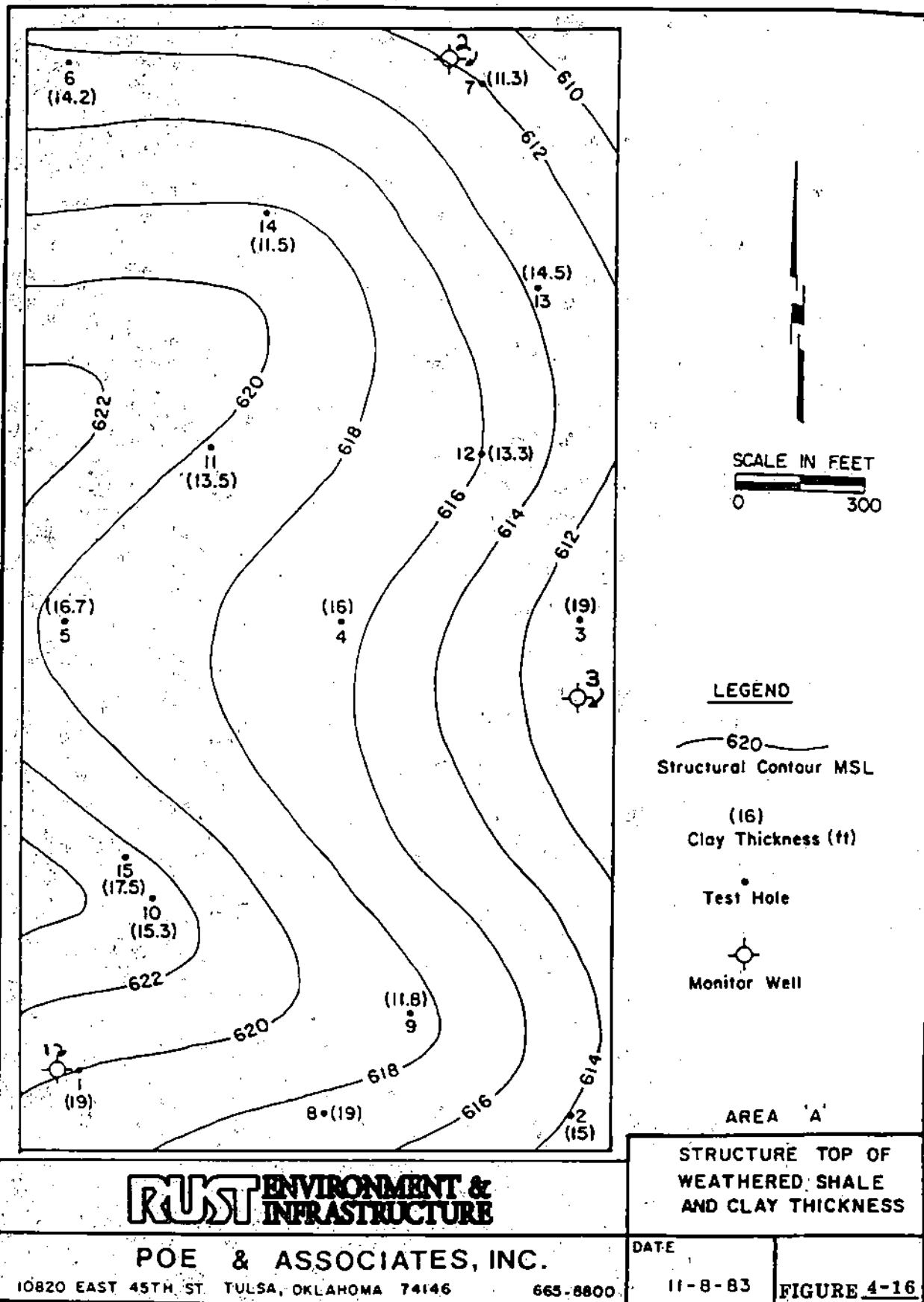


TABLE 4-2

GEOTECHNICAL AND HYDROGEOLOGIC PROPERTIES

LOCATION	SOIL SAMPLE	PERMEABILITY	ATTERBERG S			MAXIMUM DRY DENSITY, pcf	% MOISTURE	METHOD
			LL	PL	PI			
Test Pit 1	Subsoil Clay (5.0 ft)	3.0×10^{-7} cm/sec	40	19	21	--	--	Field ASTM Std 746
Test Pit 1	Subsoil Clay (10.0 ft)	2.9×10^{-8} cm/sec	42	20	22	--	--	Field ASTM Std 746
Test Pit 2	Subsoil Clay (10.0 ft)	1.4×10^{-8} cm/sec	42	20	22	--	--	Field ASTM Std 746
Test Hole 10	Subsoil Clay (8.0 ft)	9.7×10^{-7} cm/sec	--	--	--	108.7	23.6	Lab (in situ) Lambe (1951), Chap 6, Variable Head Permeability
Test Hole 11	Subsoil Clay (10.0 ft)	3.2×10^{-8} cm/sec	--	--	--	107.7	23.9	Lab (in situ) Lambe (1951), Chap 6, Variable Head Permeability
LOCATION	HYDRAULIC CONDUCTIVITY		HYDRAULIC GRADIENT		METHOD			
MW02 (Tract A)	8.56×10^{-4} cm/sec		0.007		Rising Head Pump Test			
MW03 (Tract A)	1.16×10^{-4} cm/sec		0.005		Rising Head Pump Test			
MW04 (Tract C)	6.5×10^{-4} cm/sec		0.01		Rising Head Pump Test			

The monitoring wells are screened generally within the weathered shale zone. Rising head pump tests indicate a range of hydraulic conductivities from 1.16×10^{-4} cm/sec (MW03) to 8.56×10^{-4} cm/sec (MW02). The fact that well MW02 has a greater hydraulic conductivity than well MW03 may be attributed to there being no seal between the filter pack and the infilled cuttings in the well. Well MW02 may be monitoring the full drilled zone below the surface grout. Hydraulic gradients varied around the monitoring wells from 0.01 near MW04 (in the southern part of Tract C) down to 0.005 near MW03.

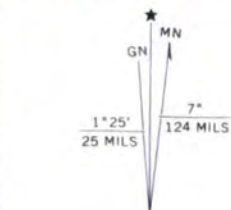
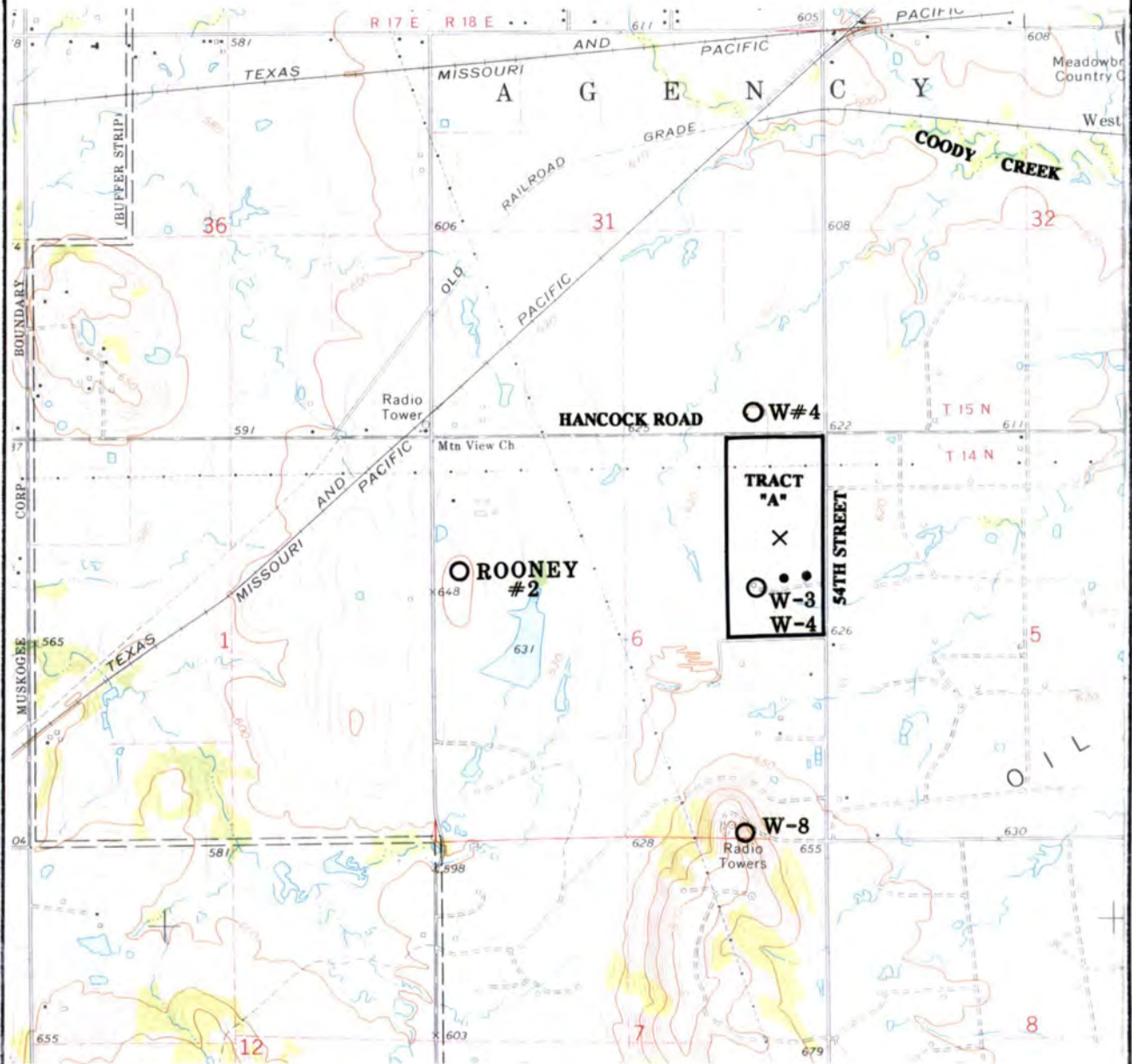
The soil has an average liquid limit of 42, a plastic limit of 20, and a plasticity index of 22. The current liner construction testing for Cell 2A has a liquid limit of 47, a plastic limit of 17, and a plasticity index of 30. Based on the Unified Soil Classification, the residual soils are classified as CL, inorganic clay of low-medium plasticity. The cation exchange capacity was 14 meg/100-year soil, indicating that most of the clay minerals are of the single lattice kaolinitic type, with little expansion capability.

4.6 Petroleum Geology

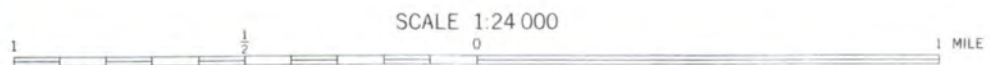
As documented in the OGS Bulletin 40-FF, the site is located in the Muskogee Oil Field. The drilling of the field first began in the early 1900s and continued through the 1960s. As a result of the exploratory drilling effort, many hundreds of wells have been drilled within the limits of this field. According to the Dunn & Bradstreet Corporation, Petroleum Information Records, there have been a total of 30 oil wells drilled on Tracts A, B, C, and D. Research of the archives of the Corporation Commission, Oil and Gas Conservation Department in Oklahoma City reveals only five registered wells in the area (Figure 4-17). Appendix B includes a map of the oil wells drilled in the area as documented by Dunn & Bradstreet Corporation, and well summaries for four wells.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

SOUTHWEST MUSKOGEE QUADRANGLE
OKLAHOMA—MUSKOGEE CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)



UTM GRID AND 1974 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET



LEGEND:



Oil wells identified from site reconnaissance (no logs available)
Oil wells with logs available from Corporation Commission
Sam Moyer Oil Well (Plugged)



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PLOTTED OIL AND GAS WELL LOCATION MAP

FIGURE 4-17

During a reconnaissance of the site, only five wells were accounted for on Tract A. Three wells on the tract have not yet been abandoned but will be plugged in accordance with the requirements of the Corporation Commission. In the center of Tract A, an extensive seep of water enriched with brine was encountered by facility personnel. At the location, small amounts of gas and brine are continuously bubbling out at the ground surface. The source of this brine has been determined to be coming from the Sam Moyen, No. 11 Robert Wrigley oil well. The brine is reportedly injection water originally used in water flooding operations for oil production. The well was drilled to a depth of 1,263 feet and plugged in March, 1935. Plugging records filed with the Oklahoma Corporation Commission indicated that all casing (1,193 feet of 6-5/8 inch and 12.5 feet of ten inch) was removed and the hole was filled with mud laden fluid to the surface (Poe and Associates, 1984).

Review of the available well summaries yielded general deep stratigraphic information surrounding the site. Several relatively shallow sand units were encountered in the wells. The stratigraphic depths and elevations are summarized in Table 4-3. Well W-3, located in Tract A, encountered two sand units of interest at elevations 581-577 feet msl and 522-485 feet msl. The shallowest sand corresponds to a depth range of 49 to 53 feet. The Rooney No. 2 well, drilled to the west on Tract B, also encounters a shallow sand with a depth range of 45 to 65 feet. This sand may be continuous between the wells and will be a target in the hydrogeological study. The other target sands, encountered in well W-3, corresponds to elevation range 522 feet msl to 485 feet msl. Depth to the top of the sand is 108 feet. Specifics of the target zones in the hydrogeological study are discussed further in Section 6.

TABLE 4-3

STRATIGRAPHIC DEPTHS OF SHALLOW SAND UNITS

	WELL NUMBER					
	Rooney #2	W-8	W-3	W-4 (Sect 6)	W-4 (Sect 31)	Unmarked ⁴
Approximate Ground Elevation, feet msl	652	799.5	630	630	630	700
Type of Well	O/G ¹	O/G	O/G	O/G	O/G	WW ²
Elevation Ranges of Shallow Sand Units	607 - 587	799 - 780	581 - 577	No logging of shallow sand units	348 - 345	697 - 658
	415 - 402	728 - 722	522 - 485			
		528-505				
Depths from Ground Surface of Shallow Sand Units	45 - 65	0.5 - 19.5	49 - 53	NA ³	282 - 285	3 - 42
		71.5 - 77.5				
	215 - 228	271.5 - 294.5	108-145			

- Notes:
- ¹ O/G indicates oil and gas well
 - ² WW indicates water well
 - ³ Not applicable
 - ⁴ Beyond map range of Figure 4-17, direction and distance is approximately two miles to the southwest of Tract D.

Section 5

5.0 HYDROLOGY

The following section describes the hydrology, hydrogeology and ground-water chemistry. The following topics are addressed: regional hydrology, site-specific hydrology, the 100-year flood plain, ground-water resources, well inventory and ground-water quality.

5.1 Regional Hydrology

Within East-Central Oklahoma, man-made lakes and reservoirs constitute a major part of the area's water resources and are the prime source of water for municipal and industrial use. Development of storage is necessary to provide dependable water supplies because of the limited availability of ground water in most of the area and the lack of sustained base flow in the smaller streams.

5.2 Site-Specific Surface Water

The major surface-water features near the site are the Arkansas River to the north, Coody Creek to the northeast, and Pecan Creek to the northwest. Both Coody Creek and Pecan Creek are perennial tributaries of the Arkansas River and ultimately discharge into the Arkansas River, as shown on Figure 4-17. Several smaller tributaries branch off of Coody Creek with one tributary located one-half mile directly east of Tract A.

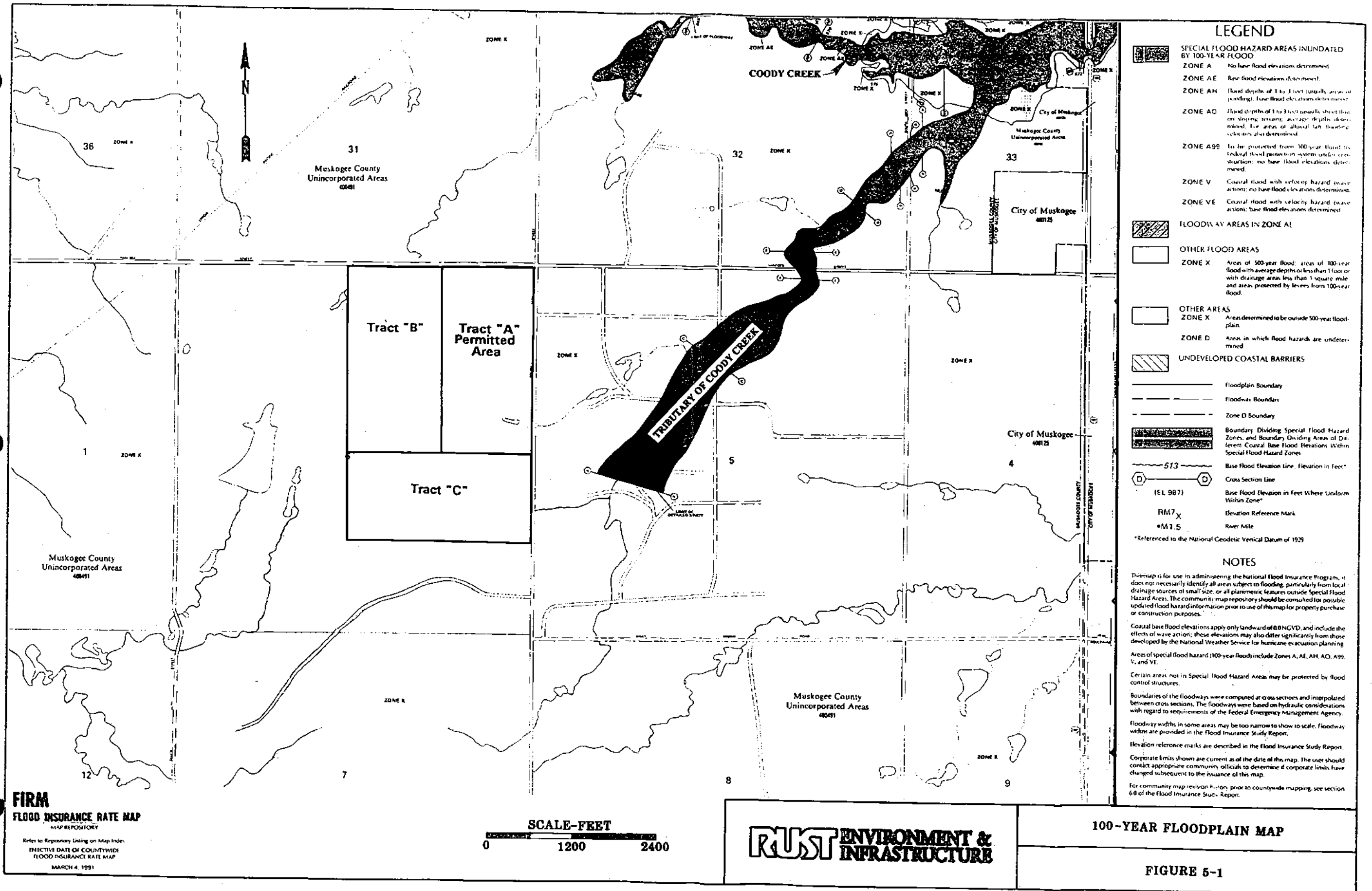
There are no ponds or manmade lakes located within the boundaries of Tract A. The nearest surface water to Tract A is to the west on Tract D with one 10-acre lake and two small ponds. The water from the ponds and lake are used mainly for stock watering. Data compiled by the Oklahoma Water Resources Board indicate that about 18,000 farm ponds in Oklahoma provide water for stock.

Drainageways run down the east side of the property line along 54th Street. The area, as shown previously on the topographic map, gently slopes toward the north-northeast on Tract A. As a result, storm-water runoff from south of the facility generally runs north by Tract B and Tract A and ultimately ends up in Coody Creek. The site reconnaissance of the facility revealed approximately five shallow trenches, oriented in a north-south direction to an approximate depth of two feet. These trenches were dug by WMO to promote drainage of the land and are located a minimum of 100 feet from landfilling activities. The trenches are recent and do not appear on the aerial photographs.

There are a few intermittent streams, or losing streams, which exist around the area, though none of these streams occur on Tract A. The intermittent streams generally connect the small ponds and lakes in the area during heavy rainfall events. The intermittent streams to the north of the site act as small tributaries of Coody Creek, a perennial creek, and contain running water during heavy storm events. The streams are considered losing streams which may be feeding fractures near the Muskogee Fault system.

5.3 100-Year Flood Plain

According to Federal Emergency Management Agency, Flood Insurance Rate Maps (FIRM), Muskogee Community Landfill is not located within the 100-year floodplain limit of any adjacent stream system. Figure 5-1 shows the 100-year floodplain for the area. Pecan Creek is located approximately three miles northwest of Muskogee Community Landfill and Coody Creek is located approximately 4.5 miles to the northeast. A tributary of Coody Creek is located one-half mile east of Tract A making the 100-year flood zone approximately 500 feet from the eastern property boundary. These creeks are the main tributaries of the Arkansas River that have any probability of flooding. The 100-year floodplain of the Arkansas River is located approximately 5.5 miles north of Muskogee Community Landfill. The location of the 100-year floodplain and the contour



intervals are based on USGS data delineated on the FIRM map. As shown on the FIRM, the 100-year floodplain elevation of the Coody Creek tributary is approximately 623 feet msl.

5.4 Ground-Water Resources

The ground-water resources vary throughout the region. Residents living adjacent to the Arkansas River obtain their drinking water directly from the river or from the unconsolidated alluvium adjacent to the river. Ground water used for human consumption is treated prior to use. Localized areas of Muskogee County once obtained their ground water from coal seams, though the water is of very poor quality. The following sections describe the ground-water resources on a regional and site-specific basis.

5.4.1 Regional Resources and Recharge Areas

Regionally, the main occurrence of ground water is in the alluvial and terrace deposits along the Arkansas River and its main tributaries. The deposits consist mainly of unconsolidated sand, silt, clay and gravel laid down by rivers and streams that flow generally to the east and southeast across the state.

The alluvial and terrace deposits typically are 10 to 50 feet thick, although they can reach 100 feet in thickness along major rivers such as the Arkansas River. The alluvial and terrace deposits commonly consist of sand and gravel layers that are highly porous and permeable which typically contain important ground-water resources. The quantity of water that can be produced from wells completed in alluvium or terrace deposits is highly variable, but many wells produce from 10 to 500 gallons per minute (gpm). Some exceptional wells produce several thousand gpm.

Well yield and water quality are controlled mainly by the type of rock in which a well is completed. In general, alluvium is the most favorable type of geologic unit for large well yields, followed by terrace deposits in local areas and, in order of decreasing favorability, weathered chert, limestone, sandstone, and siltstone, with shale the least favorable.

Ground water in this region is derived from precipitation falling directly upon the area and is controlled by fractures or sand beds exposed at the surface. Approximately 5 to 25 percent of the rainfall in the area enters the soil and slowly percolates downward to become ground water. The important factors controlling the amount of water entering the ground-water reservoir are the thickness and permeability of the soil and the permeability and storage capacity of the underlying rocks. In those parts of the area underlain by shale, the overburden soils are generally thin and poorly permeable so they cannot recharge rapidly; therefore, rainfall runs off quickly (OGS, 1988). In areas where there is an occurrence of large subsurface fractures, ground water tends to accumulate within those fractures. Water supplies for residences can sometimes be obtained from these fractures if sufficient quantities are available. Most wells in the shale, siltstone, and sandstone yield only a fraction of a gallon per minute (gpm). A few wells are reported to yield as much as 20 gpm. The other principal source of ground water in alluvial and terrace deposits is upward or lateral flow from underlying bedrock formations.

Hydrologic maps generated by the OGS indicate the facility is located approximately four miles south of the edge of the Arkansas River alluvium, two miles southwest of the Coody Creek alluvium, and two miles southeast of the Pecan Creek alluvium. Prior to being connected to a municipal water supply, the neighborhood located north and northwest of the site obtained their water from wells set in the local coal

seams of the Rowe coal, though this water is highly mineralized and of poor quality.

5.4.2 Site-Specific Resources

The site is underlain mainly by the Savanna Formation consisting of shale, sandstone and coal. The Savanna Formation yields limited amounts of poor-quality water and is located in an area which is considered least favorable for ground-water supplies.

The uppermost water-bearing unit currently being monitored is the weathered shales of the Savanna Formation. The overlying clay, with low hydraulic conductivity, acts as a confining unit. During their drilling operations, the uppermost water-bearing unit was identified near the middle of the highly weathered shale zone at a depth of approximately 28 feet below land surface (bls). Recent water-level readings taken from the wells installed by RUST E&I in November, 1992, indicated that the ground-water head is nine to 13 feet bls, or at an elevation ranging from 623.99 to 630.51 feet msl. During the installation of the three ground-water monitoring wells, RUST E&I encountered ground water in the borehole at the approximate elevation of 612 feet msl for all three wells. Table 5-1 lists the most recent water-level readings of all monitoring wells installed on the site.

Rising head pump tests were conducted by Poe and Associates on the monitoring wells, MW02 and MW03, installed during the 1984 investigation. From the tests, aquifer parameters of the weathered shale indicate a mean hydraulic conductivity of 4.86×10^{-4} cm/sec, or 8.56×10^{-4} cm/sec for MW02 and 1.16×10^{-4} cm/sec for MW03. The hydraulic

TABLE 5-1
WATER-LEVEL MEASUREMENTS

APRIL, 1993

WELL NO.	TIME	CASING ELEVATION* (msl) (A)	DEPTH TO WATER (ft) (B)	GROUND-WATER ELEVATION (msl) (A-B)
MW01R	2:40 pm	633.01	9.02	623.99
MW02R	3:15 pm	635.24	8.90	626.34
MW03R	2:05 pm	644.16	13.65	630.51
MW01	2:20 pm	642.94	14.70	628.24
MW02	2:55 pm	627.52 ^s	12.20	615.32
MW03	2:45 pm	634.68 ^s	11.30	623.38
MW04	3:40 pm	654.87 ^s	8.50	646.37
MW06	2:25 pm	663.84	25.55	638.29

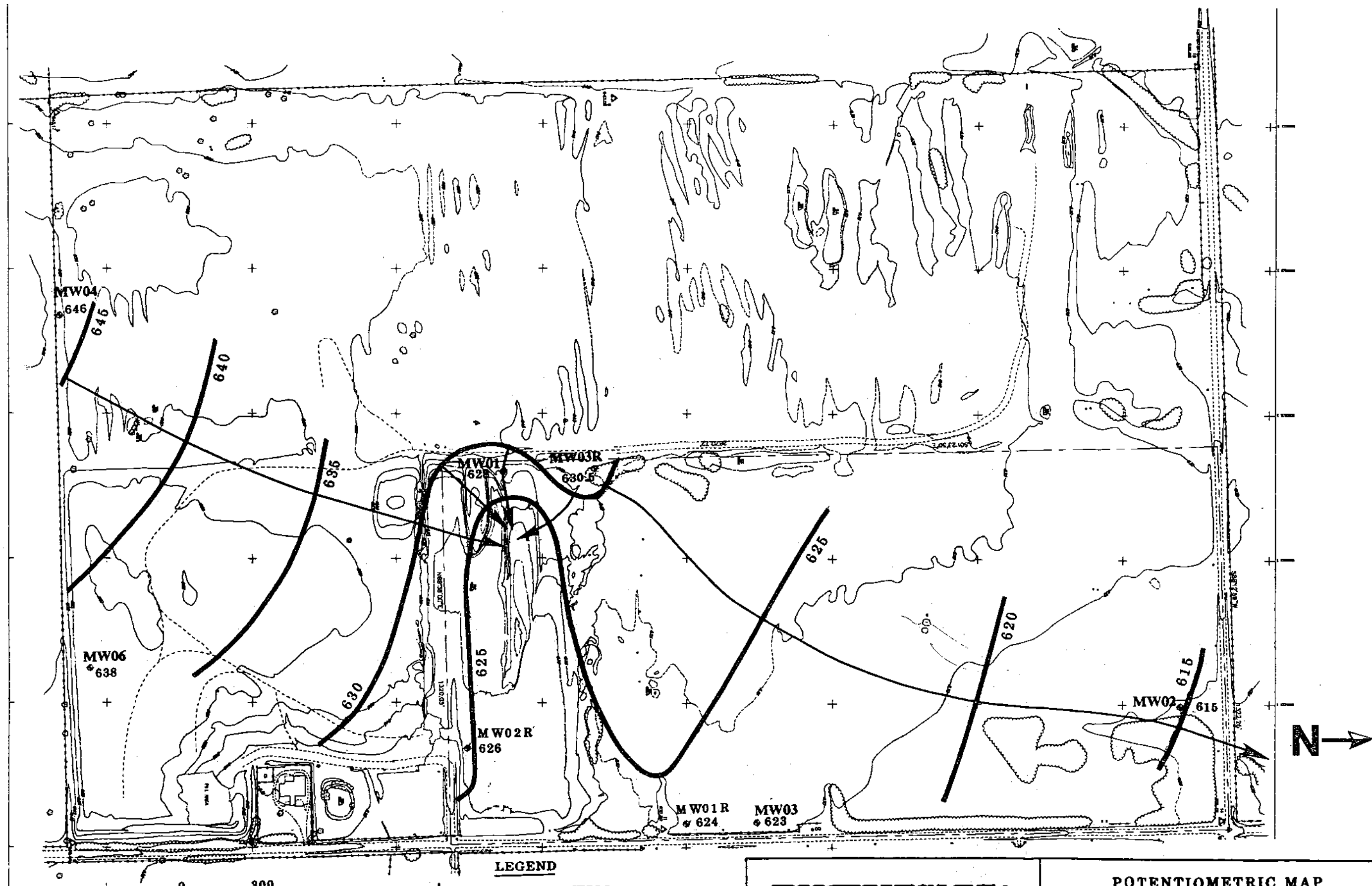
* Top of PVC casing unless otherwise noted.

^s Top of steel-protective casing

msl Mean Sea Level

ft Feet

gradient of the static water table for the Poe and Associates' investigation was calculated to be between 0.007 and 0.005. The direction of flow was found to be in a northeasterly direction across the site before excavation of Tract A had started (Poe and Associates, 1984). Recent water-level measurements of April, 1993, indicate the ground-water gradient was influenced by cell excavations previously done by the City of Muskogee. The City had excavated the western part of Cell 1 and encountered ground water. This area was left open until recently when WMO backfilled the area and started liner construction. Ground-water flow was influenced directly in the area of Cell 1 by excavation by the City of Muskogee causing flow to be diverted into the cell. Figure 5-2 represents the potentiometric surface



RUST ENVIRONMENT & INFRASTRUCTURE

for the April, 1993 water-level measurement event. At the time of the Poe and Associates' investigation, the landfill had not been in operation.

Theoretically, recharge of the ground water at the site is from the Bluejacket Sandstone member of the Boggy Formation located directly to the south of the facility. The Bluejacket Sandstone crops out in the form of resistant knobs of upland sandstone. This sandstone unit is thought to be more permeable than the residual clays which are present on the site. However, hydraulic conductivity testing of this sandstone unit has not been performed to substantiate this theory.

5.5 Well Inventory

Monitoring wells were previously installed by Stewart-White and Associates (MW01 and MW02), Poe and Associates, Inc. (MW03, MW04, and MW05), and RUST E&I (MW01R, MW02R, and MW03R). Well MW06 was formerly a water-supply well later designated a monitoring well by the City of Muskogee. Of these wells, MW04 and MW06 are on Tract C, the remaining wells are all on Tract A. Monitoring well MW05 no longer exists. The construction details and logs of monitoring wells installed by Stewart-White and Associates and Poe and Associates and RUST E&I are provided in Appendix C. Well completion details and logs for MW05 and MW06 are not available.

Monitoring wells MW01, MW02, MW03 and MW04 are not constructed to WMO and ASTM standards. Since no logs are available to review, it is unknown whether the construction of MW06 meet WMO standards. Wells MW01 and MW02 do not have a bentonite seal above the filter pack; the annulus is filled to three feet bls with drill cuttings then grouted to surface. MW03 does have a sufficient bentonite seal above the filter pack, but the remaining annulus above the seal is filled with drilling cuttings to three feet bls. The remaining annulus is grouted to surface. The borehole of MW04 was overdrilled by seven feet from where the bottom of the

screen is set. The bottom six and one-half feet of the borehole is backfilled with drill cuttings with a one-half-foot bentonite seal separating the well from the cuttings. Like the other wells, drill cuttings were backfilled in the annulus to approximately two feet bls. A concrete apron was then grouted to surface.

A water-well survey yielded minimal information for the study area. A water well search was performed for a two-mile radius around the facility; providing only one water-well log. The water well is a private supply well located approximately two miles southwest of Tract D. There were no well logs on file with the Oklahoma Water Resources Board for the neighborhood located to the northwest. This, however, does not mean that there are no wells present. The well logs were not required to be filed with the state until 1988. To verify the existence of wells prior to 1988 would require canvassing the area. Individual residences will need to be contacted.

5.6 Ground-Water Quality

The ground water is sampled in different areas of the state by the USGS, U.S. Army Corps of Engineers, and the U.S. Public Health Service to determine the availability of drinking water throughout the state. These tests are performed on a regional basis to determine if the ground water is up to U.S. Drinking Water Standards as outlined by the Environmental Protection Agency and the Oklahoma Water Resources Board. Ground-water quality testing is also performed on samples taken quarterly from the monitoring wells at the facility. The following sections describe the regional and site-specific ground-water quality.

5.6.1 Regional Ground-Water Quality

The state and federal agencies specifically sample for sulfate, chloride, nitrate, and Total Dissolved Solids (TDS) to help classify the type of ground water present. Generally, in western Muskogee County the ground water is highly mineralized due to the number of oil fields. Such contamination might be caused by seepage from waste pits, defective well casing, and water-flooding operations of the oil fields. Without detailed chemical analyses, available contamination caused by oil-well brine is difficult to distinguish from that occurring naturally.

The chemical quality of the ground water is classified in the study area by the Oklahoma Geological Society as generally poor to fair. Of the water samples tested throughout the state, 57 percent contained more than 250 parts per million (ppm) sulfate, 10 percent contained more than 250 ppm chloride, and 53 percent contained more than 500 ppm TDS. Water from sandstone is least mineralized, whereas that from shale, particularly shale that contains coal beds, is highly mineralized. Table 5-2 summarizes the water-quality data obtained by the USGS for Muskogee County. Table 5-3 summarizes the water-quality data for the samples analyzed specifically in the City of Muskogee (Oklahoma Geological Society, 1988).

All ground water in Muskogee County is classified, according to the state water laws, as Class IIB, general-use ground water including all minor ground-water basins. Class II ground waters are capable of being used as drinking water supply with no treatment or with conventional treatment methods, and also have the potential to be used for other beneficial uses. General use ground waters have an average concentration of TDS of less than 3,000 milligrams per liter (ppm) as determined by the Oklahoma Water Resources Board ground-water quality network (OWRB 787-45-7-3(b)(1)(A)(2)).

TABLE 5-2

REGIONAL GROUND-WATER QUALITY FOR MUSKOGEE COUNTY

SUMMARY OF AVAILABLE CHEMICAL DATA

LOCATION OF WELL			Depth of Well, Total (ft)	Date of Sample	Specific Conductance (umhos)	pH (units)	Temperature (°C)	Sulfate Dissolved (mg/L as SO ₄)
Section	Township	Range						
3	14N	15E	16	7/17/81	1230	6.1	18.0	200
14	14N	15E	9	7/16/81	173	7.0	20.0	15
15	14N	15E	30	7/16/81	1540	7.3	17.0	99
15	14N	15E	15	7/16/81	801	8.0	17.0	28
17	14N	15E	14	7/16/81	1110	7.3	18.5	110
22	14N	15E	74	7/15/81	1500	7.8	19.0	3.7
22	14N	15E	17	7/16/81	894	7.4	18.5	3.3
17	11N	20E	151	8/6/81	4426	7.7	20.0	12
18	11N	20E	46	8/6/81	—	7.6	19.0	73
19	11N	20E	100	8/5/81	2729	7.8	22.0	8.6
20	11N	20E	32	8/5/81	916	7.0	19.0	59
29	11N	20E	100	8/6/81	2122	7.0	20.0	320
25	11N	21E	155	8/6/81	922	8.4	21.0	15
25	11N	21E	140	8/7/81	922	6.9	21.6	92
29	11N	22E	69	8/6/81	1698	7.1	16.5	210

mg/L milligrams per liter
°C degrees Celsius

Fevée, Dale M. Ground-Water Quality Data for Oklahoma. USGS Open-File Report 83-686. Oklahoma City, Oklahoma, 1983.

TABLE 5-3

GROUND-WATER QUALITY FOR CITY OF MUSKOGEE, OKLAHOMA

SUMMARY OF AVAILABLE CHEMICAL DATA

PARAMETER	CONCENTRATION (ppm)
Hardness	67
Sulfate	6.0
Chloride	6.3
Nitrate	ND
Total Dissolved Solids	225

Oklahoma Geological Society. Reconnaissance of the Water Resources of the Fort Smith Quadrangle, East Central Oklahoma. Hydrologic Atlas, Sheet 3: Chemical Quality of Ground Water, 1988.

mg/L - milligrams per liter
 ppm - Parts per Million
 ND - Not Detected

Ground-water quality data of the water within the Rowe Coal Seam was not available for review. The only information available regarding the ground-water quality is that it is highly mineralized and of "poor quality".

5.6.2 Site-Specific Ground-Water Quality

All the monitoring wells are sampled on a quarterly basis. Appendix D includes the water quality report for April 27, 1993, which is a typical example of the analytical results for the landfill. Also included in Appendix D are the analytical results of the testing performed by Poe and Associates in 1984.

Background or "upgradient" water quality for Tract A has yet to be defined. Poe and Associates inappropriately defined MW01 as the upgradient well and MW02 as a downgradient well without sufficient hydrological data available. As a result, assumptions were made as to

the sources of "contamination" in the monitoring wells. The sources actually remain to be established.

The brine-enriched oil well was sampled twice in 1984 by Poe and Associates and had chloride concentrations of 45,450 milligrams per liter (mg/l) and 24,420 mg/l. MW01 contained a 2,449 mg/l concentration of TDS and a 204 mg/l concentration of chloride. MW02 had concentrations of 9,487 mg/l and chloride 3,693 mg/l for TDS and chloride, respectively. The concentrations of chlorides and TDS are higher than the concentrations of the newly installed wells by RUST E&I.

Due to previous water-flooding operations of brine water within Muskogee Oil Field, the concentrations of TDS and chlorides are expected to be higher around the facility than the non-oil field areas of the county. However, without establishing background water quality, it is inappropriate to define whether the concentration of any parameter is high or low as compared to background.

Poe and Associates sampled the ground water in all of their test holes for pH, specific conductivity, temperature, and chloride. The purpose of the sampling was to define the magnitude of brine contamination of Tract A. The sampling techniques used were not described, so the data cannot be validated. The data is included in Appendix D with the other water quality data. A concentration of 20,000 mg/l of chloride was detected for Test Hole No. 4, which is closest to the brine-enriched well. The same test hole had detected levels of 5.1 for pH and 10,000 mg/l for specific conductance.

• Section 6

6.0 PRELIMINARY HYDROGEOLOGICAL CONCEPTUAL MODEL

One of the primary focuses of the Phase I study is to develop the preliminary conceptual model. Information obtained from the site reconnaissance, along with data secured during the literature search, has provided the basis for the development of the conceptual model at Muskogee Community Landfill. This model will be used to develop the field investigation. The conceptual model will be tested and constantly evaluated as new data is obtained. The simple conceptual model is presented in Figure 6-1. The target monitoring zones are summarized in Table 6-1, and Table 6-2 presents the actual zones screened by the current monitoring wells. The objective for the conceptual model is to evaluate these zones and to determine the following hydrogeologic parameters:

- Hydraulic conductivity,
- Depth to ground water,
- Potentiometric surface,
- Hydraulic gradients, and
- Vertical components of flow.

TABLE 6-1

GENERALIZED TARGET MONITORING ZONES FOR CONCEPTUAL MODEL

ZONE	AVERAGE ELEVATION RANGES (msl)	AVERAGE THICKNESS (ft)	LITHOLOGY
A	630 - 617	13	Clay
B	617 - 600	17	Weathered shales and associated interbedded coals, sands, sandstone lenses limestones
C	596 - 580	1	Rowe Coal
D	581 - 577 522 - 485	4 37	Sands

- Assumptions: 1) Clay thickness based from surface elevations.
2) Elevation ranges based on average depths to lithologic surfaces.
3) Data used is Poe & Associates test holes 1-15 (Zone A,B,C); oil wells (Zone D)
4) Zone C - Elevation ranges represent top and base of zone in which Rowe Coal was encountered.
5) Zone D - Specific sands encountered from oil well (W-3) on Tract A.

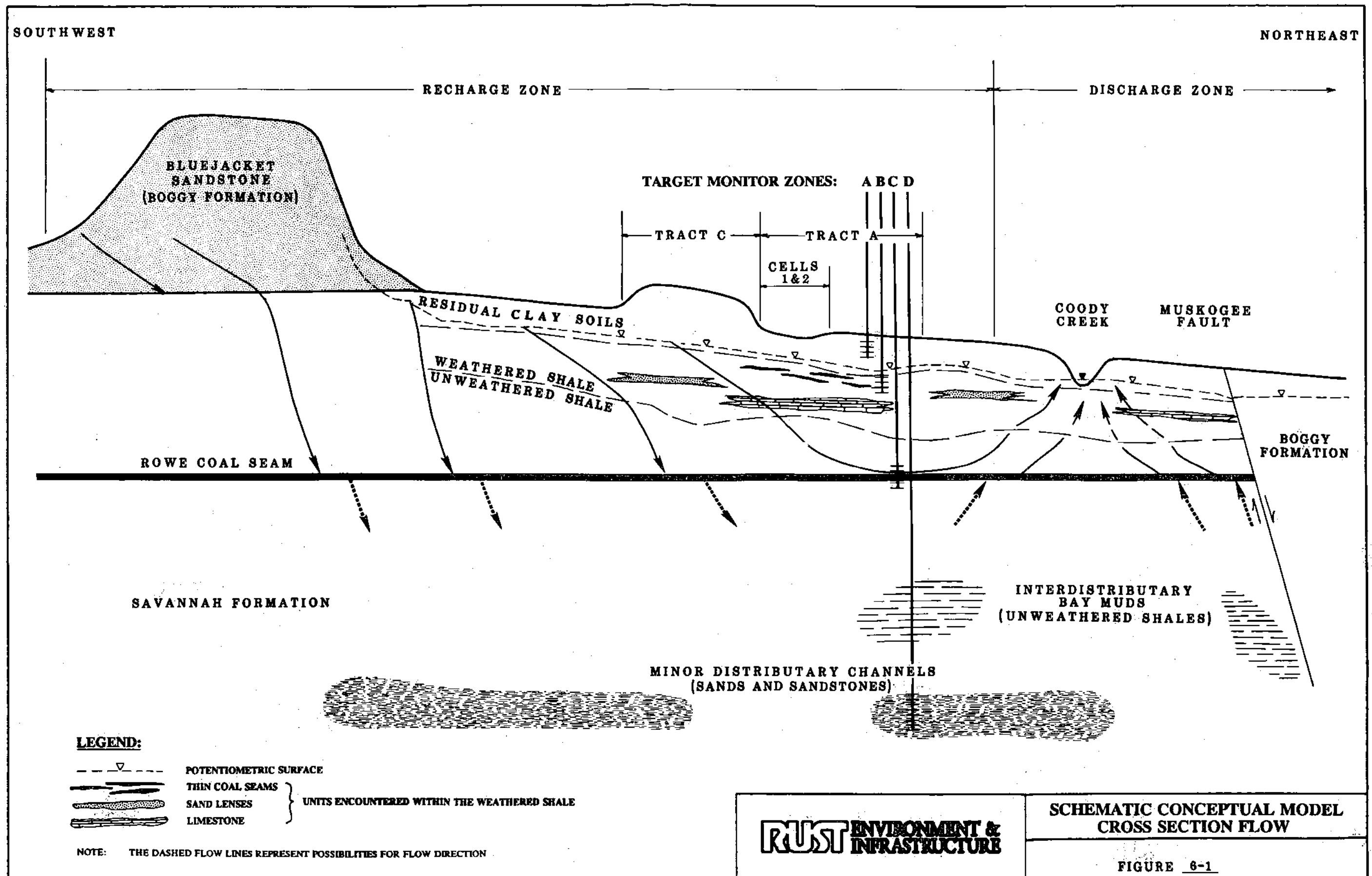


TABLE 6-2

ZONES SCREENED BY CURRENT MONITORING WELLS

MONITORING WELLS	FILTER PACK INTERVAL ELEVATIONS (msl)	FILTER PACK INTERVAL DEPTHS (ft bls)	ZONE INTERVALS
MW01R	615.7 - 603.7	14.5 - 26.5	A, B
MW02R	617.2 - 604.2	15 - 28	A, B
MW03R	615.4 - 602.5	26.1 - 39	B
MW01	621 - 614	18 - 25	A, B
MW02	600 - 594	23.5 - 29.5	A, B
MW03	613 - 603	17 - 27	A, B
MW04	635 - 615	10 - 30	B
MW05	Does not exist. No log available.		
MW06	No log available.		

Notes: Zones based on well lithology descriptions and weathered shale structure map.
 msl Mean Sea Level
 ft bls Feet Below Land Surface

The following comprises the elements of the model.

1. The geologic setting consists of Pennsylvanian sediments of the Savannah and Boggy Formations deposited during transgressive sea and regressive sea environments. These environments were cyclic in nature. Marine shales were deposited during transgressive episodes. As the seas receded, deltaic sediments were deposited atop the marine shales. Sediments, such as distributary channel sands and interdistributary muds and coal swamps, represent fluvial environments and were deposited atop the deltaic sediments. This cycle is repeated multiple times within the Savannah and Boggy Formations with coal seams culminating each cycle.

2. The major lithologies below the facility include residual soils, weathered shale, unweathered shale, and coal seams. Limestones and sands are found sporadically interbedded in the shales. Well log summaries for the oil wells indicate sand units at depth. Table 6-3 presents elevation data for major lithologies found in the borings. Four target monitoring zones, names A, B, C, and D were assigned based in part upon lithologies encountered.
3. Zone A is composed of the residual clay soils of the Savannah Formation. Previous data, as summarized in Table 4.2, indicate field permeabilities of 3.0×10^{-7} cm/sec and 1.4×10^{-8} cm/sec. Laboratory permeabilities were 9.7×10^{-8} cm/sec and 3.2×10^{-8} cm/sec. Zone A will be monitored to determine if the clay soils are saturated.
4. Zone B is represented by the weathered shale of the Savannah Formation. Zone B consists of weathered shale, sands and sandstone lenses, limestone, and coal seams of up to 12 inches thick. Results from rising-head pumping tests on monitoring wells MW02 and MW03 indicate a mean hydraulic conductivity of 4.86×10^{-4} cm/sec. MW04 (Tract C) had a hydraulic conductivity of 6.5×10^{-4} cm/sec. These wells, along with the remaining monitoring wells in Tract A, are fully screened or partially screened in Zone B, as shown in Table 6-12. Overlap occurs by having the screen and/or filter pack extend either into the overlying clay, or underlying unweathered shale. Poe and Associates' data indicate hydraulic gradients range from 0.005 to 0.007. No data is available to determine vertical flow velocities and gradients. Zone B, at this time, is considered the uppermost saturated zone and will be monitored as such.
5. Zone C is represented by the various coal seams and stringers comprising the Rowe Coal within the unweathered shale of the Savannah Formation. The coal seams readily yielded water when encountered during drilling operations. Although the water was highly mineralized and of poor quality, many residences to the northwest of Muskogee Community Landfill have used the coal seams as a source of drinking water prior to being converted to municipal water supply. The

TABLE 6-3

CURRENT BOREHOLE LITHOLOGIC/ELEVATION DATA

BORING/WELL	SURFACE ELEVATION (msl) (Top of Clay)	ELEVATION - TOP WEATHERED SHALE (msl)	ELEVATION - TOP UNWEATHERED SHALE (msl)	ELEVATION - TOP COAL (msl)	ELEVATION - SAND INTERVAL (msl)
TEST HOLE					
1	639	620	612	604.5	--
2	629	614	602	612	--
3	629.5	610.5	596	--	--
4	632.5	616.5	597	--	--
5	636	619.3	601.6	--	--
6	628.5	614.3	594	--	--
7	623.5	612.2	594.2	587	--
8	636	617	--	611	--
9	630	618.2	--	618.2	--
10	639	623.7	--	--	--
11	633.5	620	--	--	--
12	629.5	616.2	--	--	--
13	627.5	613	--	--	--
14	629.5	618	--	596; 581	--
15	640	622.5	--	--	--
16	631	--	--	--	--

BORING/WELL	SURFACE ELEVATION (msl) (Top of Clay)	ELEVATION - TOP WEATHERED SHALE (msl)	ELEVATION - TOP UNWEATHERED SHALE (msl)	ELEVATION - TOP COAL (msl)	ELEVATION - SAND INTERVAL (msl)
17	640 ¹	629	607	--	--
22	630 ¹	622	--	--	--
23	--	--	--	--	--
MONITOR WELL					
MW01R	627.7	--	602.7	--	--
MW02R	632.2	--	604.2	--	--
MW03R	641.5	--	606.5	--	--
MW01	639 ¹	--	--	--	--
MW02	623.5 ¹	--	--	--	--
MW03	630 ¹	611	--	--	--
MW04	645 ¹	638	632	--	--
OIL WELL					
W-3	630 ¹	--	--	--	581 - 577
W-3	630 ¹	--	--	--	522 - 485
W-4 (Sect. 6)	630 ¹	--	--	--	--
W-4 (Sect 31)	630 ¹	--	--	--	348 - 335
W-8	799.5	--	--	--	528 - 505
Rooney #2	652	--	--	--	607 - 587

¹ Elevations approximate on these wells/borings.

-- Not Applicable

coal unit which subcrops beneath the unweathered shale may be continuous across the site. Zone C will be monitored as the second water-bearing zone.

6. Zone D is represented by deep sands encountered by oil wells drilled on and around Tract A. There are two sand units of interest for this model at depths of approximately 50 and 100 feet bls. These sands are targeted to determine if they are saturated and possibly continuous across Tract A.
7. Ground water was encountered at elevations 581 feet msl to 612 feet msl. Ground-water flow for the currently monitored zone (primarily Zone B) is to the north-northwest direction. Ground water in Zone B generally follows topography as well as the bearing of coal seams. Ground-water gradients are apparently influenced by previous excavations in Cell 2A according to the latest data of April, 1993. The excavated cell has been recently backfilled with clay material to above ground-water level to enable WMO to start liner construction.
8. The Blue Jacket Sandstone, located within the Boggy Formation to the south, is considered a water-bearing unit and is also considered a recharge zone for the ground water within the coal seams and the weathered shale.
9. The City of Muskogee landfills, Tracts B and C, potentially recharge the weathered shale and coal seams, and could impact ground-water monitoring at the Muskogee Community Landfill.
10. Discharge of the ground water in the weathered shale is in Coody Creek. Coody Creek is a gaining stream, flowing year-round. The intermittent streams are considered drainage features only, and therefore do not significantly contribute to the recharge/discharge system for the coal seams and weathered shale.
11. For geotechnical purposes, the deepest proposed excavation of Muskogee Community Landfill is to the top of the weathered shale.

• Section 7

7.0 FIELD EXPLORATION PROGRAM

The field exploration program described herein is designed to fill the data gaps necessary to establish a hydrogeologic conceptual model for WMO based on sound engineering and geologic practices, and to meet OSDH requirements. Based on OAC 310:360-9-3(3)(C), a minimum of 19 soil borings are required per OSDH site characterization standards. RUST E&I proposes a total of 25 boreholes to be drilled at the designated locations as shown on Figure 7-1. Of the 25 boreholes, 15 borings will be drilled strictly for geotechnical testing, six borings for piezometers and geotechnical testing and four borings for piezometers.

7.1 Soil/Rock Borings

The purposes of the field exploration program are to explore the subsurface conditions of Tract A; determine the thickness of any U.S. Drinking Water aquifer underlying the facility, if any; and to determine the uppermost saturated zone to be monitored. In addition, soil and rock samples will be taken during drilling and tested for physical and engineering properties for landfill design purposes. The information obtained will be used to prepare a final report with recommendations of monitoring well locations and prepare a site-specific ground-water monitoring plan. The program is prepared on the assumption that the deepest proposed excavation will be the top of the weathered shale, not taking the depth to ground water into account. Figure 7-1 shows the locations of all geotechnical and piezometric borings to be performed in the exploration program and the buffer zone around the landfill. This buffer zone will be 50-feet wide along the southern and western property boundaries, and 75-feet wide along the northern and eastern boundaries. The locations of the borings may be altered in the field due to accessibility to each location.

September 1, 1993

Mr. Dan Gibson
Quarry Landfill
4041 N. 141st East Avenue
Tulsa, Oklahoma 74116

RECEIVED
OCT 22 1993
Solid Waste Service

**RE: ADDITIONAL PIEZOMETERS,
MUSKOGEE COMMUNITY LANDFILL
RUST E&I PROJECT NO. 86251.130**

Dear Mr. Gibson:

During our conference call with Ms. Theresa Talty, regarding the Phase I Hydrogeological Study, Ms. Talty suggested adding five piezometers to the boring plan. The intention was to cover the entire landfill since the piezometers were mainly around the perimeter of the footprint area. By installing the additional piezometers, the geotechnical boreholes will no longer remain open for seven days for water-level measurements.

The enclosed Table 7-1 and Figure 7-1 from the Hydrogeological Study have been modified to include the additional piezometers. Table 7-1 shows the designated piezometer labelling, the zones to be monitored, and the depths of each piezometer along with the geotechnical borings to be drilled in the field investigation. Figure 7-1 shows the piezometer and geotechnical boring locations. The additional five piezometers will be constructed in accordance with WMI Site Assessment Manual and the OSDH regulations.

The borings/piezometers will be located (approximately) in the field according to Figure 7-1 for the Phase II Field Investigation. Once the borings are completed, the locations will be surveyed.

If you have any questions or comments, please do not hesitate to call me at (713) 874-8973.

Sincerely,



Penny P. Carpenter
Project Geologist

cc: Mark Daniels, East Oak
Theresa Talty, WMI-South

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TABLE 7-1

BOREHOLE DEPTH CALCULATIONS
WASTE MANAGEMENT OF OKLAHOMA
MUSKOGEE COMMUNITY LANDFILL AND RECYCLING CENTER, OKLAHOMA
September 1, 1993

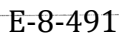
BORING	30 FEET BELOW DEEPEST PLANNED EXCAVATION ¹ (msl) (A)	SURFACE ELEVATION OF BORING (B)	DEPTH OF GEOTECHNICAL BORINGS (B-A)	MODIFIED BORING DEPTH ²
B-1	583	624	41	45
B-2	582	628	46	50
B-3	582	629	47	50
B-4	582	631	49	50
B-5/P-1	586	631	45	Zone D ⁴ $\approx$ 150
B-6/P-2	586	631	45	Zone C ⁴ $\approx$ 50
P-3	586	631	NA ³	Zone A ⁴ $\approx$ 15
B-7	586	628	42	45
B-8	587	630	43	45
B-9	588	632	44	45
B-10	588	635	47	50
B-11	589	635	46	50
B-12	587	637	50	50
B-13/P-4	587	630	43	Zone D ⁴ $\approx$ 150
B-14/P-5	587	630	43	Zone C ⁴ $\approx$ 50
P-6	587	630	NA ³	Zone B ⁴ $\approx$ 20
P-7	587	630	NA ³	Zone A ⁴ $\approx$ 15
B-15	588	633	45	45
B-16	590	637	43	45
B-17	588	637	49	50
B-18	589	638	49	50
B-19	589	626	37	40
B-20/P-8	589	641	52	Zone D ⁴ $\approx$ 150

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Table 7-1 (cont.)

BORING	30 FEET BELOW* DEEPEST PLANNED EXCAVATION ¹ (msl) (A)	SURFACE ELEVATION OF BORING (B)	DEPTH OF GEOTECHNICAL BORINGS (B-A)	MODIFIED BORING DEPTH ²
B-21/P-9	589	641	52	Zone C ⁴ $\approx$ 50
P-10	589	641	NA ³	Zone A ⁴ $\approx$ 15
P-11	589	636	NA ³	Zone B
P-12	588	634	NA ³	Zone B
P-13	588	634	NA ³	Zone B
P-14	587	629	NA ³	Zone B
P-15	583	624	NA ³	Zone B

- 1 The deepest planned excavation is defined at the elevation where top of weathered shale is encountered per previous boring data at the site.
- 2 Boring depths are rounded off to the nearest five feet.
- 3 This boring is strictly for a piezometer; no geotechnical testing will be performed.
- 4 The boring depth will be modified to the approximate depth of each zone. Zone A through D are described in detail in Section 6. A piezometer will be set in this boring to monitor the assigned zone.



7.1.1 Piezometric Borings

The subsurface investigation is designed to detect all saturated zones encountered while drilling and to obtain a field description of the deep stratigraphy underlying the facility. The anticipated target zones for saturated conditions are discussed in detail in Section 6. Six of the 25 borings to be drilled will meet dual purposes by being a piezometric boring and a geotechnical boring in one. These borings will be located within the buffer zone around the periphery of the landfill.

The piezometric borings will be drilled with hollowstem auger until refusal, then air rotary methods will be used. The borings for will be continuously logged and sampled using visual classification techniques, paying particular attention to the presence of shallow ground water.

Soil samples for geotechnical analyses will be collected from six of the ten piezometric borings; geotechnical sampling is further discussed in Section 7.1.2. Lithologic sample logs will be made of each borehole and will include the following items:

- Drilling data such as drilling method and type of rig used;
- Description of all soil and rock layers encountered using ASTM 2487 methods including:
 - Name, color, texture, thickness, structure and amount of moisture present in each layer,
 - Approximate soil classifications,
 - Rock classification as defined in the Dictionary of Geological Terms,
 - Secondary features such as slickensides, fossils, fractures, seams, calcite healing, organic debris, ferrous nodules or staining;

- The depths at which ground water was encountered and stabilized ground-water elevations.

Table 7-1 defines the boring/piezometer location number, the approximate topographic elevation where the boring is to be located, and the estimated depth or zone of all piezometric/geotechnical borings.

When rock conditions are encountered, the rock name, color, bedding, weathering, structure, and any other applicable descriptors will be recorded on the field log for each borehole. Percent recovery of the rock core and the Rock Quality Designation (RQD) will be calculated for every core. The RQD is a modified core recovery measurement used to characterize the quality of the rock mass. To calculate RQD, all pieces of a core over four inches in length are added together and divided by the total length of the core run, and is expressed as a percentage. Listed below is a table showing the relationship of RQD and rock quality.

<u>RQD%</u>	<u>Description of Rock Quality</u>
0 - 25	Very Poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

TABLE 7-1

BOREHOLE DEPTH CALCULATIONS
WASTE MANAGEMENT OF OKLAHOMA
MUSKOGEE COMMUNITY LANDFILL AND RECYCLING CENTER, OKLAHOMA
July 16, 1993

BORING	30 FEET BELOW DEEPEST PLANNED EXCAVATION ¹ (msl) (A)	SURFACE ELEVATION OF BORING (B)	DEPTH OF GEOTECHNICAL BORINGS (B-A)	MODIFIED BORING DEPTH ²
B-1	583	624	41	45
B-2	582	628	46	50
B-3	582	629	47	50
B-4	582	631	49	50
B-5/P-1	586	631	45	Zone D ⁴ = 150
B-6/P-2	586	631	45	Zone C ⁴ = 50
P-3	586	631	NA ³	Zone A ⁴ = 15
B-7	586	628	42	45
B-8	587	630	43	45
B-9	588	632	44	45
B-10	588	635	47	50
B-11	589	635	46	50
B-12	587	637	50	50
B-13/P-4	587	630	43	Zone D ⁴ = 150
B-14/P-5	587	630	43	Zone C ⁴ = 50
P-6	587	630	NA ³	Zone B ⁴ = 20
P-7	587	630	NA ³	Zone A ⁴ = 15
B-15	588	633	45	45
B-16	590	637	43	45
B-17	588	637	49	50
B-18	589	638	49	50
B-19	589	626	37	40
B-20/P-8	589	641	52	Zone D ⁴ = 150
B-21/P-9	589	641	52	Zone C ⁴ = 50
P-10	589	641	NA ³	Zone A ⁴ = 15

- 1 The deepest planned excavation is defined at the elevation where top of weathered shale is encountered per previous boring data at the site.
- 2 Boring depths are rounded off to the nearest five feet.
- 3 This boring is strictly for a piezometer; no geotechnical testing will be performed.
- 4 The boring depth will be modified to the approximate depth of each zone. Zone A through D are described in detail in Section 6. A piezometer will be set in this boring to monitor the assigned zone.

The detailed logs in the field will be recorded on WMO forms and reported upon completion of the field work. Once drilling activities are completed on each borehole, geophysical testing will be performed, as described in Section 7.2.

7.1.2 Geotechnical Borings

A total of 21 geotechnical borings will be drilled for landfill design purposes with depths detailed in Table 7-1. The borings will be sampled continuously for the first ten feet and on five-foot intervals thereafter. The borings will be advanced by hollowstem auger to refusal, then air rotary method will be used, paying close attention to the presence of shallow saturated conditions. It is anticipated to pass through the residual soils, beyond the weathered bedrock, and into unweathered bedrock. The borings will be logged as previously described for the piezometric borings.

All drilling activities will cease upon encountering shallow saturated conditions. The rise of water within the borehole will then be measured in five-minute increments until equilibrium is reached, or for a maximum period of 30 minutes, whichever is less. Drilling activities will continue upon completion of the water-level readings.* The borings will be plugged with a bentonite grout. The cores will be prepared for storage according to ASTM standards and shipped to an WMO approved testing laboratory for later determination of the geotechnical tests to be run on each core. Upon review of the logs for each boring, the landfill design engineer will assign the geotechnical tests to be performed on each core. The soil samples will be evaluated by performing the following tests:

- Sieve Analysis #4, #10, #40, #200,
- Percent Fines (ASTM 1140),
- Particle-Size Analysis (ASTM D422),
- Atterberg Limits (ASTM D4318),
- Moisture Content,
- Standard Proctor (ASTM D698),
- Organic Content,
- Soil Permeability Test (ASTM 5084),
- Unconsolidated, Undrained Triaxial Test,
- Consolidation Tests,
- Cation Exchange Capacity, and
- Soil pH.

Note that the test assignment for each borehole may vary according to the engineer's design requirements.

7.2 Downhole Geophysical Logging

Prior to the installation of the piezometers, geophysical logging of six of the boreholes will be done to meet state requirements OAC 310: 360-9-3(7). The logs will be run on the three deep piezometric borings and three of the geotechnical borings. The purpose of the downhole geophysical logging is to obtain high-resolution geologic data from within the borings. The tools used will consist of spontaneous potential, single-point resistance, and natural gamma tools in the six borings. Table 7-2 summarizes the aspects of the downhole geophysical logging to be performed.

TABLE 7-2
GEOPHYSICAL LOGGING

TECHNIQUE/APPLICATION	WATER-FILLED HOLE, SATURATED ZONE		DRY HOLE, UNSATURATED ZONE	
	UNCASED	PVC	UNCASED	PVC
Natural Gamma - Soil and rock identification, geologic correlation	Yes	Yes	Yes	Yes
Spontaneous Potential - Soil and rock identification, geologic correlation	Yes	No	No	No
Single-Point Resistance - Soil and rock identification, geologic correlation, resistive rock fracture detection	Yes	No	No	No

7.3 Piezometer Installation

To address the site-specific hydrogeology, a total of ten piezometers will be installed. The purpose of the piezometers is to adequately monitor pressure head within individual zones, and determine the potentiometric surface within each zone. The piezometers will aid in determining the following information:

- In-situ permeability of geologic units;
- Direction of ground-water flow in the uppermost saturated zone, and within the deep saturated zones, if any;
- Rates of ground-water flow;
- Maximum high elevation of piezometer surfaces;
- Ground-water recharge and discharge areas.

A total of ten piezometers will be installed which meet the OSDH requirements of at least six piezometers for an 80-acre tract (OAC-9-3(11)(B)).

A piezometer will be installed in each piezometric boring and screened within the specified zones. Three piezometers will be set in Zone A, one in Zone B, three in Zone C, and three in Zone D. The actual completion depth of each piezometer will be determined in the field after review of the logs and the geophysical logging. The screened interval within each piezometer will be either five or ten feet and will be based on drilling observations of the permeable zones, with the exception of Zone C. The screened interval for Zone C will be either two-and-one-half feet or five feet.

Existing monitoring wells MW01R and MW03R will be used to monitor Zone B. The Poe and Associates' well MW02 will not be used to monitor a specific zone. The well is not sealed around the filter pack and therefore is not definitively monitoring Zone A or B. The interval being monitored is from one foot bbs to depth of screen and is considered too long of an interval to aid in this investigation. Monitoring wells MW01 and MW03 are appropriately designed for piezometers and are monitoring Zones A and B; however, the locations of the wells are not spatially distributed across the property from the other wells to give a thorough overview of the potentiometric surface for Zone A/B.

Each piezometer group will be clustered together in the same general location. In other words, piezometers P-1, P-2, P-3, and monitoring well MW03R will be grouped together in one general location along the eastern buffer zone. Piezometers P-4, P-5, P-6, and P-7 will be located in the northwestern corner of the property. Piezometers P-8, P-9, and P-10 will be located along the western boundary next to monitoring well MW01R.

All piezometers will be constructed according to the WMI Site Assessment Manual and ASTM standards. The piezometers will be constructed of two-inch diameter, flush-threaded, Schedule 40 PVC, with a five or 10-foot screen, 0.010-inch slot, and a 40 to 60 washed Colorado silica sand filter pack. The filter pack will be tremied down hole to two feet above the screen to prevent bridging. Bentonite pellets will

be tremied above the filter pack for a three foot seal. The bentonite pellets will be hydrated using potable water. A 4-foot by 4-foot concrete pad will be set with a four-inch diameter protective casing around the piezometers.

All piezometers yielding ground water will be developed, if possible, in accordance with ASTM standards to help restore the natural hydraulic properties of the transmissive unit. The piezometers will be allowed to reach static water level prior to development. Static conditions are reached when water-level measurements, taken daily for two consecutive days, are within 90 percent of each other.

Once static conditions are reached, the water levels will be determined and recorded immediately prior to development. Development will proceed using a Waterra® inertial hand pump or QED® development pump until specific conductance, pH, and temperature are stabilized for three consecutive readings. If fine-grained sediments are a problem, development will continue to an appropriately low level of suspended material in the water.

7.4 In-Situ Permeability Testing

Hydraulic conductivity tests will be performed for all piezometers. Hydraulic conductivity will be evaluated using rising-head and/or falling head slug tests. The tests will commence after development, once the hydraulic properties of the transmissive zone has been restored. After development, static water levels will be allowed to equilibrate. The following sequence of events will occur during each slug test:

1. Determine the static water level.
2. Lower the pump into place and remove a known volume (slug) of water from the piezometer, or add a slug of water into the piezometer. The analysis assumes an instantaneous change in volume when the slug is removed or added. The elapsed time equal to zero will be recorded

immediately upon cessation of pumping or the addition of water. An electric water-level meter will measure the rise of water or fall within the piezometer.

3. Water levels in the piezometer will be recorded every 30-seconds for five minutes, then every minute until 15 minutes have elapsed. Measurements will then continue with water levels taken every five minutes until 30 minutes have elapsed; whereafter, water levels will be taken every 10 minutes until one hour has elapsed.
4. Successive time-depth measurements will proceed on an hourly basis until the static water level has met 90 percent recovery.

Transmissivity and hydraulic conductivity will be evaluated using the appropriate approach for the defined ground-water system.

7.5 Surveying

Prior to the initiation of the exploration program, the proposed locations of all boreholes and piezometers will be staked in the field by a professional surveyor licensed in the State of Oklahoma. The actual locations are dependent on accessibility and will be adjusted in the field if necessary.

Upon the installation of all the piezometers, the location of the piezometers and the top of PVC casing will be surveyed. The elevations will be surveyed to the nearest 0.01 foot using a USGS benchmark or National Geodetic Vertical Datum; the location will be given in terms of latitude and longitude of the piezometer at least to the nearest tenth of a second, based on the State of Oklahoma coordinate system. A "notch" will be cut into the top of casing to indicate the location from where the survey point was taken. The elevations of the casing and piezometer number will be permanently stamped on the cover of the protective casing for future reference.

Section 8

8.0 CONCLUSIONS

This report presents information pertaining to the historical activities, physical setting and subsurface conditions of the Muskogee Community Landfill and Recycling Center, and outlines the goals for the Phase II Field Investigation. The available data was used to develop a hydrogeological conceptual model and field exploration program. The field investigation will be undertaken to establish new geotechnical, geological and hydrogeological data. This data will aid in the landfill design and development of a ground-water monitoring plan for Tract A.

Interpretation of the data from the Phase II Field Investigation will enable potentiometric surfaces to be mapped. Additionally, it is necessary to determine if the landfills on Tracts B and C are impacting Tract A. As field investigations proceed, additional information will be sought regarding hydrogeologic information of the area. It is recommended to obtain permission to install four nested piezometers on the hill south of the site. This piezometer will help determine the hydrogeologic conditions and to verify if this area is a recharge area for the facility. Also, a door-to-door search is recommended for the neighborhood north and northwest of the facility to see if any wells exist and are in use. The Phase II-Field Investigation will proceed once the OSDH has approved the field exploration program.

REFERENCES

- National Flood Insurance Program. Flood Insurance Rate Map, Muskogee County, Oklahoma and Incorporated Areas, 40101C0109D. Federal Emergency Management Agency, March 4, 1991.
- National Oceanic and Atmospheric Administration. Climatological Data Annual Summary, Oklahoma, 1991. Volume 100, Number 13. Asheville, North Carolina: National Climatic Data Center, 1991.
- Oklahoma Geological Survey, Guidebook 25. Shelf-to-Shelf Geology and Resources of Pennsylvanian Strata in the Arkoma Basin and Frontal Ouachita Mountains of Oklahoma. Norman, Oklahoma: The University of Oklahoma, 1988.
- Oklahoma Geological Survey. Hydrologic Atlas 1 - Reconnaissance of the Water Resources of the Fort Smith Quadrangle, East-Central Oklahoma. Sheets 1 through 4. Norman, Oklahoma: University of Oklahoma, 1988.
- Poe and Associates. Geotechnical and Hydrogeological Evaluation of Proposed Muskogee Landfill Update, Revised October, 1984. Tulsa, Oklahoma, 1984.
- Poe and Associates. Geotechnical and Hydrogeological Evaluation of Muskogee Landfill Update, Revised October, 1984. Tulsa, Oklahoma, 1984.
- Soil Conservation Service. Soil Survey of Muskogee County, Oklahoma. United States Department of Agriculture, Soil Conservation Service and Forest Service, Oklahoma Agricultural Experiment Station and Oklahoma Conservation Commission, June, 1988.
- Soyster, Hale B. and Thos. G. Taylor. Oklahoma Geological Survey - Bulletin 40-FF, Oil and Gas in Oklahoma, Oil and Gas Geology of Muskogee County. Norman, Oklahoma: Oklahoma Geological Survey, 1988.

Appendix A

SOIL BOREHOLE LOG

SITE NAME AND LOCATION Muskogee Landfill Muskogee, Oklahoma N272500.8 DATUM E2731415.1 ELEVATION 627.7 ft			DRILLING METHOD: <u>Hollow-stem augers.</u> 3-1/4-inch x 7-inch O.D.				BORING NO. B-1				
			SAMPLING METHOD: 24-inch split spoon on 5-foot centers				SHEET 1 OF 1				
			WATER LEVEL				START TIME	FINISH TIME			
			TIME				DATE	DATE			
			DATE				11/18/92	11/18/92			
DRILL RIG <u>CME 75</u>			SURFACE CONDITIONS: <u>Dozer removed 3 to 4 feet of wet,</u>								
ANGLE <u>Vertical</u> BEARING			<u>loose soils so drilling rig could set up over</u>								
SAMPLE HAMMER TORQUE FT.-LBS			<u>boring location</u>								
DEPTH IN FEET (ELEVATION)	BLOWS/BLANKS ON SAMPLER (RECOVERY)	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	TEST RESULTS				
							WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	OTHER TESTS
2			CLAY (CH), tan, homogeneous structure, ferrous nodules, ferrous staining								
4											
6	2,4,7										
8											
10	5,7,10										
12											
14			- interbedded silty clay @ 14.5 feet								
16	21,26, 26		- H ₂ O within interbedded silty clay @ 16 feet, ferrous staining, fossilized plant and animal detritus								
18											
20	33,34 50		- interbedded shale with ferrous staining and weak cementation @ 20 feet, fossilized plant and animal detritus								
22			SHALE, black and gray, weathered, fissile, silt partings, dry								
24											
26	24,50		- gray @ 25 feet								
28											
			TOTAL DEPTH @ 27.5 feet BOTTOM ELEVATION @ 601.2 feet								

Note: Added fill soil from elevation 627.7 to 630.2 ft prior to completion of MW01R concrete pad.

Printed on recycled paper.

DRILLING CONTR
Terracon Environmental, Inc.

LOGGED BY Greg Hassett

DATE 11/18/92 CHK'D BY

SL 11305

SOIL BOREHOLE LOG

SITE NAME AND LOCATION Muskogee Landfill Muskogee, Oklahoma N271744.8 DATUM E2731158.9 ELEVATION 632.2 ft		DRILLING METHOD: <u>Hollow-stem Augers,</u> <u>3½-inch I.D. x 7-inch O.D.</u>				BORING NO. B-2					
		SAMPLING METHOD: <u>24-inch split spoons</u> <u>on five-foot centers.</u>				SHEET 1 OF 2					
						DRILLING					
		WATER LEVEL 18.1 17.3 9.82 9.25		TIME 10:25 10:50 12:45 13:30		START 09:00					
		DATE 11/18 11/18 11/18 11/18		FINISH 10:00		DATE 11/18/92 11/18/92					
DRILL RIG <u>CME 75</u>		SURFACE CONDITIONS <u>Level and flat on fill pad</u>									
ANGLE <u>Vertical</u> BEARING											
SAMPLE HAMMER TORQUE FT.-LBS											
DEPTH IN FEET (ELEVATION)	BLOWS/ 5 IN. ON SAMPLER (RECOVERY)	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	TEST RESULTS				
							WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	OTHER TESTS
2			FILL, silty clay, tan								
4	push		- dark brown @ 2 ft								
6			- silty sand intermixed with clay @ 3 ft								
8			- silty clay @ 6 ft								
10	3,4,4		CLAY (CH), tan, homogeneous structure, ferrous nodules								
12											
14											
16	5,5,7		- black @ 17 ft								
18											
20	5,7,20		- H ₂ O within 1-inch claystone layer @ 20 ft, silt partings, ferrous staining								
22											
24											
26	7,12,15										
28			SHALE, blue gray, weathered, fissile, dry								

Printed on recycled paper.

E-8-506

DRILLING CONTR Terracon Environmental, Inc.

LOGGED BY Greg Hassett

SL 11306

DATE 11/18/92 CHK'D BY

SOIL BOREHOLE LOG

SITE NAME AND LOCATION Muskogee Landfill Muskogee, Oklahoma		DRILLING METHOD: Hollow-stem augers, 3½-inch I.D. x 7-inch O.D.				BORING NO. B-2	
		SAMPLING METHOD: 24-inch split spoons on 5-foot centers				SHEET 2 OF 2	
						DRILLING	
		WATER LEVEL				START TIME 09:00	FINISH TIME 10:00
		TIME				DATE 11/18/92	DATE 11/18/92
DATE							
CASING DEPTH							
DATUM		ELEVATION					
DRILL RIG		SURFACE CONDITIONS					
ANGLE		BEARING					
SAMPLE HAMMER TORQUE		FT.-LBS					
DEPTH IN FEET (ELEVATION)	BLOWS/ 8 IN. ON SAMPLER (RECOVERY)	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	TEST RESULTS
21,50			SHALE, blue gray, silty, weathered, fissile, dry				WATER CONTENT %
32							LIQUID LIMIT %
34							PLASTIC LIMIT %
							SPECIFIC GRAVITY
							OTHER TESTS
			TOTAL DEPTH @ 31 feet BOTTOM ELEVATION @ 601.2 feet				

DRILLING CONTR Terracon Environmental, Inc.

LOGGED BY Greg Hassett

SL 11307

DATE 11/18/92 CHK'D BY

Printed on recycled paper.



SOIL BOREHOLE LOG

SITE NAME AND LOCATION Muskogee Landfill Muskogee, Oklahoma N272179.4 DATUM E2730189.7 ELEVATION 641.5 ft			DRILLING METHOD: Hollowstem Augers, 3½-inch I.D. x 7-in O.D.				BORING NO. B-3					
			SAMPLING METHOD: 24-inch split spoons on 5-foot centers				SHEET 1 OF 2					
							DRILLING START FINISH TIME TIME 0900 1035					
			WATER LEVEL 14.5				DATE DATE 11/19/92 11/19/92					
			TIME 10:04									
DRILL RIG CME 75			SURFACE CONDITIONS Wet and muddy									
ANGLE Vertical BEARING												
SAMPLE HAMMER TORQUE FT.-LBS												
DEPTH IN FEET (ELEVATION)	BLOWS/ 8 IN. ON SAMPLER (RECOVERY)	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL		SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	TEST RESULTS				
								WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	OTHER TESTS
2			Fill, silty clay, brown									
4			CLAY (CH), tan and gray mottling, roots, homogeneous structure, ferrous nodules									
6	4,4,5											
8												
10	3,4,6											
12												
14												
16	4,5,4											
18												
20	6,9,12		- Slickensided cleavage planes @ 20 feet									
22												
24												
26	5,8, 12		- Soils are slightly more consolidated @ 25 feet									
28												

DRILLING CONTR Terracon Environmental Inc.

LOGGED BY Greg Hassett

SL 11310

DATE 11/19/92 CHK'D BY

Printed on recycled paper.



SOIL BOREHOLE LOG

SITE NAME AND LOCATION Muskogee Landfill Muskogee, Oklahoma		DRILLING METHOD: <u>Hollowstem Augers,</u>				BORING NO. <u>B-3</u>						
		<u>3 1/2-inch I.D. x 7-inch O.D.</u>				SHEET <u>2</u> OF <u>2</u>						
		SAMPLING METHOD: <u>24-inch split spoons</u>				DRILLING						
		<u>on 5-foot centers</u>				START	FINISH					
		WATER LEVEL: <u>14.5</u>				TIME	TIME					
DATUM		ELEVATION		TIME	DATE	DATE						
TIME		DATE		DATE	DATE	DATE						
CASING DEPTH: <u>N/A</u>				<u>11/19/92</u>	<u>11/19/92</u>	<u>92</u>						
DRILL RIG		SURFACE CONDITIONS										
ANGLE		BEARING		<u>Wet and Muddy</u>								
SAMPLE HAMMER TORQUE		FT.-LBS										
DEPTH IN FEET (ELEVATION)	BLOWS/ IN. ON SAMPLER (RECOVERY)	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	TEST RESULTS					
WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	OTHER TESTS								
32	7, 9, 16		CLAY (CH) - H ₂ O within 1-inch coal seam @ 30 feet - Coal seams, 32 to 35 feet									
34												
36	21, 50		SHALE, blue gray, weathered, fissile, dry									
38												
40	50											
42			TOTAL DEPTH @ 39.5 feet BOTTOM ELEVATION @ 602.00 feet									

DRILLING CONTR Terracon Environmental, Inc.

LOGGED BY Greg Hassett

DATE 11/19/92 CHK'D BY

SL 11311



NOTE: THE POE AND ASSOCIATES' BORING LOGS NEED TO BE READ IN A CERTAIN MANNER. THE FOLLOWING TABLE SUMMARIZES THE TEST HOLE INFORMATION AND IS PERTINENT IN INTERPRETING THE BORING LOGS. THE TABLE CORRELATES WHERE THE BASE OF THE CLAY AND THE TOP OF THE UNWEATHERED SHALE IS IN EACH TEST HOLE. THE DEPTH OF THE STRATA ON THE BORING LOGS REPRESENTS THE BASE OF THE STRATA.

For example, the silt stratum for Test Hole #1 is from zero to 1.8 feet below land surface (bls). The clay stratum starts at 1.8 feet bls down to 19.2 feet bls. This depth of the clay corresponds to the table with the clay thickness (including the silt) being 19.0 feet. The top of weathered shale starts at 19.2 feet bls or at an elevation of 619.8 feet msl (or 620 ft msl). After thorough evaluation of the Poe and Associates' data and as it is shown in this example, it is concluded that they randomly round off their numbers.

TABLE 2

TEST HOLE DATA

<u>Test Hole</u>	<u>Surface Elev. MSL</u>	<u>Depth of Hole (ft.)</u>	<u>Clay Thickness (ft.)</u>	<u>Top Weathered Shale MSL</u>	<u>Top Coal MSL</u>	<u>Top Unweathered Shale MSL</u>
1	639.0	40	19.0	620.0	604.5	612.0
2	629.0	40	15.0	614.0	612.0	602.0
3	629.5	40	19.0	610.5	--	596.5
4	632.5	40	16.0	616.5	--	597.0
5	636.0	40	16.7	619.3	--	601.6
6	628.5	40	14.2	614.3	--	594.0
7	623.5	40	11.3	612.2	--	594.2
8	636.0	27	19.0	617.0	611.0	--
9	630.0	20	11.8	618.2	618.2	--
10	639.0	20	15.3	623.7	--	--
11	633.5	20	13.5	620.0	--	--
12	629.5	20	13.3	616.2	--	--
13	627.5	20	14.5	613.0	--	--
14	629.5	50	11.5	618.0	--	--
15	640.0	20	17.5	622.5	--	--
16	631.0	27				
Test Pit 1	633.0	22	18.0	--	--	--
Test Pit 2	634.5	18	12.0	--	--	--

★ FOUNDATION • CORE • SOIL TESTING ★
★ COMPLETE WATER WELL INSTALLATION ★

NELSON HOSS
PE #7868
TULSA OKLAHOMA
(918) 744-0258

REPORT NO. _____
DATE: _____

REPORT OF TEST HOLE NO. 1

REPORTED TO L. R. McComas PROJECT Landfill

JOB LOCATION Muskogee, OK **HOLE LOCATION** _____

DATE DRILLED 10-6-93 DRILLER Gabby METHOD OF DRILLING Air

SURFACE ELEVATION _____ WATER TABLE _____ DEPTH OF HOLE 40'

-68-

★ FOUNDATION • CORE • SOIL TESTING ★
★ COMPLETE WATER WELL INSTALLATION ★

NELSON HOSS
PE 07868
TULSA, OKLAHOMA
(918) 746-0258

REPORT NO. _____
DATE: _____

REPORT OF TEST HOLE NO. 2

REPORTED TO M. R. McComas PROJECT Landfill

JOB LOCATION Muskogee, OK HOLE LOCATION _____

DATE DRILLED 10-6-83 DRILLER Gabby METHOD OF DRILLING Air

SURFACE ELEVATION _____ WATER TABLE _____ DEPTH OF HOLE 40'

-69-

★ FOUNDATION - CORE - SOIL TESTING ★
★ COMPLETE WATER WELL INSTALLATION ★

NELSON HOBS
PE #7968
TULSA OKLAHOMA
(918) 748-0258

REPORT NO. _____
DATE: _____

REPORT OF TEST HOLE NO. 3

REPORTED TO M. R. McComas PROJECT Landfill

JOB LOCATION Muskogee, OK HOLE LOCATION _____

DATE DRILLED 10-6-83 DRILLER Gabby METHOD OF DRILLING Air

SURFACE ELEVATION _____ WATER TABLE _____ DEPTH OF HOLE 40'

-70-

★ FOUNDATION • CORE • SOIL TESTING ★
★ COMPLETE WATER WELL INSTALLATION ★

**NELSON MOSS
PE #7868
TULSA, OKLAHOMA
(918) 745-0268**

REPORT NO. _____
DATE: _____

REPORT OF TEST HOLE NO. 4

REPORTED TO M. R. McComas PROJECT Landfill

JOB LOCATION Muskogee, OK HOLE LOCATION

DATE DRILLED 10-6-83 DRILLER Gabby METHOD OF DRILLING Air

SURFACE ELEVATION _____ WATER TABLE _____ DEPTH OF HOLE 40'

-71-

★ FOUNDATION • CORE • SOIL TESTING ★
★ COMPLETE WATER WELL INSTALLATION ★

NELSON HOSS
PE #7968
TULSA, OKLAHOMA
(918) 744-0254

REPORT NO. _____
DATE: _____

REPORT OF TEST HOLE NO. 5

REPORTED TO M. R. McComas PROJECT Landfill

JOB LOCATION Muskogee, OK HOLE LOCATION

DATE DRILLED 10-6-83 DRILLER Gabby METHOD OF DRILLING Air

SURFACE ELEVATION _____ WATER TABLE _____ DEPTH OF HOLE 40'

E-8-516

★ FOUNDATION • CORE • SOIL TESTING ★
★ COMPLETE WATER WELL INSTALLATION ★

NELSON HOBB
PE #7868
TULSA, OKLAHOMA
(918) 745-0288

REPORT NO. _____
DATE: _____

REPORT OF TEST HOLE NO. 6

REPORTED TO M. R. McComas PROJECT Landfill

JOB LOCATION Muskogee, OK HOLE LOCATION _____

DATE DRILLED 10-6-93 DRILLER Gaby METHOD OF DRILLING Air

SURFACE ELEVATION _____ WATER TABLE _____ DEPTH OF HOLE 40'

E-8-517

WITHAM DRILLING

* FOUNDATION - CORE - SOIL TESTING *

★ COMPLETE WATER WELL INSTALLATION ★

ETAN WITHAM
TULSA, OKLAHOMA
(918) 643-6537

NELSON HOSS
PE #7868
TULSA, OKLAHOMA
(918) 748-0258

REPORT NO. _____
DATE: _____

REPORT OF TEST HOLE NO. 7

REPORTED TO W. R. McCOMB PROJECT Landfill

JOB LOCATION Muskogee, OK HOLE LOCATION _____

DATE DRILLED 10-6-83 DRILLER Gabby METHOD OF DRILLING Air

SURFACE ELEVATION _____ WATER TABLE _____ DEPTH OF HOLE 40'

ELEV	DEPTH	DESCRIPTION OF MATERIAL TYPE, TEXTURE, COLOR, CONSISTENCY	PENETRATION TEST		
			FROM	TO	BL
	2.0	Silt, sandy, brown			
	5.2	Clay, brown to tan w/red			
	7.0	Clay, tan to yellow w/grey			
	8.2	Clay, yellow & grey w/black, moist			
	11.0	Clay, slightly sandy, yellow w/grey			
	17.7	Shale, tan, soft w/clayey layers, moist			
	20.0	Shale, sandy, tan to grey			
	20.5	Clay, shaley, black			
	21.5	Limestone			
	22.0	Clay, shaley, moist			
	28.3	Shale, tan soft w/sandstone lenses			
	36.0	Shale, sandy, blue, grey w/sandstone lenses			
	38.2	Coal, wet			
	40.0	Fireclay			

SHELBY TUBES

NO. FROM TO

CORING

FROM TO L

★ FOUNDATION • CORE • SOIL TESTING ★
★ COMPLETE WATER WELL INSTALLATION ★

NELSON MOSE
PE #7968
TULSA, OKLAHOMA
(918) 748-0268

REPORT NO. _____
DATE: _____

REPORT OF TEST HOLE NO. 9

SURFACE ELEVATION _____ WATER TABLE _____ DEPTH OF HOLE 27'

E-8-519

★ FOUNDATION • CORE • SOIL TESTING ★
★ COMPLETE WATER WELL INSTALLATION ★

NELSON HOSS
FE 07055
TULSA, OKLAHOMA
(918) 746-0256

REPORT OF TEST HOLE NO. 9

SURFACE ELEVATION _____ WATER TABLE _____ DEPTH OF HOLE 20'

-76-

★ FOUNDATION • CORE • SOIL TESTING •
★ COMPLETE WATER WELL INSTALLATION ★

NELSON HOSS
FE #7866
TULSA, OKLAHOMA
(918) 746-0258

REPORT NO. _____
DATE: _____

REPORT OF TEST HOLE NO. 10

SURFACE ELEVATION _____ WATER TABLE _____ DEPTH OF HOLE 20'

E-8-521

★ FOUNDATION • CORE • SOIL TESTING ★
★ COMPLETE WATER WELL INSTALLATION ★

NELSON HOSS
PE #7868
TULSA, OKLAHOMA
(918) 746-0258

REPORT NO. _____
DATE: _____

REPORT OF TEST HOLE NO. 11

REPORTED TO M. R. McComas PROJECT Landfill

JOB LOCATION Muskogee, OK **HOLE LOCATION**

DATE DRILLED 10-7-83 DRILLER Gabby METHOD OF DRILLING Air

SURFACE ELEVATION _____ **WATER TABLE** _____ **DEPTH OF HOLE** 20'

E-8-522

★ FOUNDATION • CORE • SOIL TESTING ★
★ COMPLETE WATER WELL INSTALLATION ★

NELSON HOSS
PE 97858
TULSA OKLAHOMA
(918) 746-0258

REPORT NO. _____
DATE: _____

SURFACE ELEVATION _____ WATER TABLE _____ DEPTH OF HOLE 20'

-79-

★ FOUNDATION - CORE - SOIL TESTING ★
★ COMPLETE WATER WELL INSTALLATION ★

NELSON HOSS
PE #7968
TULSA, OKLAHOMA
(918) 746-0258

REPORT NO. _____
DATE: _____

REPORT OF TEST HOLE NO. 13

REPORTED TO M. R. McComas PROJECT Landfill

JOB LOCATION Muskogee, OK HOLE LOCATION _____

DATE DRILLED 10-7-83 DRILLER Gabby METHOD OF DRILLING Air

SURFACE ELEVATION _____ WATER TABLE _____ DEPTH OF HOLE 20'

E-8-524

★ FOUNDATION • CORE • SOIL TESTING ★
★ COMPLETE WATER WELL INSTALLATION ★

NELSON MOSE
PE #7858
TULSA OKLAHOMA
(918) 746-0258

REPORT NO. _____
DATE: _____

SURFACE ELEVATION _____ WATER TABLE _____ DEPTH OF HOLE 50'

[illegible]

★ FOUNDATION • CORE • SOIL TESTING ★
★ COMPLETE WATER WELL INSTALLATION ★

NELSON HOSS
PE #7958
TULSA OKLAHOMA
(918) 745-0256

REPORT NO. _____
DATE: _____

SURFACE ELEVATION _____ WATER TABLE _____ DEPTH OF HOLE 20'

E-8-526

★ COMPLETE WATER WELL INSTALLATION ★

NELSON HOSS
PE #7868
TULSA, OKLAHOMA
(918) 744-0254

REPORT NO. _____
DATE: _____

REPORT OF TEST HOLE NO. 16

REPORTED TO M. R. McComas PROJECT Landfill

JOB LOCATION Muskogee, OK HOLE LOCATION

DATE DRILLED 10-7-83 DRILLER Tabby METHOD OF DRILLING As

SURFACE ELEVATION _____ WATER TABLE _____ DEPTH OF HOLE 27

E-8-527

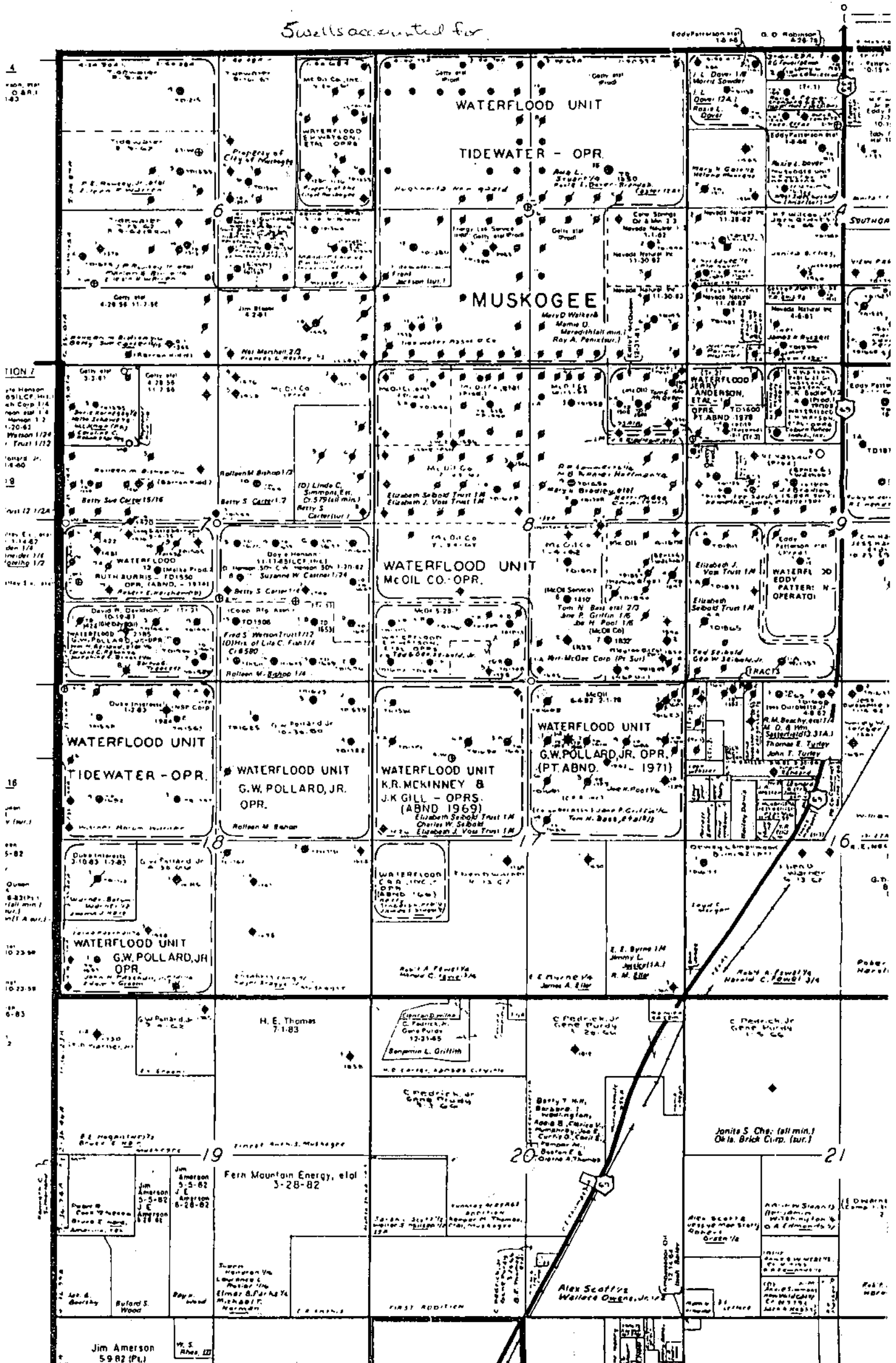
Appendix B

Petroleum Information

a company of
The Dun & Bradstreet Corporation

Midcontinent Map
P.O. Box 7812
Denver, Colorado 80202

Swells accounted for



map prices become effective July 1, 1961.

MIDCONTINENT MAP COMPANY
205 Castle Bldg. Phone LU 4-7221
TULSA 3, OKLAHOMA

MIDCONTINENT MAP COMPANY

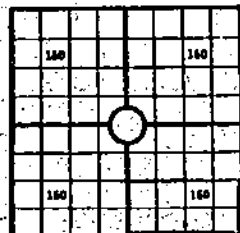
205 CASTLE BLDG. 114 W. 3RD. ST.
TULSA 3, OKLAHOMA
LUTHER 4-7221

LEGEND SHEET

- LOCATION
- ⊙ RIG UP
- ⊙ DRILLING WELL
- PRODUCING OIL WELL
- * PRODUCING GAS WELL
- ⊕ COMBINATION OIL & GAS WELL
- ⊕_{ss} GAS STORAGE WELL (ILL. ONLY)
- ◆ DRY HOLE
- ⊕_W INPUT WELL ⊕_S SUPPLY WELL
- ⊕_W WATER INPUT WELL (ILL. ONLY)
- ⊕_W "W" BEFORE WELL NO. DENOTES
CONVERSION TO INPUT WELL
- ⊕_W CONVERSION FROM OIL WELL
TO WATER INPUT WELL (ILL. ONLY)
- ⊕ ABANDONED OIL WELL
- * ABANDONED GAS WELL
- * ABANDONED COMBINATION WELL
- ⊕ ABANDONED INPUT WELL
- ⊙ STORAGE TANK
- ⊕_W SALT WATER DISPOSAL WELL
- ⊕_W SALT WATER DISPOSAL WELL (ILL.)
- (TD) TAX DEED
- (LE) LIFE ESTATE
- (SD) SHERIFF'S DEED
- (D) RESTRICTED INDIAN LANDS
- (CP) CERTIFICATE OF PURCHASE
- (CD) CONTRACT FOR DEED OR
CONTRACT FOR SALE
- ←L→ LEASES GENERALLY ARE THE
SAME ON TRACTS JOINED BY
THIS SYMBOL
- ←M→ MINERALS GENERALLY ARE THE
SAME ON TRACTS JOINED BY
THIS SYMBOL
- ←LM→ LEASES AND MINERALS GENERALLY
ARE THE SAME ON TRACTS
JOINED BY THIS SYMBOL
- (NP) NON-PARTICIPATING MINERAL OR
ROYALTY INTERESTS HAVE BEEN
CONVEYED OR RESERVED UNDER
TRACTS BEARING THIS SYMBOL

271943

FARM NAME Kitty Roberts WELL NO. W-8 COUNTY Muskogee SEC. 6 TWP. 14N RGE. 18E



Locate well correctly

OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

COUNTY Muskogee SEC. 6 TWP. 14N RGE. 18E
 COMPANY OPERATING Tidewater Oil Company
 OFFICE ADDRESS Box 752, Drumright, Oklahoma
 FARM NAME Kitty Roberts WELL NO. W-8
 DRILLING STARTED 6-20-62 DRILLING FINISHED 7-8-62
 DATE OF FIRST PRODUCTION COMPLETED 7-19-62
 WELL LOCATED SE 1/4 SW 1/4 SE 1/4 10th North of South
 Line and 3960th N. East of West Line of Quarter Section Line
 Elevation (Relative to sea level) DERRICK FLOOR GROUND 799.5
 CHARACTER OF WELL (Oil, gas or dryhole) water injection

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
1 Dutcher Series					
2 Stray	1527	1551			
3 Muskogee	1572	1598			

Perforating Record If Any

Shot Record

Formation	From	To	No. of Shots	Formation	From	To	Size of Shot
Stray	1532	1547	30	Tornado Jets, squeezed w/			50 sks.
Muskogee	1584	1592	32	Tornado Jets			
Stray	1536	1538	42	1/4 Sand perf. w/ Hawk 3-way tool.			

CASING RECORD

Amount Set						Amount Pulled				Packer Record	
Size	Wt.	Thds.	Make	Fl.	In.	Fl.	In.	Size	Length	Depth Set	Make
10 3/4	32		154								
4 1/2	9.5		1633								

Liner Record: Amount Kind Top Bottom

CEMENTING AND MUDDING

Site	Amount Set		Sacks Cement	Chemical		Method of Cementing	Amount	Mudding Method	Results (See Note)
	Fl. @	In.		Gal.	Make				
10 3/4	153	1	100			HA-5			
4 1/2	1606		450			Pozmix			

Note: What method was used to protect sands if outer strings were pulled?

NOTE: Were bottom hole plugs used? If so, state kind, depth set and results obtained

TOOLS USED

Rotary Tools were used from _____ feet to _____ Cable tools were used from _____ feet to _____
 feet, and from _____ feet to _____ feet, and from _____ feet to _____

Type Rig

INITIAL PRODUCTION TEST

Describe initial test: whether by flow through tubing or casing or by pumping

Water injection well

Amount of Oil Production _____ bbls. Size of choke, if any _____ Length of test _____ Water

Production _____ bbls. Gravity of oil _____ Type of Pump or pump is used, describe _____

OCC-3, Boone, Shackelford, File

Give detailed description and this water, oil or gas.

SEP. 8 1962

REF. NO. 7507

Formation	Top	Bottom	Formation	Top	Bottom
Soil	0	1			
Sand - Rock	1	20			
Shale	20	72			
Sand	72	78			
Shale	78	272			
Sand	272	295			
Shale	295	375			
Sand	375	420			
Shale	420	537			
Sand	537	555			
Shale	555	785			
Sand	785	795			
Shale	795	975			
Line - Blk	975	987			
Shale	987	1170			
Line - Blk	1170	1200			
Line	1200	1215			
Shale	1215	1227			
Line - Blk	1227	1237			
Shale	1237	1270			
Sand - Blk	1270	1290			
Shale	1290	1340			
Line	1340	1347			
Shale	1347	1425			
Sand	1425	1435			
Shale	1435	1441			
Sand	1441	1465			
Shale	1465	1529			
Sand	1529	1562			
Sand - Blk	1562	1571			
Sand	1571	1601			
Shale	1601	1611			
Sandy - Lime	1611	1613			
Shale - Lime	1613	1625			
	TD	1625			
	PBTD	1601			

I, the undersigned, being first duly sworn upon oath, state that this well record is true, correct complete according to the records of this office and to the best of my knowledge and belief.

Area Supt.

Name and title of representative of company

6th August

Subscribed and sworn to before me this _____ day of _____ 1962

My Commission expires 9-30-62

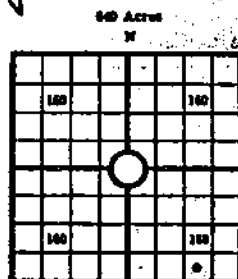
Notary Public.

FARM NAME SEIBOLD B. COUNTY Muskogee SEC 31 TWP 15 N. RGE 18 E
104717

Form 1022A

OKLAHOMA CORPORATION COMMISSION OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD



Locate well correctly

COUNTY Muskogee SEC 31 TWP 15 N. RGE 18 East
COMPANY OPERATING John K. Gill & K.R. McKinney
OFFICE ADDRESS 108 1/2 S. Morton; Okmulgee, Okla.
FARM NAME Seibold B. WELL NO. 4
DRILLING STARTED 3/13, 1964 DRILLING FINISHED 3/22, 1964
DATE OF FIRST PRODUCTION COMPLETED
WELL LOCATED 1/4 SW 1/4 SE 1/4 SE North of South
Line and 1/2 East of West Line of Quarter Section
Elevation (Relative to sea level) DERRICK FLOOR GROUND
CHARACTER OF WELL (Oil, gas or dryhole)

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
1 Muskogee	1080	1105	4		
2			5		
3			6		

Perforating Record If Any

Shot Record

Formation	From	To	No. of Shots	Formation	From	To	Size of Shot
1080	1105	SD Jet					

CASING RECORD

Amount Set								Amount Pulled		Packer Record	
Size	Wt.	Thds.	Make	Fl.	In.	Fl.	In.	Size	Length	Depth Set	Make
8	20	10	YW	280	05			8	275		
1 1/2	8.5	Std	SL	1162							

Liner Record: Amount Kind Top Bottom

CEMENTING AND MUDDING

Size	Amount Set		Sacks Cement	Chemical		Method of Cementing	Amount	Mudding Method	Results (See Note)
	Fl.	In.		Gal.	Make				
1 1/2	1162		50			Halliburton			

Note: What method was used to protect sands if outer strings were pulled?

NOTE: Were bottom hole plugs used? If so, state kind, depth set and results obtained

TOOLS USED

Rotary Tools were used from feet to Cable tools were used from 0 feet to 1162 feet and from feet to feet, and from feet to feet
Type Rig 28 - L. Bucyrus E-1a

INITIAL PRODUCTION TEST

Describe initial test: whether by flow through tubing or casing or by pumping Pumping

Amount of Oil Production 1 bbls. Size of choke, if any Length of test Water
Production bbls. Gravity of oil Type of Pump if pump is used, describe

Give detailed description and thickness of water, oil or gas.

JUL 25 1964

NATIONAL OIL WELL INDEX CO.
OKLAHOMA CITY

REF. NO. 64-3163

Formation	Top	Bottom	Formation	Top	Bottom
Soil, Clay	0	20			
Shale	20	269			
Lime	269	275			
Shale	275	282			
Sand	282	295			
Shale	295	445			
Lime	445	470			
Shale	470	597			
Lime, shale	597	602			
Shale, sand	602	650			
Shale	650	695			
Lime, shale	695	720			
Shale	720	773			
Lime	773	779			
Shale	779	789			
Lime	789	801			
Shale	801	814			
Lime	814	825			
Shale	825	865			
Lime	865	871			
Shale	871	936			
Lime	936	942			
Shale	942	994			
Sandy lime	994	1008			
Shale	1008	1061			
Sandy lime	1061	1075			
Shale	1075	1080			
Sand	1080	1105			
Shale	1105	1136			
Lime	1136	1162			

I didn't have any record in the NE 1/4 of Sec 31
OKLAHOMA CORPORATION
COMMISSION
JUL 21 1964
RECEIVED
CONSERVATION DEPARTMENT

I, the undersigned, being first duly sworn upon oath, state that this well record is true, correct and complete according to the records of this office and to the best of my knowledge and belief.

Name and title of representative of company

Subscribed and sworn to before me this 20th day of July 1964
My Commission expires 7-28-67 Margaret L. Addicum
Notary Public

Form 102A

(Mail to Corporation Commission, Oklahoma City, Oklahoma)
OKLAHOMA CORPORATION COMMISSION
 OIL AND GAS CONSERVATION DEPARTMENT

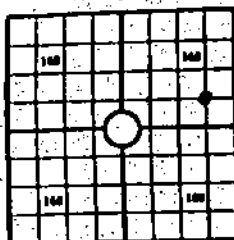
Give detailed description and thickness
 water, oil or gas.

OCT 23 1965

NAT. OIL INDEX
 OKLAHOMA CITY
 REF. NO. 65-4279

WELL RECORD

COUNTY MUSKOGEE, SEC. 6, TWP. 14-N., RGE. 18 East
 COMPANY OPERATING Watson & Watson
 OFFICE ADDRESS Morris, Oklahoma
 FARM NAME Wrigley WELL NO. 8
 DRILLING STARTED 7-23-1965 DRILLING FINISHED 8-27-1965
 DATE OF FIRST PRODUCTION 8-27-65 COMPLETED 8-27-65
 WELL LOCATED CL 1/4, SE 1/4, NE 1/4, 660' North of South
 Line and 660' E. East of West Line of Quarter Section
 Deviation (Relative to sea level) DERRICK FLOOR GROUND
 CHARACTER OF WELL (Oil, gas or dryhole) Oil



Locate well correctly

OIL OR GAS SANDS OR LONES

Name	From	To	Name	From	To
1 Stray	1175	1190	4		
2 Muskogee	1206	1218	5		
3 Timberidge	1246	1250	6		

Perforating Record If Any

Formation	From	To	No. of Shots	Formation	From	To	Size of Shot
				Muskogee	1206	1226	40 gts

CASING RECORD

Amount Set								Amount Pulled		Packer Record	
Size	Wt.	Thda.	Make	Fl.	In.	Fl.	In.	Size	Length	Depth Set	Make
8 5/8	28	8	LW	SW	508						
10	60	8	SS	60							
5 1/2	17	10	LW	1200							

Line Record: Amount Kind Top Bottom

CEMENTING AND MUDDING

Size	Amount Set		Bags Cement	Chemical		Method of Cementing	Amount	Mudding Method	Results (See Note)
	Fl.	In.		Gal.	Make				
5 1/2	1200		100			Haliburton			

Note: What method was used to protect sands if outer strings were pulled? Cementing

NOTE: Were bottom hole plugs used? NO If so, state kind, depth set and results obtained

TOOLS USED

Rotary Tools were used from 1st to 0 feet in 1272
 Cable tools were used from 0 feet to 1272
 Tool and from 1st to 1st, and from 1st to 1st
 Type Rig Spudger

DETAIL PRODUCTION TEST

Describe initial test: whether by flow through tubing or casing or by pumping pumping

Formation	Top	Bottom	Formation	Top	Bottom
Surface	0	25	Sandy Lime	1218	1225
Clay	25	33	Sand with Shale	1225	1236
Blue Shale	33	49	Shale	1236	1246
Water Sand	49	53	Sandy Lime	1246	1250
Shale	53	60	Show of oil		
Limy Shale	60	76	Shale	1250	1268
Shale	76	108	Lime	1268	1272
Sand	108	145			
Sandy Shale	145	178			
Shale	178	395			
Shale	395	472			
Sand	472	478			
Shale	478	494			
Sand	494	506			
Shale	506	578			
Sandy Shale	578	596			
Shale	596	665			
Lime	665	675			
Shale	675	770			
Lime	770	775			
Limy Shale	775	800			
Shale	800	851			
Lime and Shale	851	900			
Lime	900	910			
Shale	910	938			
Sand	938	968			
Shale	968	1030			
Sandy Lime	1030	1040			
Shale	1040	1095			
Sand	1095	1118			
Shale	1118	1140			
Shale	1140	1176			
Stray Sand	1176	1182			
Sand	1182	1190			
Limy Sand	1190	1192			
Shale	1192	1200			
Sand	1200	1218			

I, the undersigned, being first duly sworn upon oath, state that this well record is true, correct and complete according to the records of this office and to the best of my knowledge and belief.

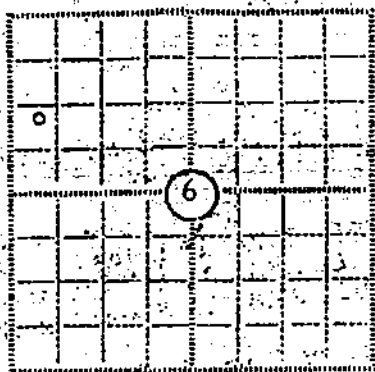
Watson Partner
 Name and title of representative of company

274931

CORPORATION COMMISSION
OIL AND GAS CONSERVATION DEPT
OKLAHOMA CITY, OKLAHOMA

490293

Muskogee County



COMPANY— William H. Pine
FARM— Rooney # 2
LOCATION— NW SW NW
COUNTY— Muskogee
TOTAL DEPTH— 2082'
PRODUCTION— oil
ROCK PRESSURE—
ELEVATION— Derrick 653' Ground 652'
DRILLING COMMENCED— 11-20-49
DRILLING COMPLETED— 11-27-49

SEC. 6
TWP. 14N
RGE. 18E

This record received by the Corporation
Commission Dec. 12, 1949

William H. Pine
Okmulgee, Oklahoma.

NW SW NW OF SEC. 6-14N-18E-990' North from Line Wells Logs which are off from
of south line and 275' East of West Line plus 3 1/2' at 750 to minus 7' at 2082.
of Quarter section.

Date of first Production 11-20-49
Completed 11-20-49. OIL

OIL OR GAS SANDS OR ZONES:

band - Sho oil	752	756
Wapanucka-Sho O&G	1240	1252
Simpson Dolo. Wtr.	1776	1789
Sandy Line, stain	1970	1982
Sand- Sho Oil & wtr.	2018	2025
Sand- Sho oil	2033	2035

NOTE: All above measurements are taken
from Line Wells Logs which are off from
plus 3 1/2' at 750 to minus 7' at 2082.

The shows in the Burgen below 2018 prob.
justify drilling out to 2082 T.D. running
string 5 1/2" & cementing above Simpson.
Re- run Gamma Ray & Neutron & Perf. off
same line. If Production is obtained rip
off pipe above Simpson & produce all
three zones.

This well drilled to 2021' By McAdams
& Wallace, Bristow, and taken over at
2021 by Williams H. Pine.

PERFORATING RECORD:

		No. Shots	FORMATION	TOP	BOTTOM
Burgen	2042	2047	10 holes Clay, yellow		8
Burgen	2031	2038	14 holes Shale	5	45
Burgen	2011	2018	14 holes Sand	45	65
Burgen	1976	1989	26 holes Shale	65	237
Burgen	1976	1989	500 Gals. Sand	237	250
			Shale	250	298

SHOT RECORD:

		Size shot	Line, broken	TOP	BOTTOM
Simpson Dolo.	1785	1794	17 holes Shale	298	301
Simpson Dolo.	1785	1794	500 Gall Lime	301	425
Wapanucka	1244	1254	34 holes Shale	425	437
Wapanucka	1239	1244	17 holes Sand, sho, Gas	437	498
Wapanucka	1239	1254	1000 Gal Shale	498	506
Simpson Dolo	1785	1794	17 holes Sand, wtr. 3 blr./hr.	506	510
Simpson Dolo.	1785	1794	500 gal. Shale	510	524
Wapanucka	1244	1254	34 holes Lime	524	635
Wapanucka	1239	1244	17 holes Shale	635	645
Wapanucka	1239	1254	1000 gal Sand, so	645	752
Wapanucka	1239	1254	4000 gal shale	752	756
	777		1 hole Lime	756	796
Booch	753 1/2	758 1/2	10 holes shale	796	811
Booch	753 1/2	754 1/2	Hydrafrac	811	996

CONT. PAGE # 2. Wm. H. Pine

Page # 2. William H. Pine
Okmulgee, Oklahoma.

NW SW NW OF SEC. 6-14N-18E
Muskogee County.
FARM NAME: Rooney # 2.

FORMATION	TOP	BOTTOM
Sand HFW	996	1013
Sandy lime	1013	1022
Sand	1022	1045
Shale	1045	1059
Lime	1059	1076
Shale	1076	1082
Lime	1082	1086
Shale	1086	1111
Lime	1111	1126
Shale	1126	1184
Sand, no sho	1184	1206
Shale	1206	1215
Sand	1215	1222
Shale	1222	1228
Lime	1228	1233
Shale	1233	1236
Lime, blk	1236	1240
Wapanucka, SO	1240	1265
Shale	1265	1301
Lime	1301	1316
Shale	1316	1329
Lime	1329	1339
Shale	1339	1344
Lime	1344	1439
Shale	1439	1544
Lime	1544	1636
Shale	1636	1796
Hunton Lmr	1696	1702
Shale	1702	1750
Viola Lime	1750	1765
Dense	1765	1776
Dolomite	1776	1789
Sandy Dolo.	1789	1796
Wilcox wtr. 2 blrs. /hr.	1796	1805
Green Sandy shale	1805	1859
Sand, hd.	1859	1874
Gr en sandy shale	1874	1970
Sandy lime, stain	1970	1983
Lime	1983	2006
Sand	2006	2018
Sand, oil & wtr.	2018	2025
Sand, So 2033 1/2 wtr. 2041	2025	2044
Lime	2044	2052
Sandy lime, wtr.	2052	2079
Sand	2079	2082
TOTAL DEPTH		2082'

Filled to top with rotary mud. Pulled
85/8" casing- Ran Schlumberger. Ran 7"
Casing and cemented.
Bailed hole dry & ran Gamma Ray & Neutron
Logs.

PERFORATING, PLUG BACK, ACIDIZING AND HYDRAFRACING RECORD

FORMATION	No.	OR	Size	Results
Burgen	2035	2040	10 holes	HF SW
Burgen	2024	2031	14 "	Nothing shn
Burgen	2011	2018	14 "	Nothing shwn
Lane Wells Bridging Plug	1993'			Leaking
Lane-Wells " " "	1987			Shut off.
Burgen	1989	1982	26 holes	N. Shwn
Burgen	1969	1982	500 gal.	N. Coming
				in
Lane-Wells Bridging Plug	1823			ShutOff
Dolomite	1778	1787	17 holes	Nothing
				shown
Dolomite	1778	1787	500 gals.	Est.
			30 bbls.	SW/day
Lane Wells Bridging Plug	1271			Shut off
Wapanucka	1239	1254	51 holes	Sho-
			gas- est. 1 gal.	oil/day.
Wapanucka	1239	1254	1000 Gals.	
				Inc. in gas.
Wapanucka	1239	1254	4000 Gals.	
			200 M. Gas,	2 bbls. oil
HOWCO Bridging Plug	794'			shut off
Booch	757	758	10 holes-	est.
			1 bbl.-	oil/day
Booch	757	758	Hydrafrac	
			very little increase	

Drilled out plug at 790' & producing from
both Booch & Wapanucka.

CASING RECORD:

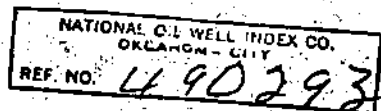
10-3/4"	40# 8 Used	At. Set	
		70	N.P.
8 5/8"	32# 8 Used	1071	All P
7"	17# 10 Used	2082	N.P.

LINER RECORD: NONE.

CEMENTING AND MUDDING.

7" Amt. set 2082' max- cem 300 HOWCO
Cemented to abt. 700 ft. top.
Cont. Page # 3. Wm.H.Pine

Page # 3. William H. Pine
Okmulgee, Oklahoma.



NW SW NW OF SEC. 6-14N-18E
FARM NAME: Rooney # 2.
Muskogee, Oklahoma.

Bottom hole Plugs used.

CABLE TOOLS FROM 0 to 2062'

TYPE RIG: Wichita Falls Spudder.

INITIAL PRODUCTION TEST:
Pumping thru 2" tubing.

Amount of Oil Production 5 bbls.
Length of test 24 hrs.
Gravity of Oil 41°
PUMP 1 5/8" Thompson.

TOTAL DEPTH 2062'

Signed: G.S. Pine, Office Manager.

Stenciled: 2-17-50.p.c.

**WATER WELL SEARCH
HANCOCK RD. AND 51ST ST.
MUSKOGEE, OKLAHOMA
PROJECT #: 86251**

RUST E & I



Geosource Incorporated

May 20, 1993

Project #: 86251

Penny Carpenter
Rust E & I
100 Glenborough #300
Houston, Texas 77067

In re: Water well search for a site at Hancock Rd. and 51st St. in Muskogee, Oklahoma.

Dear Ms. Carpenter,

Geosource Inc. (GI) has performed a water well search for a site in Muskogee County. GI utilized data provided by the State of Oklahoma Water Resources Board. The board is the central depository for water well logs from the licensed water well drillers in the state. The data is what the board currently has within their files. GI was able to identify four total wells: #1-three monitor wells and #2-1 domestic well within the area of review. The location map will have two locations.

If you have any questions concerning this project or need additional information, please call me at 512 474 6721.

Sincerely,

Eloy Del Bosque

Enclosures

**WELL RECORDS
HANCOCK RD. AND 51ST ST.
MUSKOGEE COUNTY**

White — Water Resources Board
Canary — Drillers Copy
Pink — Drillers Copy

MULTI-PURPOSE WATER WELL REPORT

STATE OF OKLAHOMA
WATER RESOURCES BOARD
1000 N.E. 10th St., P.O. Box 53585
Oklahoma City, Oklahoma 73152

Application No. _____
Aquifer _____
Steam System Code _____
Use Code _____
County _____
(Official Use Only)

1. OWNER B.E. Davis ADDRESS Tahlequah, OK 74464

2. LEGAL DESCRIPTION OF WELL

SW 1/4 of SE 1/4 of SE 1/4 of sec. 11, TWP. 14N S; RGE 17E EIM; COUNTY MUSTASKEE

3. TYPE OF WORK

☒ New Well ☐ Plugging
☐ Reconditioning Work
☐ Test/Monitoring

4. USE

☒ Domestic
☐ Stock
☐ Test/Monitoring

NON-DOMESTIC

☐ Irrigation
☐ Municipal
☐ Industrial
☐ Commercial
☐ Other

5. DRILLING METHOD

☒ Rotary ☐ Rev. Rotary
☐ Cable ☐ Other
☐ Air

6. LOCATION PERMIT

Material	From	To	Set
Overburden	0	3	
Sandstone	3	42	
Shale	42	102	

If this well is Non-Domestic, has this location been permitted?

☐ Yes ☐ No Permit No. _____

7. WELL CONSTRUCTION DATA

DATES: Started 7/23/86 Completed 7/23/86
Contractor Ventura Drilling, Inc.
Driller Steve Ludwig
Diameter Hole 6 in. Total Depth 102 ft.

CASING RECORD

Inside Diameter 6 in. From 0 ft. to 18 1/2 ft.
Outside _____ in. _____ ft. _____ ft.
Cement Grout Surface Seal ☒ Yes ☐ No
Type of Surface Seal: _____ Depth of Seal: 1.9 ft.
GRAVEL PACKED:
Gravel Packed From _____ ft. to _____ ft.
Amount Used: _____

PERFORATION RECORD

Type/Size _____
From _____ ft. To _____ ft.
From _____ ft. To _____ ft.
From _____ ft. To _____ ft.

8. WELL TEST DATA

Static Water Level Below Land Surface _____ ft.
If Artesian: Flows _____ gpm.
Approximate Yield 7 gpm.

9. PLUGGING DATA

Date Plugged _____
Backfilled With _____ Material To _____ ft.
Grouted or Cemented From _____ ft. To _____ ft.
Plot Location in Item 11. Show Distances From 2 Section Lines.

10. RECONDITIONING WORK

Date Completed _____
☐ Replaced Casing From _____ ft. To _____ ft.
☐ Replaced Screen From _____ ft. To _____ ft.
Deepened Well From _____ ft. To _____ ft.
Redeveloped Well By _____

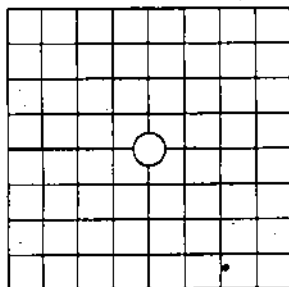
11. CERTIFICATION

The work described above was done under my supervision, and this report is true and correct to the best of my knowledge.

Name Steve Ludwig License # WD-216
Address P.O. Box 790 Phone # 918/456-5119
Signed Steve Ludwig Date 8/19/86

11. PLAT

10 AC



SW 1/4 of SE 1/4 of SE 1/4 of SEC 11
TWP. 14N S; RGE 17E EIM, WIM, ECM

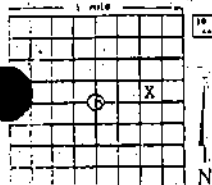
12. PUMP INFORMATION

Pump Type _____
Power Source _____
Rated Capacity _____ gpm.
Depth of Bowls or Cylinder _____ ft.

MULTIPURPOSE CONSTRUCTION PERMIT

OKLAHOMA WATER RESOURCES BOARD
600 N. HARVEY AVE.
P.O. BOX 1501
OKLAHOMA CITY, OK 73101-0150

Please plot well location.



Legal Description

SW 1/4 SE 1/4 NE 1/4 of Sec. 6 Twp. 14N Rge. 18E
County Muskogee Well No: MM03R
Well Owner SEC Donohue Phone (713) 875-0004
Address 100 Glenborough, Suite 300, Houston, TX 77067
Finding location 1/2 mile south of Hancock Road and 1-1/2 mile west of US Highway 69

Type of work:		G.W. Use	Drilling Method
☐ Geotechnical Boring ☐ W. Heat Pump Well ☐ Monitor Well ☐ Observation Well ☐ Piezometer ☐ Logging	☐ Pump Inst. & Reconditioning ☐ W.W. Test Hole ☐ Dam-watershed ☐ Other	☐ Domestic ☒ Non-Domestic Specify Purpose: <u>Monitoring Well</u>	☐ Hand Auger ☐ Cable Tool ☐ Air Rotary ☒ Fluid Rotary ☒ H.S. Auger ☐ S.S. Auger
☐ Rev. Rotary ☐ D.W. Rev. Rotary ☐ Other			

Lithologic Log		Non-Domestic Permitting																					
Material	From To	If this well is for other than domestic use, use of water for household purposes for term and domestic amounts up to the normal average demand of this land is for the purpose of being not to exceed 2 acres. Permit No: _____																					
Fill: silty clay, tan	0 2	New Boring or Well Construction Data Date Started <u>11-18-92</u> Completed <u>11-20-92</u> Firm <u>Terracon Consultants, Inc.</u> Operator <u>Allan Brantley</u> Type of Construction ☒ Open Hole ☐ Cased Hole Hole Diameter <u>8"</u> inches total depth <u>39.5</u> feet Hole Diameter _____ inches total depth _____ feet																					
clay, tan and gray	2 35	CASING RECORD <table border="1"> <tr> <th>diameter</th> <th>from</th> <th>to</th> <th>feet</th> </tr> <tr> <td>Surface pipe</td> <td>_____</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Well casing</td> <td><u>2"</u></td> <td><u>0.5</u></td> <td><u>39.5</u></td> </tr> <tr> <td>Well casing</td> <td>_____</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Well casing</td> <td>_____</td> <td>_____</td> <td>_____</td> </tr> </table>		diameter	from	to	feet	Surface pipe	_____	_____	_____	Well casing	<u>2"</u>	<u>0.5</u>	<u>39.5</u>	Well casing	_____	_____	_____	Well casing	_____	_____	_____
diameter	from	to	feet																				
Surface pipe	_____	_____	_____																				
Well casing	<u>2"</u>	<u>0.5</u>	<u>39.5</u>																				
Well casing	_____	_____	_____																				
Well casing	_____	_____	_____																				
Weathered shale, gray	35 39.5	SCREEN or PERFORATION RECORD <table border="1"> <tr> <th>Type and Slot Size</th> <th>from</th> <th>to</th> <th>feet</th> </tr> <tr> <td><u>0.010 Slot Screen PVC</u></td> <td><u>25.5</u></td> <td><u>39.5</u></td> <td>_____</td> </tr> <tr> <td>_____</td> <td>_____</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>_____</td> <td>_____</td> <td>_____</td> <td>_____</td> </tr> </table>		Type and Slot Size	from	to	feet	<u>0.010 Slot Screen PVC</u>	<u>25.5</u>	<u>39.5</u>	_____	_____	_____	_____	_____	_____	_____	_____	_____				
Type and Slot Size	from	to	feet																				
<u>0.010 Slot Screen PVC</u>	<u>25.5</u>	<u>39.5</u>	_____																				
_____	_____	_____	_____																				
_____	_____	_____	_____																				
		GRAVEL PACK <table border="1"> <tr> <th>Type and Size</th> <th>from</th> <th>to</th> <th>feet</th> </tr> <tr> <td><u>Colorado Silica 10/20</u></td> <td><u>27.5</u></td> <td><u>39.5</u></td> <td>_____</td> </tr> <tr> <td>_____</td> <td>_____</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>_____</td> <td>_____</td> <td>_____</td> <td>_____</td> </tr> </table>		Type and Size	from	to	feet	<u>Colorado Silica 10/20</u>	<u>27.5</u>	<u>39.5</u>	_____	_____	_____	_____	_____	_____	_____	_____	_____				
Type and Size	from	to	feet																				
<u>Colorado Silica 10/20</u>	<u>27.5</u>	<u>39.5</u>	_____																				
_____	_____	_____	_____																				
_____	_____	_____	_____																				
		SEAL Cement Grout Surface Seal Installed ☒ Yes ☐ No Type of Surface Seal <u>Enviroseal</u> from <u>0</u> feet <u>28.5</u> feet Aquifer Seal Type <u>1/4" bentonite pellets</u> <u>24.5</u> feet <u>22.5</u> feet _____ feet _____ feet																					
		HYDROLOGIC DATA First Water Zone Encountered <u>28.0</u> ft. Approximate Yield _____ GPM Artesian ☐ Yes ☐ No																					
		Plugging Data Date Plugged _____ Backfilled From _____ feet _____ feet Type _____ Cement Grouted From _____ feet _____ feet																					
		Reconditioning Work Replaced Casing/Screen From _____ feet _____ feet Deepened Well From _____ feet _____ feet Redeveloped Well By _____																					
		Certification The work described above was done under my supervision. This report is correct to the best of my knowledge. Name <u>Terracon Consultants, Inc.</u> Lic. No. <u>OP-0315</u> Address <u>5865 S. Garnett</u> Phone <u>918 250 0461</u> Signed <u>Allan Brantley</u> Date <u>12-17-92</u>																					

*Two additional monitor wells installed

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Oklahoma Water Resources Board

*See Pump Installers Form On Back

04928521

KW

Appendix C

Well No. MW-01R
Boring No. X-Ref: B-1

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: N272500.8 Elevation Ground Level 630.2 ft
E2731415.1 Top of Casing 633.01 ft

Drilling Summary:

Total Depth 2925 feet from toc
Borehole Diameter 7 inches
Casing Stick-up Height: 2.81 ft
Driller Terracon Environmental, Inc.
Driller - Allen Brantley
Helper - Matt Johnson
Rig CME-75
Bit(s) 3 1/2-inch I.D. x 7-inch O.D.
hollow-stem augers
Drilling Fluid None
Protective Casing 6-inch anodized aluminum

Well Design & Specifications

Basis: Geologic Log ☒ Geophysical Log ☐
Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
+2.81 - 16.44	C1	633 - 614
16.44 - 26.44	S1	614 - 604
-	-	-
-	-	-
-	-	-

Casing: C1 2-inch schedule 40 PVC,
flush-jointed with O-rings
S1 2-inch schedule 40 PVC,
flush-jointed with O-rings,
0.010-inch slots

Filter Pack: 10-20 washed Colorado
silica sand, 14.5 to 26.5 ft

Grout Seal: Envirogrout bentonite
grout, 2 to 11.5 ft

Bentonite Seal: 3/4-inch bentonite pellets
11.5 to 14.5 ft

Construction Time Log:

Task	Start		Finish	
	Date	Time	Date	Time
Drilling 0 to 25 ft	11/18	14:30	11/18	15:30
Geophys. Logging:	NA		NA	
Casing:				
C1	11/18	15:30	11/18	15:32
S1	11/18	15:32	11/18	15:36
Filter Placement:	11/18	15:40	11/18	15:47
Cementing:	11/18	16:15	11/18	16:30
Development:	11/19	16:15	11/19	17:10

Well Development: B-K Hand Pump

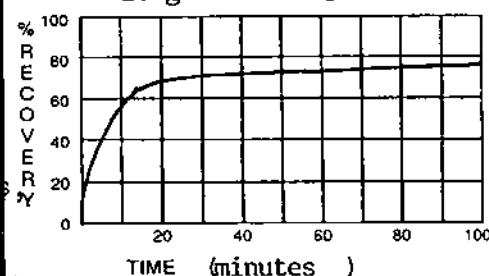
Initial H₂O level = 15.10 feet
TOC/Well volume = 1.7 gallons
Amount developed = 10 gallons or
5.8 well volumes

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)
16:30	6.90	31.8	61.6°F
16:40	7.03	34.9	61.2°F
16:50	7.05	32.5	61.1°F
17:10	7.10	32.3	60.3°F

Recovery Data:

Q = 10 gallons S₀ = 15.10 ft



Comments: Borehole open to 27.5 ft. 26.5 to 27.5 feet, auger cuttings.

Centralizers (stainless steel) at 5.5 ft and 24.5 ft from ground
surface.

Note: Added fill soil from elevation 627.7 to 630.2 ft prior to completion
of MW01R concrete pad. Adjusted depth and dimensions from the MW01R field
report accordingly.

SITE NAME Muskogee Landfill

LOCATION Muskogee, Oklahoma

WC 03246

SUPERVISED BY Greg Hassett

DATE 11/18/92

DATE

Boring No. X-Ref: B-2

Survey Coords: N271744.8
E2731158.9

Elevation Ground Level 632.2 ft
Top of Casing 635.24 ft

Total Depth 30 feet from toc
Borehole Diameter 7 inches
Casing Stick-up Height: 3 feet
Driller Terracon Environmental Inc.
Driller - Allen Brantley
Helper - Matt Johnson
Rig CME 75
Bit(s) 3 1/4-inch I.D. x 7 inch O.D.
hollow-stem augers
Drilling Fluid None

Well Design & Specifications

Basis: Geologic Log X Geophysical Log _____
Casing String (s): C = Casing S = Screen.

Depth		String(s)	Elevation
+3.0	- 17.0	C1	635 - 615
17.0	- 27.0	S1	615 - 605
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

Casing: C1 2-inch schedule 40 PVC,
flush-jointed with: O-rings
C2

Screen: S1 2-inch schedule 40 PVC
flush-jointed with O-rings,
xx 0.010-inch slots

Filter Pack: 10-20 washed Colorado
silica sand, 15 to 28 feet

Grout Seal: Envirogrout, bentonite
2 to 12 feet grout

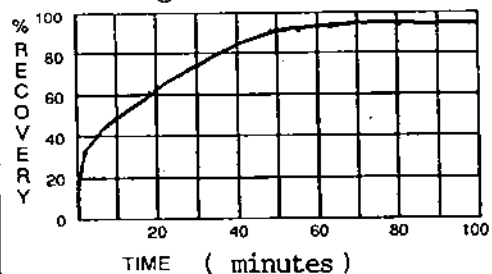
Bentonite Seal: 1/4-inch bentonite pellets, 12 to 15 feet

Task	Start		Finish	
	Date	Time	Date	Time
Drilling				
0 - 30 ft	11/18	09:00	11/18	10:00
Geophys. Logging:	NA		NA	
Casing:				
C1	11/18	13:30	11/18	13:31
S1	11/18	13:31	11/18	13:34
Filter Placement:	11/18	13:40	11/18	14:00
Cementing:	11/18	16:00	11/18	16:15
Development:	11/18	14:30	11/19	16:10

Well Development: B-K Hand Pump Initial
H₂O level (estimated) = 9.50 ft,
TOC/well volume = 3.5 gallons
Amount developed = 31 gallons
or 8.8 well volumes

Time	p H	Spec. Cond.	Temp (C)
15:25	6.88	32.4	63.5°F
15:30	6.79	32.9	63.4°F
15:35	6.63	33.3	63.0°F
16:00	6.79	33.4	61.5°F
16:05	6.86	33.3	61.9°F

$Q = 31$ gallons $S_o = 9.50$



Comments: Borehole collapse and settlement of fines 28 to 30 feet, ~~major cuttings~~. Centralizers (stainless steel) at 3 feet and 25 feet from ground surface.

SITE NAME	Muskogee Landfill
LOCATION	Muskogee, Oklahoma

WC 03250

SUPERVISED BY Greg Hassett

Printed on recycled paper



Well No. MW-03R
Boring No. X-Ref: B-3

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: N272179.4 Elevation Ground Level: 641.5 ft
E2730189.7 Top of Casing 644.16 ft

Drilling Summary:

Total Depth 39 feet
Borehole Diameter 7 inches
Casing Stick-up Height: 2.66 feet
Driller Terracon Environmental, Inc.
Driller - Allan Brantley
Helper - Matt Johnson
Rig CME 75
Bit(s) 3 1/2-inch I.D. x 7-inch O.D.
hollow-stem augers
Drilling Fluid None
Protective Casing 6-inch anodized aluminum

Well Design & Specifications

Basis: Geologic Log XX Geophysical Log
Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
+2.66 - 28.1	C1	644 - 613
28.1 - 38.1	S1	613 - 603
-	-	-
-	-	-
-	-	-

Casing: C1 2-inch schedule 40 PVC,
flush-jointed with O-rings

Screen: S1 2-inch schedule 40 PVC
flush-jointed with O-rings
0.010-inch slots

Filter Pack: 10-20 washed Colorado
silica sand, 26.1 to 39 ft

Grout Seal: Envirogrout bentonite
grout, 2 to 23 ft

Bentonite Seal: 1/2-inch bentonite pellets
23.1 to 26.1 ft

Construction Time Log:

Task	Start		Finish	
	Date	Time	Date	Time
Drilling 0 to 39.5	11/19	09:00	11/19	10:35
Geophys. Logging:	NA		NA	
Casing:				
C1	11/19	11:00	11/19	11:02
S1	11/19	11:05	11/19	11:08
Filter Placement:	11/19	11:15	11/19	11:45
Cementing:	11/19	11:45	11/19	12:00
Development:	11/20	08:15	11/20	09:12

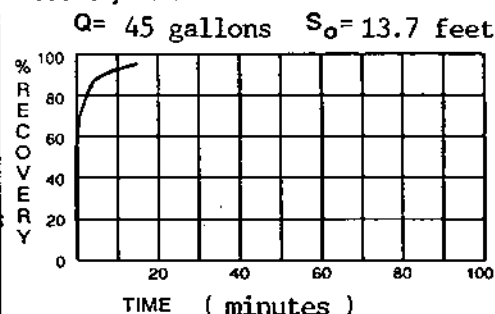
Well Development: B-K Hand Pump

Initial H₂O level = 13.7
TOC/well volume = 4.5 gallons
Amount developed = 45 gallons or
10 well volumes

Stabilization Test Data: Inoperable Meter

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

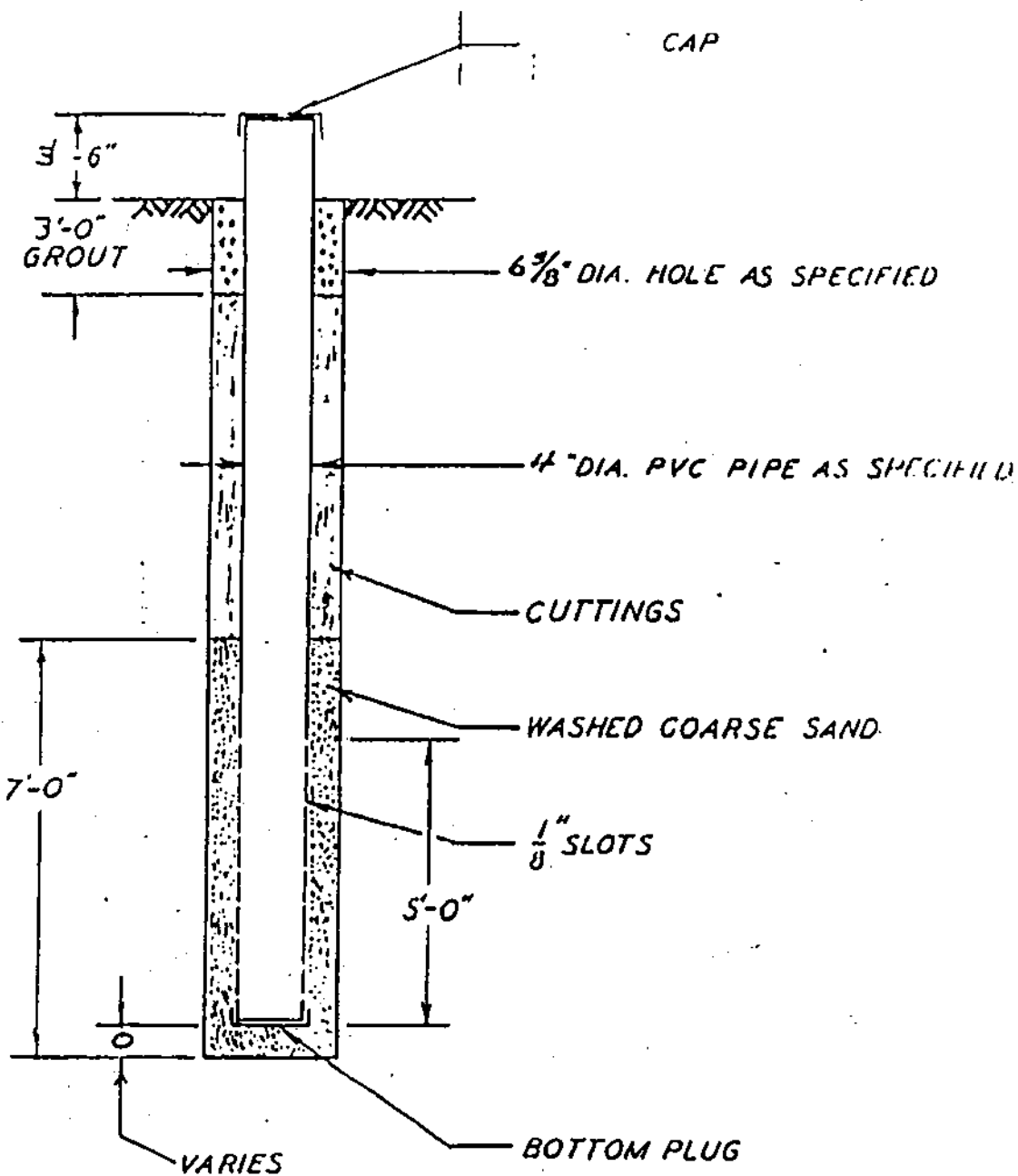


Comments: Centralizers (stainless steel) at 3 feet and 36 feet from
ground surface. Auger cuttings 39 to 39.5 feet

SITE NAME Muskogee Landfill
LOCATION Muskogee, Oklahoma

WC 03248

SUPERVISED BY Greg Hassett
DATE 11/19/92

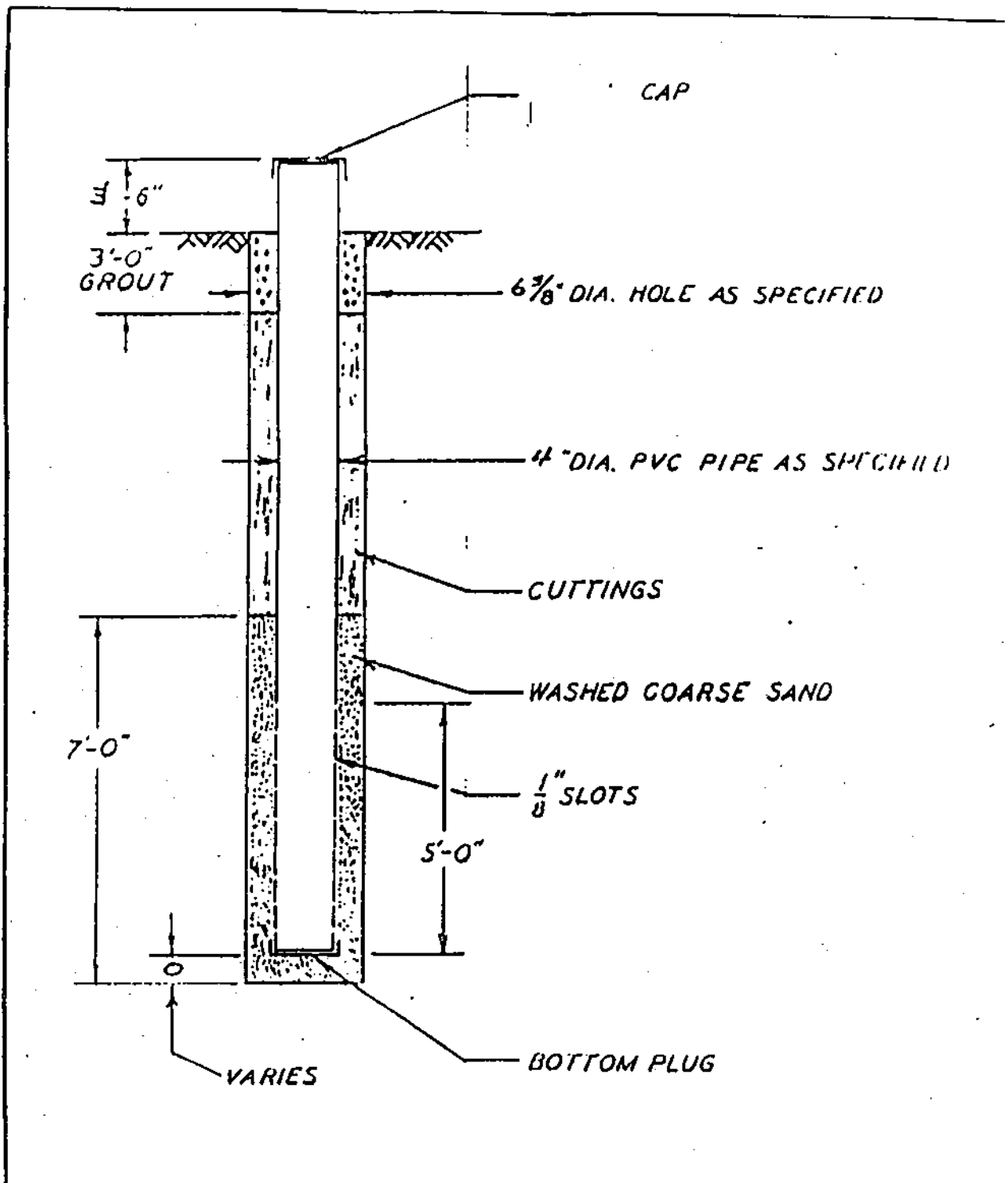


CITY OF MUSKOGEE, OKLAHOMA
Land Fill Southwest of City
Well located near entrance
Depth 25.0 feet

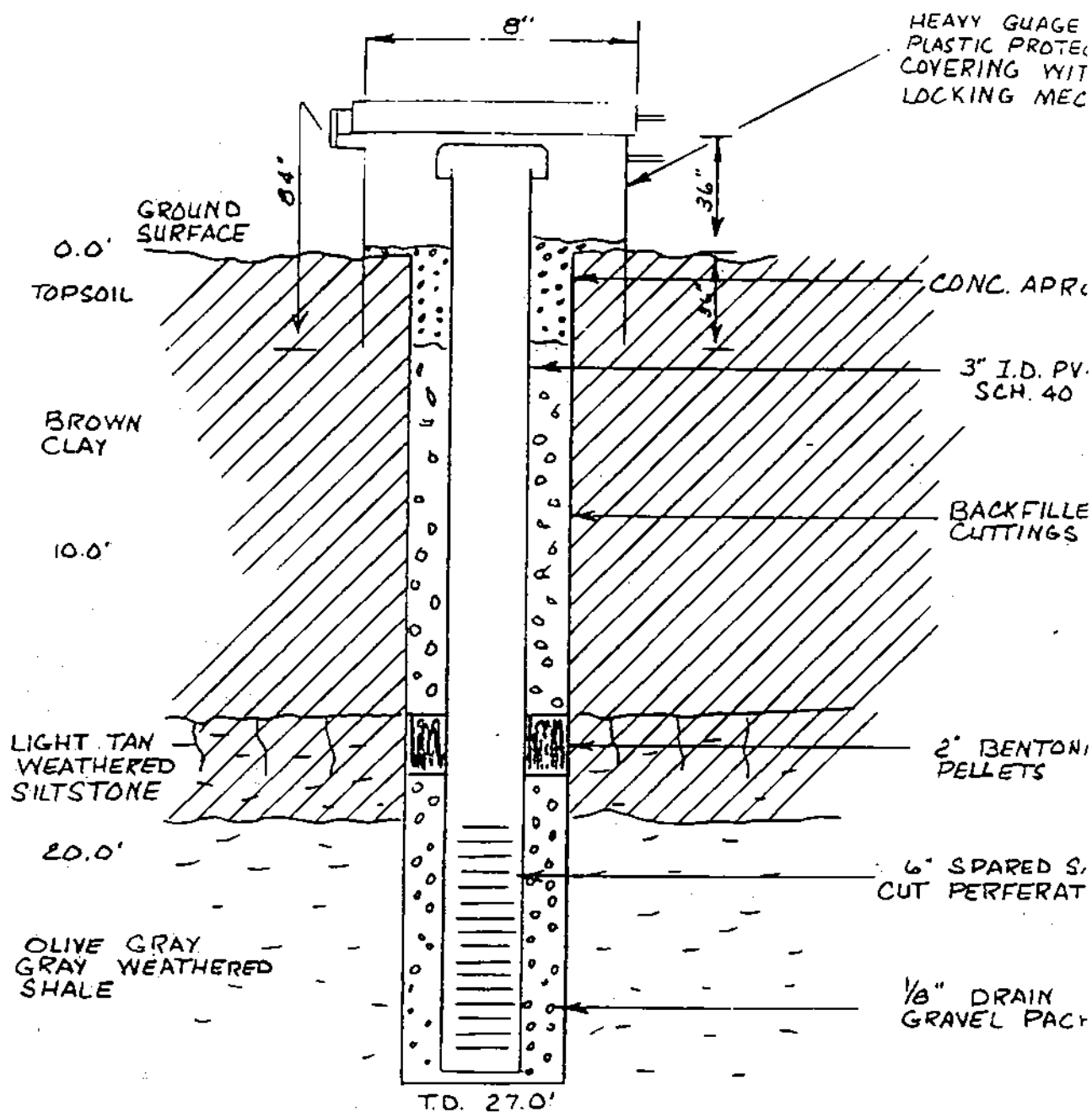
MONITORING WELL
NO. 1

SCALE: NONE

STEWART, WHITE & ASSOCIATES, I
Tulsa, Oklahoma

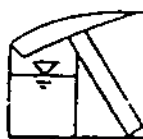


City of Muskogee, Oklahoma Land Fill Southwest of City Well located Northeast area Depth 30.0 feet.	DATE	BY	MONITORING WELL NO. 2 SCALE: NONE STEWART, WHITE & ASSOCIATES. Tulsa, Oklahoma
	DATE	BY	
	DATE	BY	



M.R. McComas
& Associates, Inc.

HYDROGEOLOGY



MONITOR WELL
COMPLETION DIAGRAM
(MW 3)

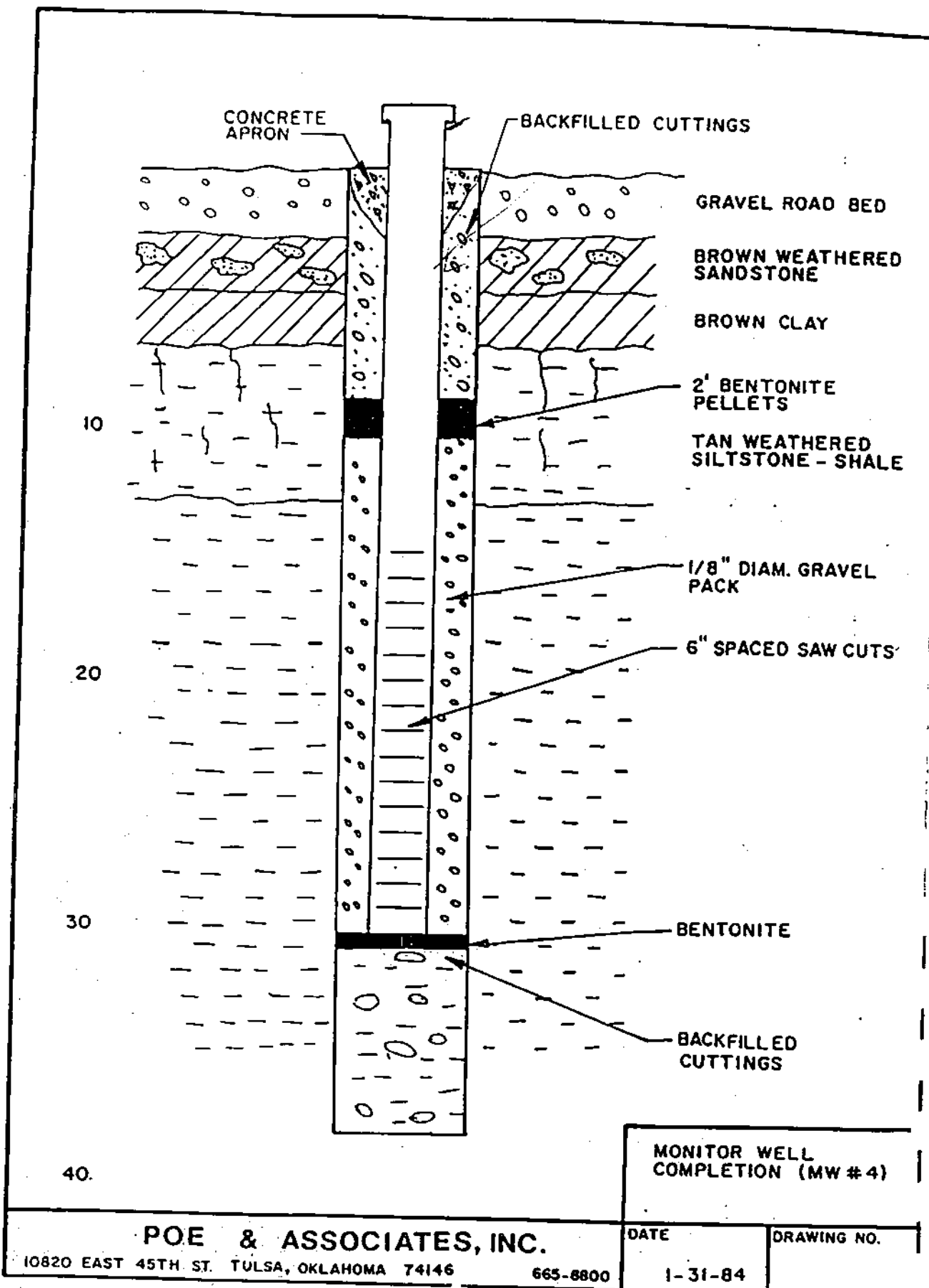
SCALE
NONE

DATE

APPROVED BY

DESIGNED BY

CHECKED BY



Appendix D



WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

Page: 1

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000ENS: 93-11523
MP: 852931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

FIELD Blank

Analyte	Sample Point: Sample Number: Sampled:	852-01FB AH0591 27-APR-1993	EML RL	852-MW01 AH0585 27-APR-1993	EML RL	852-MW01R AH0587 27-APR-1993	EML RL	Units
FIELD DATA:								
COLOR		CLEAR		BROWN		BROWN		
DEPTH TO WATER FROM TOP OF CASING		NA		14.38		8.68		FT
FIELD DISSOLVED OXYGEN		7.50		3.50		6.10		MG/L
GROUNDWATER ELEV.		NA		628.56		624.33		FT MSL
ODOR		NONE		STRONG		NONE		
PH FIELD		8.98		6.52		6.96		PH UNITS
SPECIFIC CONDUCTANCE FIELD		45.1		5560		4850		UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS		20.9		14.8		14.8		DEGREES C
WELL DEPTH TOTAL		NA		43.18		29.25		FT
CHEMICAL METHODS & ROBOTICS:								
CHEMICAL OXYGEN DEMAND		ND	10.	12	10.	ND	10.	MG/L
CYANIDE, TOTAL		ND	0.020	ND	0.020	ND	0.020	MG/L
NITROGEN, AMMONIA		0.27	0.020	1.30	0.020	ND	0.020	MG/L
NITROGEN, NITRATE		ND	0.050	ND	0.050	0.52	0.050	MG/L
PH		6.87	0.05	6.67	0.05	7.20	0.05	PH UNITS
PHENOLS		ND	0.050	ND	0.050	ND	0.050	MG/L
SOLIDS, TOTAL DISSOLVED		11	5.	5800	25.	1110	5.	MG/L
SPECIFIC CONDUCTANCE		4.1	1.0	6120	1.0	1860	1.0	UMHOS/CM
TOTAL ORGANIC CARBON		ND	1.0	2.4	1.0	ND	1.0	MG/L
TOTAL ORGANIC CARBON		ND	1.0	2.4	1.0	ND	1.0	MG/L
INORGANICS:								
ALKALINITY, BICARBONATE		ND	10.	534	10.	282	10.	MG/L
ANTIMONY-TOTAL		ND	100.	ND	100.	ND	100.	UG/L
ARSENIC-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L
BARIUM-TOTAL		ND	200.	ND	200.	ND	200.	UG/L
BERYLLIUM-TOTAL		ND	5.0	ND	5.0	ND	5.0	UG/L
BORON-TOTAL		24.2	10.0	677	10.0	86.7	10.0	UG/L
CADMIUM-TOTAL		ND	5.0	ND	5.0	ND	5.0	UG/L
CALCIUM-TOTAL		ND	5000	461000	5000	133000	5000	UG/L
CHLORIDE		ND	0.5	315	5.0	404	0.5	MG/L
CHROMIUM-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L
COBALT-TOTAL		ND	50.0	ND	50.0	ND	50.0	UG/L
COPPER-TOTAL		ND	25.0	ND	25.0	ND	25.0	UG/L
FLUORIDE		ND	0.050	0.38	0.050	0.43	0.050	MG/L
IRON-TOTAL		ND	100.	729	100.	622	100.	UG/L
LEAD-TOTAL		ND	5.0	ND	16.0	ND	5.0	UG/L
MAGNESIUM-TOTAL		ND	5000	240000	5000	41200	5000	UG/L
MANGANESE-TOTAL		ND	15.0	2960	15.0	20.8	15.0	UG/L
MERCURY-TOTAL		ND	0.20	ND	0.20	ND	0.20	UG/L
NICKEL-TOTAL		ND	40.0	ND	40.0	ND	40.0	UG/L
POTASSIUM-TOTAL		ND	5000	ND	5000	ND	5000	UG/L
SELENIUM-TOTAL		ND	5.0	ND	16.0	ND	5.0	UG/L
SILVER-TOTAL		ND	25.0	ND	25.0	ND	25.0	UG/L
SODIUM-TOTAL		ND	5000	719000	5000	188000	5000	UG/L
SULFATE		ND	5.0	2780	50.0	54.7	5.0	MG/L
THALLIUM-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L

NA = Not Analyzed

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WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

Page:

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL
2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000

ENS: 93-11523
MP: 852931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

Analyte	Sample Point: Sample Number: Sampled:	852-01FB AH0591 27-APR-1993	EML RL	852-MW01 AH0585 27-APR-1993	EML RL	852-MW01R AH0587 27-APR-1993	EML RL	Units
VANADIUM-TOTAL	ND	50.0	ND	50.0	ND	50.0	UG/L	
ZINC-TOTAL	ND	20.0	ND	20.0	ND	20.0	UG/L	
VOLATILE ORGANICS:								
1,1,1,2-TETRACHLOROETHANE	ND	5.	ND	5.	ND	5.	UG/L	
1,1,1-TRICHLOROETHANE	ND	5.	ND	5.	ND	5.	UG/L	
1,1,2,2-TETRACHLOROETHANE	ND	5.	ND	5.	ND	5.	UG/L	
1,1,2-TRICHLOROETHANE	ND	5.	ND	5.	ND	5.	UG/L	
1,1-DICHLOROETHANE	ND	5.	ND	5.	ND	5.	UG/L	
1,1-DICHLOROETHENE	ND	5.	ND	5.	ND	5.	UG/L	
1,2,3-TRICHLOROPROPANE	ND	10.	ND	10.	ND	10.	UG/L	
1,2-DIBROMO-3-CHLOROPROPANE	ND	10.	ND	10.	ND	10.	UG/L	
1,2-DIBROMOETHANE	ND	10.	ND	10.	ND	10.	UG/L	
1,2-DICHLOROBENZENE	ND	10.	ND	10.	ND	10.	UG/L	
1,2-DICHLOROETHANE	ND	5.	ND	5.	ND	5.	UG/L	
1,2-DICHLOROPROPANE	ND	5.	ND	5.	ND	5.	UG/L	
1,4-DICHLOROBENZENE	ND	10.	ND	10.	ND	10.	UG/L	
2-BUTANONE	ND	10.	ND	10.	ND	10.	UG/L	
2-HEXANONE	ND	10.	ND	10.	ND	10.	UG/L	
4-METHYL-2-PENTANONE	ND	10.	ND	10.	ND	10.	UG/L	
ACETONE	ND	34.	ND	34.	ND	34.	UG/L	
ACRYLONITRILE	ND	100	ND	100	ND	100	UG/L	
BENZENE	ND	5.	ND	5.	ND	5.	UG/L	
BROMOCHLOROMETHANE	ND	10.	ND	10.	ND	10.	UG/L	
BROMODICHLOROMETHANE	ND	5.	ND	5.	ND	5.	UG/L	
BROMOFORM	ND	5.	ND	5.	ND	5.	UG/L	
BROMOMETHANE	ND	10.	ND	10.	ND	10.	UG/L	
CARBON DISULFIDE	ND	5.	ND	5.	ND	5.	UG/L	
CARBON TETRACHLORIDE	ND	5.	ND	5.	ND	5.	UG/L	
CHLOROBENZENE	ND	5.	ND	5.	ND	5.	UG/L	
CHLOROETHANE	ND	10.	ND	10.	ND	10.	UG/L	
CHLOROFORM	ND	5.	ND	5.	ND	5.	UG/L	
CHLOROMETHANE	ND	10.	ND	10.	ND	10.	UG/L	
CIS-1,2-DICHLOROETHENE	ND	10.	ND	10.	ND	10.	UG/L	
CIS-1,3-DICHLOROPROPENE	ND	5.	ND	5.	ND	5.	UG/L	
DIBROMOCHLOROMETHANE	ND	5.	ND	5.	ND	5.	UG/L	
DIBROMOMETHANE	ND	10.	ND	10.	ND	10.	UG/L	
ETHYLBENZENE	ND	5.	ND	5.	ND	5.	UG/L	
IODOMETHANE	ND	10.	ND	10.	ND	10.	UG/L	
METHYLENE CHLORIDE	ND	5.	ND	5.	ND	5.	UG/L	
STYRENE	ND	5.	ND	5.	ND	5.	UG/L	
TETRACHLOROETHENE	ND	5.	ND	5.	ND	5.	UG/L	
TOLUENE	ND	5.	ND	5.	ND	5.	UG/L	
TRANS-1,2-DICHLOROETHENE	ND	10.	ND	10.	ND	10.	UG/L	
TRANS-1,3-DICHLOROPROPENE	ND	5.	ND	5.	ND	5.	UG/L	
TRANS-1,4-DICHLORO-2-BUTENE	ND	10.	ND	10.	ND	10.	UG/L	
TRICHLOROETHENE	ND	5.	ND	5.	ND	5.	UG/L	
TRICHLOROFLUOROMETHANE	ND	10.	ND	10.	ND	10.	UG/L	

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WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

Page: 1

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST

MUSKOGEE OK 73111-0000

ENS: 93-11523
MP: 852931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

Analyte	Sample Point: Sample Number: Sampled:	852-01FB AH0591 27-APR-1993	EML RL	852-MW01 AH0585 27-APR-1993	EML RL	852-MW01R AH0587 27-APR-1993	EML RL	Units
VINYL ACETATE		ND	10.	ND	10.	ND	10.	UG/L
VINYL CHLORIDE		ND	10.	ND	10.	ND	10.	UG/L
XYLENE (TOTAL)		ND	10.	ND	10.	ND	10.	UG/L

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ND = Not Detected

TBK = Trip Blank

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WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

Page: 1

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000ENS: 93-11523
MP: 852931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW02 AH0589 27-APR-1993	EML RL	852-MW02R AH0590 27-APR-1993	EML RL	852-MW03 AH0588 27-APR-1993	EML RL	Units
FIELD DATA:								
COLOR		CLEAR		CLEAR		CLEAR		
DEPTH TO WATER FROM TOP OF CASING		19.72		8.50		9.39		FT
FIELD DISSOLVED OXYGEN		2.75		6.20		5.80		MG/L
GROUNDWATER ELEV.		607.02		655.34	624.74 H. Damsel	624.25		FT MSL
ODOR		NONE		NONE		SLIGHT		
PH FIELD		7.25		6.20		8.25		PH UNITS
SPECIFIC CONDUCTANCE FIELD		4880		3880		8850		UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS		18.1		17.7		18.8		DEGREES C
WELL DEPTH TOTAL		28.72		30.01		30.10		FT
CHEMICAL METHODS & ROBOTICS:								
CHEMICAL OXYGEN DEMAND ¹		30	10.	ND	10.	ND	10.	MG/L
CYANIDE, TOTAL ²		ND	0.020	ND	0.020	ND	0.020	MG/L
NITROGEN, AMMONIA ³		0.15	0.020	0.96	0.020	ND	0.020	MG/L
NITROGEN, NITRATE ⁴		ND	0.050	ND	0.050	0.40	0.050	MG/L
PH ⁵		6.89	0.05	6.87	0.05	7.23	0.05	PH UNITS
PHENOLS ⁶		ND	0.050	ND	0.050	ND	0.050	MG/L
SOLIDS, TOTAL DISSOLVED ⁷		3180	25.	2380	25.	1040	5.	MG/L
SPECIFIC CONDUCTANCES		4930	1.0	4010	1.0	1920	1.0	UMHOS/CM
TOTAL ORGANIC CARBON ⁸		1.4	1.0	1.4	1.0	ND	1.0	MG/L
TOTAL ORGANIC CARBON		1.5	1.0	1.3	1.0	ND	1.0	MG/L
INORGANICS:								
ALKALINITY, BICARBONATE ⁹		296	10.	710	10.	393	10.	MG/L
ANTIMONY-TOTAL ¹⁰		ND	100.	ND	100.	ND	100.	UG/L
ARSENIC-TOTAL ¹¹		17.2	10.0	ND	10.0	ND	10.0	UG/L
BARIUM-TOTAL ¹²		ND	200.	ND	200.	ND	200.	UG/L
BERYLLIUM-TOTAL ¹³		ND	5.0	ND	5.0	ND	5.0	UG/L
BORON-TOTAL ¹⁴		230	10.0	773	10.0	146	10.0	UG/L
CADMIUM-TOTAL ¹⁵		ND	5.0	ND	5.0	ND	5.0	UG/L
CALCIUM-TOTAL ¹⁶		282000	5000	163000	5000	98400	5000	UG/L
CHLORIDE ¹⁷		1210	5.0	335	2.5	371	0.5	MG/L
CHROMIUM-TOTAL ¹⁸		ND	10.0	ND	10.0	ND	10.0	UG/L
COBALT-TOTAL ¹⁹		ND	50.0	ND	50.0	ND	50.0	UG/L
COPPER-TOTAL ²⁰		ND	25.0	ND	25.0	ND	25.0	UG/L
FLUORIDE ²¹		0.22	0.050	0.52	0.050	0.49	0.050	MG/L
IRON-TOTAL ²²		3530	100.	2310	100.	2120	100.	UG/L
LEAD-TOTAL ²³		ND	16.0	ND	16.0	ND	5.0	UG/L
MAGNESIUM-TOTAL ²⁴		117000	5000	57000	5000	40500	5000	UG/L
MANGANESE-TOTAL ²⁵		2640	15.0	779	15.0	52.3	15.0	UG/L
MERCURY-TOTAL ²⁶		ND	0.20	ND	0.20	ND	0.20	UG/L
NICKEL-TOTAL ²⁷		ND	40.0	ND	40.0	ND	40.0	UG/L
POTASSIUM-TOTAL ²⁸		ND	5000	ND	5000	ND	5000	UG/L
SELENIUM-TOTAL ²⁹		ND	5.0	ND	16.0	ND	5.0	UG/L
SILVER-TOTAL ³⁰		ND	25.0	ND	25.0	ND	25.0	UG/L
SODIUM-TOTAL ³¹		584000	5000	706000	5000	255000	5000	UG/L
SULFATE ³²		393	50.0	903	25.0	36.5	5.0	MG/L
THALLIUM-TOTAL ³³		ND	10.0	ND	10.0	ND	10.0	UG/L

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WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

Page

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL
2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000

ENS: 93-11523
MP: 852931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW02 AH0589 27-APR-1993	EML RL	852-MW02R AH0590 27-APR-1993	EML RL	852-MW03 AH0588 27-APR-1993	EML RL	Units
VANADIUM-TOTAL		ND ³⁵	50.0	ND	50.0	ND	50.0	UG/L
ZINC-TOTAL		ND ³⁶	20.0	ND	20.0	ND	20.0	UG/L
VOLATILE ORGANICS:								
1,1,1,2-TETRACHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,1-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2,2-TETRACHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1-DICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1-DICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
1,2,3-TRICHLOROPROPANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DIBROMO-3-CHLOROPROPANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DIBROMOETHANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,2-DICHLOROPROPANE		ND	5.	ND	5.	ND	5.	UG/L
1,4-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
2-BUTANONE		ND	10.	ND	10.	ND	10.	UG/L
2-HEXANONE		ND	10.	ND	10.	ND	10.	UG/L
4-METHYL-2-PENTANONE		ND	10.	ND	10.	ND	10.	UG/L
ACETONE		ND	34.	ND	34.	ND	34.	UG/L
ACRYLONITRILE		ND	100	ND	100	ND	100	UG/L
BENZENE		ND	5.	ND	5.	ND	5.	UG/L
BROMOCHLOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
BROMODICHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
BROMOFORM		ND	5.	ND	5.	ND	5.	UG/L
BROMOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
CARBON DISULFIDE		ND	5.	ND	5.	ND	5.	UG/L
CARBON TETRACHLORIDE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROBENZENE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROETHANE		ND	10.	ND	10.	ND	10.	UG/L
CHLOROFORM		ND	5.	ND	5.	ND	5.	UG/L
CHLOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
CIS-1,2-DICHLOROETHENE		ND	10.	ND	10.	ND	10.	UG/L
CIS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
DIBROMOCHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
DIBROMOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
ETHYLBENZENE		ND	5.	ND	5.	ND	5.	UG/L
IODOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
METHYLENE CHLORIDE		ND	5.	ND	5.	ND	5.	UG/L
STYRENE		ND	5.	ND	5.	ND	5.	UG/L
TETRACHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TOLUENE		ND	5.	ND	5.	ND	5.	UG/L
TRANS-1,2-DICHLOROETHENE		ND	10.	ND	10.	ND	10.	UG/L
TRANS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
TRANS-1,4-DICHLORO-2-BUTENE		ND	10.	ND	10.	ND	10.	UG/L
TRICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TRICHLOROFLUOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L

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WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

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EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000ENS: 93-11523
MP: 852931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW02 AH0589 27-APR-1993	EML RL	852-MW02R AH0590 27-APR-1993	EML RL	852-MW03 AH0588 27-APR-1993	EML RL	Units
VINYL ACETATE		ND	10.	ND	10.	ND	10.	UG/L
VINYL CHLORIDE		ND	10.	ND	10.	ND	10.	UG/L
XYLENE (TOTAL)		ND	10.	ND	10.	ND	10.	UG/L

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MUSKOGEE OK 73111-0000

ENS: 93-11523

MP: 852931

Rev / Task: 01 / 01

Sample Type: WELL

Reported: 20-MAY-1993

*Background**Hand*

Analyte	Sample Point: Sample Number: Sampled:	852-MW03R AH0586 27-APR-1993	EML RL	852-MW04 AH0583 27-APR-1993	EML RL	852-MW06 AH0584 27-APR-1993	EML RL	Units
FIELD DATA:								
COLOR		CLEAR		CLEAR		CLEAR		
DEPTH TO WATER FROM TOP OF CASING		14.25		4.70		25.28		FT
FIELD DISSOLVED OXYGEN		4.0		2.9		6.2		MG/L
GROUNDWATER ELEV.		629.91		646.67		638.56		FT MSL
ODOR		NONE		NONE		SLIGHT		
PH FIELD		6.75		7.12		6.70		PH UNITS
SPECIFIC CONDUCTANCE FIELD		4100		8150		2810		UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS		15.5		16.0		15.8		DEGREES C
WELL DEPTH TOTAL		40.76		32.50		69.38		FT
CHEMICAL METHODS & ROBOTICS:								
CHEMICAL OXYGEN DEMAND		42	10.	94	10.	ND	10.	MG/L
CYANIDE, TOTAL		ND	0.020	ND	0.020	ND	0.020	MG/L
NITROGEN, AMMONIA		0.96	0.020	ND	0.020	1.16	0.020	MG/L
NITROGEN, NITRATE		ND	0.050	ND	0.050	ND	0.050	MG/L
PH		6.13	0.05	6.78	0.05	6.45	0.05	PH UNITS
PHENOLS		ND	0.050	ND	0.050	ND	0.050	MG/L
SOLIDS, TOTAL DISSOLVED		3920	25.	7950	25.	2140	25.	MG/L
SPECIFIC CONDUCTANCE		4430	1.0	9010	1.0	2900	1.0	UMHOS/CM
TOTAL ORGANIC CARBON		13.3	1.0	21.9	1.0	3.8	1.0	MG/L
TOTAL ORGANIC CARBON		13.1	1.0	21.8	1.0	4.3	1.0	MG/L
INORGANICS:								
ALKALINITY, BICARBONATE		220	10.	1110	10.	490	10.	MG/L
ANTIMONY-TOTAL		ND	500.	ND	100.	ND	100.	UG/L
ARSENIC-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L
BARIUM-TOTAL		ND	200.	ND	200.	ND	200.	UG/L
BERYLLIUM-TOTAL		ND	12.0	ND	5.0	ND	5.0	UG/L
BORON-TOTAL		190	50.0	1700	10.0	282	10.0	UG/L
CADMIUM-TOTAL		ND	25.0	ND	5.0	ND	5.0	UG/L
CALCIUM-TOTAL		421000	5000	633000	5000	148000	5000	UG/L
CHLORIDE		214	5.0	862	0.5	201	2.5	MG/L
CHROMIUM-TOTAL		ND	50.0	12.8	10.0	ND	10.0	UG/L
COBALT-TOTAL		ND	250.	ND	50.0	ND	50.0	UG/L
COPPER-TOTAL		ND	125.	ND	25.0	ND	25.0	UG/L
FLUORIDE		0.43	0.050	0.082	0.050	0.27	0.050	MG/L
IRON-TOTAL		6630	360.	787	100.	5280	100.	UG/L
LEAD-TOTAL		ND	16.0	ND	16.0	51.1	5.0	UG/L
MAGNESIUM-TOTAL		146000	5000	678000	5000	109000	5000	UG/L
MANGANESE-TOTAL		462	56.0	4420	15.0	2040	15.0	UG/L
MERCURY-TOTAL		ND	0.20	ND	0.20	ND	0.20	UG/L
NICKEL-TOTAL		ND	200.	46.3	40.0	ND	40.0	UG/L
POTASSIUM-TOTAL		ND	5000	8020	5000	ND	5000	UG/L
SELENIUM-TOTAL		ND	16.0	ND	16.0	ND	5.0	UG/L
SILVER-TOTAL		ND	125.	ND	25.0	ND	25.0	UG/L
SODIUM-TOTAL		491000	8000	753000	5000	355000	5000	UG/L
SULFATE		2080	50.0	3420	50.0	791	25.0	MG/L
THALLIUM-TOTAL		ND	10.0	ND	10.0	ND	10.0	UG/L

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2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000ENS: 93-11523
MP: 852931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW03R AH0586 27-APR-1993	EML RL	852-MW04 AH0583 27-APR-1993	EML RL	852-MW06 AH0584 27-APR-1993	EML RL	Units
VANADIUM-TOTAL		ND	96.0	ND	50.0	ND	50.0	UG/L
ZINC-TOTAL		ND	84.0	ND	20.0	731	20.0	UG/L
VOLATILE ORGANICS:								
1,1,1,2-TETRACHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,1-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2,2-TETRACHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1,2-TRICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,1-DICHLOROETHANE		ND	5.	ND	5.	30.	5.	UG/L
1,1-DICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
1,2,3-TRICHLOROPROPANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DIBROMO-3-CHLOROPROPANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DIBROMOETHANE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
1,2-DICHLOROETHANE		ND	5.	ND	5.	ND	5.	UG/L
1,2-DICHLOROPROPANE		ND	5.	ND	5.	ND	5.	UG/L
1,4-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
2-BUTANONE		ND	10.	ND	10.	ND	10.	UG/L
2-HEXANONE		ND	10.	ND	10.	ND	10.	UG/L
4-METHYL-2-PENTANONE		ND	10.	ND	10.	ND	10.	UG/L
ACETONE		ND	34.	ND	34.	ND	34.	UG/L
ACRYLONITRILE		ND	100	ND	100	ND	100	UG/L
BENZENE		ND	5.	ND	5.	ND	5.	UG/L
BROMOCHLOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
BROMODICHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
BROMOFORM		ND	5.	ND	5.	ND	5.	UG/L
BROMOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
CARBON DISULFIDE		ND	5.	ND	5.	ND	5.	UG/L
CARBON TETRACHLORIDE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROBENZENE		ND	5.	ND	5.	ND	5.	UG/L
CHLOROETHANE		ND	10.	ND	10.	46.	10.	UG/L
CHLOROFORM		ND	5.	ND	5.	ND	5.	UG/L
CHLOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L
CIS-1,2-DICHLOROETHENE		ND	10.	ND	10.	ND	10.	UG/L
CIS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
DIBROMOCHLOROMETHANE		ND	5.	ND	5.	ND	5.	UG/L
DIBROMOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
ETHYLBENZENE		ND	5.	ND	5.	ND	5.	UG/L
IODOMETHANE		ND	10.	ND	10.	ND	10.	UG/L
METHYLENE CHLORIDE		ND	5.	ND	5.	8.	5.	UG/L
STYRENE		ND	5.	ND	5.	ND	5.	UG/L
TETRACHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TOLUENE		ND	5.	ND	5.	ND	5.	UG/L
TRANS-1,2-DICHLOROETHENE		ND	10.	ND	10.	ND	10.	UG/L
TRANS-1,3-DICHLOROPROPENE		ND	5.	ND	5.	ND	5.	UG/L
TRANS-1,4-DICHLORO-2-BUTENE		ND	10.	ND	10.	ND	10.	UG/L
TRICHLOROETHENE		ND	5.	ND	5.	ND	5.	UG/L
TRICHLOROFLUOROMETHANE		ND	10.	ND	10.	ND	10.	UG/L

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WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

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E V E N T S U M M A R Y R E P O R T

Site: 852 - MUSKOGEE LANDFILL
2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000

ENS: 93-11523
MP: 852931
Rev / Task: 01 / 01
Sample Type: WELL
Reported: 20-MAY-1993

Analyte	Sample Point: Sample Number: Sampled:	852-MW03R AH0586 27-APR-1993	EML RL	852-MW04 AH0583 27-APR-1993	EML RL	852-MW06 AH0584 27-APR-1993	EML RL	Units
VINYL ACETATE		ND	10.	ND	10.	ND	10.	UG/L
VINYL CHLORIDE		ND	10.	ND	10.	ND	10.	UG/L
XYLENE (TOTAL)		ND	10.	ND	10.	ND	10.	UG/L

NA = Not Analyzed

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METLAB Testing Services, Inc.

6825 East 38th Street Tulsa, Oklahoma 74145
(918) 664-7767

MLTS 83-3576

October 21, 1983

M.R. McComas & Associates Inc.
1808 So. Main
Broken Arrow, Ok 74012

Attn: Mr. Marty *Smitz* *Schmitt*

Dear Mr. Smitz,

In accordance with your instructions chemical analysis was performed on five (5) water samples submitted on October 14, 1983.

All testing was performed in accordance with EPA analytical guidelines. The results of the chemical analysis are summarized in Table I.

If you have any questions regarding this report please contact Mr. Dan Lawson or myself.

Sincerely,

METLAB TESTING SERVICES, INC.

Tony Mummolo
Tony Mummolo
Analytical Chemist

TCM/sc



10-14-76

METLAB

MLTS 83-3576

Table 1

Summary of Chemical Analysis of Five (5) Muskogee Water Samples
Tested for M.R. McComas and Associates, Inc.

<u>Constituents</u>	<u>Units</u>	<u>MW-1</u>	<u>MW-2</u>	<u>MW-3</u>	<u>Abd. Well</u>	<u>Cody Creek</u>
As	mg/l	.002	<.001	.001	<.001	<.001
Ba	mg/l	<.30	<.30	<.30	65.4	<.30
Cd	mg/l	<.006	<.006	<.006	<.006	<.006
Cr	mg/l	<.05	<.05	<.05	<.05	<.05
Pb	mg/l	<.05	<.05	<.05	<.05	<.05
Hg	mg/l	0.0001	0.0004	<0.0001	<0.0001	<0.0001
Nitrate Nitrogen	mg/l	5.6	9.1	1.0	48.	0.41
Se	mg/l	0.010	<.001	<.001	<.001	<.001
Total Dissolved Solids	mg/l	2449	9487	1120	45450	560
pH	STD	7.60	7.18	7.50	7.41	7.16
Chloride	mg/l	204	3693	119	24420	389.0
Sulfate	mg/l	1600	102	51.0	16.0	21.0
Alkalinity (as CaCO ₃)	mg/l	320.	318.	464.	432.	45.
Color	(Pt. Co.)	10	10	5	30	50
Fe	mg/l	<.03	<.03	<.03	.23	.50
Mn	mg/l	<.02	1.43	<.02	.12	<.02

Approved by Tony Mommolo

Tony Mommolo, Analytical Chemist

Test Hole	pH	mmhos/cm Specific Conductivity	Chlorides mg/l	Temp °C
1	--	--	--	--
2	5.6	4,100	100	16.0
3	5.8	4,000	820	18.0
4	5.1	10,000	20,000	17.0
5	--	--	--	--
6	6.0	800	50	18.0
7	5.4	10,000	3,700	19.0
8	--	--	--	--
9	--	--	--	--
10	6.4	1,300	25	17.0
11	6.2	1,200	50	17.0
12	5.9	2,600	500	18.0
13	6.0	1,600	150	17.0
14	5.6	10,000	825	17.0
15	6.1	1,400	250	16.5
MW1	5.7	3,100	--	16.0
MW2	5.8	10,000	--	--
MW3	6.0	1,650	--	--

SAMPLES ANALYZED IN FIELD BY WM. BULLER, M. SCHMIDT

APPENDIX F

**GROUNDWATER SAMPLING AND ANALYSIS PLAN
(GWSAP)**

Note: This appendix includes the following.

- The Groundwater Sampling and Analysis Plan.
- This GWSAP was previously submitted to ODEQ in January 2016 as part of a Tier I Permit Modification permit process.
- ODEQ approved the Tier I Permit Modification on January 26, 2016.



SCOTT A. THOMPSON
Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

MARY FALLIN
Governor

January 26, 2016

Mr. Pete Schultze
Waste Management, Inc.
2801 S. 54th St. W.
Muskogee, OK 74401

Re: Permit Modification – Groundwater Sampling and Analysis Plan
Muskogee Recycling & Disposal Facility (Permit No. 3551020)
Muskogee County

Dear Mr. Schultze:

The Oklahoma Department of Environmental Quality (DEQ) received the Permit Modification to update the Groundwater Sampling and Analysis Plan dated January 7, 2016, submitted by Biggs & Mathews Environmental on behalf of Waste Management of Oklahoma, Inc. for the Muskogee Recycling and Disposal Facility. On January 25, 2016, DEQ received a revised Table 6-1 via email from Biggs & Mathews Environmental. The modification was processed as a Tier I permit modification in accordance with Oklahoma Administrative Code (OAC) 252:4-7-58(2)(A)(ii).

The updated Groundwater Sampling and Analysis Plan was submitted in response to DEQ correspondence dated December 4, 2015, that approved the proposed alternative list of groundwater constituents contained in the *Groundwater Detection Monitoring Optimization Evaluation* report. The alternative list of constituents was approved in accordance with OAC 252:515-9-72.

The permit modification has been approved and includes the following updates to the Groundwater Sampling and Analysis Plan: alternative list of constituents, field procedures, analytical procedures, and statistical approach. A copy of the permit modification is enclosed with this letter. If you have any questions or concerns, please contact Rachel Hanigan at (405) 702-5196.

Sincerely,

A handwritten signature in black ink, appearing to read "Hillary Young", is written over the typed name.

Hillary Young, P.E.
Chief Engineer
Land Protection Division

HY/rh

cc: Michael Snyder, Biggs & Mathews Environmental
Paula Carboni, Waste Management

Enclosure: Solid Waste Permit Modification





SCOTT A. THOMPSON
Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

MARY FALLIN
Governor

SOLID WASTE PERMIT MODIFICATION

The Oklahoma Department of Environmental Quality hereby approves the following modification:

Permit Number: 3551020
Facility: Muskogee Community Recycling & Disposal Facility
Facility Type: Municipal Solid Waste Landfill
County: Muskogee County

Modification: Modify the existing permit to update the Groundwater Sampling and Analysis Plan.

Incorporated By Reference:

Revisions dated January 2016 to Sections 5.0 through 9.0 of the Groundwater Sampling and Analysis Plan, previously approved in July 1993.

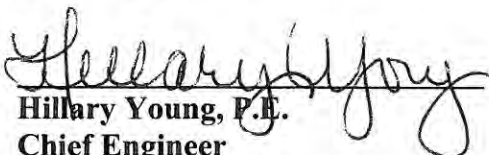
Table 8-1 Detection Monitoring Parameter List

Table 8-2 Water Quality Parameters List

Conditions:

1. If sampling data indicates significant changes in groundwater quality, the constituents listed in Table 8-2 *Water Quality Parameters List* (calcium, chemical oxygen demand, dissolved solids, iron, magnesium, manganese, potassium, sodium, and sulfate) may require semi-annual sampling and analysis.

The permittee is authorized to operate in conformity with the application dated January 7, 2016, submitted to the Land Protection Division. Commencing operations under this modification constitutes acceptance of, and consent to, the conditions contained herein.


Hillary Young, P.E.
Chief Engineer
Land Protection Division

Date: 1-26-16



**MUSKOGEE RECYCLING AND DISPOSAL FACILITY
MUSKOGEE COUNTY, OKLAHOMA
DEQ PERMIT NO. 3551020**

PERMIT MODIFICATION

**GROUNDWATER SAMPLING AND ANALYSIS PLAN
(GROUNDWATER MONITORING PLAN,
SECTIONS 5.0 THROUGH 9.0)**

Prepared for

Waste Management of Oklahoma

Approved July 1993

Revised January 2016



Prepared by

BIGGS & MATHEWS ENVIRONMENTAL

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TEXAS BOARD OF PROFESSIONAL ENGINEERS
FIRM REGISTRATION NO. F-256

TEXAS BOARD OF PROFESSIONAL GEOSCIENTISTS
FIRM REGISTRATION NO. 50222

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INTRODUCTION

The following Groundwater Sampling and Analysis Plan for the Muskogee Recycling and Disposal Facility (RDF) was created following the approval of the *Groundwater Detection Optimization Evaluation*, approved by the Oklahoma Department of Environmental Quality (DEQ) on December 4, 2015. The Optimization Evaluation included a request to update the currently approved monitoring plan with an optimized Detection Monitoring Parameter List, in accordance with OAC 252:515-9-72.

While updating the currently approved Groundwater Monitoring Plan (July 1993) with the revised Detection Monitoring Parameter List, it was determined that the procedures for collecting representative samples from the Muskogee RDF groundwater monitoring wells and the laboratory requirements for obtaining valid defensible data also needed to be updated in accordance with; the federal requirements in 40 CFR Part 258, the current U.S. Environmental Protection Agency (USEPA) guidance documents, and the Oklahoma Administrative Code (OAC) 252:515 Municipal Solid Waste Landfill (MSWLF) Regulations. ***Therefore, the following Groundwater Sampling and Analysis Plan will replace Sections 5.0 through Section 8.0 of the currently approved monitoring plan, including all Tables and Figures referenced in these sections. In addition, Section 9.0 (References) has been revised to include all references used in the updated Sections 5.0 through Sections 8.0.***

5.0 GROUNDWATER SAMPLING PROCEDURES

Proper sampling procedures are the most important and fundamental aspect in an effective monitoring program. All environmental quality sampling at the site will be accomplished by personnel trained in proper sampling protocol.

This section summarizes specific tasks involved in sampling of the groundwater monitoring system and presents the proposed groundwater monitoring parameters and sampling schedule for the Muskogee RDF.

5.1 Well Inspection

Prior to performing any purging or sampling each monitoring well will be inspected to assess its integrity. The condition of each well will be evaluated for any physical damage that may have been caused by the operation of site equipment or other vehicular traffic. The security of each well will be assessed in order to confirm that no outside source constituents have been introduced to the well. All inspection information, as well as the date and time, general weather conditions, and sampling personnel identification, will be documented on the Field Information Form (Figure 5-1) or equivalent form and a copy will be maintained in the site operating record.

5.2 Equipment Decontamination

Any non-dedicated equipment used for purging and the collection of groundwater samples will be decontaminated prior to use at each well location. An appropriate decontamination procedure will be sufficient to avoid (and prevent) the introduction of any contaminant into a well and to not allow any contaminant to be transported between wells that will create false sample results or otherwise harm the environment.

5.3 Water Level Measurements

Prior to groundwater purging and sampling, water level measurements will be taken at each well location utilizing a portable water level indicator, fiberglass tape, or other suitable measuring device. Water level measurements will be collected over a period of time short enough to avoid temporal variations in water levels. Water levels will be measured from a permanent, clearly marked location at the top of the well riser or dedicated sampling device cap. Measurements will be recorded to the nearest hundredth of a foot.

5.4 Purging/Bailing

Prior to sampling at each well location, water will be evacuated until a minimum of three

well volumes has been purged, until the well has been pumped or bailed dry, or until an appropriate amount of water has been purged to achieve the collection of a representative sample. Groundwater will be considered representative once pH, specific conductance, temperature, and turbidity drop to levels consistent with historical readings for the site. If low flow/minimal drawdown purging has been approved, the procedures described in EPA/540/S-95/504 will be followed. This will ensure that samples are drawn from the water bearing unit and not from stagnant water left in the well screen between sampling events. If the well contains less than three well volumes, the well will be pumped or bailed dry, allowed to recover and immediately sampled. If sufficient water is not available for sampling within 24 hours of purging for slowly recovering wells, the well will be considered dry and the well will not be sampled during that sampling event. As discussed previously a dedicated sampling device or a properly decontaminated (or disposable) bailer will be utilized for this task. Purge water will be disposed of properly.

5.5 Sample Collection

Each monitoring well in the groundwater monitoring system will have a dedicated sampling device (e.g., a Well Wizard™ bladder pump or equivalent or a Teflon® or stainless steel bailer). If a non-dedicated sampling device is used it will be properly decontaminated prior to its use. For bladder pumps, flow rates when sampling should not exceed the EPA recommended 0.1 liters per minute for collection of volatile organic compounds (VOCs). The sample collection rate is to be maintained between 0.1 and 0.5 liters per minute for all other organic and inorganic analytes.

Sampling for analysis of VOCs involves extra care. Water should flow slowly from the sampling device into each sample vial until a positive meniscus is formed over the top of the container. After the cap has been placed on the vial and tightened, the vial should be checked for air bubbles by turning it upside down and tapping with your finger. If an air bubble is seen rising to the bottom of the vial, the sample should be discarded and the process outlined above should be repeated. If no air bubbles are seen in each vial, the sample is accepted.

5.6 Sample Preservation and Filtering

It is recommended that an in-line flow system be used. When using an in-line flow system a minimum of three pump cycles of water must be allowed to pass through the in-line flow system before obtaining a sample. All equipment must be properly decontaminated prior to use at each well. As required by 252:515-9-3(c), samples will not be filtered prior to laboratory analysis. The material and use of prefiltration bottles must be noted on the Field Information Form (Figure 5-1) and Chain of Custody Record (Figure 5-2).

The appropriate sample container and preservative requirement for each analyte is listed on Table 5-1. Pre-labeled containers may be supplied by the laboratory or sampling personnel for each sampling event. The appropriate preservatives will be added to each sample container based on the analytical method.

5.7 Sample Shipment

After collection and sample preservation, the sample bottles will be wiped clean, checked for proper labeling and placed into an insulated, plastic-shelled cooler or other suitable shipping container with frozen ice packs or ice. The samples will be maintained at about 4°C. The temperature of the samples will be recorded when the shipping container arrives at the analytical laboratory to assure that the appropriate sample temperature was maintained during shipment. All samples included in the cooler will be packed in such a manner to minimize the potential for container breakage. VOA vials and TOX bottles (if any) will never be placed directly on the ice packs. A Field Information Form (Figure 5-1) and Chain of Custody Record (Figure 5-2) will be sealed in a water resistant bag and placed with the appropriate sample bottle set. Actual forms used may vary in format, but the information indicated is considered typical. The coolers will then be properly sealed with a tamper proof custody seal and sent to the designated analytical laboratory. All shipments will be scheduled for next day delivery. Upon arrival of the shipping container at the laboratory, the cooler will be opened and the Chain of Custody forms will be signed and time/dated by the person taking custody of the samples. If the cooler is shipped, this person will affix the bill of lading or receipt to the Chain of Custody form.

5.7.1 Chain of Custody

Appropriate Chain of Custody procedures for samples will be implemented to ensure sample integrity, and to provide technically and legally defensible groundwater quality data. At the time each sample is collected, the Field Information Form (Figure 5-1) and Chain of Custody Record (Figure 5-2) will be completed and placed in the shipping container. The Field Information Form will include general sampling event information including location, time, weather conditions, sampler identification, sample observations, any numerical field data values and well purging procedures.

6.0 GROUNDWATER ANALYSIS PROCEDURES

6.1 Laboratory Analytical Methods/Procedures

Table 6-1 presents the methodologies used by Waste Management of Oklahoma's (WMO) designated laboratory for each parameter or group of parameters. All methods are USEPA approved.

6.2 Quality Assurance/Quality Control

In addition to strict chain of custody procedures, field blanks and trip blanks are used to assure the integrity of the sampling and shipping process. A record of laboratory sample receipt, storage and analysis procedures will be kept for each sample received. A summary of this record will be part of the laboratory analysis report. Any internal quality control problem associated with the submitted sample/analyte will be identified on the data qualifier report included with each sample's analytical client report.

Field Sampling QA/QC

Field Procedures. As quality assurance procedures are an integral part of each segment of field sampling methodology, the quality assurance procedures associated with each step of the field sampling routine (e.g., proper well purging, field sampling and preservation methodologies) have been directly incorporated into each respective field sampling subsection of this document.

Field and Trip Blanks. The trip blank, containing laboratory-grade distilled water, will remain unopened and be packaged and sent from and to the laboratory in the same manner as the site environmental samples. The trip blank will be provided by the analytical laboratory supplying the sample bottles and shipping containers. One trip blank will be taken and analyzed for volatile organic compounds (VOCs) only in each groundwater sampling event.

The field blank will be prepared in the field by pouring the supplied laboratory-grade distilled water into one of the clean sample containers opened in the field. The field blank will then be sealed and shipped in the same manner as the environmental samples. One field blank will be collected and analyzed for VOCs only in each groundwater sampling event.

Laboratory QA/QC

Analytical Blanks and Spikes. The selected laboratory will use method quality control procedures that are equivalent to those described in SW-846. Duplicate samples, method blanks, instrument/reagent blanks, matrix spikes, blank/water reagent spikes and surrogate spikes are typical quality control checks performed throughout the

analysis process at the analytical laboratory. With the exception of instrument/reagent blanks and surrogate spikes, these checks are performed at a frequency of 5% or 10% (i.e., 1 in 20 samples, 1 in 10 samples). Instrument/reagent blanks and surrogate spikes are performed on a daily or per sample (where required by method) frequency. Each of the above applied quality control checks will be compared against the acceptance criterion for each quality control check to ensure that analytical quality is maintained.

Instrument Calibration. Applicable instruments are calibrated using calibration standards and method specified calibration criteria. A solution containing various compounds of known concentrations is diluted and analyzed to establish calibration curves and performed daily or per the method to monitor the accuracy and precision of the instrument. Instrument calibration is verified by analyzing a solution containing a known concentration of the pure compound(s) of interest and comparing it against the calibration curve. This standard compound is taken from the same stock as that used to develop the calibration curve. Calibration verification is done at a 5% frequency, or as the method requires, checking the stability of the calibration curve as well as the accuracy and precision of the system or analyst.

All standards and reagents used in laboratory procedures will be inventoried, labeled, logged and documented in accordance with the designated laboratory's documentation procedures. All stock standards are purchased as certified primary solutions from reputable, commercial lab suppliers, and are prepared from neat chemicals with certified purity. Stock standards are combined and/or diluted into secondary dilution standards, which are then diluted into working standards.

Instrument Maintenance. Routine maintenance is performed and documented for all major instruments. In addition, any service agreements for laboratory equipment are renewed annually. The EPA's "Good Automated Laboratory Practices" (GALPs) are followed in the laboratory.

7.0 ESTABLISHMENT OF BACKGROUND GROUNDWATER QUALITY

Background groundwater quality will be established for all upgradient and downgradient wells in the groundwater monitoring system on a quarterly basis for two full years to establish background water quality, as required by OAC 252:515-9-31(a).

Constituents to be monitored for establishment of background are listed in Table 7-1. This background constituent list, as required by 252:515-9-31(d), consists of pH, chemical oxygen demand, specific conductivity, chloride, sulfate, calcium, magnesium, nitrates, sodium, carbonates, potassium, those constituents listed in Appendix A of OAC 252:515, as well as alkalinity, total dissolved solids, iron, and manganese.

8.0 DETECTION AND ASSESSMENT MONITORING

The Detection and Assessment Monitoring Program procedure for the site is summarized and discussed in the following subsections.

8.1 Groundwater Detection Monitoring Parameters

Parameters that will be monitored during detection monitoring are listed in OAC 252:515-9-31(d), unless alternative constituents are approved in accordance with OAC 252:515-9-72. The site-specific detection monitoring parameters list has been included as Table 8-1.

In accordance with OAC 252:515-9-72(c), "The DEQ may approve the use of an alternative list of indicator constituents, in lieu of some or all of the heavy metal constituents of the approved groundwater monitoring program, if the alternative constituents provide a reliable indication of inorganic releases from the disposal facility to groundwater," a *Groundwater Detection Optimization Evaluation* was conducted by WMO and approved by the DEQ in December 2015. The Optimization Evaluation modified the list of constituents for statistical analysis to only those that are inherent to waste streams and that will facilitate a statistical program that will be more protective of human health and the environment by lowering the false positive rate and raising the statistical power to more accurately identify real releases from the landfill to the environment.

Therefore, the indicator and general water quality parameters have been removed from the Detection Monitoring Parameter List and are listed separately in Table 8-2, *Water Quality Parameters List*. As stipulated in the approved *Groundwater Detection Optimization Evaluation*, the water quality parameters will not be included in statistical analysis but instead be presented annually using Piper and Stiff plots. WMO will also re-evaluate the leachate constituents on an annual basis to monitor any increases or additions to the constituent list.

8.2 Groundwater Detection Monitoring Frequency

After the establishment of background groundwater quality (Refer to Section 4), in accordance with 252:515-9-73, groundwater from each monitoring well shall be sampled and analyzed at least semi-annually during the active life of the facility and during the post-closure monitoring period. The DEQ may, in the future, approve alternate sampling and analysis frequencies in the approved detection monitoring program. Alternative detection monitoring frequencies shall not be less than annual during the active life, but may be less than annual during the post-closure monitoring period.

8.3 Reporting Requirements

Within 60 days after sampling, a statistical analysis evaluation shall be performed on the groundwater monitoring results to determine whether there has been a statistically significant increase (SSI) over background values at each monitoring well and the groundwater monitoring analytical report and the results of the statistical evaluation shall be submitted to the DEQ.

To determine if an SSI has occurred, first the groundwater quality of each chemical parameter or hazardous constituent at each monitoring well shall be compared to the background value of that constituent in the upgradient well (inter-well comparison), according to the specified statistical procedures and performance standards. If an SSI over background values in any parameter or constituent is evident, that is, if it has failed the inter-well comparison, then the groundwater quality of each parameter or constituent that failed the inter-well analysis shall be compared to the background value of that parameter or constituent in the same well (intra-well comparison), according to the specified statistical procedures and performance standards.

If there is an SSI over background (that is exceedance of both inter-well and intra-well analysis) for one or more of the constituents at any monitoring well, the owner/operator:

(1) must notify the DEQ in writing within 14 days of the determination and place a notice in the operating record indicating which constituents have shown statistically significant changes from background levels; and

(2) must establish an assessment monitoring program meeting the requirements of Part 9 of 252:515-9 within 90 days of the determination, and have the assessment monitoring program approved by the DEQ; or

(3) may, during the 90-day development of an assessment monitoring program, demonstrate that a source other than the facility causes the contamination or that the SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. A report documenting this demonstration shall be submitted to the DEQ for approval.

If a successful demonstration is approved by the DEQ, then the landfill may return to detection monitoring. If at the end of the 90-day period, a successful demonstration is not made, the assessment monitoring program must be initiated.

8.4 Statistical Method

Statistical analysis will be conducted in accordance with OAC 252:515-9. The most appropriate method will be selected for each individual parameter based on the analysis of the data. The statistical method has not been selected at this time and is dependent upon the evaluation of the analytical data selected to be representative of background groundwater quality. Additionally, the background groundwater quality may require the statistical method to include procedures to control or correct for seasonal and spatial variability, as well as temporal conditions in the data. An appropriate statistical methodology will be selected in accordance with ASTM D 6312-98, "Standard Guide for Developing Appropriate Statistical Approaches for Ground-Water Detection Monitoring"

Programs" (ASTM, 2005). The statistical evaluation methodology will be established such that the statistical method(s) chosen are technically sound and are the most appropriate method(s) to be protective of human health and the environment.

8.4.1 Volatile Organic Compounds

Practical quantitation limits (PQLs) assure that the true value of the analyte is close to the measured value. Conversely, method detection limits (MDLs), indicate that the analyte is present in the sample with a specified degree of confidence. For analytes with estimated concentrations greater than the MDL but not the PQL, it can only be concluded that the true concentration is greater than zero; the actual concentration cannot be determined. Comparison of a detected concentration to any regulatory standard (such as a maximum contaminant level [MCL]), or any other concentration limit, is by definition not meaningful unless the concentration is greater than the PQL.

If a MSWLF facility actually produces a release to groundwater, multiple constituents contained in the leachate are typically associated with the source fluids and are subsequently detected by the groundwater monitoring program. A single constituent at very low concentration (i.e., below the PQL) typically is not the signature that is produced from an actual release.

VOCs represent very effective indicators of a release from a solid waste unit. Because these compounds are rarely detected in background groundwater samples, establishing monitor well-specific limits for VOCs is generally not an option. Therefore, detection decision rules based on laboratory-specific PQLs will be used.

8.4.2 Inorganic Parameters

The statistical analysis methodology for inorganic parameters with a detection frequency greater than 25% will be based on a combined Shewhart-cumulative sum (CUSUM) control chart that is capable of detecting both sudden and gradual changes in groundwater chemistry (Gibbons, 1994). Combined Shewhart-CUSUM control charts will be constructed for each well and parameter monitored to provide a statistical/visual tool for detecting trends and abrupt changes in inorganic groundwater chemistry. For inorganic parameters with a detection frequency less or equal to 25%, calculation of non-parametric or Poisson prediction limits will be conducted. Some facilities may require alternate methods (such as normal prediction limits) based on the number of statistical comparisons required for the site and the alternatives allowed to manage the site-wide false positive and false negative rates.

The combined Shewhart-CUSUM procedure requires a minimum of eight historical independent samples (i.e., background data) to provide a reliable estimate of the mean and standard deviation of each constituent in each well. The combined Shewhart-CUSUM control chart procedure assumes that the data are independent and normally distributed with a fixed mean and constant variance. Shewhart-CUSUM control charts are not recommended for data sets of less than 8 independent samples except as time-series plots and evaluation of trends. Once background data are obtained from each detection monitor well, subsequent sample results are statistically compared to the estimated control limit both in terms of their absolute magnitude and cumulative sum.

If all inorganic parameter data collected during the background period (minimum of 8 independent events) are not detected in concentrations greater than the respective PQLs, the PQL will be used as the non-parametric prediction limit. The collection of thirteen (13) samples in background for this detection frequency provides a 99% confidence non-parametric prediction limit with one re-sample. Note that 99% confidence is equivalent to a 1% false positive rate and pertains to a single comparison (that is, well and constituent) and not the site-wide error rate (all wells and constituents), which is set to 5%. If the detection frequency is greater than zero but less than 25%, the non-parametric prediction limit is the largest of the 13 background samples (for 1 verification re-sample) or 8 background samples if a pass “1 of 2” verification re-sampling program is implemented.

8.5 Statistical Analysis

The statistical analysis program for inorganic parameters DUMPStat® will be based on combined Shewhart-CUSUM control charts or prediction limits at all compliance point wells. Future intra-well measurements that do not exceed the statistical limits and do not exhibit a significant trend will be combined with historical data to update these estimates every two years.

In selecting the statistical evaluation methodology using DUMPStat®, a screening procedure based on the data set and total number of statistical comparisons per event should be conducted for each monitoring event to allow for management of the site-wide false positive rate. Following selection of the monitoring points and parameters, a statistical power curve should be computed to allow the determination of a site-wide false positive rate. The EPA guidance document entitled “Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance” (USEPA, 2009) recommends that the selected statistical method for multiple constituent comparisons provide a site-wide false positive rate of 5% or less while maintaining a statistical power (1 minus the false negative rate) from the EPA reference power curve (correlating to a statistical power of >50% for a 3-sigma release and >80% for a 4-sigma release). If this cannot be achieved through a parameter or monitoring point reduction, then options available within DUMPStat® can be used. Adjustments to the control chart factor (for intra-well control charts) and verification re-sampling options, or the use of normal prediction limits may be implemented to achieve the statistical standards recommended by USEPA (2009) and Robert Gibbons (1994).

8.5.1 Detection Verification Procedure

Once groundwater analysis results have been collected, checked for QA/QC consistency and determined to be above the appropriate statistical level, the results must be verified in accordance with the objectives of 40 CFR Part 258.53. Verification re-sampling is an integral part of the statistical methodology described by EPA's Addendum to Interim Final Guidance Document. Without verification re-sampling, much larger statistical limits would be required to achieve site-wide false positive rates of 5% or less. Furthermore, the resulting false negative rate would be greatly increased. The following procedure will be performed for each compound determined to be initially above its statistical limit. Only compounds that initially exceed their statistical limit will be sampled for verification purposes. The use of “pass 1 of 1” or “pass 1 of 2” verification options will be evaluated on a per event basis based on the calculated site-wide false positive rate.

8.5.1.1 Volatile Organic Compounds

If one or more VOCs are detected above their statistical limit (i.e., PQL), up to two verification resamples will be scheduled no sooner than 30 days apart to provide sample independence. A statistically significant increase (SSI) will be recorded if any single VOC is verified in each of the scheduled re-sampling events in a concentration greater than the PQL.

8.5.1.2 Inorganic Constituents

If one or more of the inorganic parameters are detected above their statistical limit (i.e., Shewhart-CUSUM control chart computation value/prediction limit), up to two verification re-samples will be collected at the next sampling event with the re-sampling event scheduled no sooner than 30 days apart to provide sample independence. A SSI will be recorded if verification of one elevated parameter is confirmed in a concentration greater than the control/prediction limit for each of the discrete verification re-samples. If the re-sampling program confirms that the initial sample represented a laboratory or sampling-induced outlier, the verification sample will replace the original reported value to eliminate bias from the CUSUM calculation, which considers all data points collected at the site.

8.6 Assessment Monitoring

Assessment monitoring will be conducted if, during detection monitoring, an SSI over background is detected and verified for the constituents identified in Section 5.1, Groundwater Detection Monitoring Parameters, in accordance with DEQ regulations. Upon commencement of assessment monitoring, a minimum of one groundwater sample will be collected from each downgradient well and a minimum of four independent samples from each well to establish background for any OAC 252:515 Appendix C constituents detected. In accordance with 252:515-9-94, the DEQ may specify a subset of wells to be sampled and analyzed during assessment monitoring. This sampling (assessment monitoring) will occur within a period of 180 days from the date of notice to the DEQ of the SSI identified during detection monitoring. Samples collected for assessment monitoring will be analyzed for the assessment constituents listed in Appendix C of OAC 252:515 and for the detection monitoring constituents identified in Table 8-1. For assessment monitoring, an abbreviated list of assessment constituents may be approved by the DEQ in accordance with OAC 252:515-9-93.

If one or more assessment monitoring constituents are detected at statistically significant levels above the groundwater protection standard of OAC 252:515-9-96 in any sampling event, the owner/operator shall comply with all procedures listed in OAC 252:515-9-95(c) within 14 days of this finding.

Data evaluation during assessment monitoring will consist of the establishment of 95% Lower Confidence Limits (LCLs) for any Appendix II constituent detected in concentrations greater than the PQL, assuming that a minimum of four background samples exist for each parameter detected during the assessment monitoring program. If inadequate background data exists, sufficient background data will be collected to provide adequate sample size for statistical analysis. According to USEPA technical guidance, if the 95% Lower Confidence Limit (LCL) of one parameter exceeds action

levels defined as MCLs, if applicable, or a health-based alternate groundwater protection standard (GWPS), the facility is to initiate an assessment of corrective measures.

The use of LCLs for assessment monitoring is stipulated by USEPA in the 2009 statistical guidance document and supported by Dr. Kirk Cameron (statistical consultant to USEPA), Jim Brown (USEPA), and Dr. Robert Gibbons. In accordance with the USEPA document entitled "Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance" (USEPA, 2009), Section 21,

"Confidence intervals are the recommended general statistical strategy in compliance/assessment or corrective action monitoring. Groundwater monitoring data must typically be compared to a fixed numerical limit set as a GWPS. In compliance/assessment, the comparison is made to determine whether groundwater concentrations have increased above the compliance standard. In corrective action, the test determines whether concentrations have decreased below a clean-up criterion or compliance level. In compliance/assessment monitoring, the lower confidence limit [LCL] is of primary interest, while the upper confidence limit [UCL] is most important in corrective action."

"Furthermore, Section 21.1.1 states, "Confidence intervals around the mean of a normal distribution should only be constructed if the data are approximately normal or at least are reasonably symmetric. An inaccurate confidence interval is likely to result if the sample data are highly non-normal...*Therefore, checking for normality is an important first step.* A confidence interval should not be constructed with less than 4 measurements per compliance well, and preferably 8 or more." This is important because, "...statistically significant evidence of a violation during compliance/assessment or success during corrective action is indicated only when the entire confidence interval is to one side of the standard."

If the concentrations of all assessment constituents are at or below the established statistical limit for two consecutive assessment monitoring events, normal detection monitoring can be resumed in subsequent events, if approved by the DEQ.

9.0 REFERENCES

- American Society of Testing Materials, 1986, *Standard Guide for Sampling Groundwater Monitoring Wells*, D 4448 – 850.
- American Society of Testing Materials, 2005, *Standard Guide for Developing Appropriate Statistical Approaches for Ground-Water Detection Monitoring Programs*, D6312-98.
- Gibbons, Robert, D. 1994, *Statistical Methods for Groundwater Monitoring*, John Wiley & Sons, Inc, New York.
- Gibbons, Robert, D. and Coleman, David E., 2001, *Statistical Methods for Detection and Quantification of Environmental Contamination*, John Wiley and Sons, New York, 384 p.
- Gilbert, R.O., 1987, *Statistical Methods for Environmental Pollution Monitoring*, Van Nostrand Reinhold, New York.
- Martin, W.F., Lippitt, J.M., and Protherd, T.G., 1987, *Hazardous Waste Handbook for Health and Safety*, Butterworth Publishers, Stoneham, Massachusetts, pp. 28 – 30.
- National Flood Insurance Program. *Flood Insurance Rate Map, Muskogee County, Oklahoma and Incorporated Areas*, 40101C0109D. Federal Emergency Management Agency, March 4, 1991.
- National Oceanic and Atmospheric Administration. *Climatological Data Annual Summary, Oklahoma, 1991*. Volume 100, Number 13. Asheville, North Carolina: National Climatic Data Center, 1991.
- Oklahoma Geological Survey, Guidebook 25. *Shelf-to-Shelf Geology and Resources of Pennsylvanian Strata in the Arkoma Basin and Frontal Ouachita Mountains of Oklahoma*. Norman, Oklahoma: The University of Oklahoma, 1988.
- Poe and Associates. *Geotechnical and Hydrogeological Evaluation of Proposed Muskogee Landfill Update, Revised October, 1984*. Tulsa, Oklahoma, 1984.
- Poe and Associates. *Geotechnical and Hydrogeological Evaluation of Muskogee Landfill Update, Revised October, 1984*. Tulsa, Oklahoma, 1984.
- RUST Environment & Infrastructure. *Hydrogeologic Study for Muskogee Community Landfill and Recycling Center Muskogee Oklahoma*. Houston, Texas, 1993.
- Soil Conservation Service. *Soil Survey of Muskogee County, Oklahoma*. United States Department of Agriculture, Soil Conservation Service and Forest Service, Oklahoma Agricultural Experiment Station and Oklahoma Conservation

Commission, June, 1988.

Soyster, Hale B. and Thos. G. Taylor. *Oklahoma Geological Survey – Bulletin 40-FF, Oil and Gas in Oklahoma, Oil and Gas Geology of Muskogee County*. Norman Oklahoma: Oklahoma Geological Survey, 1988.

State of Oklahoma, Oklahoma Administrative Code, Title 252, Department of Environmental Quality, Chapter 515, Municipal Solid Waste Landfill Regulations, Subchapter 9 Groundwater, Effective June 1, 2003.

U.S. Environmental Protection Agency, 1986, *RCRA Groundwater Monitoring Technical Enforcement Guidance Document*, OSWER – 99550.1, Office of Waste Programs Enforcement, Office of Solid Waste and Emergency Response, Washington, D.C.

U.S. Environmental Protection Agency, November 1986, *Test Methods for Evaluating Solid Waste – Physical/Chemical Methods*, Third Edition (Revised), SW-846, Office of Solid Waste and Emergency Response, Washington, D.C.

U.S. Environmental Protection Agency, 1989, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities*, Interim Final Guidance, Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency, Federal Register, 40 CFR 258, October 9, 1991.

U.S. Environmental Protection Agency, 1991b, *Handbook – Groundwater, Volume II: Methodology*, EPA/625/6-90/0166.

U.S. Environmental Protection Agency, 1992, *RCRA Groundwater Monitoring: Draft Technical Guidance*, EPA/530-R-93-001, NTIC #PB93-139-350, Office of Solid Waste and Emergency Response, Washington, D.C.

U.S. Environmental Protection Agency, November 1993, *Solid Waste Disposal Facility Criteria Technical Manual*, EPA/530-R-93-017, NTIC #PB94-100-450, Office of Solid Waste and Emergency Response, Washington, D.C.

U.S. Environmental Protection Agency, 2009, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance*, Office of Resource Conservation and Recovery, Program Implementation and Information Division, U.S. Environmental Protection Agency, Washington, D.C.

TABLES

5-1	Sample Collection, Preservation and Holding Times
6-1	Methodologies for Testing and Analysis
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Table 5-1
Muskogee Recycling and Disposal Facility
Sample Collection, Preservation, and Holding Times

PARAMETER	SAMPLE COLLECTION¹ AND CONTAINER	SAMPLE^{2,3} PRESERVATION	RECOMMENDED⁴ HOLDING TIMES
Acid Extractables	1000 ml Glass only (amber) with Teflon liner	Cool, 4°C	Extract within 7 days; analyze within 40 days
Alkalinity	100 ml P, G	Cool, 4°C	14 days
Ammonia	125 ml P, G	Cool, 4°C H ₂ SO ₄ to pH < 2	28 days
Base/Neutral Extractables (priority pollutants)	1000 ml Glass only (amber) with Teflon liner	Cool, 4°C	Extract within 7 days; analyze within 40 days
Biochemical Oxygen Demand, 5 day (BOD 5)	1000 ml P, G	Cool, 4°C	48 hours
Calcium (dissolved)	500 ml P, G	Filter on site, HNO ₃ to pH < 2	6 months
Chemical Oxygen Demand (COD)	125 ml P, G	Cool, 4°C H ₂ SO ₄ to pH < 2	28 days
Chloride	250 ml P, G	None required	28 days
Coliform, fecal and total	100 ml P, G sterilized	Cool, 4°C	24 hours
Cyanide	1000 ml P, G	Cool, 4°C NaOH to pH > 12 0.6 g ascorbic acid	14 days
Fluoride	250 ml P	None required	28 days
Hardness	100 ml P, G	HNO ₃ to pH < 2	6 months
Metals			
Chromium (hexavalent)	200 ml P, G	Cool, 4°C	24 hours
Mercury (dissolved)	1000 ml P, G	Filter on site HNO ₃ to pH < 2	28 days
Mercury (total)	1000 ml P, G	HNO ₃ to pH < 2	28 days

Table 5-1 (Cont'd)
Muskogee Recycling and Disposal Facility
Sample Collection, Preservation, and Holding Times

PARAMETER	SAMPLE COLLECTION¹ AND CONTAINER	SAMPLE^{2,3} PRESERVATION	RECOMMENDED⁴ HOLDING TIMES
Other Metals, (dissolved) (Arsenic, Antimony, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Nickel, Potassium, Sodium, Silver, Sodium, Thallium, Vanadium, Zinc)	1000 ml P, G	Filter on site HNO ₃ to pH < 2	6 months
Other Metals, (totals) (Arsenic, Antimony, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Nickel, Potassium, Sodium, Silver, Sodium, Thallium, Vanadium, Zinc)	1000 ml P, G	HNO ₃ to pH < 2	6 months
Nitrate	125 ml P, G	Cool, 4°C	48 hours
Nitrite	125 ml P, G	Cool, 4°C	48 hours
Oil and grease	1000 ml G only	Cool, 4°C H ₂ SO ₄ to pH < 2	28 days
PCB (Priority Pollutant)	1000 ml Glass only (amber) with Teflon liner	Cool, 4°C	Extract within 7 days; analyze within 40 days
Pesticides Endrin Lindane Toxaphene Methoxychlor	1000 ml Glass only (amber) with Teflon liner	Cool, 4°C	Extract within 7 days; analyze within 40 days
pH (field)	25 ml P, G	None required	Analyze immediately
Phenols	500 ml G only	Cool, 4°C H ₂ SO ₄ to pH < 2	28 days
Phosphorus (total)	125 ml P, G	Cool, 4°C H ₂ SO ₄ to pH < 2	28 days

Table 5-1 (Cont'd)
Muskogee Recycling and Disposal Facility
Sample Collection, Preservation, and Holding Times

PARAMETER	SAMPLE COLLECTION¹ AND CONTAINER	SAMPLE^{2,3} PRESERVATION	RECOMMENDED⁴ HOLDING TIMES
Specific Conductance (field)	100 ml P, G	None required	Analyze immediately
Sulfate	50 ml P, G	Cool, 4°C	28 days
Temperature (field)	1000 ml P, G	None required	Analyze immediately
Total Dissolved Solids Residue on evaporation (TDS/ROE) 180°C	1000 ml P	Cool, 4°C	7 days
Total Organic Carbon (TOC)	2-40 ml P	Cool, 4°C H ₂ SO ₄ to pH < 2	28 days
Total Suspended Solids (TSS)	1000 ml P	Cool, 4°C	7 days
Volatile Organic Acids, Priority pollutants	4-40 ml glass vial with septum caps	Cool, 4°C	14 days

1. Plastic (P) or Glass (G). For metals, polyethylene with polypropylene cap (no liner) is preferred.
2. Simple preservation should be performed immediately upon sample collection. For composite samples, each aliquot should be preserved at the same time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.
3. When any sample is to be shipped by common carrier or sent through the United States mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring each compliance. For the preservation requirements of Table 5-4, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCL) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO₃) in water solutions and concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H₂SO₄) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).
4. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still considered valid; samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of sample under study are stable for the longer time, and has received a variance from the Regional Administrator. Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show this is necessary to maintain sample stability.

Table 6-1
Muskogee Recycling and Disposal Facility
Methodologies for Testing and Analysis

PARAMETER	METHOD DESCRIPTION	METHOD
Acid Extractables	GC/MS	EPA 625/8270C(D)
Alkalinity	Colorimetric, Automated Methyl Orange/Titrimetric	(A)310.2/310.1
Ammonia	Colorimetric, Automated Phenate	(A)350.1
Base/Neutral Extractables	GC/MS	EPA 625/8270C(D)
Biological Oxygen Demand, 5 day (BOD5)	BOD (5 day, 20°C)	(A)405.1
Calcium	Atomic Emission Spectrometric	(A)200.7/6010B(D)
Chemical Oxygen Demand (COD)	Colorimetric, Automated; Manual	(A)410.4
Chloride	Colorimetric, Automated Ferricyanide/Ion Chromatography	(A)325.2/300.0A
Coliform (fecal)	Standard Membrane Filtration	(B)9221
Coliform (total)	Standard Membrane Filter Procedure	(B)9222
Cyanide (total)	Colorimetric, Automated UV	(A)335.3/9012(D)
Fluoride	Potentiometric, Ion Selective Electrode	(A)340.2
Hardness	Calculation	(C)2340B
<u>Metals, dissolved</u>		
Antimony	Atomic Absorption, furnace technique, ICP	(A)200.7/7041/6010B(D)
Arsenic	Atomic Absorption, furnace technique, ICP	(A)200.7/7060A/6010B(D)
Barium	ICP	(A)200.7/6010B(D)
Beryllium	ICP	(A)200.7/6010B(D)
Boron	ICP	(A)200.7/6010B(D)
Cadmium	ICP	(A)200.7/6010B(D)
Chromium	ICP	(A)200.7/6010B(D)
Chromium (hexavalent)	Colorimetric	7196A
Copper	Atomic Absorption, Furnace, ICP	(A)200.7/6010B(D)
Iron	ICP	(A)200.7/6010B(D)
Lead	Atomic Absorption, Furnace, ICP	(A)200.7/7421/6010B(D)
Magnesium	ICP	(A)200.7/6010B(D)
Manganese	ICP	(A)200.7/6010B(D)
Mercury	Atomic Absorption, cold vapor technique	7470A
Nickel	ICP	(A)200.7/6010B(D)
Potassium	ICP	(A)200.7/6010B(D)
Selenium	Atomic Absorption, furnace technique, ICP	(A)200.7/7740/6010B(D)

Table 6-1 (Cont'd)
Muskogee Recycling and Disposal Facility
Methodologies for Testing and Analysis

PARAMETER	METHOD DESCRIPTION	METHOD
<u>Metals, dissolved</u>		
Silver	ICP	(A)200.7/6010B(D)
Sodium	ICP	(A)200.7/6010B(D)
Thallium	ICP	(A)200.7/7841/6020(D)
Zinc	ICP	(A)200.7/6010B(D)
<u>Metals, total</u>		
Antimony	Atomic Absorption, furnace technique, ICP	(A)200.7/7041/6010B(D)
Arsenic	Atomic Absorption, furnace technique, ICP	(A)200.7/7060A/6010B(D)
Barium	ICP	(A)200.7/6010B(D)
Beryllium	ICP	(A)200.7/6010B(D)
Boron	ICP	(A)200.7/6010B(D)
Cadmium	ICP	(A)200.7/6010B(D)
Chromium	ICP	(A)200.7/6010B(D)
Chromium (hexavalent)	Colorimetric	7196A
Copper	Atomic Absorption, Furnace, ICP	(A)200.7/6010B(D)
Iron	ICP	(A)200.7/6010B(D)
Lead	Atomic Absorption, Furnace, ICP	(A)200.7/7421/6010B(D)
Magnesium	ICP	(A)200.7/6010B(D)
Manganese	ICP	(A)200.7/6010B(D)
Mercury	Atomic Absorption, cold vapor technique	7470A
Nickel	ICP	(A)200.7/6010B(D)
Potassium	ICP	(A)200.7/6010B(D)
Selenium	Atomic Absorption, furnace technique, ICP	(A)200.7/7740/6010B(D)
Silver	ICP	(A)200.7/6010B(D)
Sodium	ICP	(A)200.7/6010B(D)
Thallium	ICP	(A)200.7/7841/6020(D)
Zinc	ICP	(A)200.7/6010B(D)
Nitrate	Colorimetric, Automated, Cadmium Reduction, Ion Chromatography	(A)353.2/300.0A
Nitrite	Colorimetric, Automated, Cadmium Reduction, IC	(A)353.2/300.0A
Oil and Grease	Gravimetric, Seperatory Funnel Extraction	1664A
PCB (priority pollutants)	Gas Chromatography	EPA 608/8083
Pesticides	Gas Chromatography	EPA 608/8081A
pH (field)	Electrometric	(A)150.1
Phenols	Colorimetric, Automated 4-AAP with Distillation	(A)420.2/9066(D)
Phosphorous, Total	Colorimetric, Automated Ascorbic Acid	(A)365.3

Table 6-1 (Cont'd)
Muskogee Recycling and Disposal Facility
Methodologies for Testing and Analysis

PARAMETER	METHOD DESCRIPTION	METHOD
Specific Conductance (field)	Wheatstone bridge	(A)120.1
Sulfate	Turbidimetric, Ion Chromatography	(A)375.4/300.0A
Temperature (field)	Revering Thermometer	(B)212.7
Total Dissolved Solids (TDS)	Gravimetric, Dried at 180°C	(A)160.1
Total Organic Carbon (TOC)	Combustion or Oxidation	(A)415.1
Total Suspended Solids (TSS)	Gravimetric, Dried at 103-105°C	(A)160.2
Volatile Organic Compounds	Purge and Trap/GC/MS	EPA 624/8260B(D)

**NOTE: Analytical methods listed above may be substituted for as deemed necessary provided that the alternate methods provide adequate analytical data to fulfill monitoring requirements and meet regulatory standards.*

References:

- A: Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-0920, EMSL, Cincinnati, Revision (March 1983).
- B: Standard Methods for the Examination of Water and Wastewaters, 15th Edition, APHA-AQWQA-WPCF, 1980.
- C*: Standard Methods for the Examination of Water and Wastewaters, 18th Edition, APHA-AWWA-WEF, 1992.
- D: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition, July 1992 (as Revised).

* 2340B is the same in the 18th Edition as in the 17th Edition.

Table 7-1
Muskogee Recycling and Disposal Facility
Background Monitoring Parameter List

COMMON NAME

Inorganic Parameters:

CAS RN

Alkalinity	Total
Ammonia, Nitrogen	
Antimony	Total
Arsenic	Total
Barium	Total
Beryllium	Total
Cadmium	Total
Calcium	Total
Chloride	
Chromium	Total
Cobalt	Total
Chemical Oxygen Demand	
Copper	Total
Dissolved Solids	Total
Iron	Total
Lead	Total
Magnesium	Total
Manganese	Total
Nickel	Total
Nitrate	
pH	
Potassium	Total
Selenium	Total
Silver	Total
Sodium	Total
Specific Conductance	
Sulfate	
Thallium	Total
Vanadium	Total
Zinc	Total

Organic Constituents:

Acetone	67-64-1
Acrylonitrile	107-13-1
Benzene	71-43-2
Bromochloromethane	74-97-5
Bromodichloromethane	75-27-4
Bromoform (tribromomethane)	75-25-2
Carbon disulfide	75-15-0
Carbon tetrachloride	56-23-5
Chlorobenzene	108-90-7
Chloroethane (ethyl chloride)	75-00-3
Chloroform (trichloromethane)	67-66-3
Dibromochloromethane (chlorodibromomethane)	124-48-1
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8
1,2-Dibromoethane (ethylene dibromide, EDB)	106-93-4

Table 7-1 (Cont'd)
Muskogee Recycling and Disposal Facility
Background Monitoring Parameter List

COMMON NAME	CAS RN
<u>Organic Constituents:</u>	
o-Dichlorobenzene (1,2-dichlorobenzene)	95-50-1
p-Dichlorobenzene (1,4-dichlorobenzene)	106-46-7
trans-1,4-Dichloro-2-butene	110-57-6
1,1-Dichloroethane (ethylidene chloride)	75-34-4
1,2-Dichloroethane (ethylene dichloride)	107-06-2
1,1-Dichloroethylene (1,1-dichloroethene, vinylidene chloride)	75-35-3
cis-1,2-Dichloroethylene (cis-1,2-dichloroethene)	156-59-2
trans-1,2-Dichloroethylene (trans-1,2-dichloroethene)	156-60-5
1,2-Dichloropropane (Propylene dichloride)	78-87-5
cis-1,3-Dichloropropene	10061-01-5
trans-1,3-Dichloropropene	10061-02-6
Ethylbenzene	100-41-4
2-Hexanone (methyl butyl ketone)	591-78-6
Methyl bromide (bromomethane)	74-83-9
Methyl chloride (chloromethane)	74-87-3
Methylene bromide (dibromomethane)	74-95-3
Methylene chloride (dichloromethane)	75-09-2
Methyl ethyl ketone (MEK, 2-butanone)	78-93-3
Methyl iodide (iodomethane)	74-88-4
4-Methyl-2-pentanone (methyl isobutyl ketone)	108-10-1
Styrene	100-42-5
1,1,1,2-Tetrachloroethane	630-20-6
1,1,2,2-Tetrachloroethane	79-34-5
Tetrachloroethylene (tetrachloroethane, perchloroethylene)	127-18-4
Toluene	108-88-3
1,1,1-Trichloroethane (methylchloroform)	71-55-6
1,1,2-Trichloroethane	79-00-5
Trichloroethylene (trichloroethene)	79-01-6
Trichlorofluoromethane (CFC-11)	75-69-4
1,2,3-Trichloropropane	96-18-4
Vinyl acetate	108-05-4
Vinyl chloride	75-01-4
Xylenes (total)	1330-20-7

Table 8-1
Muskogee Recycling and Disposal Facility
Detection Monitoring Parameter List

COMMON NAME

Inorganic Parameters¹:

CAS RN

Alkalinity	Total
Ammonia, Nitrogen	
Arsenic	Total
Barium	Total
Chloride	
Chromium	Total
Nickel	Total
Zinc	Total

Organic Constituents:

Acetone	67-64-1
Acrylonitrile	107-13-1
Benzene	71-43-2
Bromochloromethane	74-97-5
Bromodichloromethane	75-27-4
Bromoform (tribromomethane)	75-25-2
Carbon disulfide	75-15-0
Carbon tetrachloride	56-23-5
Chlorobenzene	108-90-7
Chloroethane (ethyl chloride)	75-00-3
Chloroform (trichloromethane)	67-66-3
Dibromochloromethane (chlorodibromomethane)	124-48-1
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8
1,2-Dibromoethane (ethylene dibromide, EDB)	106-93-4
o-Dichlorobenzene (1,2-dichlorobenzene)	95-50-1
p-Dichlorobenzene (1,4-dichlorobenzene)	106-46-7
trans-1,4-Dichloro-2-butene	110-57-6
1,1-Dichloroethane (ethylidene chloride)	75-34-4
1,2-Dichloroethane (ethylene dichloride)	107-06-2
1,1-Dichloroethylene (1,1-dichloroethene, vinylidene chloride)	75-35-3
cis-1,2-Dichloroethylene (cis-1,2-dichloroethene)	156-59-2
trans-1,2-Dichloroethylene (trans-1,2-dichloroethene)	156-60-5
1,2-Dichloropropane (Propylene dichloride)	78-87-5
cis-1,3-Dichloropropene	10061-01-5
trans-1,3-Dichloropropene	10061-02-6
Ethylbenzene	100-41-4
2-Hexanone (methyl butyl ketone)	591-78-6
Methyl bromide (bromomethane)	74-83-9
Methyl chloride (chloromethane)	74-87-3
Methylene bromide (dibromomethane)	74-95-3
Methylene chloride (dichloromethane)	75-09-2

Table 8-1 (Cont'd)
Muskogee Recycling and Disposal Facility
Detection Monitoring Parameter List

COMMON NAME

Organic Constituents:

CAS RN

Methyl ethyl ketone (MEK, 2-butanone)	78-93-3
Methyl iodide (iodomethane)	74-88-4
4-Methyl-2-pentanone (methyl isobutyl ketone)	108-10-1
Styrene	100-42-5
1,1,1,2-Tetrachloroethane	630-20-6
1,1,2,2-Tetrachloroethane	79-34-5
Tetrachloroethylene (tetrachloroethane, perchloroethylene)	127-18-4
Toluene	108-88-3
1,1,1-Trichloroethane (methylchloroform)	71-55-6
1,1,2-Trichloroethane	79-00-5
Trichloroethylene (trichloroethene)	79-01-6
Trichlorofluoromethane (CFC-11)	75-69-4
1,2,3-Trichloropropane	96-18-4
Vinyl acetate	108-05-4
Vinyl chloride	75-01-4
Xylenes (total)	1330-20-7

Notes:

¹Inorganic parameters have been optimized in accordance with OAC 252:515-9-72(c).

Table 8-2
Muskogee Recycling and Disposal Facility
Water Quality Parameters List

COMMON NAME

Indicator Parameters:

CAS RN

Calcium	Total
Chemical Oxygen Demand	
Dissolved Solids	Total
Iron	Total
Magnesium	Total
Manganese	Total
Potassium	Total
Sodium	Total
Sulfate	Total

FIGURE 5-1

FIELD INFORMATION FORM

(For informational purposes only. Actual may vary.)

FIELD INFORMATION FORM										
Site Name: _____ Site No.: _____	Sample Point: _____ Sample ID	This Waste Management Field Information Form is Required This form is to be completed, in addition to any State Forms. The Field Form is submitted along with the Chain of Custody Forms that accompany the sample containers (i.e. with the cooler that is returned to the laboratory).					Laboratory Use Only/Lab ID: _____			
PURGE INFO	PURGE DATE (MM DD YY)	PURGE TIME (2400 Hr Clock)	ELAPSED HRS (hrs:min)	WATER VOL IN CASING (Gallons)	ACTUAL VOL PURGED (Gallons)	WELL VOLs PURGED				
<i>Note: For Passive Sampling, replace "Water Vol in Casing" and "Well Vols Purged" w/ Water Vol in Tubing/Flow Cell and Tubing/Flow Cell Vols Purged. Mark changes, record field data, below.</i>										
PURGE/SAMPLE EQUIPMENT	Purging and Sampling Equipment ... Dedicated: ☐ Y or ☐ N			Filter Device: ☐ Y or ☐ N 0.45 µ or _____ µ (circle or fill in)						
	Purging Device: _____ A- Submersible Pump D-Bailer B-Peristaltic Pump E-Piston Pump Sampling Device: _____ C-QED Bladder Pump F-Dipper/Bottle X-Other: _____			Filter Type: _____ A-In-line Disposable C-Vacuum B-Pressure X-Other: _____ Sample Tube Type: _____ A-Teflon C-PVC X-Other: _____ B-Stainless Steel D-Polypropylene						
WELL DATA	Well Elevation (at TOC) (ft/msl)		Depth to Water (DTW) (from TOC) (ft)		Groundwater Elevation (site datum, from TOC) (ft/msl)					
	Total Well Depth (from TOC) (ft)		Stick Up (from ground elevation) (ft)		Casing ID (in)		Casing Material 			
<i>Note: Total Well Depth, Stick Up, Casing Id, etc. are optional and can be from historical data, unless required by Site/Permit. Well Elevation, DTW, and Groundwater Elevation must be current.</i>										
STABILIZATION DATA (Optional)	Sample Time (2400 Hr Clock) 	Rate/Unit 	pH (std) 	Conductance (SC/EC) (µmhos/cm @ 25°C) 	Temp. (°C) 	Turbidity (ntu) 	D.O. (mg/L - ppm) 	eH/ORP (mV) 	DTW (ft) 	
Suggested range for 3 consec. readings or note Permit/State requirements: +/- 0.2 +/- 3% -- -- +/- 10% +/- 25 mV Stabilize										
Stabilization Data Fields are Optional (i.e. complete stabilization readings for parameters required by WM, Site, or State). These fields can be used where four (4) field measurements are required by State/Permit/Site. If a Data Logger or other Electronic format is used, fill in final readings below and submit electronic data separately to Site. If more fields above are needed, use separate sheet or form.										
FIELD DATA	SAMPLE DATE (MM DD YY) 	pH (std) 	CONDUCTANCE (µmhos/cm @ 25°C) 	TEMP. (°C) 	TURBIDITY (ntu) 	DO (mg/L-ppm) 	eH/ORP (mV) 	Other: _____ Units _____		
Final Field Readings are required (i.e. record field measurements, final stabilized readings, passive sample readings before sampling for all field parameters required by State/Permit/Site.										
Sample Appearance: _____ Odor: _____ Color: _____ Other: _____										
Weather Conditions (required daily, or as conditions change): Direction/Speed: _____ Outlook: _____ Precipitation: ☐ Y or ☐ N										
Specific Comments (including purge/well volume calculations if required): _____ _____ _____ _____ _____										
FIELD COMMENTS										
I certify that sampling procedures were in accordance with applicable EPA, State, and WM protocols (if more than one sampler, all should sign): _____ _____ _____ _____ _____										
	Date _____	Name _____	Signature _____	Company _____						
DISTRIBUTION: WHITE/ORIGINAL - Stays with Sample, YELLOW - Returned to Client, PINK - Field Copy										

FIGURE 5-2

CHAIN-OF-CUSTODY RECORD

(For informational purposes only. Actual may vary.)

TAL-4124-280 (0508)

Drinking Water? Yes ☐ No ☐

THE LEADER IN ENVIRONMENTAL TESTING

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy