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

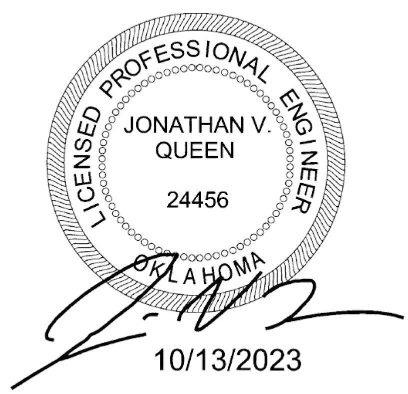
TIER III PERMIT MODIFICATION LANDFILL EXPANSION

VOLUME 2B OF 4

Prepared for

Waste Management of Oklahoma, Inc.

October 2023



Prepared by

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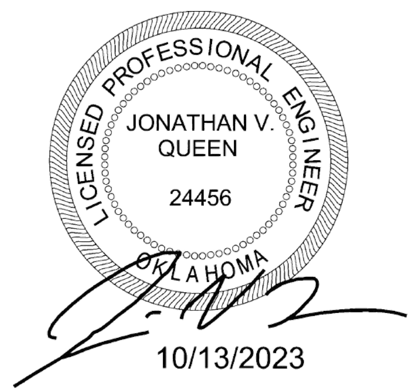
WCG Project No. 0086-364-11-19

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

TIER III PERMIT MODIFICATION LANDFILL EXPANSION

VOLUME 2B OF 4

CONTENTS



ATTACHMENT E-8

PERMITTED LANDFILL SUBSURFACE INVESTIGATION REPORTS

Includes pages E-8-1 through E-562

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RUST
RUST PHASE II HYDROGEOLOGICAL INVESTIGATION REPORT
(1994)

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

RECEIVED
MAR 24 1995

3551020

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

APPENDICES

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

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PROJECT NO. 86251.150

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APPENDICES

APPENDIX A
CLIMATOLOGICAL DATA

Muskogee\86251dp2.3rd

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

WS FORM B-91
(7-89)

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION (Climatological): Muskogee (River Station, if different)
MONTH: Jan 19 23
STATE: Oklahoma
COUNTY: Muskogee
RIVER: Arkansas
TIME (local) OF OBSERVATION RIVER — TEMP. 5pm 17 — PRECIPITATION 7am
STANDARD TIME IN USE: CST
TYPE OF RIVER GAGE
ELEVATION OF RIVER GAGE ZERO Ft.
FLOOD STAGE Ft.
NORMAL POOL STAGE Ft.

DATE	TEMPERATURE F. 24 HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets, hail (Ins. and tenths)	REMARKS (Special observations, etc.)
1	31.4	20.3	31.4			
2	42	31	42			
3	65	41	55	.12		
4	60	30	33			
5	60	21.3	35			
6	43	26	39			
7	47	31	45	.04		Lt. Mist
8	46	37	39			
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, Frz.
19	35.9	30	35.9	1.03		
20	41.8	30.5	38.6			
21	47	37	44			
22	57	29	55			
23	55 ~~56.9~~	29.4	48	T		
24	47.8	27.5	42.4			
25	48.2	22.8	46.4			
26	54.8	25.8	48.3			
27	63	29	59			
28	59.3	39.9	53.6			
29	52.6	25	38.8			
30	53.6	20.3	47.1			
31	64	28	63			
SUM				2.14	0	

CHECK BAR (For wire-weight) NORMAL CK. BAR — READING — DATE

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice.
B. Frozen, but open ...
C. Upper surface of ...
D. Ice gorge above ...
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

OBSERVER: Mary J. Fuller
SUPERVISING OFFICE: ..., TULSA, OKLAHOMA
STATION INDEX NO. 34-6130-6

KEYED BY [illegible]

T = .01

STATION (Climatological)	(River Station, if different)	MONTH	19	WS FORM B-91 (7-89)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE
Muskogee		Feb	93	RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS	

STATE	COUNTY	RIVER
Oklahoma	Muskogee	Arkansas

TIME (local) OF OBSERVATION RIVER	TEMP.	PRECIPITATION	STANDARD TIME IN USE
	17 5pm	8 am	C.S.T.

TYPE OF RIVER GAGE	ELEVATION OF RIVER GAGE ZERO	FLOOD STAGE	NORMAL POOL STAGE
	Ft.	Ft.	Ft.

DATE	TEMPERATURE F. 24 HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets (Ins. and tenths)	At Ob. Snow, ice pellets, hail, ice on ground (Ins.)	WEATHER (Calendar Day) Fog	Ice Pellets	Glaze	Thunder	Hail	Damaging Winds	Time of observation if different from above	RIVER STAGE CONDITION	GAGE READING AT ___ A.M.	TENDENCY	REMARKS (Special observations, etc.)
1	64	28	59			O											
2	57.7	37.4	52.8	T													
3	52.8	42.2	45.1	T			X										
4	46.7	42	45	.41			X										
5	49.8	41.5	46.2				X										Visibility 3 blocks
6	55.5	31.8	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	[illegible]	35.9	37.5														
13	48	28.3	48.3														
14	48	27	46	1.60	9.0	M											Hvy. Wet Snow Began 10pm
15	41.5	31.8	33.2	.03	T												Changed to Rain+Snow 7am, Snow till 11am
16	33.2	18.5	21.7														
17	21.7	17.2	17.4														
18	44.6	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	32.9														
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			SUM	4.09													

PRECIPITATION: Draw a straight line (——) through hours precipitation was observed, and a waved line (~~~) through hours precipitation probably occurred unobserved. A.M. NOON P.M.

CHECK BAR (For wire-weight) NORMAL CK. BAR | READING | DATE

CONDITION OF RIVER AT GAGE

A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

OBSERVER: Mary J. Fuller

SUPERVISING OFFICE: WSO, TULSA, OKLAHOMA

STATION INDEX NO. 34-6130-6

WS FORM B-91 (7-89)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION (Climatological): Muskogee (River Station, if different)
STATE: Oklahoma
COUNTY: Muskogee
MONTH: March 19 93
RIVER: Arkansas
TIME (local) OF OBSERVATION RIVER / TEMP. 5 pm / PRECIPITATION 7 am
STANDARD TIME IN USE
TYPE OF RIVER GAGE
ELEVATION OF RIVER GAGE ZERO Ft.
FLOOD STAGE Ft.
NORMAL POOL STAGE Ft.

DATE	TEMPERATURE F. 24 HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets (Ins. and tenths)	At Ob. Snow, ice pellets, hail, ice on ground (Ins.)	WEATHER (Calendar Day) Fog	Ice Pellets	Glaze	Thunder	Hail	Damaging Winds	Time of observation if different from above	RIVER STAGE CONDITION	GAGE READING AT ___ A.M.	TENDENCY	REMARKS (Special observations, etc.)
1	45	40	45	.23		0											
2	50.7	43.3	47.6														
3	47.8	39	44	.02													
4	44	41	42	.10													
5	53.2	31.8	50.5														
6	58.6	28.9	56.8														
7	66.7	26.5	61.7	.15													
8	75.2	37.2	69.9														
9	80.4	45.6	70.3														
10	72.8	44	50														
11	50.7	35	46.2														
12	46.2	31	41														
13	41	23	35														
14	56.5	18.5	54.8														
15	54.8	42.8	44.4	.79													
16	70	44	58														
17	58	32.5	42.4														
18	52.7	35	38.1														
19	45.8	32.7	45.8	.08													
20	46	37.7	43.9														
21	56.1	40.9	54														
22	56	47	52	.08													
23	57.9	34.7	56.6	.27													
24	69.9	42.6	66.5														
25	67	38	57														
26	66.7	36.1	65.1														
27	73.5	41.5	71.2														
28	78	51	75														
29	79	55	71	1.13						X	X						Pea Size - Thdr-lightning 40 mph wind Gusts
30	77	58	73														
31	73	49	52														
SUM			SUM	2.85													

PRECIPITATION: Draw a straight line (——) through hours precipitation was observed, and a waved line (~~~~) through hours precipitation probably occurred unobserved. A.M. NOON P.M.

CHECK BAR (For wire-weight) NORMAL CK. BAR
READING | DATE

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice.
B. Frozen, but open at [illegible]
C. Upper surface of [illegible]
D. Ice gorge above [illegible]
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

OBSERVER: Mary J. Fuller
SUPERVISING OFFICE: NWSO TULSA OKLAHOMA
STATION INDEX NO. 34-6130-6

KEYED BY 17540

STATION (Climatological)	(River Station, if different)	MONTH	19
Muskogee		April	93

STATE	COUNTY	RIVER
Oklahoma	Muskogee	Arkansas

TIME (local) OF OBSERVATION RIVER	TEMP.	PRECIPITATION	STANDARD TIME IN USE
	7am	7am	CDT

TYPE OF RIVER GAGE	ELEVATION OF RIVER GAGE ZERO	FLOOD STAGE	NORMAL POOL STAGE
	Ft.	Ft.	Ft.

WS FORM B-91
(7-89)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

DATE	TEMPERATURE F. 24 HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets (Ins. and tenths)	At Ob. Snow, ice pellets, hail, ice on ground (Ins.)	REMARKS (Special observations, etc.)
1	52	39	42				
2	57.7	30.2	56.7				
3	56	44	50	.17			Rain off & on All Day & Night.
4	50.3	40.1	43.3	1.22			
5	47	38	47				
6	63.6	35	61				
7	65.6	39	65.1	.12			
8	65.1	48	51				
9	72	39	71				
10	81.8	50.7	80.2				
11	80.2	49	79				
12	82	58	80				
13	78.7	66.9	67.6	.52			Rain 4-7am. Lightening Wind-out of N 15 mph
14	48	43	43	1.04			
15	50	39	50				
16	66	39	65				
17	66.3	39.2	51	.62			
18	74	48	73				
19	88.4	64.9	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	75.7				
27	76.8	54.5	75.3				
28	77.1	55.7	68.7	1.63			Rain 3:30pm Till 8:45am
29	71.2	58.4	71	T			
30	71	69.2	69.4				
31							
SUM				5.32			

PRECIPITATION: Draw a straight line (——) through hours precipitation was observed, and a waved line (~~~) through hours precipitation probably occurred unobserved. A.M. NOON P.M.

WEATHER (Calendar Day): Mark 'X' for all types occurring each day. Fog | Ice Pellets | Glaze | Thunder | Hail | Damaging Winds | Time of observation if different from above

RIVER STAGE: CONDITION | GAGE READING AT ___ A.M. | TENDENCY

CHECK BAR (For wire-weight) NORMAL CK. BAR: READING | DATE

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice.
B. Frozen, but open ... .
C. Upper surface of ... .
D. Ice gorge above g...
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

OBSERVER Mary J. Fuller

SUPERVI... ...FFICE
WSO, TULSA, OKLAHOMA

STATION INDEX NO.
34-6130-6

STATION (Climatological)	(River Station, if different)	MONTH	19
Muskogee		May	93

STATE	COUNTY	RIVER
Oklahoma	Muskogee	Arkansas

TIME (local) OF OBSERVATION RIVER	TEMP.	PRECIPITATION	STANDARD TIME IN USE
	7am	07 am	CDT

TYPE OF RIVER GAGE	ELEVATION OF RIVER GAGE ZERO	FLOOD STAGE	NORMAL POOL STAGE
	19 Ft.	Ft.	Ft.

WS FORM B-91 (7-89)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

TEMPERATURE F. — 24 HRS. ENDING AT OBSERVATION

PRECIPITATION — Draw a straight line (——) through hours precipitation was observed, and a waved line (~~~) through hours precipitation probably occurred unobserved.

WEATHER (Calendar Day) — Mark 'X' for all types occurring each day.

DATE	MAX.	MIN.	AT OBSN.	24-HR AMOUNTS: Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets, hail (Ins. and tenths)	At Ob.: Snow, ice pellets, hail, ice on ground (Ins.)	Fog	Ice Pellets	Glaze	Thunder	Hail	Damaging Winds	Time of observation if different from above	RIVER STAGE: CONDITION	GAGE READING AT A.M.	TENDENCY	REMARKS (Special observations, etc.)
1	78.2	58.6	72.2														
2	78	60.5	68.5	.81													Mist began 4pm Rain 5:15 - Hvy Rain
3	68.5	55.9	61.3				X										between 5:30 & 7pm
4	81.1	48.6	80				X										Till 8:30am
5	82.4	64.2	75.7	.60													
6	80.9	64.4	72.5														
7	81.5	68.6	78.8														
8	78.9	62.4	67.8	.42													Began 3pm Sat. Rained Mod. to Hvy
9	67.8	57.5	57.9	5.33													Till 1:35am Sun; light Rain off & on till 5 pm
10	68.6	54.5	55.4	.21													
11	61.5	52.8	60.9	.39													
12	69	51.9	65														
13	71	53	68														
14	76.8	45.3	74.6														
15	84	56	82														
16	84.2	56.3	77							X	X						Lght. Pea Size / Lightning C-C/C-G
17	84.5	62.9	83.1	.29													
18	83.1	60.8	68.9														
19	69.9	47.8	65.1														
20	69.4	50.5	66.9														
21	67	49	66	.26													
22	76	57	76														
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	80.8	66.5	84.9														
31	85.2	59.9	7.3														
SUM				8.40													

CHECK BAR (For wire-weight) NORMAL CK. BAR

READING	DATE

CONDITION OF RIVER AT GAGE

A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of ...
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

OBSERVER: Mary J. Fuller

SUPERVISING OFFICE: ... TULSA, OKLAHOMA

STATION INDEX NO.: 34-6130-6

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

WS FORM B-91
(7-89)

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION (Climatological): Muskogee (River Station, if different):
MONTH: June 19 93
STATE: Oklahoma COUNTY: Muskogee RIVER: Arkansas
TIME (local) OF OBSERVATION RIVER: TEMP.: 5pm PRECIPITATION: 7am STANDARD TIME IN USE: CDT
TYPE OF RIVER GAGE: ELEVATION OF RIVER GAGE ZERO: Ft. FLOOD STAGE: Ft. NORMAL POOL STAGE: Ft.

Date	Temperature F. 24 hrs. ending at observation: Max.	Min.	At obsn.	Precipitation 24-hr amounts: Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets, hail (Ins. and tenths)	At Ob. Snow, ice pellets, hail, ice on ground (Ins.)	Weather: Thunder	Remarks (Special observations, etc.)
1	76.7	52.8	75			0		
2	85	63	84					
3	87	69.6	84.5					
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			X	Lightening - Lt. Rain
8	80.9	66.2	72.1	.36				
9	82.3	64.7	67.1	.43				
10	78	63.6	76.4					
11	79	67	73					
12	85.1	56.6	84.5					
13	87	69.4	86.5					
14	91	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	70	81	.15				
21	86	69	85	1.23				
22	86.7	71.2	85.8					
23	90.6	71	71.2	.15				
24	88	69	88					
25	88	67	74.4	.05				
26	82.9	67.6	81.6					
27	85	68	85					
28	89	73	89					
29	90	75	90					
30	90.8	78.2	89.4					
31								
Sum				4.11				

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

CHECK BAR (For wire-weight) NORMAL CK. BAR
READING | DATE

OBSERVER: Mary J. Fuller
SUPERVISING OFFICE: [illegible]30, TULSA, OKLAHOMA
STATION INDEX NO. 34-6130[illegible]

BEST AVAILABLE RECORD

Punched 3873

STATION (Climatological) Muskogee (River Station, if different)
MONTH July 19 93

STATE Oklahoma COUNTY Muskogee RIVER Arkansas

TIME (local) OF OBSERVATION RIVER TEMP. 5 pm PRECIPITATION 07 am. STANDARD TIME IN USE C.D.T.

TYPE OF RIVER GAGE ELEVATION OF RIVER GAGE ZERO Ft. FLOOD STAGE Ft. NORMAL POOL STAGE Ft.

WS FORM B-91 (7-89)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

DATE	TEMPERATURE F. 24 HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (ins. and hundredths)	Snow, ice pellets, hail (ins. and tenths)	At Ob. Snow, ice pellets, hail, ice on ground (ins.)	WEATHER (Calendar Day)	RIVER STAGE	REMARKS (Special observations, etc.)
1	87.6	76.1	84			0			
2	90	75	90						
3	89	74	89						
4	89.7	75.9	87.1						
5	88.8	77.7	84.9						
6	90.3	75.2	89.2	.03					
7	89.7	72	89						
8	91	75	90.3						
9	92.8	74.6	92.4						
10	93	69.1	92.3						
11	94.8	72.5	92.8						
12	92.8	72.6	87.9	T					
13	89.4	76.4	85.2						
14	86	78	83.4	.10					
15	92.1	73.5	75.9						
16	94.2	72.3	93						
17	96	72	96						
18	97.5	76.6	95.5						
19	96.8	72.8	94						
20	98	74	98						
21	99.1	76.6	96						
22	98.6	73.4	96.8						
23	98.6	76.1	98						
24	101	78	101						
25	101.7	79.3	99.1						
26	102	75.5	100.5						
27	101.1	72.5	100						
28	101.1	73	100.5						
29	101	76	98						
30	102.7	75.3	102.2						
31	103.6	76.4	102.5						
SUM			SUM	.13					

Draw a straight line (——) through hours precipitation was observed, and a waved line (~~~) through hours precipitation probably occurred unobserved.

WEATHER (Calendar Day): Mark 'X' for all types occurring each day. Fog | Ice Pellets | Glaze | Thunder | Hail | Damaging Winds | Time of observation if different from above

RIVER STAGE: CONDITION | GAGE READING AT ___ A.M. | TENDENCY

CHECK BAR (For wire-weight) NORMAL CK. BAR
READING DATE

CONDITION OF RIVER AT GAGE

A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. surface of smooth ice.
D. above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

OBSERVER Mary J. Fuller

SUPERVISING OFFICE ..., OKLAHOMA

STATION INDEX NO. 34-6130

KEYED

WS FORM B-91 (7-69)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION (Climatological): Muskogee (River Station, if different)

MONTH: Aug 1923

STATE: Oklahoma

COUNTY: Muskogee

RIVER: Arkansas

TIME (local) OF OBSERVATION RIVER / TEMP. 5pm / PRECIPITATION 7am

STANDARD TIME IN USE: CDT

TYPE OF RIVER GAGE / ELEVATION OF RIVER GAGE ZERO Ft. / FLOOD STAGE Ft. / NORMAL POOL STAGE Ft.

DATE	TEMPERATURE °F. 24 HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets, hail (Ins. and tenths)	At Ob. Snow, ice pellets, hail, ice on ground (Ins.)	WEATHER: Thunder	REMARKS (Special observations, etc.)
1	102.5	76	97	.08		0	X	Thunder Sun. Afternoon - No Rain
2	99	74	94					
3	99.3	69.8	86.5	.08				
4	88	70	85					
5	85	67	72	.96				Began 8:15am End 4am
6	85.2	63.3	72.5					
7	95	58	83					
8	88.3	68.1	86.5					
9	94.4	75.9	94.2					
10	98	75	97					
11	98	77.1	95.7					
12	103	72.5	101.1					
13	104	73	100					
14	107	77.1	101.4					
15	104.4	75.9	98.9					
16	103	77	101					
17	101.8	73.3	101.3					
18	103	75	101.1					
19	103.4	75	101					
20	103.6	78	102.3					
21	104	75	102.2					
22	102.6	77	98.5					
23	105.8	77	93	.19				
24	93	68.5	87.4	.14				
25	98	75	93					
26	99.1	70.7	92.6					
27	98.4	73.8	94.6					
28	97.7	73.2	95.5					
29	97.5	75.9	94.8					
30	95	75	87	2.92				Lightning Bgn 8:45pm - Thunder
31	89	67	72				X	Bgn 9:35pm - Rain 4am End.
SUM			SUM	4.37				

CONDITION OF RIVER AT GAGE

A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

CHECK BAR (For wire-weight) NORMAL CK. BAR: READING / DATE

OBSERVER: Mary J. Fuller

SUPERVISING OFFICE: WSO, TULSA, OKLAHOMA

STATION INDEX NO. 34-6130

KEYED BY 00732

STATION (Climatological): Muskogee
(River Station, if different)
MONTH: Sept 19 83
STATE: Oklahoma
COUNTY: Muskogee
RIVER: Arkansas
TIME (local) OF OBSERVATION RIVER
TEMP. 5pm
PRECIPITATION 7am
STANDARD TIME IN USE: CDT
TYPE OF RIVER GAGE
ELEVATION OF RIVER GAGE ZERO Ft.
FLOOD STAGE Ft.
NORMAL POOL STAGE Ft.

WS FORM B-91
(7-89)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

DATE	TEMPERATURE F. 24 HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets (Ins. and tenths)	At Ob. Snow, ice pellets, hail, ice on ground (Ins.)	WEATHER (Calendar Day) Fog	Ice Pellets	Glaze	Thunder	Hail	Damaging Winds	RIVER STAGE Condition	Gage Reading at A.M.	Tendency	REMARKS (Special observations, etc.)
1	88.7	60.4	85.8													
2	93	74	86.7	1.03						X						lightening - Wind 30 mph
3	86.7	63.8	79.7													
4	84.5	56.4	83.6													
5	87.4	59	86.9													
6	85.7	63	83													
7	84	66	81	.47												
8	84.5	63.6	65.6	.10			X									Light Fog
9	82	54	81													
10	82.5	60.8	78.6													
11	85.6	57.7	85.2													
12	87.4	72.3	86.3													
13	89	76	77	7.47						X						Sam's Creek Flooded
14	77	50	60	.05												at 8' - 4' out of Banks
15	68	43	68													
16	69	46	59													
17	74.1	42.8	72.8													
18	79.1	55	78.6													
19	86.5	65.6	83.6													
20	84.5	66.3	83.6	1.49												
21	87	61	82													
22	89.7	71	88.3													
23	88.3	73	82													
24	83.8	62.9	74.6	.37			X									Lg-Hvy Vis 1/2 - 1 1/2 Blks
25	77	61	68	.44												
26	74	53	68													
27	72.3	46.9	71.2													
28	80	46	79													
29	80.9	46.9	73.0													
30	81.5	56.6	80.4													
31																
SUM			SUM	11.57												

PRECIPITATION: Draw a straight line (——) through hours precipitation was observed, and a waved line (~~~) through hours precipitation probably occurred unobserved.
A.M. NOON P.M.

CONDITION OF RIVER AT GAGE

A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. [illegible] surface of smooth ice.
D. [illegible] above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

CHECK BAR (For wire-weight) NORMAL CK. BAR
READING
DATE

OBSERVER: Mary J. Fuller
SUPERVISING OFFICE: WSO, TULSA, OKLAHOMA
STATION INDEX NO. 34-6130-6

BEST AVAILABLE RECORD

STATION (Climatological): Muskogee | (River Station, if different)
MONTH: Oct. | 19 93
STATE: Oklahoma | COUNTY: Muskogee | RIVER: Arkansas
TIME (local) OF OBSERVATION RIVER | TEMP. 5pm | PRECIPITATION 7am | STANDARD TIME IN USE: C.D.T.
TYPE OF RIVER GAGE | ELEVATION OF RIVER GAGE ZERO Ft. | FLOOD STAGE Ft. | NORMAL POOL STAGE Ft.

WS FORM B-91
(7-89)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

DATE	TEMPERATURE F. 24 HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets, hail (Ins. and tenths)	At Ob. Snow, ice pellets, hail, ice on ground (Ins.)	REMARKS (Special observations, etc.)
1	84.1	47.6	82.9			O	
2	83.3	56.8	62.2	.06			
3	72	46	71				
4	77.7	50.3	77				
5	78.9	52.8	77.7				
6	82	52.8	80.4				
7	82	62	74				
8	80.7	61.4	79.5	.18			
9	78.5	38.8	56.1				
10	67.6	42.8	66.3				
11	66.3	42.2	66.3				
12	75.9	47.4	71.4				
13	75.9	42.4	68.7				
14	72	49.2	64.4				
15	74.4	55.5	72.9				
16	73.7	64.9	73.3				
17	73.5	56.3	66				
18	73.5	56.3	67.6	.07			
19	73.5	56.3	60.2	.64			
20	66.3	57	60.9				
21	62.2	46.1	46.2				
22	66.7	36.1	65.1				
23	66.3	39	62				
24	67	39	65				
25	68.5	38.8	66.9				
26	66.9	44.6	60.4				
27	66.9	38.4	52.3				
28	68.5	37.9	68				
29	48.1	31.8	31.8	.05	1/4"	M	Began snow 4:25pm
30	48	26	37			O	
31	42.9	26	44				
SUM				1.00	1/4"		

PRECIPITATION: Draw a straight line (——) through hours precipitation was observed, and a waved line (~~~) through hours precipitation probably occurred unobserved. A.M. NOON P.M.

WEATHER (Calendar Day): Mark 'X' for all types occurring each day. Fog | Ice Pellets | Glaze | Thunder | Hail | Damaging Winds | Time of observation if different from above

RIVER STAGE: CONDITION | GAGE READING AT ___ A.M. | TENDENCY

CHECK BAR (For wire-weight) NORMAL CK. BAR: READING | DATE

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

OBSERVER: Mary J. Fuller
SUPERVISING OFFICE: WSO, TULSA, OKLAHOMA
STATION INDEX NO. 34-6130-6

BEST AVAILABLE RECORD

TYPED BY 17540

KEYED BY

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

WS FORM B-91
(7-89)

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION (Climatological): Muskogee (River Station, if different)
MONTH: Nov. 19 93
STATE: Oklahoma | COUNTY: Muskogee | RIVER: Arkansas
TIME (local) OF OBSERVATION RIVER | TEMP. 5pm | PRECIPITATION 7am | STANDARD TIME IN USE: CST
TYPE OF RIVER GAGE | ELEVATION OF RIVER GAGE ZERO Ft. | FLOOD STAGE Ft. | NORMAL POOL STAGE Ft.

Date	Temp. Max.	Temp. Min.	Temp. At Obsn.	Rain, melted snow, etc. (in. and hundredths)	Snow, ice pellets, hail (ins. and tenths)	Snow, ice pellets, hail, ice on ground (ins.)	Weather: Fog	Ice Pellets	Glaze	Thunder	Hail	Damaging Winds	Remarks (Special observations, etc.)
1	56.4	29.4	42.6			0							
2	56.4	42.4	44.6	.32									Lgt Rain
3	61.7	42.6	54.1										
4	71.6	44	71.4										
5	71.6	36.3	43.3										
6	43.3	23	39										
7	54.3	25.7	56										
8	56.4	32.9	52.3										
9	59.7	32.9	54.5										
10	61.8	32.9	53										
11	64.7	45.8	60.6	.10									
12	69.8	55	67	.11									
13	68.7	48	48.2	.41									
14	48.2	48	52	2.00									
15	68.7	37.2	41										
16	43.5	35.7	42.6	.78									Lgt Mist 2:45 to 5pm Rain
17	46.9	38.8	45.8										
18	57	33.9	51.6				X						
19	59	41	44										
20	52.8	35.8	42.4										
21	58.4	34	53.9										
22	59.7	38.8	54.1										
23	70.1	33.8	63.5										
24	63.5	29.1	30										Sleet or Ice Pellets
25	30	22.2	25.3	.14	1/4"	M							
26	35.6	17.4	32.9			0							
27	50.9	17.4	50										
28	63.1	24	56.1										
29	63.1	24	51.1										
30	59.9	24.1	45.6										
31													
Sum				3.86	1/4"								

CHECK BAR (For wire-weight) NORMAL CK. BAR | READING | DATE

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.

OBSERVER: Gary J. Fuller
SUPERVISING OFFICE: NWSO, TULSA, OKLAHOMA
STATION INDEX NO. 34-6130-6

STATION (Climatological): Muskogee | (River Station, if different) | MONTH: Dec | 19 93

STATE: Oklahoma | COUNTY: Muskogee | RIVER: Arkansas

TIME (local) OF OBSERVATION RIVER | TEMP. 5 pm | PRECIPITATION 7 am | STANDARD TIME IN USE: CST

TYPE OF RIVER GAGE | ELEVATION OF RIVER GAGE ZERO Ft. | FLOOD STAGE Ft. | NORMAL POOL STAGE Ft.

WS FORM B-91
(7-89)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

DATE	TEMPERATURE °F 24 HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets, hail (Ins. and tenths)	At Ob. Snow, ice pellets, hail, ice on ground (Ins.)
1	64.1	41.6	62.6	58		0
2	63.7	51.6	52.2	48		
3	62.7	51.6	55.9	10		
4	56.1	30.5	46.2	42		
5	60.9	35.7	52.6			
6	52.6	34.8	41.9			
7	59	32	53			
8	57.9	29.4	58.1			
9	73.7	29.4	68.5			
10	68.5	44	55			
11	55.5	33.4	43.4			
12	55.5	33.4	50.9			
13	50.9	42.0	47.8	.97		
14	48	36	36			
15	42	34.5	44.5			
16	47.8	38.3	42.6			
17	49	37	42			
18	45.3	30.5	42.9			
19	51.4	28.7	50			
20	50	34	41			
21	53.6	22.2	44.9			
22	44.9	31.2	35.4			
23	46	18	41			
24	41.7	28.2	40.4			
25	44.9	35.2	44.7			
26	69.2	32.3	58.1			
27	60.3	47.1	47.1			
28	47.1	24.6	25.8			
29	47	24	41			
30	45.5	18.5	43.8			
31	51	30	47			
SUM			SUM	255		

PRECIPITATION: Draw a straight line (——) through hours precipitation was observed, and a waved line (~~~) through hours precipitation probably occurred unobserved. A.M. NOON P.M.

WEATHER (Calendar Day): Mark "X" for all types occurring each day. Fog | Ice Pellets | Glaze | Thunder | Hail | Damaging Winds | Time of observation if different from above

RIVER STAGE: CONDITION | GAGE READING AT ___ A.M. | TENDENCY

REMARKS (Special observations, etc.)

CHECK BAR (For wire-weight) NORMAL CK. BAR | READING | DATE

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.

OBSERVER: Mary J. Fuller

SUPERVISING OFFICE: WSO TULSA OKLAHOMA

STATION INDEX NO. 34-6130-6

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

WS FORM B-91
(7-89)

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

KEYED BY, 17840

STATION (Climatological): Muskogee (River Station, if different):
MONTH: JAN 19 94
STATE: Oklahoma
COUNTY: Muskogee
RIVER: Arkansas
TIME (local) OF OBSERVATION RIVER: TEMP. 5 pm PRECIPITATION 7 am
STANDARD TIME IN USE: CST
TYPE OF RIVER GAGE:
ELEVATION OF RIVER GAGE ZERO: 17 Ft.
FLOOD STAGE: Ft.
NORMAL POOL STAGE: Ft.

DATE	TEMPERATURE F. 24 HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets, hail (Ins. and tenths)	At Ob. Snow, ice pellets, hail, ice on ground (Ins.)	WEATHER (Calendar Day) Glaze	REMARKS (Special observations, etc.)
1	59	29	57			0		
2	51.8	27.6	45.8	.08				Began Rain 8:50 p.m. - Some Ex. Rn Later
3	46	27.3	31.9					
4	35.7	26.2	33					
5	55	26	51					
6	58	26	35					
7	35.6	12	22.2					
8	43.5	17.8	41.9					
9	51.9	27.3	48.9					
10	49	42	46					
11	49	42.2	42.1					
12	47	32	35					
13	55	31	49					
14	49.2	22.2	27.6					
15	31	21	29					
16	31.1	22.2	31.1	.26	M	M	X	Ice - No Rain
17	32	13	17			M		
18	19.5	12.3	16.5			M		
19	34	12	32			0		
20	44	31.3	39.3					
21	43.8	20.6	35.2					
22	45.5	31.1	43.1					
23	47.6	39	47.4	.13				
24	53.9	46.4	53					
25	62	42	58					
26	41.6	30.7	37	1.94				
27	57.2	33	37.7					
28	38	26	36					
29	46.8	22.1	40.4					
30	40.4	27.1	32.9					
31	32.9	15.4	26.1					
SUM			SUM	2.41				

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice. B. Frozen, but open at gage. C. Upper surface of smooth ice.
E. Ice gorge below gage. F. Shore ice. G. Floating ice.

CHECK BAR (For wire-weight) NORMAL CK. BAR
READING | DATE

OBSERVER: Gary J. Fuller
SUPERVISING OFFICE
STATION INDEX NO.

KEYED BY 01114

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

WS FORM B-91 (7-89)

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION (Climatological): Muskogee (River Station, if different)
MONTH: FEB 94
STATE: Oklahoma COUNTY: Muskogee
RIVER: Arkansas
TIME (local) OF OBSERVATION RIVER / TEMP. 5 pm / PRECIPITATION 07 am
STANDARD TIME IN USE: CST
TYPE OF RIVER GAGE / ELEVATION OF RIVER GAGE ZERO (17) Ft. / FLOOD STAGE Ft. / NORMAL POOL STAGE Ft.

TEMPERATURE F. / PRECIPITATION / WEATHER (Calendar Day) / RIVER STAGE / REMARKS (Special observations, etc.)

DATE	MAX. (24 hrs. ending at observation)	MIN. (24 hrs. ending at observation)	AT OBSN.	24-HR AMOUNTS: Rain, melted snow, etc. (ins. and hundredths)	24-HR AMOUNTS: Snow, ice pellets, hail (ins. and tenths)	At Ob.: Snow, ice pellets, hail, ice on ground (ins.)	Weather	REMARKS
1	44	15	41			M		
2	47.1	15.9	44.7					
3	57	27	53					
4	53	41	51					
5	53.4	36.5	40.6	.15				
6	60.9	24.6	57.7					
7	59.7	53.4	46.7					
8	46.7	26.6	26.7					
9	37.1	10.2	17.2	.08	1/2			
10	37.2	16.8	35.2					
11	48.9	20.8	45.6					
12	49.4	36.6	44.4					
13	49.6	23	49.1					
14	57	30.5	55					
15	62.4	27.7	56.6					
16	65	30	60					
17	68.9	30.3	60					
18	69	48.3	65.3					
19	65.3	58	61	.61				Lt Rain 12pm thru with 6-9pm Hvy Rain 9:15-9pm
20	66	44	62	.65			X	Lt " rest of Night
21	62.2	41.5	56.1					
22	56.1	46.4	41.8	T	T			Spit Snow all day
23	47.8	28	29					
24	59.8	19.9	53.7					
25	53.7	30.1	33.9					
26	39.9	17.4	35					
27	42.4	23.1	42.2					
28	44	39	43	.44		M		Rain Bgn 1pm - still Raining 3-1-94 with Fog
29								
30								
31								
			SUM	1.93	1/2			

PRECIPITATION: Draw a straight line (——) through hours precipitation was observed, and a waved line (~~~) through hours precipitation probably occurred unobserved.
A.M. NOON P.M.

WEATHER: Mark "X" for all types occurring each day. Fog / Ice Pellets / Glaze / Thunder / Hail / Damaging Winds

RIVER STAGE: Time of observation if different from above / CONDITION / GAGE READING AT ___ A.M. / TENDENCY

CHECK BAR (For wire-weight) NORMAL CK. BAR / READING / DATE

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice. E. Ice gorge below gage.
B. Frozen, but open at gage. F. Shore ice.
G. Floating ice.

OBSERVER: Mary J. Fuller
SUPERVISING OFFICE
STATION INDEX NO. 34-6130-6

E-8-20

KEYED BY 1753

99

STATION (Climatological)	(River Station, if different)	MONTH	YR.
Muskogee		March	94

STATE	COUNTY	RIVER
Oklahoma	Muskogee	Arkansas

TIME (local) OF OBSERVATION RIVER	TEMP.	PRECIPITATION	STANDARD TIME IN USE
	5 pm	7 am	CST

TYPE OF RIVER GAGE	ELEVATION OF RIVER GAGE ZERO	FLOOD STAGE	NORMAL POOL STAGE
	14	Ft.	Ft.

WS FORM B-91 (7-89)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

TEMPERATURE F. — 24 HRS. ENDING AT OBSERVATION

PRECIPITATION — Draw a straight line (——) through hours precipitation was observed, and a waved line (~~~) through hours precipitation probably occurred unobserved. A.M. NOON P.M.

WEATHER (Calendar Day) — Mark 'X' for all types occurring each day.

RIVER STAGE — GAGE READING AT A.M.

DATE	MAX.	MIN.	AT OBSN.	24-HR AMOUNTS: Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets, hail (Ins. and tenths)	Snow, ice pellets, hail, ice on ground (Ins.)	Fog	Ice Pellets	Glaze	Thunder	Hail	Damaging Winds	CONDITION	GAGE READING AT A.M.	TENDENCY	REMARKS (Special observations, etc.)
1	41	34	34	~~.49~~ .99		M	X									
2	50	32	50													
3	71.2	28.5	69													
4	76.1	41.5	73.5													
5	76.1	41.6	74													(Thunder & lightening)
6	79.1	39.3	76.4	1.60						X						Rain akig TO Snow 9:30am Snow
7	76	49	50	1.01	7.0											lluy Til 6:30pm Lt Snow End 3:1
8	51	30	30													
9	39.3	29.6	37.7													
10	56	26	55													
11	64.9	35	58.1													
12	59.9	58.1	58.2													
13	63	47	63													
14	N/T			8												
15																
16	69.6	38.3	67.4													
17	79.1	38.3	77													
18	77	55	71													
19	82.7	49.8	80.6													
20	82.3	66	77.9													
21	78.4	44.9	68.5													
22	75.9	40.1	72.3													
23	82.7	57.7	80.9													
24	80.9	42	43	.18												
25	63	34	59.9													
26	59.9	49.4	58.1	1.35						X						
27	53	45.3	52.3													
28	52.3	33.4	50.7													
29	60.6	33.4	59.7													
30	59.9	34.1	50													
31	66.2	31.8	65.3			M										
SUM			SUM	5.06	7*											

CHECK BAR (For wire-weight) NORMAL CK. BAR — READING — DATE

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.

OBSERVER: Mary J. Fuller

SUPERVISING OFFICE: WSO, TULSA, OKLAHOMA

STATION INDEX NO. 34-6130-6

STATION (Climatological): Muskogee | (River Station, if different) | MONTH: April 19 94

STATE: Oklahoma | COUNTY: Muskogee | RIVER: Arkansas

TIME (local) OF OBSERVATION RIVER: | TEMP: 5pm | PRECIPITATION: 7am | STANDARD TIME IN USE: CDT

TYPE OF RIVER GAGE | ELEVATION OF RIVER GAGE ZERO Ft. | FLOOD STAGE Ft. | NORMAL POOL STAGE Ft.

WS FORM B-91
(7-89)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

Date	Temperature °F: 24 hrs. ending at observation: Max.	Min.	At Obsn.	Precipitation 24-hr amounts: Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets, hail (Ins. and tenths)	At Ob.: Snow, ice pellets, hail, ice on ground (ins.)	Weather (Calendar Day): Fog	Ice Pellets	Glaze	Thunder	Hail	Damaging Winds	River Stage: Condition	Gage reading at A.M.	Tendency	Remarks (Special observations, etc.)
1	76.8	47.6	73.5								X					Hail 3-5 min Nickel Sized
2	73.9	56.1	70													
3	73	40	56	.45												
4	71	38	66.7													
5	66.7	39.7	40.1	.05												
6	48.3	31.8	48.3													
7	60.8	35.5	60													
8	70	46	69								X					Hail Quarter Size
9	69	38	65													
10	79.3	62.7	78.8	.02												
11	78.8	57.3	57.3	1.73												
12	70.4	42	58.6													
13	84.5	39.3	82.5													
14	82.7	63.5	79.7													
15	80.1	55.7	68.5													
16	77	39.3	76.4													
17	80.9	45.5	80													
18	80.9	45.2	72.5													
19	83	54	82													
20	84	57	83													
21	83.8	68	82													
22	84.9	60.2	74.6													
23	75.9	58.6	74.8													
24	82.9	60	81													Tornado Watch
25	81.6	65.3	69.9	T												" "
26	83.3	66.3	78.4	T						X						
27	78.4	53	58.4	.40												Svr. Thstm Watch
28	63.1	50.1	59.7	.21												
29	60.6	45.1	49.8	.61												
30	52	45	51													
31																
Sum				3.47												

CHECK BAR (For wire-weight) NORMAL CK. BAR | READING | DATE

CONDITION OF RIVER AT GAGE
A. Obstructed [illegible] ice. | B. Frozen, but [illegible] gage. | C. Upper surface of smooth ice. | D. Ice gorge above gage. | E. Ice gorge below gage. | F. Shore ice. | G. Floating ice. | H. Pool stage.

OBSERVER: [illegible] J. Faller

SUPERVISING OFFICE: #R30, TULSA, OKLAHOMA

STATION INDEX NO. 34-6130-6

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

WS FORM B-91
(7-69)

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION (Climatological): Muskogee (River Station, if different)
MONTH: May 19 84
STATE: Oklahoma COUNTY: Muskogee RIVER: Arkansas
TIME (local) OF OBSERVATION RIVER TEMP. 5pm PRECIPITATION 7am STANDARD TIME IN USE C.S.T.
TYPE OF RIVER GAGE ELEVATION OF RIVER GAGE ZERO Ft. FLOOD STAGE Ft. NORMAL POOL STAGE Ft.

DATE	TEMPERATURE F: 24 HRS. ENDING AT OBSERVATION MAX	MIN.	AT OBSN.	PRECIPITATION 24-HR AMOUNTS: Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets, hail (Ins. and tenths)	At Ob.: Snow, ice pellets, hail, ice on ground (Ins.)
1	60.9	44.4	60.9	1.03		
2	61.7	41.7	45.6	1.14		
3	67.4	45.3	66.9			
4	73.2	42.3	71.2			
5	78	50	77			
6	79.3	60	77.3			
7	77.5	57.3	62.6	.46		
8	66.9	44	66	.40		
9	71.5	57.2	70.3			
10	79	54	77			
11	79	59	76			
12	76.8	65.3	74.8	.08		
13	78.4	63.3	78.2	.59		
14	78.2	65.3	72.3	.03		
15	79.7	60.4	79.1			
16	83.3	56.4	82.5			
17	83.9	64.7	80.6			
18	81.5	56.9	80.9			
19	81.6	55.7	79.5			
20	80	55	76			
21	79.7	55.5	78.6			
22	80.9	56.5	80.2			
23	83.4	56.8	81.5			
24	83.1	64.7	81	.03		
25	86.3	64.7	85.1			
26	85.4	64	76.6	.32		
27	78	57	74			
28	77.3	60.6	76.8			
29	78.6	60.6	76.8	.54		
30	86.9	61.8	84.9			
31	88.8	64.7	82.9			
			SUM	4.46		

PRECIPITATION: Draw a straight line (——) through hours precipitation was observed, and a waved line (~~~~) through hours precipitation probably occurred unobserved. A.M. NOON P.M.

WEATHER (Calendar Day): Mark 'X' for all types occurring each day. Fog | Ice Pellets | Glaze | Thunder | Hail | Damaging Winds | Time of observation if different from above

RIVER STAGE: CONDITION | GAGE READING AT A.M. | TENDENCY

REMARKS (Special observations, etc.)

CHECK BAR (For wire weight) NORMAL CK. BAR
READING | DATE

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

OBSERVER: Mary J. Fuller
SUPERVISING OFFICE: WSO, TULSA, OKLAHOMA
STATION INDEX NO. 34-6130-8

WS FORM B-91
(7-89)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

STATION (Climatological): Muskogee	(River Station, if different):	MONTH: June	YR: 94
STATE: Oklahoma	COUNTY: Muskogee	RIVER: Arkansas	
TIME (local) OF OBSERVATION RIVER:	TEMP: 7pm	PRECIPITATION: 7am	STANDARD TIME IN USE: CDT
TYPE OF RIVER GAGE:	ELEVATION OF RIVER GAGE ZERO: Ft.	FLOOD STAGE: Ft.	NORMAL POOL STAGE: Ft.

DATE	TEMPERATURE F. 24-HRS. ENDING AT OBSERVATION MAX.	MIN.	AT OBSN	PRECIPITATION 24-HR AMOUNTS Rain, melted snow, etc. (Ins. and hundredths)	Snow, ice pellets, hail (Ins. and tenths)	AT OB Snow, ice pellets, hail, ice on ground (Ins.)	WEATHER Fog	Ice Pellets	Glaze	Thunder	Hail	Damaging Winds	REMARKS (Special observations, etc.)
1	86	66	85										
2	88.7	66	86.1										
3	87	70	72							X			Lightening No Rain
4	87	68	76										
5	88.1	69.9	86										Rain Bg 4am End 5:15 am
6	87.4	66.2	85.6	1.09									
7	92.5	68.5	90.1										
8	91	73	89										
9	91.2	63.8	76.4	1.03						X		X	Rain lasted 30 min 6:30 - 7:00 am 15 mph wind
10	91.2	63.8	80.6										
11	82	69	82										
12	89.6	69.2	83.3										
13	89.6	69.2	88.7										
14	88.8	75.3	82.9										
15	84.9	75.0	81.5	.07									
16	88.8	76	87.4										
17	90.1	70.9	88.8										
18	90.5	72.5	72.8										
19	91.4	70.3	88.4										
20	90.5	71.2	84	.18									
21	93.2	70.8	92.8										
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	96										
26	96.9	78.2	92.5										
27	96.9	74.3	94.8										
28	98	70	96										
29	98.9	69.4	98.7										
30	98.9	71.4	95.1										
31													
SUM				2.37									

CHECK BAR (For wire weight) NORMAL CK. BAR
READING | DATE

CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice.
B. Frozen, but open at gage.
C. Upper surface of smooth ice.
D. Ice gorge above gage.
E. Ice gorge below gage.
F. Shore ice.
G. Floating ice.
H. Pool stage.

OBSERVER: Gary J. Fuller
SUPERVISING OFFICE: WSO, TULSA, OKLAHOMA
STATION INDEX NO: 71 6170

APPENDIX B

OIL AND GAS WELL INVENTORY

Muskogee\86251dp2.3rd

Petroleum Information

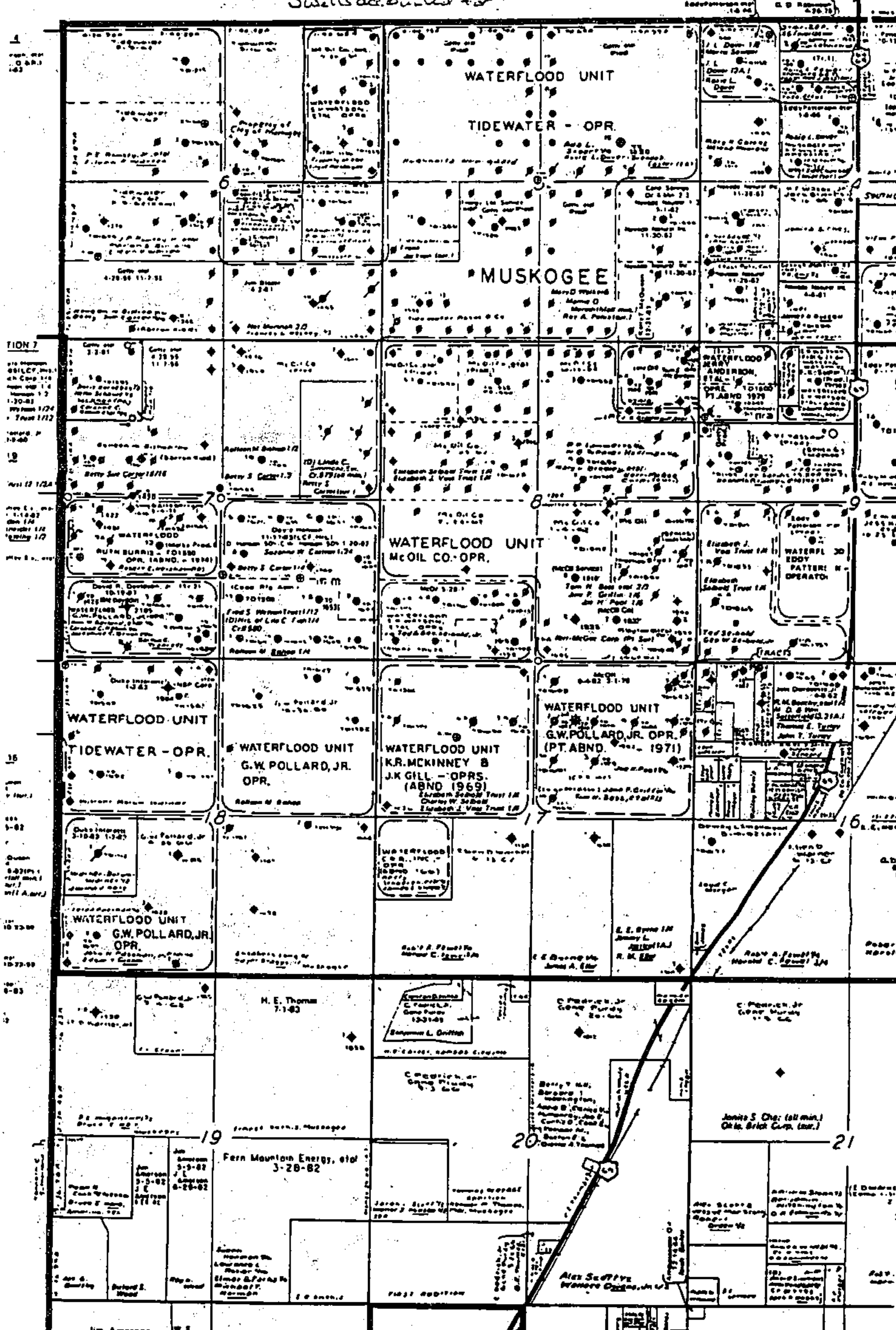
a company of The Dun & Bradstreet Corporation

Midcontinent Map

P.O. Box 2612

Denver, Colorado 8020

5 wells 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

640 Acres

N

160 160

160 160

Locate well correctly

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

COMPANY OPERATING Beebe Oil Company

OFFICE ADDRESS Box 1631, Muskogee, Oklahoma

FARM NAME Warren WELL NO. 1

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

DATE OF FIRST PRODUCTION .... COMPLETED ....

WELL LOCATED C ¼ NE ¼ SW ¼ 1980 ft. 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

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

Shot Record

Formation	From	To	Size of Shot

CASING RECORD

Size	Wt.	Thds.	Make	Amount Set Ft.	Amount Set In.	Amount Pulled Ft.	Amount Pulled In.	Packer Record Size	Packer Record Length	Depth Set	Make
4½"				1368							

Liner Record: Amount........ Kind........ Top........ Bottom........

CEMENTING AND MUDDING

Size	Amount Set Ft.	Amount Set In.	Sacks Cement	Chemical Gal.	Chemical Make	Method of Cementing	Amount	Mudding Method	Results (See Note)
4½"	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........ feet to........ Cable tools were used from 0 feet to 1385 .... feet, and from........ feet to........ feet, and from........ feet to........

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........ Length of test 24 hr. Water Prod. .... bbls. Gravity of oil........ Type of Pump if pump is used, describe........

9/16/61

OIL WELL INDEX OKLAHOMA CITY

REF. NO. 490

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

Formation	Top	Bottom
Clay	0	20
Shale	20	132
Sand	132	145
Shale	145	177
Sandy Lime	177	189
Shale	189	222
Sand	222	240
Shale	240	320
Sand	320	337
Shale	337	548
Sand	548	565
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
Sand - Stray	1238	1
Sandy Shale	1265	1
Sand - Muskogee	1279	1
Shale	1313	1
Sand	1316	1
Sandy Shale	1330	1
Shale	1335	1
Sand	1350	1
Lime	1360	1
Shale	1373	1
Lime	1379	1

FILE COPY DO NOT REMOVE CONSERVATION DEPT

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.

Jerry Beebe

Name and title of representative of company

Subscribed and sworn to before me this .... day of ...., 19....

(Mail to Corporation Commission, Oklahoma City, Oklahoma)

Form

OKLAHOMA CORPORATION COMMISSION

OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

640 Acres

N

Locate well correctly

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

COMPANY OPERATING ...ee 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 SW ¼ NW ¼ SW ¼ 1770 ft. North of South Line and 330 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	1115	1134	4 Timberridge	1250	1264
2 Stray	1182	1200	5		
3 Muskogee	1210	1240	6		

Perforating Record If Any / Shot Record

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
[illegible]				406				6	400		
[illegible]				1350							

Liner Record; Amount Kind Top Bottom

CEMENTING AND MUDDING

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

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 1625 feet, and from feet to feet, and from feet to

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 12 bbls. Size of choke, if any Length of test 24 hr. Water

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

10/14/61

NATIONAL OIL WELL INDEX CO. OKLAHOMA CITY

REF. NO. 5437

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

Formation	Top	Bottom
Clay	0	10
Shale	10	85
Sand	85	95
Shale	95	115
Sand	115	125
Shale	125	180
Sand	180	191
Shale	191	297
Sand	297	315
Shale	315	390
Sand	390	405
Shale	405	532
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 - Bad Hole	1115	1134
Shale	1134	1182
Sand	1182	1200
Shale	1200	1205
Sand	1205	1210
Sand - Muskogee	1210	1240
Shale	1240	1255
Brown Lime-Broken	1255	[illegible]
Lime	1293	[illegible]
Shale	1325	[illegible]
Lime	1332	[illegible]
Shale & Shells	1335	[illegible]
Shale	1343	[illegible]
Shale & Shells	1367	[illegible]
Shale	1390	[illegible]
Lime	1400	[illegible]
Shelly Shale	1525	[illegible]
Shale	1580	[illegible]
Lime - Miss.	1600	[illegible]

FILE COPY
DO NOT REMOVE
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 Bech...

Name and title of representative of company

Subscribed and sworn to before me this 10th day of ...

SEC. ... TWP 14 N RGE 18 ... COUNTY Muskogee WELL NO. 2 FARM NAME

(Mail to Corporation Commission, Oklahoma City, Oklahoma)

OKLAHOMA CORPORATION COMMISSION

OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

640 Acres

N

Locate well correctly

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

COMPANY OPERATING Beebe Oil Company

OFFICE ADDRESS Box 1631

FARM NAME Warren WELL NO. 3

DRILLING STARTED 12/27, DRILLING FINISHED 1/2, 1962

DATE OF FIRST PRODUCTION COMPLETED

WELL LOCATED C ¼ SE ¼ NW ¼ 3300 ft. 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

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
Bal Hole	1085	1107	4		
2 Muskogee	1150	1220	5		
3 Timberridge	1280	1285	6		

Perforating Record If Any

Formation	From	To	No. of Shots
Muskogee Sand	1118	1218	30
Timberridge	1278	1284	6 s

Shot Record

Formation	From	To	Size of Shot

CASING RECORD

Size	Wt.	Thds	Make	Amount Set Ft.	In.	Ft.	In.	Amount Pulled Size	Length	Packer Record Depth Set	Make
				30							
				1335							

Liner Record: Amount Kind Top Bottom

CEMENTING AND MUDDING

Size	Amount Set Ft.	In.	Sacks Cement	Chemical Gal.	Make	Method of Cementing	Amount	Mudding Method	Results (See Note)
	30		10						
	1335		100						

Note: 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

Rotary Tools were used from feet to Cable tools were used from 0 feet to 1335 feet, and from feet to feet, and from feet to

Type Rig Bucyrus Erie 28-L

INITIAL PRODUCTION TEST

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

Amount of Oil Production 30 bbls. Size of choke, if any Length of test 24 hr Water Production bbls. Gravity of oil Type of Pump if pump is used, describe

Give detailed description and thickness of all formations drilled through, contents of sand, whether dry, water, oil or gas.

JAN 20 1962

NATIONAL OIL WELL INDEX CO. OKLAHOMA CITY

REP. NO. 2-0393

Formation	Top	Bottom
Clay	0	15
Shale	15	315
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

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.

Name and title of representative of company

Subscribed and sworn to before me this 15th day of January, 19

CORPORATION COMMISSION
CONSERVATION

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, 19 62
DATE OF FIRST PRODUCTION ... COMPLETED ...
WELL LOCATED C ¼ NE ¼ NW ¼ 4620 ft. 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	1115	1125	4			
2	Muskogee	1125	1160	5			
3	Timberridge	1165	1180	6			

Perforating Record If Any / Shot Record

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

CASING RECORD

Size		Amount Set Thds.	Make	Ft.	In.	Ft.	In.	Amount Pulled Size	Length	Packer Record Depth Set	Make
7"				1202							
10"				23							

Liner Record: Amount ___ Kind ___ Top ___ Bottom ___

CEMENTING AND MUDDING

Size	Amount Set Ft.	In.	Sacks Cement	Chemical Gal.	Make	Method of Cementing	Amount	Mudding Method	Results (See Note)
7"	1202		150						
10"	23		7						

Note: 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

Rotary tools were used from ___ feet to ___ Cable tools were used from 0 feet to 1215 feet, and from ___ feet to ___ feet, and from ___ feet to ___
Type Rig Bucryus-Erie 28L

INITIAL PRODUCTION TEST

Describe initial test; whether by flow through tubing or casing or by pumping 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 ___
not in production yet

62-1581

Formation	Top	Bottom
Soil	0	3
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

FILE COPY DO NOT REMOVE CONSERVATION DEPT

RECEIVED CONSERVATION DEPARTMENT MAR 22 1962 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.

Name and title / Name of company

Subscribed and sworn to before me this ___ day of ___

(Mail to Corporation Commission, Oklahoma City, Oklahoma)

OKLAHOMA CORPORATION COMMISSION

OIL AND GAS CONSERVATION DEPARTMENT

Form 2A

WELL RECORD

640 Acres

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. 7

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

DATE OF FIRST PRODUCTION .... COMPLETED ....

WELL LOCATED N L ¼ SW ¼ SW ¼ 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

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

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 / Shot Record

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

CASING RECORD

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

Liner Record: Amount ..... Kind ..... Top ..... Bottom .....

CEMENTING AND MUDDING

Size	Amount Set Ft.	In.	Sacks Cement	Chemical Gal.	Make	Method of Cementing	Amount	Mudding Method	Results (See Note)
8"	25		10						
2½"	1290		150						

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 1290 ..... feet, and from ..... feet to ..... feet, and from ..... feet to .....

Type Rig Bucyrus-Erie 28L

INITIAL PRODUCTION TEST

... initial test, whether by flow through tubing or casing or by pumping .....

Oil Production ..... bbls. Size of choke, if any ..... Length of test ..... Water ..... bbls. Gravity of oil ..... Type of Pump if pump is used, describe .....

Give detailed description and thickness of all formations drilled through, contents of sand, whether dry, 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		
Lime	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

FILE COPY DO NOT REMOVE CONSERVATION D...

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.

Subscribed and sworn to before me this ...

(Mail to Corporation Commission, Oklahoma City, Oklahoma)

Fo 2A

OKLAHOMA CORPORATION COMMISSION

OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

640 Acres

N

160 | 160

160 | 160

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. 8

DRILLING STARTED 8/20, 1962 DRILLING FINISHED 9/18, 1962

DATE OF FIRST PRODUCTION .... COMPLETED ....

WELL LOCATED SE ¼ NW ¼ SW ¼ 1400 ft. 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

Formation	From	To	No. of Shots

Shot Record

Formation	From	To	Size of Shot

CASING RECORD

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

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 Bucyrus-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 .... bbls. Gravity of oil .... Type of Pump if pump is used, describe Common working barrel

SEC. .... TWP. 14N RGE. 18E COUNTY Muskogee WELL NO. 8 FARM NAME Warren

OCT 20 1962

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

Give detailed description and thickness of all formations drilled through, contents of sand, whether dry, water, oil or gas.

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
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CONSERVATION DE

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.

Jerry Beebe

Name and title of representative of company

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

Form 1002A

OKLAHOMA CORPORATION COMMISSION

OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

640 Acres

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, 19 62 DRILLING FINISHED 10/26, 19 62

DATE OF FIRST PRODUCTION ______ COMPLETED ______

WELL LOCATED NE SE NE ¼ SW ¼ 1800 North of South Line and 2310 ft. East of West Line of Quarter Section

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

Locate well correctly

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
Shale	1302	1318	32
Sand	1266	1276	20
Sand	1238	1256	36

Shot Record

Formation	From	To	Size of Shot

CASING RECORD

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

Liner Record: Amount ______ Kind ______ Top ______ Bottom ______

CEMENTING AND MUDDING

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

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 1345 feet, and from ______ feet to ______ feet, and from ______ feet to ______

Type Rig Bucyrus-Erie 28L

INITIAL PRODUCTION TEST

Describe initial test; whether 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

DEC 15 1962

Give detailed description and thickness of all formations drilled through, contents of sand, whether dry, water, oil or gas.

NATIONAL OIL WELL INDEX CO. 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		

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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, 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 10th day of ______

My Commission expires ______

SEC. 6 TWP. 14N RGE. 18E

COUNTY Muskogee

WELL NO. 9

FARM NAME Warren

(Mail to Corporation Commission, Oklahoma City, Oklahoma)

OKLAHOMA CORPORATION COMMISSION
OIL AND GAS CONSERVATION DEPARTMENT
WELL RECORD

RGE. 18E TWP. 14N SEC. 6 Muskogee Co. 10

640 Acres
N

160			160
	6		
160			160

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. 10

DRILLING STARTED 9/18, 19 63 DRILLING FINISHED 9/27, 19 63

DATE OF FIRST PRODUCTION ______ COMPLETED ______

WELL LOCATED SW ¼ NE ¼ SW ¼ 1650 ft. 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	Timberridge	1298	1312
2	Stray	1200	1228	5			
3	Muskogee	1228	1292	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.	Ft.	In.	Size	Length	Depth Set	Make
4½				1332							
8"				30							

Liner Record: Amount ______ Kind ______ Top ______ Bottom ______

CEMENTING AND MUDDING

Size	Amount Set Ft.	In.	Sacks Cement	Chemical Gal.	Make	Method of Cementing	Amount	Mudding Method	Results (See Note)
4½"	1332		125						
8"	30		25						

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 1332 ______ feet, and from ______ feet to ______ feet, and from ______ feet to ______

Type Rig Bucyrus Erie 28L

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 ______ Length of test 24hrs Water

Production ______ bbls. Gravity of oil ______ Type of Pump if pump is used, describe 40 gravity. Common working barrel pump

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

NOV 16 1963

NATURAL OIL WELL INDEX OKLAHOMA CITY
REF. NO. 3-5016

Formation	Top	Bottom
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

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CONSERVATION DEPT.

OKLAHOMA CORPORATION COMMISSION
NOV 8
CONSERVATION DEPARTMENT
RECEIVED

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.

Jerry Beebe
Name and title of representative of company

Subscribed and sworn to before me this 7th day of Nov.

OKLAHOMA CORPORATION COMMISSION
OIL AND GAS CONSERVATION DEPARTMENT
WELL RECORD

SEC 6 TWP 14N RGE 16E COUNTY Muskogee FARM NAME Warren

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, 1965 DRILLING FINISHED 6-11, 1965
DATE OF FIRST PRODUCTION - COMPLETED 7-17-65
WELL LOCATED SE ¼ SW ¼ NW ¼ 501' North of South Line and 1023' ft. 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
[illegible]	[illegible]	1190	4		
2 Muskogee	1198	1248	5		
[illegible] Timber Ridge	1251	1253	6		

Perforating Record If Any / Shot Record

Formation	From	To	No. of Shots	Formation	From	To	Size of Shot
Stray	1174	1178	2 (Sand Cut)				
Muskogee	1202	1245	10 (")				
[illegible] Ridge	-	1251.5	1 (")				

CASING RECORD

Size	Amount Set Thds	Make	Ft.	In.	Ft.	In.	Amount Pulled Size	Length	Packer Record Depth Set	Make
[illegible]	8R		154							
[illegible]	8R		1275							
									1224	Shaw

Liner Record Amount [illegible] Kind ___ Top ___ Bottom ___

CEMENTING AND MUDDING

Size	Amount Set Ft.	In.	Sacks Cement	Chemical Gal.	Make	Method of Cementing	Amount	Mudding Method	Results (See Note)
[illegible]	158		100			Dowell			
[illegible]	1274		188			"			

Note: 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

Rotary Tools were used from ___ feet to ___ Cable tools were used from 0 feet to 1275' ___ 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 ___

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 all formations drilled through, contents of sand, whether dry, water, oil or gas.

OCT 16 1965

NATIONAL OIL WELL INDEX CO. OKLAHOMA CITY
REF. NO. [illegible]-1188

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	O.C.C.		
Sand, TR	1251	1260	W.L. Boone		
Shale	1260	1265	H. P. Sheckelford		
Hole Caving	1265	1275	File		

RECEIVED
CONSERVATION DEPARTMENT
OCT 12 1965
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.

[signature] Area Supt
W.H.McPhail 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 [signature]

OKLAHOMA CORPORATION COMMISSION
OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

COUNTY Muskogee SEC. 6 TWP. 14N RGE. 16
COMPANY OPERATING Tidewater Oil Company
OFFICE ADDRESS Box 752, Drumright, Okla.
FARM NAME Warren WELL NO. W-22
DRILLING STARTED 8-9-65 19 DRILLING FINISHED 8-17-65 19
DATE OF FIRST PRODUCTION — COMPLETED 9-7-65
WELL LOCATED NE ¼ NW ¼ SW ¼ 1320' North of South Line and 1288' ft. 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

OCT 16 1965

NATIONAL OIL WELL INDEX CO. OKLAHOMA CITY
REF. NO. E-4189

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
Stray	1238	1249	4		
[illegible]	1280	1293	5		
Tucker Ridge	1303	1325	6		

Perforating Record If Any / **Shot Record**

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

CASING RECORD

Size	Wt	Thds	Make	Amount Set Ft	In	Amount Pulled Ft.	In.	Packer Record Size	Length	Depth Set	Make
10-3/4	25	8R		153							
[illegible]-1/2	9.[illegible]	8R		1391							
										1296	Shaw

Liner Record: Amount ______ Kind ______ Top ______ Bottom ______

CEMENTING AND MUDDING

Size	Amount Set Ft	In	Sacks Cement	Chemical Gal	Make	Method of Cementing	Amount	Mudding Method	Results (See Note)
10-3/4	157		125			Dowell			
[illegible]	1384		188			"			

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 1385'
______ 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 ______

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 all formations drilled through, contents of sand, whether dry, water, oil or gas.

Formation	Top	Bottom
Soil	0	2
Clay	2	4
Shale	4	125
Sand	125	143
Shale	143	312
Lime	312	330
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
Sand	1275	1325
Shale	1325	1330
Sand	1330	1334
Shale	1334	1340
Brown Lime	1340	1360
Lime	1360	1385

RECEIVED
CONSERVATION DEPARTMENT
OCT 12 1965
OKLAHOMA CORPORATION COMMISSION

1 - O. C. C.
1 - W. L. Poone
1 - H. F. Shackelford
1 - File

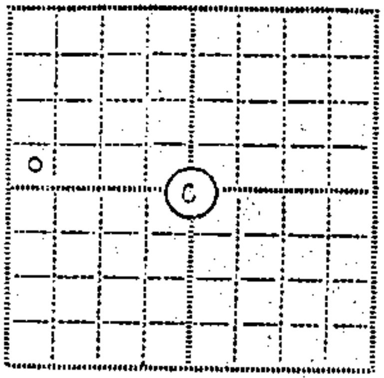
I, the undersigned, being first duly sworn upon oath, state that this well record is true, correct and complete according to the records of this office and to the best of my knowledge and belief.

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

Subscribed and sworn to before me this 11th day of October 19 [illegible]

My Commission expires 7-16-65 (signature)

CORPORATION COMMISSION
OIL AND GAS CONSERVATION DEPT
OKLAHOMA CITY, OKLAHOMA



MUSKOGEE COUNTY

COMPANY— T.P. McADAMS		SEC.
FARM— Rooney #1		6
LOCATION— SW C SW NW		
COUNTY— Muskogee		
TOTAL DEPTH— 922'		TWP.
PRODUCTION— OIL		11N
ROCK PRESSURE—		
ELEVATION—		
DRILLING COMMENCED—	8-10-49	RGE.
DRILLING COMPLETED—	8-2[illegible]-49	18E

This record received by Corporation Commission Sept. 15, 1949.

T. P. McAdams
Bristow, Oklahoma

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

CASING RECORD
10" - Amount Set 127'
6 5/8" " " 887'

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

FORMATION RECORD	TOP	BOTTOM
Soil & clay	0	20
Shale	20	40
Lime	40	49
Shale & slate	49	235
Sand	235	245
Shells	245	255
Shale	255	308
Lime	308	310
Shale	310	505
Lime	505	510
Shale	510	545
Lime	545	550
Shale	550	640
Lime	640	642
Shale	642	745
Lime	745	750
Shale	750	755
Sand	755	765
Shale	755	820
Lime	820	835
Shale	835	850
Lime	850	860
Shale	860	870
Lime	870	885
Sand (Oil @ 908')	885	992

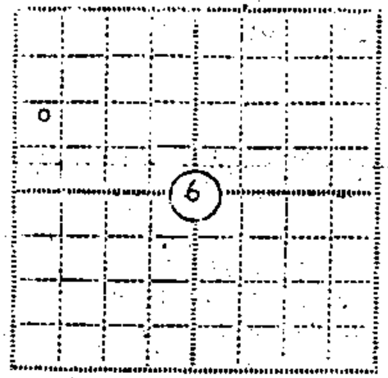
TOTAL DEPTH: 992'

SIGNED: T.P.M (Owner)

STENCILED: 11-17-49 mi

CORPORATION COMMISSION
OIL AND GAS CONSERVATION DEPT
OKLAHOMA CITY, OKLAHOMA

Muskogee County



COMPANY—	William H. Pine	SEC. 6
FARM—	Mooney # 2	
LOCATION—	NW SW NW	
COUNTY—	Muskogee	
TOTAL DEPTH—	2082'	TWP. 14N
PRODUCTION—	OIL	
ROCK PRESSURE—		
ELEVATION—	Derrick 653' Ground 652'	
DRILLING COMMENCED—	11-20-49	RGE.
DRILLING COMPLETED—	112-27-49	18E

William H.Pine
Okmulgee, Oklahoma.

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

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

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

NOTE: All above measurements are taken from Lane Wells Logs which are off from plus 3½' at 750 to minus 7' at 2082.

The shows in the Burgen below 2018 prob. justify drilling out to 2082 T.D. running string 5½" & 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
Burgen	2042	2047	10 holes
Burgen	2031	2038	14 holes
Burgen	2011	2018	14 holes
Burgen	1976	1989	26 holes
Burgen	1976	1989	500 Gals.

SHOT RECORD:

			Size shot
Simpson Dolo.	1785	1794	17 holes
Simpson Dolo.	1785	1794	500 Gall
Wapanucka	1244	1254	34 holes
Wapanucka	1239	1244	17 holes
Wapanuka	1239	1254	1000 Gal.
Simpson Dolo	1785	1794	17 holes
Simpson Dolo.	1785	1794	500 gal.
Wapanucka	1244	1254	34 holes
Wapanucka	1239	1244	17 holes
Wapanucka	1239	1254	1000 gal
Wapanucka	1239	1254	4000 gal.
	777		1 hole
Booch	753½	758½	10 holes
Booch	753½	754½	Hydrafrac

FORMATION	TOP	BOTTOM
Clay, yellow		5
Shale	5	45
Sand	45	65
Shale	65	237
Sand	237	250
Shale	250	298
Lime, broken	298	301
Shale	301	425
Lime	425	437
Shale	437	498
Sand, sho, Gas	498	506
Shale	506	510
Sand, wtr. 3 blr./hr.	510	524
Shale	524	635
Lime	635	645
Shale	645	752
Sand, so	752	756
Shale	756	796
Lime	796	811
Shale	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 , SD	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
Hunten Limr	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 2033½ 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
Burgan	2011	2018	14 "	Nothing shwn

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

Burgan	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	1767	500 gals.	Est. 30 bbls. SW/day

Lane Wells Bridging Plud 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.

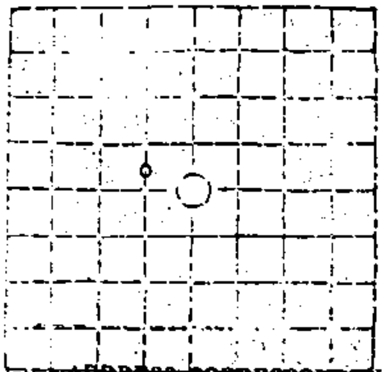
CASING RECORD:

			At. Set	
10-3/4"	40#	8 Used	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' sax- cem 300 HOWCO
Cemented to abt. 700 ft. top.
Cont. Page # 3. Wm.H.Pine

CORPORATION COMMISSION
WELL LOG DIVISION
OKLAHOMA CITY, OKLAHOMA



Muskogee

COMPANY—Tidal Oil Company
FARM— Sallie Sango NO. 8
LOCATION—C S½ SE NW
COUNTY— Muskogee
TOTAL DEPTH— 2046'
PRODUCTION— Well is pumping
ROCK PRESSURE— water.
ELEVATION—
DRILLING COMMENCED— 9-25-26
DRILLING COMPLETED— 11-19-26

SEC. 6
TWP. 14N
RGE. 18E

ADDRESS CORRESPONDENCE REGARDING THIS WELL TO—
Tidal Oil Co.,
Box 2046,
Tulsa, Okla.

REMARKS:

CASING RECORD:

SE SE NW 330' North of South line and 660' West of East Line.

10"	24#	29'
8¼"	20#	135'
6 5/8"	17#	1162'

FORMATION	TOP	BOTTOM
Clay		27
black shale		28
black shale		45
gray lime		60
shale		90
lime & water		96
shale		127
lime		135
shale		200
brown lime		220
dark shale		280
slate		295
brown shale		360
light shale		420
light shale		540
dark shale		600
brown lime		610
light shale		775
black shale		810
brown shale		890
brown lime		905
gray lime		935
shale		1040
sand-bad hole		1063
shale		1077
gas sand		1105
shale		1162
Muskogee sand		1187 - fair show oil
Black shale		1196
timber ridge sand Slight show.		1218 -
sand		1225
black shale		1241
brown lime		1250
gray & brown lime		1580
brown shale		1610
gray lime		1630
black shale		1644
brown lime		1685
black shale		1760
brown lime		1785
buttermilk lime		1830
lime		2021
Wilcox sand		2041
Wilcox sand - Water		2046

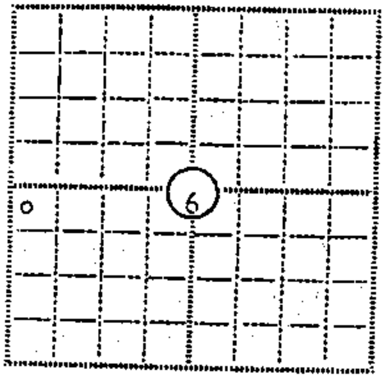
Plugged back to 1235'

Total Depth 2046'

3-30-27 G

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	
ROCK PRESSURE—		14N
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	TOP	BOTTOM
Soil & Clay	0	20
Set Shale 10 3/4" Casing @	20	95
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	865
Lime	865	869
Shale	869	870
Sand	870	902
Lime	902	908

FORMATION	TOP	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.

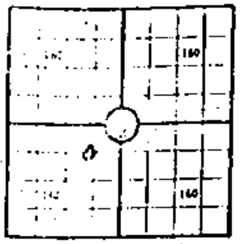
Form 1002A

V 101. 31

OKLAHOMA CORPORATION COMMISSION

OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD



Locate well correctly

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 WELL NO. Tr.1 No.11

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

DATE OF FIRST PRODUCTION 8-19-66 COMPLETED 8-4-66

WELL LOCATED ¼ NE ¼ SW ¼ 1980' ft. North of South Line and 1858' ft. 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

OIL OR GAS SANDS OR ZONES

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

Perforating Record If Any / Shot Record

Formation	From	To	No. of Shots	Formation	From	To	Size of Shot
Stray	1218	1235	Sand				
Muskogee	1248	1269	Cuts				
[illegible]	1282	1296					

CASING RECORD

Size	Amount Set: Thds	Make	Ft	In	Ft	In	Amount Pulled: Size	Length	Packer Record: Depth Set	Make
[illegible] 32.75	8R	SH	177							
[illegible]	8R	SH	1387							

[illegible] Amount — Kind — Top — Bottom —

CEMENTING AND MUDDING

Size	Amount Set: Ft	In	Sacks Cement	Chemical: Gal	Make	Method of Cementing	Amount	Mudding Method	Results (See Note)
10 3/4	155		100	3%	Cacl	Dowell			
5 1/2	1349		175		E437	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

Rotary Tools were used from 1297 feet to 1350 Cable tools were used from 0 feet to 1297 feet, and from — feet to — feet, and from — feet to —

Type Rig Rotary & Cable Tools

INITIAL PRODUCTION TEST

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

Amount of Oil Production 0 bbls. Size of choke, if any — Length of test 24 hrs Water Production 220 bbls. Gravity of oil — Type of Pump if pump is used, describe Tubing Pump

Give detailed description and thickness of all formations drilled through, contents of sand, whether dry, water, oil or gas.

SEP 24 1966

NATIONAL OIL INDEX CO. OKLA. CITY REF. NO. 66 2220

Formation	Top	Bottom	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	OCC—		
Sand	1275	1290	Boone		
Lime	1290	1315	Shackelford		
Shale	1315	1331	File		
Lime	1331	1350			
Total Depth	1350				

RECEIVED CONSERVATION DEPARTMENT SEP 21 1966 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.

[signature] Area Supt.

Name and title of representative of company

Subscribed and sworn to before me this 20 th day of September 1966

My Commission expires 11-22-69

OKLAHOMA CORPORATION COMMISSION
OIL AND GAS CONSERVATION DEPARTMENT
WELL RECORD

NATIONAL OIL WELL INDEX CO.
OKLAHOMA CITY
REF. NO. 6

DEC 17 1966

1/17/57

COUNTY Muskogee SEC 6 TWP 14 N RGE 18 East

COMPANY OPERATING Tidewater Oil Company

OFFICE ADDRESS PO Box 752, Drumright, Oklahoma

FARM NAME N. Muskogee Royalty Unit WELL NO. Tr. 1 No. 1

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

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

WELL LOCATED ¼ NW ¼ SE ¼ 1980' North of South Line and 579' ft. 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

(Locate well correctly)

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
Stray	1170	1187	4		
Muskogee	1192	1226	5		
Timber Ridge	1240	1248	6		

Perforating Record If Any / Shot Record

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

CASING RECORD

Size	Wt.	Thds	Make	Ft	In	Ft	In	Amount Pulled Size	Length	Packer Record Depth Set	Make
10 3/4	32	8r	SH	154							
5 1/2	17	8r	N	1301							

Liner Record: Amount — Kind — Top — Bottom —

CEMENTING AND MUDDING

Amount Set	Sacks Cement	Chemical Gal	Make	Method of Cementing	Amount	Mudding Method	Results (See Note)
10 3/4 158	100	3%	CaCl	Dowell			
5 1/2 1279	200	10%	Salt	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

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

Type Cable Tools

INITIAL PRODUCTION TEST

Describe initial test; whether by flow through tubing or casing or by pumping Flowing

Amount of Oil Production 10 bbls. Size of choke, if any — Length of test 24 Water Production — bbls. Gravity of oil — Type of Pump if pump is used, describe —

Give detailed description and thickness of all formations drilled through, contents of sand, whether dry, water, oil or gas

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	1025	1040			
Sand	1040	1050			
Sandy Shale	1050	1060			
Shale	1060	1092			
Sand	1092	1100			
Shale	1100	1103			
Sand	1103	1125			
Shale	1125	1173			
Sand	1173	1183			
Shale	1183	1187			
Sand	1187	1230			
Shale	1230	1244			
Lime	1244	1260			
Shale	1260	1265			
Lime	1265	1280			
Total Depth	1280				

RECEIVED
DEC 15 1966
OKLAHOMA CORPORATION COMMISSION
CONSERVATION DEPARTMENT

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.

[signature] 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 11-22-69

SEC. 6 TWP 14 N RGE 18

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 Tr. 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 ¼ SW ¼ NW ¼ 3300' North of South Line and 579' ft 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

Locate well correctly

OIL OR GAS SANDS OR ZONES

Name	From	To	Name	From	To
Stray	1134	1160	4		
Muskogee	1167	1215	5		
[illegible]	1218	1220	6		

Perforating Record If Any — Shot Record

Name	From	To	No. of Shots	Formation	From	To	Size of Shot
Stray							
Muskogee	1198	1202	Sand Cuts				

CASING RECORD

Size	Wt.	Thds	Make	Amount Set Ft.	In.	Ft.	In.	Amount Pulled Size	Length	Packer Record Depth Set	Make
8 5/8	24	8r	SH	150							
5 1/2	15	8r.	SH	1249							

Liner record: Amount______ Kind______ Top______ Bottom______

CEMENTING AND MUDDING

Size	Amount Set Ft.	In.	Sacks Cement	Chemical Gal.	Make	Method of Cementing	Amount	Mudding Method	Results (See Note)
8 5/8	152		100	3%	HA-5	Halliburton			
5 1/2	1260		200	10%	Salt.	Halliburton			

NOTE: 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

Rotary tools were used from 0 feet to 1261 feet, and from______ feet to______ feet. Cable tools were used from______ feet to______ feet, and from______ feet to______ feet.

Type of rig Rotary

INITIAL PRODUCTION TEST

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

Amount of Oil Production 17 bbls. Size of choke, if any______ Length of test 24 hrs Water 11 bbls. Gravity of oil______ Type of Pump if pump is used, describe Tubing Pump

Give detailed description and thickness of all formations drilled through, contents of sand, whether dry, water, oil or gas

JUN 24 1967

OIL WELL INDEX CO. 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 No1	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
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 ___ 196_

My Commission expires 11-23-69

FARM NAME No. Muskogee Royalty (WELL NO.) COUNTY Muskogee SEC. 6 TWP. 14 N. RGE 18E

OKLAHOMA CORPORATION COMMISSION

OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

Locate well correctly

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 Wanita 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 ¼ NE ¼ SW ¼ 1370' North of South Line and 2615' ft. East of West Line of Quarter Section

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

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

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			

Perforating Record If Any / Shot Record

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

CASING RECORD

Amount Set								Amount Pulled		Packer Record	
Size	Wt.	Thds.	Make	Ft.	In.	Ft.	In.	Size	Length	Depth Set	Make
10 3/4	32	8rd		152							
4 1/2	9.5	8rd		1398							

Liner Record: Amount — Kind — Top — Bottom —

CEMENTING AND MUDDING

Size	Amount Set Ft.	In.	Sacks Cement	Chemical Gal.	Make	Method of Cementing	Amount	Mudding Method	Results (See Note)
10 3/4	158		100	3%	CaCl	Dowell			
4 1/2	1399		150		F437	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 —

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 all formations, water, oil or gas MAR 19 1966

NATIONAL OIL WELL INDEX CO. OKLAHOMA CITY 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			

RECEIVED MAR 1 1966 OKLAHOMA CORPORATION COMMISSION

O.C.C.
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.

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

(Mail to Corporation Commission, Oklahoma City, Oklahoma)
Form 1002A

OKLAHOMA CORPORATION COMMISSION
OIL AND GAS CONSERVATION DEPARTMENT

Capped

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. 3
DRILLING STARTED 7-23 1965 DRILLING FINISHED 8-27 1965
DATE OF FIRST PRODUCTION 8-27-65 COMPLETED 8-27-65
WELL LOCATED CL ¼ SE ¼ NE ¼ 660' North of South Line and 660 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

OCT 23 1965

NAT. OIL INDE
OKLAHOMA CITY
REF. NO. 65-4279

OIL OR GAS SANDS OR ZONES

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

Perforating Record If Any

Formation	From	To	No. of Shots

Shot Record

Formation	From	To	Size of Shot
Muskogee	1206	1226	40 qts

CASING RECORD

Size	Wt.	Thds.	Make	Amount Set Ft.	In.	Ft.	In.	Amount Pulled Size	Length	Packer Record Depth Set	Make
8 5/8	28	8	LW	SH 508							
10	50	8	SS	60							
5½	17	10	LW	1200							

Liner Record: Amount Kind Top Bottom

CEMENTING AND MUDDING

Size	Amount Set Ft.	In.	Sacks Cement	Chemical Gal.	Make	Method of Cementing	Amount	Mudding Method	Results (See Note)
5½	1200		100			Halliburton			

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 feet to feet, Cable tools were used from 0 feet to 1272 feet, and from feet to feet, and from feet to
Type Rig Spudder

INITIAL PRODUCTION TEST

pumping

Give detailed description and thickness water, oil or gas.

Formation	Top	Bottom
Surface	0	25
Clay	25	33
Blue Shale	33	49
Water Sand	49	53
Shale	53	60
Limey Shale	60	75
Shale	75	108
Sand	108	145
Sandy Shale	145	176
Shale	176	395
Shale	395	472
Sand	472	476
Shale	476	494
Sand	494	505
Shale	505	578
Sandy Shale	578	596
Shale	596	665
Lime	665	675
Shale	675	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	1095
Sand	1095	1118
Shale	1118	1140
Shale	1140	1175
Stray Sand	1175	1182
Sand	1182	1190
Limey Sand	1190	1192
Shale	1192	1200
Sand	1200	1218
Sandy Lime	1218	1225
Sand with Shale	1225	1236
Shale	1236	1246
Sandy Lime Show of oil	1246	1250
Shale	1250	1268
Lime	1268	1272

RECEIVED OCT 18 1965 OKLAHOMA CORPORATION COMMISSION CONSERVATION DEPARTMENT

RECEIVED SEP 29 1965 OKLAHOMA CORPORATION COMMISSION 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.

WRIGLEY WELL NO. 3 CO. COUNTY MUSKOGEE

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

271943

OKLAHOMA CORPORATION COMMISSION
OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

640 Acres N

Locate well correctly

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 ¼ SW ¼ SE ¼ 10' North of South Line and 3960' ft. 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			4			
2 Stray	1527	1554	5			
3 Muskogee	1572	1598	6			

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	1536-38-42-44 Sand perf. w/ Howco 3-way tool.						

CASING RECORD

Size	Wt.	Thds.	Make	Ft.	In.	Ft.	In.	Size	Length	Depth Set	Make
10 3/4	32#		154'								
4 1/2	9.5		1633'								

(Amount Set; Amount Pulled; Packer Record)

Liner Record: Amount _____ Kind _____ Top _____ Bottom _____

CEMENTING AND MUDDING

Size	Amount Set Ft.	In.	Sacks Cement	Chemical Gal.	Make	Method of Cementing	Amount	Mudding Method	Results (See Note)
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 if pump is used, describe _____

Give detailed description and thickness of all formations drilled through, contents of sand, whether dry, water, oil or gas.

SEP 8 1962 REF. NO -730

RECEIVED
CONSERVATION DEPARTMENT
AUG 31 1962
OKLAHOMA CORPORATION COMMISSION

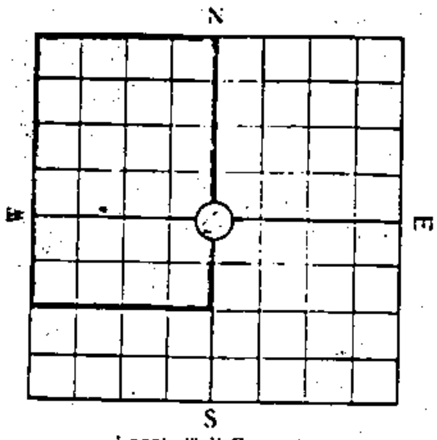
Formation	Top	Bottom	Formation	Top	Bottom
Soil	0	1			
Sand - Rock	1	20			
Shale	20	72			
Sand	72	78			
Shale	78	272			
Sand	272	295			
Shale	295	375			
Sand	375	420			
Shale	420	537			
Sand	537	555			
Shale	555	785			
Sand	785	795			
Shale	795	975			
Lime - Bkn	975	987			
Shale	987	1170			
Lime - Blk	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	1441			
Sand	1441	1465			
Shale	1465	1529			
Sand	1529	1562			
Sand - Bkn	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 and complete according to the records of this office and to the best of my knowledge and belief.

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

Subscribed and sworn to before me this 6th day of August

(1970) 640 Acres



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 answere and mailed to District Office in duplicate. Within 15 day after plugging is completed.

Company Operating GETTY OIL COMPANY

Office Address P. O. [illegible] [illegible] 74030

County [illegible] Sec. 26 Twp. 19N Range 15E

Location in Section SE ¼ SW ¼ NW ¼ [illegible]

Farm Name [illegible] Unit Well No. [illegible] Field [illegible]

Character of Well (whether oil, gas or dry) [illegible]

Commenced Plugging 4-26-72 Finished 4-26-72 Total Depth 1275

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

Signature of District Manager Original Signed By E. J. McNally Perforations: 1174 - 1231

Name of Field Supervisor [illegible]

Name of producing sand Dutcher Series Depth top 1165 Bottom 1235

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
Dutcher Series	Oil & Water	1174	1231	10¾	155	0
				4½	1274	0

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

Pumped 75 sacks of cement down 4½ casing @ 3250 [illegible] between the [illegible] casing and cemented with 125 sacks of cement. Cut casing off 3' below [illegible] casing 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

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

Injection

RECEIVED

Plugging Contractor's Name Address:

Correspondence regarding this well should be addressed to GETTY OIL COMPANY P. O. BOX 752 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 records of this office and to the best of my knowledge and belief.

[signature]

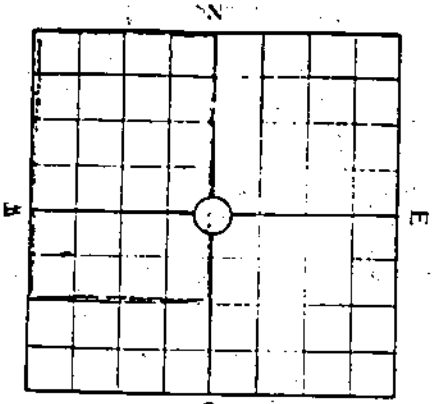
Name and title of representative of company

Subscribed and sworn to before me this the [illegible] day of May 19 72

Commission expires [illegible]

(1970) 640 Acres

N



S

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 GETTY OIL COMPANY

Office Address DRUMRIGHT, OKLAHOMA 74030

County Muskogee Sec. 6 Twp. 17N Range 17E

Location in Section ____ ¼ ____ ¼ ____ ¼

Farm Name Muskogee Keystone Well No. 1 Field Muskogee

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

Commenced Plugging 4-21-72 Finished 4-26-72 Total Depth 1255

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

Original Signed By

Signature of District Manager E. J. ______ Perforations: 1114 - 1246

Name of Field Supervisor L. A. Duncanette

Name of producing sand Dutcher Series Depth top 1114 Bottom 1246

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
Dutcher Series	Oil & Water	1110	1248	10 3/4	155	←
				5 1/2	1277	←

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 1100 and put pressure 900 psi. Perforated 5½ casing at 250-252 with 4 holes per foot. Pumped 100 sacks regular cement into well and circulated cement to surface. Capped casing cut off 2' below G.L. 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
OIL & GAS DIVISION

REMARKS: Why plugged? Old Lease If abandoned oil or gas well, state amount and date of last production: 1972

Plugging Contractor's Name: ____ Address: OKLAHOMA CORPORATION COMMISSION

Correspondence regarding this well should be addressed to GETTY OIL COMPANY
P. O. BOX 752
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 records of this office and to the best of my knowledge and belief.

W. A. McGlaun

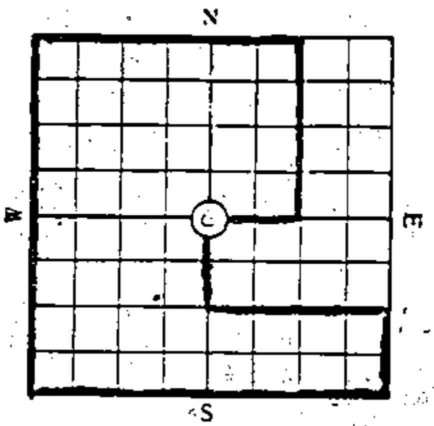
Name and title of representative of company

Subscribed and sworn to before me this the 22 day of May, 19 72

Commission expires 11-23-75

P. W. Gillett

Form No. 1003
(1970) 640 Acres



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 GETTY OIL COMPANY
Office Address P. O. BOX 752 [illegible]RIGHT, OKLAHOMA - 7403[illegible]
County Muskogee Sec. 6 Twp. 14N Range 17E
Location in Section SW 1/4 NE 1/4 SW 1/4 1845' [illegible] 1500' [illegible]
Farm Name Mo. [illegible] Well No. — Field Muskogee
Character of Well (whether oil, gas or dry) Old Hole

Commenced Plugging 5-17-72 Finished 5-17-72 Total Depth Unknown
Was permission obtained from the Corporation Commission or its agents before plugging was commenced yes
Signature of District Manager ____ Perforations: Unknown
Name of Field Supervisor T.W. [illegible]
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

Formation	Content	From	To	Size	Put In	Pulled Out
	Unknown					

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 plugged on 5-17-72 with 655 sacks of regular cement and circulating cement to surface. Pressured to 600 psi and pumped in 50 additional sacks of reg 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 Required

REMARKS: Why plugged? [illegible] Old Hole If abandoned oil or gas well, state amount and date of last production
Unknown

Plugging Contractor's Name: ____ Address: ____

Correspondence regarding this well should be addressed to GETTY OIL COMPANY
P. O. BOX 752
[illegible]RIGHT, OKLAHOMA - 7403[illegible]

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.

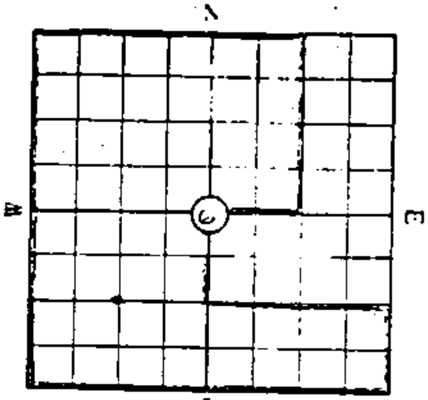
[signature]
Name and title of representative of company

Subscribed and sworn to before me this the 2nd day of August, 1972

Commission expires ____

Form No. 1003
(1970) 640 Acres

N



S

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 GETTY OIL COMPANY ~~P. O. BOX 752~~

Office Address DRUMRIGHT, OKLAHOMA - 74030

County Muskogee Sec. 6 Twp. 14N Range 15E

Location in Section C SW 1520' N3L 1288' EWL

Farm Name No. Muskogee ... Well No. W-22 Field Muskogee

Character of Well (whether oil, gas or dry) Ex. well

Commenced Plugging 1-19-71 Finished 1-19-71 Total Depth 1355

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. Dunnavant

Name of producing sand Dutcher Series Depth top 1238 Bottom 1355

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
Dutcher Series	Oil & water	1238	1365	10 3/4	153	—
				4 1/2	1371	—

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:

Cleaned out to 320'. Cement was pumped down the 2 3/8" tubing and circulated to the surface in the surface casing. Closed 2" outlet and squeezed with 50 sacks of cem. Total cement used was 175 sacks. Cut casing off 3' below ground 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: RECEIVED

Not Required

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

Ex. 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 ______

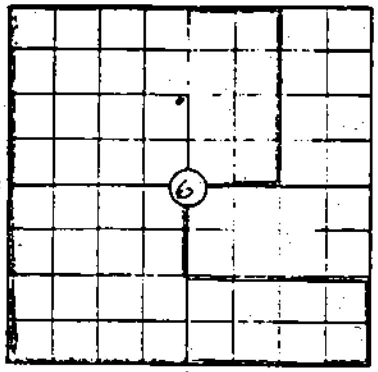
I, the undersigned, being duly sworn upon oath, state that this well record is true, correct and complete according to the records of this office and to the best of my knowledge and belief.

Name and title of representative of company

Subscribed and sworn to before me this ___ day of February, 19 71

Form No. 1003
(1970) 640 Acres

N

W  E

S

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 GETTY OIL COMPANY
~~P. O. BOX 752~~
Office Address DRUMRIGHT, OKLAHOMA - 74030
County Muskogee Sec. 6 Twp. 14N Range 15E
Location in Section NE ¼ SE ¼ NW ¼ [illegible]
Farm Name [illegible] Well No. [illegible] Field Muskogee
Character of Well (whether oil, gas or dry) [illegible]

Commenced Plugging 1-19-71 Finished 1-19-71 Total Depth [illegible]

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

Signature of District Manager ______ Perforations: 1121 - 1132

Name of Field Supervisor E. H. Dunnsette

Name of producing sand Dutcher 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
Dutcher Series	Oil & Water	1118	1154	10¾	156	-0-
				4½	1251	-0-

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

Cleaned out 2⅜" tubing to 320'. Cut tubing off and pulled 300'. Cleaned out and perforated casing with 8 holes at 300'. Pumped cement down 4½" casing and circulated to the surface outside the casing using 100 sacks of cement. Capped casing cut off 3' below ground level 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: RECEIVED

Not Required

REMARKS: Why plugged? [illegible] 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 COMPANY
~~P. O. BOX 752~~
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 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 the 25 day of [illegible]

Form No. 1003
(1970) 640 Acres

N

E W

S

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 [illegible]

Office Address [illegible]

County Muskogee Sec. 6 Twp. 14N Range 18E

Location in Section [illegible]

Farm Name Muskogee Well No. [illegible] Field Muskogee

Character of Well (whether oil, gas or dry) [illegible]

Commenced Plugging [illegible] Finished [illegible] Total Depth [illegible]

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

Signature of District Manager Perforations: 1213 - 1273

Name of Field Supervisor [illegible]

Name of producing sand Dutcher Series Depth top 1213 Bottom 1273

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
Dutcher Series	Oil & Water	1213	1273	10 3/4	155	—
				5 1/2	1319	—

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 1050 with 20 bbls of mud and 25 sacks cement top plug. Ran 1" tubing between casing and surface pipe to 120'. Circulate cement to surface using 60 sacks of cement. Cut casing off 2' below G.L. on 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:

Helma Oil

REMARKS: Why plugged? [illegible] 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 this office and to the best of my knowledge and belief.

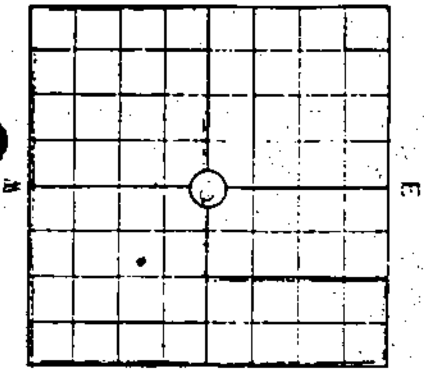
[illegible signature]

Name and title of representative of company

Subscribed and sworn to before me this the 25 day of [illegible] 19 [illegible]

(1970) 640 Acres

N



S

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 Muskogee Sec. 6 Twp. 12 N Range 18 E

Location in Section SW 1/4 NE 1/4 1/4 1650' 1375'

Farm Name ______ Well No. ______ Field Muskogee

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

Commenced Plugging 1-5-71 Finished 1-5-71 Total Depth 1332

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

Signature of District Manager ______ Perforations: 1211-1292

Name of Field Supervisor T.H. Duncisette

Name 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
Dutcher Series	Oil & Water	1200	1312	8	30	-0-
				4 1/2	1332	-0-

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 regular cement and displaced to 1100' with 11 bbls of mud and 25 sx cement surface plug. Well previously cemented from 1005' to surface outside the casing. Cut off casing 2' below G.L. 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:

Jet oil

REMARKS: 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 ______

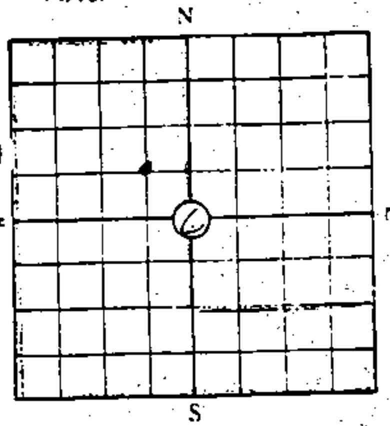
I, the undersigned, being duly sworn upon oath, state that this well record is true, correct and complete according to the records of this office and to the best of my knowledge and belief.

[signature] Asst. Sec.

Name and title of representative of company

Subscribed and sworn to before me this 15 day of January, 19 71

Form No. 1003
(1970) 640 Acres



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 GETTY OIL COMPANY

Office Address DRUMRIGHT, OKLAHOMA - 74030

County Muskogee Sec. 6 Twp. 14N Range 15E

Location in Section C 1/2 SE 1/4 NW 1/4 3300' NSL

Farm Name N. Muskogee Booth Unit Well No. 3 Field Muskogee

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 ______ Perforations: 1174 - 1179

Name of Field Supervisor Bill Desrosiers

Name of producing sand Dutcher Series Depth top 1174 Bottom 1179

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
Dutcher Series	Oil & Water	1174	1179	8 1/4	30	0
				4 1/2	1335	0

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 cement and displaced to 1050' with 12 bbls of mud and 5 bbls of water. In 48 hours perforated casing at 250'-252'. Ran 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 off 2' below G.L., 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:

B.E. Davis

REMARKS: Why plugged? Depleted If abandoned oil or gas well, state amount and date of last production
1 BOPD 216 BWPD 5-14-68

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 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 the 23rd day of January 19 71

Form No. 1001
(1970) 640 Acres

N

S

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 [illegible]

Office Address [illegible]

County [illegible] Sec. [illegible] Twp. [illegible] Range [illegible]

Location in Section [illegible]

Farm Name [illegible] Well No. [illegible] Field [illegible]

Character of Well (whether oil, gas or dry) [illegible]

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 [illegible] Perforations: 1262 – 1259

Name of Field Supervisor F. H. Dunnavette

Name of producing sand Dutcher Series Depth top 1276 Bottom 1257

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
Dutcher Series	Oil & water	1270	1254	10 3/4	27	0
				5 1/2	1340	0

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 regular cement and displaced to 1000' with 17 bbls of mud and 25 sacks of cement. Casing previously cemented on the outside. Cut casing off 2' below G.L. 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

Selma Oil

REMARKS: Why plugged? Sold 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 this office and to the best of my knowledge and belief.

[illegible signature]

Name and title of representative of company

Subscribed and sworn to before me this 15th day of [illegible]

Form No. ___ (1970) 640 Acres

N

W E

S

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 GETTY OIL COMPANY

Office Address P. O. BOX 752 DRUMRIGHT, OKLAHOMA 74030

County Muskogee Sec. [illegible] Twp. [illegible] Range [illegible]

Location in Section ___ ¼ SW ¼ NW ¼ [illegible]

Farm Name [illegible] Well No. 13 Field [illegible]

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: [illegible]

Name of Field Supervisor [illegible]

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
Dutcher Series	Oil & Water	1134	1220	8 5/8	132	—
				5½	1220	—

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 regular cement and displaced to [illegible] with 18 bbls. of mud and 25 sacks of cement top plug. Top of cement outside casing at 150'. Ran 1" tubing to 130' outside casing. Circulated cement to surface using 50 sacks. Pulled 1" tubing. Cut csg off 2' below G.L. 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:

Aetna Oil

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

Plugging Contractor's Name: ___ Address: ___ [illegible]

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 this office and to the best of my knowledge and belief.

[illegible signature]

Name and title of representative of company

Subscribed and sworn to before me this the [illegible] day of [illegible] 19[illegible]

[illegible signature]

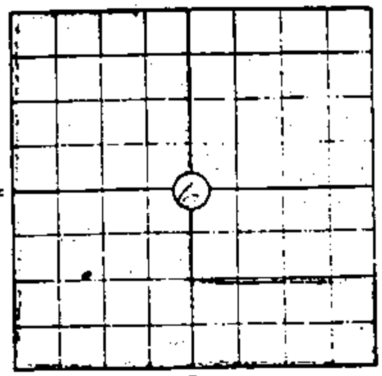
My commission expires [illegible]

E-8-58

Form No. 1003
(1970)

640 Acres

N



S

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 [illegible]

Office Address [illegible] 74030

County *Muskogee* Sec. *6* Twp. *14N* Range *18E*

Location in Section *SE* ¼ *NW* ¼ *SW* ¼ [illegible]

Farm Name *N. Muskogee Unit* Well No. *5* Field *Muskogee*

Character of Well (whether oil, gas or dry) [illegible]

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 [illegible] Perforations: *Open Hole*

Name of Field Supervisor *L. H. Dinsmore*

Name of producing sand *Dutcher Sands* 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
Dutcher Sands	*Oil & Water*	*1216*	*1266*	*7*	*1144*	*0*

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 1010' with 23 bbls of mud and 12 bbls of water. WOC 48 hrs. Perforated casing at 250-252'. Pumped 160 sacks of cement down casing and circulated to the surface outside the casing. Cut casing off 2' below G.L. Capped well & 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

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

1 BOPD 72 BWPD [illegible] *4-30-61*

Plugging Contractor's Name: Address:

Correspondence regarding this well should be addressed to [illegible]

Address [illegible]

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.

[illegible signature]

Name and title of representative of company

Subscribed and sworn to before me this the *21* day of [illegible]

[illegible]

Form No. 1003
(1970) 640 Acres

N

W E

S

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 GETTY OIL COMPANY ~~P. O. BOX 788~~

Office Address DRUMRIGHT, OKLAHOMA - 74030

County Muskogee Sec. 6 Twp. 14N Range 19E

Location in Section NE 1/4 NE 1/4 SW 1/4

Farm Name N. Muskogee Unit Well No. 2 Field Muskogee

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

Commenced Plugging 12-31-70 Finished 12-31-70 Total Depth 1290

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

Signature of District Manager ________ Perforations: —

Name of Field Supervisor E. H. Duncanette

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
Dutcher Series	Oil & water	1170	1275	8	25	—
				2½	1290	—

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 left 2½ casing filled cement. Ran 1" tubing between surf. pipe and 2½ casing to a depth of 250' and circulated cement from this depth [to] the surface. Pulled 1" tubing and filled annulus with cement. Total cement used in the casing was 150 sacks. Cut casing off 2' below G.L. Capped well and leveled loc.

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 Dry hole If abandoned oil or gas well, state amount and date of last production

Unknown

Plugging Contractor's Name ________ Address: ________

Correspondence regarding this well should be addressed to GETTY [illegible] P. O. [illegible] DR[illegible]

Address

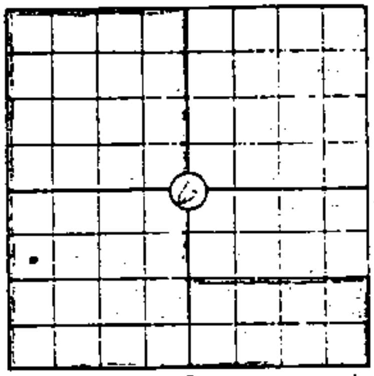
I, the undersigned, being duly sworn upon oath, state that this well record is true, correct and complete according to the record of the office and to the best of my knowledge and belief.

[signature]

Subscribed and sworn to before me this the [illegible] day of [illegible]

(1970) 640 Acres

N



S

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 GETTY OIL COMPANY
Office Address P. O. BOX [illegible] DRUMRIGHT, OKLAHOMA [illegible]
County Muskogee Sec. 6 Twp. 14N Range 18E
Location in Section SW [illegible] NE [illegible]
Farm Name [illegible] Well No. 2 Field Muskogee
Character of Well (whether oil, gas or dry) [illegible] Oil

Commenced Plugging 1-2-71 Finished 1-6-71 Total Depth 1350

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

Signature of District Manager ______ Perforations: Unknown

Name of Field Supervisor T. H. Durossette

Name of producing sand Dutcher Series 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
Dutcher Series	Oil Water	Unknown		8 1/4	21	—
				4 1/2	1350	—

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 1000' with 11 bbls of mud and 5 bbls of water. W.O.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. 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

REMARKS: Why plugged Nonprofitable If abandoned oil or gas well, state amount and date of last production
1 BOPD 7 BWPD 9-30-70

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 this office and to the best of my knowledge and belief.

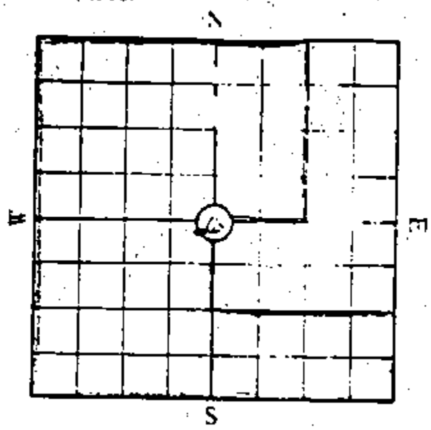
[illegible signature]

Name and title of representative of company

Subscribed and sworn to before me this the 22 day of [illegible]

[illegible]

Form 1003
(1970) 640 Acres



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: GETTY OIL COMPANY ~~P. O. BOX 752~~
Office Address: DRUMRIGHT, OKLAHOMA - 74030
County: Muskogee Sec. 6 Twp. 14N Range 15E
Location in Section: C NW SE 1/4 ~~SE~~ NW
Farm Name: ... Well No. W-17 Field: Muskogee
Character of Well (whether oil, gas or dry): Injection 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: ______ Perforations: 1213' - 1257
Name of Field Supervisor: T.H. Durossette
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
Dutcher Series	Oil & Water	1204	1262	8 5/8	145	0
				4 1/2	1335	0

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 240 sacks of cement between casing & surface pipe in 1966. Cleaned out to 520'. Put tubing at 300'. Pumped 20 sacks of cement down tubing and circulated cement to surface between tubing & casing. Squeezed with 10 sacks of cement at 250 psi. Cut casing off 3' below G.L. capped casing 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

REMARKS: Why plugged? Hit 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

Address

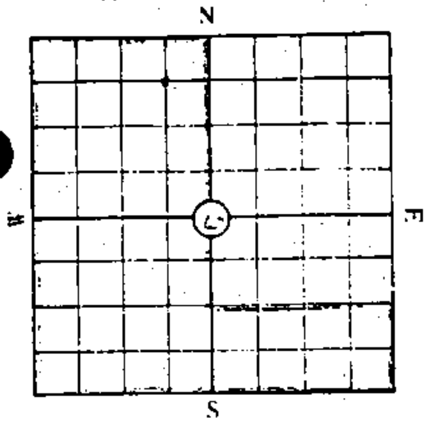
I, the undersigned, being duly sworn upon oath, state that this well record is true, correct and complete according to the records of this office and to the best of my knowledge and belief.

[signature]
Name and title of representative of company

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

Form No. 1003
(1970)

640 Acres



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 [illegible]

Office Address [illegible]

County [illegible] Sec. 6 Twp. [illegible] Range [illegible]

Location in Section C NE NW [illegible]

Farm Name [illegible] Well No. [illegible] Field [illegible]

Character of Well (whether oil, gas or dry) [illegible]

Commenced Plugging 1-2-71 Finished 1-6-71 Total Depth 1194

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

Signature of District Manager ____ Perforations: 1136-1165

Name of Field Supervisor [illegible]

Name of producing sand Dutcher Series Depth top 1115 Bottom 1165

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
Dutcher Series	Oil & Water	1115	1165	10	23	-0-
				7	1202	-0-

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:

Pressured to 1200 psi. Pumped 100 sacks of cement and displaced to [illegible] with 23 bbls mud and 12 bbls of water. W.O.C. 48 hrs. and perforated casing at 250'-252'. Pumped 175 sacks of cement down casing and circulated to the surface outside the casing.

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:

BE Davis

REMARKS: Why plugged? [illegible] If abandoned oil or gas well, state amount and date of last production
-0- BOPD -0- BWPD 4-30-[illegible]

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 this office and to the best of my knowledge and belief.

[illegible signature]
Name and title of representative of company

Subscribed and sworn to before me this the [illegible] day of [illegible]

Form No. 1003
(1970)

640 Acres

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.

N
E W
S

Locate Well Correctly and Outline Lease

Company Operating: GETTY OIL COMPANY

Office Address: [illegible]

County: Muskogee Sec. 6 Twp. 14N Range 19E

Location in Section: [illegible]

Farm Name: [illegible] Well No. 2 Field: Muskogee

Character of Well (whether oil, gas or dry): Dry

Commenced Plugging: [illegible] Finished: [illegible] Total Depth: [illegible]

Was permission obtained from the Corporation Commission or its agents before plugging was commenced: [illegible]

Signature of District Manager: Perforations: —

Name of Field Supervisor: [illegible]

Name of producing sand: — 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
		—				

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:

Ran 2" tubing to 250'. Circulated cement down 2 3/8" tubing to the surface using 160 sacks of cement. Pulled tubing and filled hole with 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:

Aetna Oil

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

Dry Hole

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 this office and to the best of my knowledge and belief.

[illegible signature]

Name and title of representative of company

Subscribed and sworn to before me this [illegible] day of [illegible]

[illegible]

APPENDIX C
WATER WELL INVENTORY

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

OKLAHOMA WATER RESOURCES BOARD
600 N. HARVEY AVE.
P.O. BOX 150
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: MW03R

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

N

Type of work

- Geotechnical Boring
- Pump Well
- Monitor Well
- Observation Well
- Piezometer
- Plugging
- Pump Inst. *
- Reconditioning
- W.W. Test Hole
- De-watering
- Other

G.W. Use

- Domestic
- ☒ Non-Domestic

Specify Purpose: Monitoring Well

Drilling Method

- Hand Auger
- Cable Tool
- Air Rotary
- Fluid Rotary
- ☒ H.S. Auger
- S.S. Auger
- Rev. Rotary
- O.W. Rev. Rotary
- Other

Lithologic Log

Material	From	To
Fill: silty clay, tan	0	2
clay, tan and gray	2	35
Weathered shale, gray	35	39.5

* two additional monitor wells installed

RECEIVED
DEC 21 1992
Oklahoma Water Resources Board

Non-Domestic Permitting

If this well is for other than domestic use ...

Permit No:

New Boring or Well Construction Data

Date Started 11-18-92 Completed 11-20-92

Firm Terracon Consultants, Inc.

Operator Allen Brantley

Type of Construction ☒ Open Hole ☐ Cased Hole

Hole Diameter 8" inches total depth 39.5 feet

Hole Diameter inches total depth feet

CASING RECORD

	diameter	from	to
Surface pipe	inches	feet	feet
Well casing	2" inches	-0.5 feet	39.5 feet
Well casing	inches	feet	feet
Well casing	inches	feet	feet

SCREEN or PERFORATION RECORD

Type and Slot Size	from	to
0.010 Slot Screen PVC	29.5 feet	39.5 feet

GRAVEL PACK

Type and Size	from	to
Colorado Silica 10/20	27.5 feet	39.5 feet

SEAL

Cement Grout Surface Seal Installed ☒ Yes ☐ No

	from	to
Type of Surface Seal Enviroagrout	0 feet	24.5 feet
Aquifer Seal Type 1/4" bentonite pellets	24.5 feet	27.5 feet

HYDROLOGIC DATA

First Water Zone Encountered 28.0 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 Terracon Consultants, Inc. Lic. No. OP-0315

Address 5865 S. Garnett Phone 918 250 0461

Signed [signature] Date 12-17-92

Pump installers Form On Back

04928521

KW

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:

I:\geo\86251dp2.3rd

- 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.

RQD%	Description of Rock Quality
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

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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.

I:\ge[illegible]5251dp2.3rd

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	Muskogee Landfill Muskogee, Oklahoma
DATUM	N272500.8 E2731415.1
ELEVATION	627.7 ft
DRILLING METHOD:	Hollow-stem augers, 3-½-inch x 7-inch O.D.
SAMPLING METHOD:	24-inch split spoon on 5-foot centers
BORING NO.	B-1
SHEET	1 OF 1
DRILLING START TIME	14:30
DRILLING START DATE	11/18/92
DRILLING FINISH TIME	15:30
DRILLING FINISH DATE	11/18/92
WATER LEVEL	
TIME	
DATE	
CASING DEPTH	
DRILL RIG	CME 75
ANGLE	Vertical
BEARING	
SAMPLE HAMMER TORQUE	FT.-LBS
SURFACE CONDITIONS	Dozer removed 3 to 4 feet of wet, loose soils so drilling rig could set up over boring location

DEPTH IN FEET (ELEVATION)	BLOWS/ 6 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			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_2O within interbedded silty clay @ 16 feet, ferrous staining, fossilized plant and animal detritus								
18			- interbedded shale with ferrous staining and weak cementation @ 20 feet, fossilized plant and animal detritus								
20	33,34 50										
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.

DRILLING CONTR

LOGGED BY Greg Hassett

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 five-foot centers		SHEET 1 OF 2
DATUM N271744.8 E2731158.9	ELEVATION 632.2 ft		

					DRILLING START	DRILLING FINISH
WATER LEVEL	18.1	17.3	9.82	9.25	TIME 09:00	TIME 10:00
TIME	10:25	10:50	12:45	13:30	DATE 11/18/92	DATE 11/18/92
DATE	11/18	11/18	11/18	11/18		
CASING DEPTH	NA	NA	NA	NA		

DRILL RIG: CME 75

ANGLE: Vertical   BEARING:

SAMPLE HAMMER TORQUE: FT.-LBS

SURFACE CONDITIONS: Level and flat on fill pad

DEPTH IN FEET (ELEVATION)	BLOWS/6 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
0–2			FILL, silty clay, tan								
2			- dark brown @ 2 ft								
3–5	push		- silty sand intermixed with clay @ 3 ft								
6			- silty clay @ 6 ft								
8			CLAY (CH), tan, homogeneous structure, ferrous nodules								
10–12	3,4,4										
15–17	5,5,7										
17			- black @ 17 ft								
20			- H_2O within 1-inch claystone layer @ 20 ft, silt partings, ferrous staining								
20–22	5,7,20'										
25–27	7,12,15										
28			SHALE, blue gray, weathered, fissile, dry								

DRILLING CONTR. Terracon Environmental, Inc.

LOGGED BY Greg Hassett

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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
		START TIME 09:00 / DATE 11/18/92
		FINISH TIME 10:00 / DATE 11/18/92

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DATUM	ELEVATION
DRILL RIG	SURFACE CONDITIONS
ANGLE	BEARING
SAMPLE HAMMER TORQUE	FT.-LBS

DEPTH IN FEET (ELEVATION)	BLOWS/ ~~6 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
	21,50		SHALE, blue gray, silty, weathered, fissile, dry								
32			TOTAL DEPTH @ 31 feet								
34			BOTTOM ELEVATION @ 601.2 feet								

DRILLING CONTR Terracon Environmental, Inc.

LOGGED BY Greg Hassett

Printed on recycled paper.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
Muskogee Landfill Muskogee, Oklahoma	Hollowstem Augers, 3¼-inch I.D. x 7-in O.D.	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			
CASING DEPTH	n/a			

DRILLING	START	FINISH
TIME	0900	1035
DATE	11/19/92	11/19/92

DATUM N272179.4 E2730189.7 ELEVATION 641.5 ft

DRILL RIG CME 75

ANGLE Vertical BEARING

SAMPLE HAMMER TORQUE FT.-LBS

SURFACE CONDITIONS Wet and muddy

DEPTH IN FEET (ELEVATION)	BLOWS/ 6 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
			Fill, silty clay, brown								
2											
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 CONTRACTOR Terracon Environmental Inc.

LOGGED BY Greg Hassett

Printed on recycled paper.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	Muskogee Landfill Muskogee, Oklahoma
DRILLING METHOD:	Hollowstem Augers, 3½-inch I.D. x 7-inch O.D.
SAMPLING METHOD:	24-inch split spoons on 5-foot centers
BORING NO.	B-3
SHEET	2 OF 2
DRILLING START TIME / DATE	09:00 / 11/19/92
DRILLING FINISH TIME / DATE	10:35 / 11/19/92
WATER LEVEL	14.5
TIME	10:04
DATE	11/19
CASING DEPTH	N/A
DATUM	
ELEVATION	
DRILL RIG	
ANGLE	
BEARING	
SAMPLE HAMMER TORQUE FT.-LBS	
SURFACE CONDITIONS	Wet and Muddy

DEPTH IN FEET (ELEVATION)	BLOWS/ 6 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
	7,9,16		CLAY (CH)								
32			- H_2O within 1-inch coal seam @ 30 feet								
34			- Coal seams, 32 to 35 feet								
36	21,50		SHALE, blue gray, weathered, fissile, dry								
38											
	50										
40											
42			TOTAL DEPTH @ 39.5 feet BOTTOM ELEVATION @ 602.00 feet								

DRILLING CONTR. Terracon Environmental, Inc.

LOGGED BY Greg Hassett

11/19/92

Printed on recycled paper.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:	DRILLING METHOD: Hollow Stem Auger with 3.25"ID x 7.25"OD augers.	BORING NUMBER: B-1
Muskogee Community Landfill 2801 S 54th Street W., Muskogee, Ok RUST Project # 86251	SAMPLING METHOD: 1.5" dia. Split-spoon (SS) and 3" dia. Shelby tube (ST)	Sheet 1 of 1

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME	TIME
TIME					17:30	18:45
DATE					DATE	DATE
CAVE DEPTH					9/27/93	9/27/93

DATUM: ft. MSL ELEVATION: 622.85

DRILL RIG: Mobil Drill B-61

ANGLE: Vertical BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

SURFACE CONDITIONS: clay, flat, moist ground. Boring relocated inside property boundary

N = 271199.00 E = 2731376.00

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LAB CLASSIFICATION	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			SS		CL					
	THS			Brown SANDY CLAY (CL); damp, homogeneous structure, iron nodules	ST			21.8			3.14	
	THS	5		Tan & gray CLAY sandy clay interbed @ 5.0 to 5.2 ft	ST							
	C=3.0	65		- very stiff w/ root structures, slickensided cleavage planes; blocky structure @ 8 to 10 ft.	ST	NONE	CL	19.6			4.50	
10												
								15.3	41	27		
	2/4/7			- abundant root structures, slickensided cleavage planes @ 13 to 14.5 ft	SS		CL	18.9				
15												
	6/10/1[illegible]			- remnant bedding plane @ 18 to 19 ft	SS		CL	17.3	52	27		
				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								
20				Discontinue hollow-stem augering - resume w/ rotary operations @ 20 ft								
25												
30												

DRILLING CONTRACTOR A. W. Pool Clinton, Ok.

LOGGED BY G. Hassell CHECKED BY

DATE 09/27/93

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:
Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DATUM: Ft. MSL **ELEVATION:** 822.85

DRILLING METHOD: Air Rotary

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

BORING NUMBER: B-1

Sheet 1 of 1

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING	
START	FINISH
TIME	TIME
17:15	10:15
DATE	DATE
9/28/93	9/29/93

DRILLING CONTRACTOR A. W. Pool, Clinton, Oklahoma

DRILL RIG: Failing 1500

SURFACE CONDITIONS: N = 274298.94, E = 2731347.58

ANGLE: 0 **BEARING:** –

SAMPLE HAMMER TORQUE: ft.-lbs.

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	PERMEABLITY CM/SEC
							Tan severly 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'						
25			1	3>6"	77	32	Gray unweathered SHALEY LIMESTONE		Damp fine grained argillaceous matrix weak calcite cement, fossilifer-ous						
30															
							Dark gray Unweathered LIMEY-SHALE		Damp, well sorted, weak calcite cement, highly weathered zone @ 31.9 - 36.1						
35			2	0>8"	85	0									
							COAL		high grade coal						
							CLAYSTONE								
							LIMEY-SHALE								
40							Gray SHALEY-LIMESTONE		light gray, damp, well sorted, massive bedding weathered zone 41.2 - 42.6 fossiliferous @ 42.7 - 43.1						
			3	2>8"	100	45	LIMEY-SHALE		gray, dry, well sorted, calcitic cement						
45							TD @ 45 feet		TD @ 45 ft.						
50															
55															

CHECKED BY G. Hassett

LOGGED BY D.Smith

DATE 09/29/93

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:
Muskogee Community Landfill
2801 S 54th Street W., Muskogee, OK
RUST Project # 86251

DATUM: ft. MSL ELEVATION: 624.54

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

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

BORING NUMBER: **B-2**

Sheet 1 of 1

WATER LEVEL	DRY	15.0		
TIME	15:30	07:45		
DATE	9/15/93	9/16/93		
CAVE DEPTH	17.0	17		

DRILLING	
START	FINISH
TIME	TIME
11:45	14:30
DATE	DATE
9/15/93	9/15/93

DRILL RIG: Mobil Drill B-61

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	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
	4/7/11	100		Brown and tan CLAY (CL), damp, homogeneous structure, iron nodules, roots	SS		CL	19.3				
	2/2/2	100		- firm, brown, tan, and gray @ 2 - 4 ft.	SS		CL	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		CL	17.8				
	c=2.25	65		tan & gray w/ sand streaks (<2mm) & root structures below 8 ft.	ST		CL	18.5	48	32		
	TWS				TWS							
10						NONE						
	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	
15												
		100		hard below 18 ft.	SS			14.7	44	21		
20												
		100		wet at 24 ft.	SS			10.9				
				Discontinue Hollow-stem augering @ 24, continue w/ rotary @ 24 ft								
25												
30												

DRILLING CONTRACTOR *A. H. Pool* *Clinton, Ok.*

LOGGED BY *G. Hassell* CHECKED BY

DATE *09/15/93*

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:
Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 88251

DRILLING METHOD: air Rotary

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

BORING NUMBER: B-2

Sheet 1 of 1

DRILLING	START	FINISH
TIME	07:45	11:30
DATE	9/16/93	9/16/93

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DATUM: Ft. MSL ELEVATION: 624.54

DRILL RIG: Failing 1500

SURFACE CONDITIONS:

ANGLE: 0 BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 273771.17 E = 2731320.00

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TO	PERMEABILITY CM/SEC
25			1	110+ < 6"	100	0	Tan severly 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>6"	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 @ 38 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 (bivalves)	3" Core					
45			5	2>6"	94	40	LIMEY-SHALE		Damp fine grained, well sorted, firm calcareous cement, thin bedding planes (< 0.03 ft), 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. Hassett CHECKED BY
DATE 09/16/93

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:	DRILLING METHOD: Hollow Stem Auger with 3.25"ID x 7.25"OD augers. air coring	BORING NUMBER: B-3
Muskogee Community Landfill 2801 S 54th Street W., Muskogee, Ok RUST Project # 86251	SAMPLING METHOD: 1.5" dia. split-spoon (SS) and 3" dia. Shelby tube (ST)	Sheet 1 of 1

						DRILLING START	DRILLING FINISH
WATER LEVEL	4.0					TIME	TIME
TIME	11:45					14:45	17:15
DATE	9/16/93					DATE	DATE
CAVE DEPTH	7.0					9/15/93	9/15/93

DATUM: ft. MSL ELEVATION: 625.45

DRILL RIG: Mobil Drill B-61 SURFACE CONDITIONS: clay

ANGLE: Vertical BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs. N = 273305.18 E = 2731342.99

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
	4/4/4			Tan and brown CLAY (CL),damp,homogeneous structure, iron nodules roots	SS		CL	21.7 19.1	36	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		CL	21.1				
	TWS				TWS		CL					
	c=2.25	75			ST		CL	21.2				
	c=4.5	75		Tan CLAY w/ sand (CL) damp, homogeneous structure, slicken-sided cleavage planes concentration of iron nodules	TWS		CL	17.5	38	23		
10	4/4/6			- sandy clay pockets @ 10.5 ft	SS		CL	19.1				
		50		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		18.9	44	20		
15												
	31/50-4"			- moderate weathering; vertical fractures (0.03ft) w/ oxidized surfaces	SS			11.7	43	19		
20				- moderate weathering								
	50-5"				SS			11.8				
25				discontinue hollowstem augering @ 24,move 4' South, continue w/ rotary Begin air coring @ 20 ft.								
30												

DRILLING CONTRACTOR A. M. Pool Clinton, Ok.

LOGGED BY G. Hassett 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 # 86251	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
DATUM: Ft. MSL		
ELEVATION: 625.45		

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING	
START	FINISH
TIME	TIME
13:00	16:30
DATE	DATE
9/16/93	9/16/93

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/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	PERMEABILITY CM/SEC
			1	1 > 6"	100	10	Tan severly weathered CLAY-SHALE		Damp,fine-grained,well sorted, weak quartzitic cement,thin bedding planes (0.03 ');flat beddedoxidized surfaces; inclined fractures from 20° to 60° from horizontal, common						
25			2	1>6"	56	10			– ripple laminae w/ ripple marks, inclined fractures 15° to 20° from horiz. w/ oxidized surfaces, vertical fractures from 25 – 30 ft						
30			3	2>6"	100	28	Gray unweathered CLAY-SHALE		Damp,fine-grained,,well sorted, weak quartzitic cement,thin bedding planes,flat bedded vertical & 30° to 45° fractures w/ oxidized surfaces (<0.01 ft)						
35			4	3>6"	100	60			vertical & 30° to 60° fractures w/ secondary mineralization (calcite) & oxidation @ 35 to 40 ft.						
40			5	3>6"	63	38	Gray SHALEY-LIMESTONE		Damp, finely crystalline argillaceous matrix, firm calcareous cement thin (<0.03 ft) to thick bedding (1.0 ft) flat bedded, inclined fractures of 30°, cleavage planes & fracture planes w/ 2° min. (pyrite) – interbedded glauconitic shale @ 40.4 to 41.5 ft – ripple laminae w/ ripple marks @ 42.5 to 45 ft – shell hash @ 46.5 to 47 ft						
45			6	2>6"	100	35									
50							TD @ 48 feet								
55															

DRILLING CONTRACTOR A. N. Pool, Clinton, Oklahoma

LOGGED BY G. Hassett

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.	BORING NUMBER: B-4
	SAMPLING METHOD: Split-spoon (SS) with 2' drives and Shelby tube (ST)	Sheet 1 of 1

WATER LEVEL	dry			
TIME	17:30			
DATE	9/16/93			
CAVE DEPTH	13 ft			

DRILLING	START	FINISH
TIME	17:20	18:45
DATE	9/15/93	9/15/93

DATUM: ft. MSL ELEVATION: 627.88

DRILL RIG: Mobil Drill B-61 SURFACE CONDITIONS: clay

ANGLE: Vertical BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs. N = 272924.16 E = 2731350.25

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

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
	4/7/7			Tan CLAY (CL),damp,homogeneous structure, roots,iron nodules	SS		CL	19.1			22	
	c=3.0	100		Tan and Black CLAY (CH) damp,homogeneous,blocky structure, slicken-sided cleavage planes,iron nodules	ST		CL	15.8	42	25		
	c=3.0	100			ST		CL	21.4	40	25		
	TWS			tan & gray CLAY (CL) damp, homogeneous blocky structure, slicken-sided cleavage planes,iron nodules - poor sample reccovery @ 6 - 8 FT.	TWS		CL					
	c=4.5	95			ST	NONE	CL	22.2				
10							CL					
	C=4.25	77		bivalve fossil @ 0.5 inch @ 14 ft.	ST			18.8			5.00	
15				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								
	14/34/50				SS			14.7	44	20		
20				end hollowstem augering @ 19.5 ft, wet rotary from 20 to 48 ft								
25												
30												

LOGGED BY G. Hassell CHECKED BY

DATE 12/17/93

ROCK BOREHOLE LOG

SITE NAME AND LOCATION: Muskogee Community Landfill 2801 S. 54 Street W., Muskogee, Ok RUST Project # 88251	DRILLING METHOD: Wet Rotary Coring, 20 to 48 ft. SAMPLING METHOD: coring w/ 5.25" OD X 3" ID core barrel	BORING NUMBER: B-4 Sheet 1 of 1

WATER LEVEL	dry			
TIME	17:30			
DATE	9/16/93			
CASING DEPTH	(cave)@13.0			

DRILLING	START	FINISH
TIME	17:30	09:00
DATE	9/16/93	9/17/93

DATUM: Ft. MSL ELEVATION: 627.86

DRILL RIG: Failing 1500 SURFACE CONDITIONS: clay

ANGLE: 0 BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs. N = 272924.16 E = 2731350.25

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	PERMEABILITY CM/SEC
			1	1 > 6"	78	16	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 .025 - transmissive zone w/ severe weathering and bedrock intermixed w/ residual soil @ 30.8 to 32 ft.						
25			2	1>6"	100	10									
30			3	1>6"	85	20	Gray unweathered CLAY-SHALE		Damp, fine-grained, well sorted, firm quartzitic cement; thin bedding planes, (<0.03 ft) flat bedded						
35			4	3>6"	100	83			fine grained massive stratification, minor fractures (80° to vertical)						
40			5	2>6"	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.						
45			6	3>6"	100	81			coal seam @ 45.7 to 45.8 ft						
							Gray SHALEY-LIMESTONE		Dry, finely crystalline argillaceous and fosiliferous matrix; firm calcareous cement; massive bedding; abundant shell hash-bivalves						
							Gray LIMEY-SHALE		damp, fine-grained, goood sorting, firm calcareous cement, thin bedding planes (<0.03 ft) flat-bedded, glauconitic clay-shale interbeds						
50							TD @ 48 feet								
55															

DRILLING CONTRACTOR A. N. Pool Clinton, Oklahoma

LOGGED BY G. Hassett DATE 09/15/93

CHECKED BY ______ DATE ______

SOIL BOREHOLE LOG

SITE NAME AND LOCATION: Muskogee Community Landfill, 2801 S 54th Street W., Muskogee, Ok, RUST Project # 86251	BORING NUMBER: P-1/B-5
DRILLING METHOD: Hollow Stem Auger with 3.25"ID x 7.25"OD augers.	Sheet 1 of 1
SAMPLING METHOD: 1.5" dia. Split spoon (SS) and 3" dia. Shelby tube (ST)	

WATER LEVEL				
TIME				
DATE				
CAVE DEPTH				

DRILLING	
START	FINISH
TIME	TIME
08:00	09:10
DATE	DATE
10/21/93	10/21/93

DATUM: ft. MSL ELEVATION: 628.50

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/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
	c=1.5	37.5		Tan CLAY; damp, homogeneous structure, sandy pockets	ST		CL	23.5				
	c=2.5	82			ST		CL					
	c=3.0	75		- iron nodules @ 4 ft.	ST		CL	20.8	47	29		
	c=3.5	77		- tan & gray color, mottled appearance, blocky structure, black oxidized nodules @ 8 ft.	ST							
	c=3.0	75			ST	NONE	CL	19.1			3.83	88.0
10												
				- slickensided cleavage planes @ 13 ft.								
	c=4.25				ST							
15												
	37/50-5"			Tan severly weathered CLAY-SHALE; dry, homogeneous structure, relect 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. H. Pool Clinton, Ok.

LOGGED BY D. Smith CHECKED BY

DATE 12/21/93 DATE

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:
Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DATUM: Ft. MSL ELEVATION: 629.50

DRILLING METHOD: air-Rotary

SAMPLING METHOD: 3" ID X 5.25" OD
10 foot core barrel

BORING NUMBER: **P-1/B-5**

Sheet 1 of 4

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING	
START	FINISH
TIME	TIME
10:45	14:30
DATE	DATE
10/21/93	10/22/93

DRILL RIG: Badger 1250

ANGLE: 0 BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

SURFACE CONDITIONS:

N = 272591.38 E = 2731409.77

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

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	PERMEABLITY CM/SEC
							RED claystone		Red to purple, vertical fracture infilled w/ cement						
			1	23<6"	80	0	Gray moderately weathered CLAY-SHALE		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						
25															
			2	2>6"	80	18									
30							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				
35															
			3	8>6"	95	58									
40									- no transmissive zones						
45															
			4	4>6"	69	61									
50															
55			5	3>6"	80	27	gray SHALEY-LIMESTONE		Finely crystalline, strong calcareous cement, no						

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

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; 10 foot core barrel	Sheet 2 of 4
DATUM: Ft. MSL	ELEVATION: 629.50	

					DRILLING	
WATER LEVEL					START	FINISH
TIME					TIME: 16:45	TIME: 14:30
DATE					DATE: 10/21/93	DATE: 10/22/93
CASING DEPTH						

DRILL RIG: Badger 1250 — SURFACE CONDITIONS:

ANGLE: 0 — BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs. — N = 27259L38 E = 2731409.77

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TO	PERMEABILITY CM/SEC
							Glauconitic CLAY		wet, fine grained, well sorted						
60			5	3>6"	80	27	Gray SHALEY LIMESTONE		Finely crystalline, strong calcareous cement, argillaceous matrix, thin beds, ripple bedded, CLAY zones @ 57.8 - 58.2, 59.1 - 59.3, & 60.6 to 60.8 ft; wet, potentially transmissive zones						
							Gray LIMEY-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/ LIMEY SHALE - 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			7	2>6"	45	43									
80															
85			8	1>6"	86	80	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						
90															

DRILLING CONTRACTOR A. N. Pool, Clinton, Oklahoma

LOGGED BY D. Smith/G. Hassett CHECKED BY G. Hassett

DATE 10/22/93

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
DATUM: Ft. MSL	ELEVATION: 629.50		

WATER LEVEL					START	FINISH
					TIME	TIME
TIME					16:45	14:30
DATE					DATE	DATE
CASING DEPTH					10/21/93	10/22/93

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

DRILLING CONTRACTOR A. N. Pool Clinton, Oklahoma

LOGGED BY D. Smith/G. Hassell CHECKED BY G. Hassell

DATE 10/22/93

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:
Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: air-Rotary

SAMPLING METHOD: 3" ID X 5.25" OD
10 foot core barrel

BORING NUMBER: P-1/B-5

Sheet 4 of 4

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING	
START	FINISH
TIME	TIME
18:45	14:30
DATE	DATE
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 = 272591.38 E = 2731409.77

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	PERMEABILITY CM/SEC
			12	6>6"	100	48			- CLAY & CLAY-SHALES @ 127.5 to 128 ft						
130			13	1>6"	67	40	Gray SHALE		Damp, fine grained, well sorted, thin beds, ripple bedded,interbedded w/ CLAY, potentially transmissive						
							TD @ 133 FT								
135															
140															
145															
150															
155															
160															

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

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

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:	Muskogee Community Landfill 2801 S 54th Street W., Muskogee, Ok. RUST Project # 88251
DATUM:	ft. MSL
ELEVATION:	629.71
DRILLING METHOD:	Hollow Stem Auger with 3.25"ID x 7.25"OD augers.
SAMPLING METHOD:	CME 5 foot continuous sampler
BORING NUMBER:	P-2/B-6
	Sheet 1 of 2
DRILL RIG:	Mobil Drill B-61
SURFACE CONDITIONS:	clay
ANGLE:	Vertical
BEARING:	---
SAMPLE HAMMER TORQUE:	ft.-lbs.
	N = 272535.73 E = 2731414.18

WATER LEVEL				
TIME				
DATE				
CAVE DEPTH				

DRILLING	
START	FINISH
TIME	TIME
14:00	15:30
DATE	DATE
10/29/93	10/29/93

DRILLING CONTRACTOR A. W. Pool Clinton, Ok.

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
				Tan, SILTY CLAY; damp, homogeneous structure, occasional iron nodules	CME		CL	18.4				
							CL	2.1				
					CME							93.0
							CL	20.5				
							CL	21.3	48	30		
10					CME		CL	17.2				
							CL	23.8				
15				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	CME	NONE		11.9	42	26		
				- ferruginous cemented shale w/ secondary calcite mineralization @ 17 to 17.2 ft.				12.9				
20					CME							
				- moderately weathered @ 22 ft., gray, w/ vertical fractures, wet at 22 ft.				18.7	44	20		
25					CME							
				- numerous vertical fractures @ 27 - 32 ft.	CME							
30												

LOGGED BY G. Hassett CHECKED BY

DATE 12/21/93

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
	SAMPLING METHOD: CME 5 foot continuous sampler	Sheet 2 of 2
DATUM: ft. MSL ELEVATION: 629.71		

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME	TIME
TIME					14:00	15:30
DATE					DATE	DATE
CAVE DEPTH					10/29/93	10/29/93

DRILL RIG: Mobil Drill B-61	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	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
					CME	NONE						
				discontinue hollowstem augering @ 32 ft continue w/ rotary @ 32 ft								
40												
45												
50												
55												
60												

DRILLING CONTRACTOR A. M. Pool Clinton, Ok.

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

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:
Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: Air rotary

SAMPLING METHOD: 3" ID X 5.25" OD
10 foot core barrel

BORING NUMBER: P-2/B-6

Sheet 1 of 2

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING	
START	FINISH
TIME	TIME
09:50	11:45
DATE	DATE
10/30/93	10/30/93

DATUM: Ft. MSL   ELEVATION: 629.71

DRILL RIG: Badger 1250   SURFACE CONDITIONS: clay

ANGLE: 0   BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.   N = 272535.73 E = 2731414.16

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TO	PERMEABILITY CM/SEC
35			1	3>6"	77	19	Gray unweathered CLAY-SHALE		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 - 36.4'						
40									- broken zones @ 36.4 - 37.3', 40.6 - 41.9', 43.1 - 44.4'						
45			2	2>6"	92	32			- 40° angular fractures w/ pyrite in the fracture. 44.7 - 45.2' - 20° angular fractures w/ cement infill @ 47.9'						
50															
55			3	5>6"	100	8	SHALE & COAL		interbedded dark gray shale and coal (0.01')						
							Glauconitic CLAY		wet, light gray-green						
							Gray LIMESTONE		finely crystalline, strong calcitic cement, fossiliferous, interbeds of 0.1 ft thick clay.						
							Glauconitic CLAY		wet, slickensided cleavage planes						
							Medium gray SHALEY-LIMESTONE		strong calcareous cement, ripple bedded w/ shale interbeds						
60															
			4	2>6"	100	12	Gray LIMEY-SHALE		Thin beds, flat bedded, strong calcareous cement, broken zone @ 63.3 to 65.5, interbed of claystone @ 63.3 - 63.5						
65															

DRILLING CONTRACTOR A. W. Pool
Clinton, Oklahoma

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

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:
Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DATUM: Ft. MSL
ELEVATION: 829.71

DRILLING METHOD: Air rotary

SAMPLING METHOD: 3" ID X 5.25" OD
10 foot core barrel

BORING NUMBER: **P-2/B-6**

Sheet 2 of 2

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING	
START	FINISH
TIME 08:50	TIME 11:45
DATE 10/30/93	DATE 10/30/93

DRILL RIG: Badger 1250
SURFACE CONDITIONS: clay
ANGLE: 0
BEARING: –
SAMPLE HAMMER TORQUE: ft.-lbs.
N = 272535.73 E = 2731414.18

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

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	TEST RESULTS: PERMEABILITY CM/SEC
			4	2>8"	100	12	Gray LIMESTONE		strong calcareous cement, fossiliferous						
							COAL		fissile, vertical fractures						
							Gray CLAY-SHALE		dry, interbedded w/ clay						
							Gray LIMESTONE		Thin beds, flat bedded, weak calcareous cement, broken zone @ 63.3 to 65.5						
70							TD @ 70 ft.								
75															
80															
85															
90															
95															
100															

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

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-7

Sheet 1 of 1

WATER LEVEL	dry				
TIME	18:10				
DATE	9/18/93				
CAVE DEPTH	Cave @ 11 ft				

DRILLING	
START	FINISH
TIME	TIME
12:00	13:20
DATE	DATE
9/18/93	9/18/93

DATUM: ft. MSL ELEVATION: 623

DRILL RIG: Mobil Drill B-61
ANGLE: Vertical BEARING: ---
SAMPLE HAMMER TORQUE: ft.-lbs.

SURFACE CONDITIONS: Pit dug to remove saturated surface silt.
approximate elevation of 623 (-3 ft below surface)
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	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
	C=3.0	50		Tan CLAY (CL),dry,homogeneous structure,iron nodules & staining	ST		CL	25.8				
	c=4.5	75		Brown,Tan and gray @ 2 FT.	ST		CL	20.5	46	32		
	TWS				TWS							
	C=3.0	70		- black oxidation along remnant vertical fractures	ST		CL	20.2	46	31		
	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		12.1			5.38	
10												
	18/50-4"			- secondary mineralization and oxidation along bedding planes	SS			11.7				
15												
	48/50-3"			- oxidation along bedding planes	SS			11.7				
				Discontinue Hollowstem augering @ 18'9", resume w/ wet rotary at 20 ft								
20												
25												
30												

DRILLING CONTRACTOR A. W. Pool
Clinton, Ok.

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

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

WATER LEVEL					DRILLING START	DRILLING FINISH
TIME					TIME 08:15	TIME 10:30
DATE					DATE 9/30/93	DATE 9/30/93
CASING DEPTH						

DATUM: Ft. MSL ELEVATION: 823

DRILL RIG: Failing 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: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	TEST RESULTS: PERMEABILITY CM/SEC
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 o 0.05 ft tk) 22.0 to 23.7 ft. intermixed & interbedded w/ residual soil @ 22 to 26 ft.						
							Gray unweathered CLAY-SHALE		Damp, fine-grained, well sorted weak quartzitic cement, thin beds (<0.03 ft) flat bedded						
30							Black COAL		severly weathered and fractured high grade coal transmissive cross- bedded						
35			2	1 > 6"	55	20	Gray SHALEY-LIMESTONE		Finely crystaline, 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 (hair- line to 0.003 ft) at 2.5 ft separation @ 42 to 45.5 ft. interbedded w/ LIMEY-SHALE @ 41.7 to 44.5 ft						
45							TD @ 45 ft								
50															
55															

DRILLING CONTRACTOR A. W. 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. air coring. SAMPLING METHOD: 1.5" dia. Split-spoon (SS) and 3" dia. Shelby tube (ST)	BORING NUMBER: B-8
		Sheet 1 of 1

WATER LEVEL	dry			
TIME	18:08			
DATE	9/18/93			
CAVE DEPTH	Cave @ 12 ft			

DRILLING	
START	FINISH
TIME 9:55	TIME 11:05
DATE 9/18/93	DATE 9/18/93

DATUM: ft. MSL ELEVATION: 829.5

DRILL RIG: Mobil Drill B-61

ANGLE: Vertical BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

SURFACE CONDITIONS: brown soil, approximate elevation of 829.5 Boring was slightly offset to drill on level ground. N = 272795.17 E = 2730768.82

DRILLING CONTRACTOR A. W. Pool Clinton, Ok.

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
		100		Brown SILTY SAND, dry fine grained, well sorted	ST							
	TWS			Tan CLAY (CL), dry, homogeneous structure.	TWS		CL	20.2	49	32		
				- vertical sand pockets due to bioturbation			CL	18.5				
	c=4.5				ST							
				- damp, blocky structure, iron nodules			CL	21.4				74.0
	C=4.0	72			ST							
	c=4.0	70			ST	NONE						
10												
				Tan to gray severely weathered CLAY-SHALE; dry, well sorted. thin bedding w/ oxidized surfaces, vertical fractures, no fossils				18.8				
	c=4.25+	100			ST							
15												
	31/50-4.5"			- slicken-sided cleavage planes, iron nodules	SS			14.2				
				stopped hollowstem @ 19 ft								
20												
25												
30												

LOGGED BY D. Smith CHECKED BY

DATE 12/17/93

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:
Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DRILLING METHOD: air-Rotary

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

BORING NUMBER: B-8

Sheet 1 of 1

WATER LEVEL	8.8	8.7		
TIME	10:48	18:15		
DATE	9/23	9/23		
CASING DEPTH	Cave at 18.8			

DRILLING	
START	FINISH
TIME	TIME
14:25	16:15
DATE	DATE
9/22/93	9/22/93

DATUM: Ft. MSL ELEVATION: 629.5

DRILL RIG: Failing 1500

SURFACE CONDITIONS: loose silty sand

ANGLE: 0 BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 273752.17 E = 2730768.82

DRILLING CONTRACTOR A. M. Pool
Clinton, Oklahoma

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	PERMEABILITY CM/SEC
			1	25+ >6"	100	0	Tan and gray severly weathered CLAY-SHALE		wet (20 to 25 ft);fine grained, well sorted, thin bedding (<0.03 ft) flat bedded,angular fractures 30° to 60° w/ oxidized surfaces						
25			2	1>6"	100	31			- interbedded w/ severely weathered potentially transmissive zones; angular fractures 15° to 85° w/ oxidized surfaces						
30			3	8>6"	100	85	Gray unweathered CLAY-SHALE		- severely weathered potentially transmissive zones @ 30 to 32 ft damp,fine grained,well sorted,thin bedding (<0.03 ft) firm quartzitic cement,thin bedding (<0.03 ft),flat bedded, some fractures @ 45°						
35			4	3>6"	78	42	COAL Gray SHALEY-LIMESTONE		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						
40			5	2>6"	100	85			fossiliferous @ 44.0 - 45.0 ft						
45							TD @ 45 ft								
50															
55															

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

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	
	SAMPLING METHOD: 1.5" dia. Split-spoon (SS) and 3" dia. Shelby tube (ST)					Sheet 1 of 1	
						DRILLING	
						START	FINISH
	WATER LEVEL	7.3	2.2			TIME	TIME
	TIME	10:21	0950			10:15	11:30
	DATE	9/18/93	9/21			DATE	DATE
DATUM: ft. MSL ELEVATION: 625.12	CAVE DEPTH	8.3	2.8			9/17/93	9/17/93

DRILL RIG: Mobil Drill B-61 | 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	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		CL	21.8				
							CL	21.9				
				iron concretion and sand pockets @ 3ft	TWS							97.3
							CL	19.6				
	c=2.5	85		thin sand streaks (<0.01ft)	ST							
						NONE	CL	15.0			4.08	
	c=4.5+	50		- remnant bedding planes (<0.03ft) w/ oxidized surfaces, broken sample @ 8 to 8 ft., wet at 7 ft.	ST			17.6	37	22		
	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							
10												
								17.2	47	24		
	25/50 for 3"			- decreased residual soil content	SS							
15				discontinue hollowstem augering, resume w/ rotary @ 15 ft								
20												
25												
30												

DRILLING CONTRACTOR A. W. Pool, Clinton, Ok.

LOGGED BY G. Hassett CHECKED BY

DATE 09/17/93

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:	DRILLING METHOD: air-Rotary	BORING NUMBER:
Muskogee Community Landfill 2801 S. 54 Street W., Muskogee, Ok RUST Project # 88251	SAMPLING METHOD: 5 foot core 3" ID X 5.25" OD core barrel	B-9 Sheet 1 of 1
DATUM: Ft. MSL	ELEVATION: 625.12	

WATER LEVEL	1.7	10.0		
TIME	07:25	18:30		
DATE	9/22/93	9/23/94		
CASING DEPTH	Cave at 51.7'			

DRILLING	
START	FINISH
TIME	TIME
10:10	14:09
DATE	DATE
9/21/93	9/21/93

DRILL RIG: Failing 1500

SURFACE CONDITIONS: clay

ANGLE: 0

BEARING: –

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 273282.30 E = 2730777.70

DRILLING CONTRACTOR A. W. Pool Clinton, Oklahoma

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	TEST RESULTS: PERMEABILITY CM/SEC
			1	1>6"	98	13						
20			2	0>6"	80	0						
25			3	3>6"	90	46						
30			4		92	0						
35			5	2>6"	95	43						
40			6	3>6"	85	76						
45			7	2>6"	87	30						
50			8	1>6"	100	75						
55												
60												

SOIL DESCRIPTION OR ROCK LITHOLOGY	ROCK STRUCTURE
Gray weathered CLAY-SHALE	Damp, well sorted, thin bedding planes, oxidized surfaces highly fractured zones @ 15.1 - 15.5',16.3-16.6',17.3-18.0', 18.3-18.5' water @ 15.1 ft in fractures; vertical fracture w/ oxidation, weathering decreasing w/ depth
	20' - 45' angular fractures w/ oxidized surfaces
	angular fractures w/ oxidzdation - change in rock color +/- 2 ft from fracture surface (green to grey) @ 25 to 26.5 ft.
Gray unweathered CLAY-SHALE	Damp, well sorted, weak quartzile cement, very thin bedding
COAL	coal seam
LIMESTONE	Damp, finely crystalline argellaceous fine calcareous cement, fossili-ferous
Green CLAYSTONE	green, fine grained, weak calcareous cement
Gray SHALEY-LIMESTONE	Damp, finely crystalline, argellaceous, fine calcareous cement, ripple laminated, trace fossils along bedding
Gray LIMEY-SHALE	fine grain calcareous cement, thin bedding
Gray SHALEY-LIMESTONE	shell hash @ top of limestone Damp, finely crystaline argellaceous matrix, fine calcareous cement
Gray LIMEY-SHALE	fine grained calcareous cement, thin bedding fossiliferous at base of bed
COAL	coal seam
FIRECLAY	fine grained, soft, weakly cemented
Gray LIMEY-SHALE	as above, @ 45 to 48.3
TD @ 53 ft.	

LOGGED BY D.Smith

DATE 09/21/93

CHECKED BY G. Hassell

SOIL BOREHOLE LOG

SITE NAME AND LOCATION: Muskogee Community Landfill 2801 S 54th Street W., Muskogee, Ok RUSTProject # 86251	DRILLING METHOD: Hollow Stem Auger with 3.25"ID x 7.25"OD augers. air coring SAMPLING METHOD: 1.5" Split-spoon (SS) and 3" dia. Shelby tube (ST)	BORING NUMBER: B-10 Sheet 1 of 1
DATUM: ft. MSL ELEVATION: 830.98		

WATER LEVEL	dry			
TIME	10:18			
DATE	9/18/93			
CAVE DEPTH	Cave @ 11.5			

DRILLING	
START	FINISH
TIME	TIME
11:45	13:00
DATE	DATE
9/17/93	9/17/93

DRILL RIG: Mobil Drill B-61	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	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 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 homogeneous,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	NONE	CL	19.0			5.03	
10												
	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_2O @ 14 ft	ST			16.9	48	30		
15												
	25/30-5"			Tan severely weathered CLAY-SHALE	SS			18.8				
				discontinue hollowstem augering @ 19ft, resume w/ rotary operation @ 20 ft								
20												
25												
30												

DRILLING CONTRACTOR A. W. Pool Clinton, Ok.

LOGGED BY G. Hassell CHECKED BY

DATE 09/17/93 DATE

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 47 ft	BORING NUMBER: B-10
	SAMPLING METHOD: air coring w/ 3" ID X 5.25" ID core barrel; wet coring after 1st h_2 encountered	Sheet 1 of 1
DATUM: Ft. MSL	ELEVATION: 630.98	

WATER LEVEL	2.8			
TIME	07:30			
DATE	9/22/93			
CASING DEPTH	cave @ 28.0 ft			

DRILLING	
START	FINISH
TIME	TIME
14:25	16:45
DATE	DATE
9/21/93	9/21/93

DRILL RIG: Failing 1500

ANGLE: 0 BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

SURFACE CONDITIONS:

N = 272835.19 E = 2730778.24

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	PERMEABLITY CM/SEC
			1	22 < 8"	97	0	Tan and gray severly weathered CLAY-SHALE		Damp, well sorted, angular fractures (30° - 45°) w/ oxidized surfaces, vertical fractures wet zones @ 21.8 - 22.1 ft, 23.2 - 23.3 ft less weathered @ 23.5 ft						
25			2	25+< 8"	100	0			severely fractured, from vertical to parallel w/ bedding planes, vertical fractures up to 0.9 ft; severe weathering from 25 to 26.5 ft & 28.5 to 29.2 ft. severe weathering from 31.7 to 31.8 ft & 32.4 to 32.8 ft						
30			3		100	0									
35			4	3>6"	45	32	Gray unweathered LIMEY-SHALE		Damp, fine-grained, well sorted, firm quartzitic cement, thin bedding (< 0.03 '), flat bedded; angular fractures from 45° to 80°						
40			5	1>6"	100	100			weathered friable zone from 43.5 to 44.3 ft						
45			6	1=6"	25	25									
50							TD @ 47 feet								
55															

DRILLING CONTRACTOR A. W. Pool, Clinton, Oklahoma

LOGGED BY G. Hassell / D. Smith CHECKED BY

DATE 09/21/93 DATE

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:
Muskogee Community Landfill
2801 S 54th Street W., Muskogee, Ok
RUST Project # 86251

DATUM: ft. MSL — ELEVATION: 627

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-11
Sheet 1 of 1

WATER LEVEL				
TIME				
DATE				
CAVE DEPTH				

DRILLING	START	FINISH
TIME	08:53	10:30
DATE	9/24/93	9/24/93

DRILL RIG: Mobil Drill B-61
ANGLE: Vertical — BEARING: ---
SAMPLE HAMMER TORQUE: ft.-lbs.

SURFACE CONDITIONS: clay, approximate elevation at 627
75 ft w & 100 ft n of abandoned oil well
N = 272534.32 E = 2730734.81

DRILLING CONTRACTOR A. W. Pool Clinton, Ok.

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	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
	1/10/12				SS	NONE						
10				- drillers notice change in drill characteristics								
	18/50			Tan severely weathered CLAY-SHALE; dry, thin beds w/ some oxide along bedding planes fossiliferous (crinoid, fronds, bivalves) 2" iron stained zone.	SS							
15												
	32/50-3"			Gray moderately weathered @ 18 ft.	SS			5.8	40	19		
				discontinue hollowstem augering @ 18.75, resume w/ rotary @ 20ft								
20												
25												
30												

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

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*

WATER LEVEL	11			
TIME	10:08			
DATE	9/27/94			
CASING DEPTH	Cave at 29.0			

DRILLING	
START	FINISH
TIME	TIME
14:15	18:30
DATE	DATE
9/24/93	9/24/93

DATUM: Ft. MSL ELEVATION: 627

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/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TO	PERMEABLITY CM/SEC
20–25			1	1>6"	70	17	Tan moderately weathered CLAY-SHALE		wet (20-23 ft);fine grained, well sorted, weak quartzitic cement,thin bedding (< 0.03 ft),flat bedded, fractures 1 @ 80° & 1 at 30°) with oxidized surfaces. red LIMESTONE (fireclay) at 20.8 to 21.0 ft						
25–30			2	1>6"	92	23	Gray unweathered CLAY-SHALE		vertical fractures (5) from 25 to 27 ft;0.9 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; hairline vertical fractures @ 29.5 to 29.8 ft						
30–35			3	3>6"	98	48			calcite infilled fractures: 30° @ 31 and 32.5 ft; 80° @ 33 ft potentially transmissive zone @ 31.8 ft						
35–40			4	2>6"	100	31									
40–45			5	1>6"	100	92			highly fractured & wet @ 42 - 44 ft; 6" vertical fracture.						
45							TD @ 45 ft.								
50															
55															

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

LOGGED BY *G. Hassell/D. Smith* CHECKED BY

DATE *09/24/93*

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	BORING NUMBER: B-12
	SAMPLING METHOD: 1.5" dia. Split-spoon (SS) and 3" dia. Shelby tube (ST)	Sheet 1 of 1
DATUM: ft. MSL		DRILLING
ELEVATION: 827.85		START: TIME 14:45, DATE 9/27/93
		FINISH: TIME 18:25, DATE 9/27/93

WATER LEVEL				
TIME				
DATE				
CAVE DEPTH				

DRILL RIG: Mobil Drill B-61

SURFACE CONDITIONS: clay

ANGLE: Vertical BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272332.67 E = 2730611.57

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
	TWS			Tan and grey CLAY (CL),damp,homogeneous structure,iron nodules & iron staining	TWS		CL	21.4				
	c=2.75	65			ST		CL	20.1	48	32		
	TWS				TWS		CL					
	c=3.5	75			ST		CL	18.7			7.29	
	5/7/10				SS		CL	16.9				
10						NONE						
	4/10/21			remenant 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,interermixed w/ residual clay soils; limestone interbedded (fireclay) @ 18 TO 18.2 Ft.								
	0/22/24				SS			11.6				
20				discontinue hollowstem augering @ 19.5, resume w/ air rotary at 20 ft								
25												
30												

DRILLING CONTRACTOR A. W. Pool, Clinton, Ok.

LOGGED BY G. Hassell DATE 12/17/93

CHECKED BY

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:	DRILLING METHOD: air Rotary	BORING NUMBER: B-12
Muskogee Community Landfill 2801 S. 54 Street W., Muskogee, Ok RUST Project # 86251	SAMPLING METHOD: air coring w/ 5.25" OD X 3" ID core barrel	Sheet 1 of 1

WATER LEVEL	1.8			
TIME	12:58			
DATE	9/28			
CASING DEPTH	39.8			

DRILLING	START	FINISH
TIME	08:15	10:40
DATE	9/28/93	9/28/93

DATUM: Ft. MSL ELEVATION: 827.85

DRILL RIG: Failing 1500 SURFACE CONDITIONS: clay

ANGLE: 0 BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs. N = 272332.87 E = 2730811.57

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	PERMEABILITY CM/SEC
25			1		80	60	Tan and gray severely weathered CLAY-SHALE Black LIMESTONE Gray unweathered LIMEY-SHALE Black COAL Gray unweathered LIMEY-SHALE		Damp, fine-grained, well sorted; thin bedding (, 0.03ft) flat bedded, weak quartzitic cement, - red limestone (fireclay) @ 20.8 to 20.9 ft - interbedded red limestone (0.10 ft tk) from 20.9 to 24.2 ft (~0.25 ft apart) - vertical fracture in LS infilled w/ calcite (0.01' tk) Black fossiliferous LS @ 23.5 to 25.7 ft shaley coal seam @ 27.8 to 28 ft						
30 35			2		70	18	Gray CLAY-SHALE		Dry, fine-grained, well sorted, firm calcareous cement thin bedding flat bedded, abundant fossils (bivalves, trace fossils, fronds of some kind) Damp, fine-grained, well sorted, firm quartzitic cement, thin bedding flat bedded interbedded friable zones @ 30.0 to 30.5, 31.5 to 33.0 & 36.5 to 37 ft.						
40			3		70	31			interbedded friable zones @ 40.5 to 41.9						
45							TD @ 45 ft								
50															
55															

DRILLING CONTRACTOR A. W. Pool, Clinton, Oklahoma

LOGGED BY G. Hassett CHECKED BY

DATE 09/28/93

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
	SAMPLING METHOD: 1.5" dia. Split-spoon (SS) and 3" dia. Shelby tube (SP)	Sheet 1 of 1
DATUM: ft. MSL	ELEVATION: 628	

WATER LEVEL				
TIME				
DATE				
CAVE DEPTH				

DRILLING	START	FINISH
TIME	13:25	14:40
DATE	10/23/93	10/23/93

DRILL RIG: Mobil Drill B-61

ANGLE: Vertical BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

SURFACE CONDITIONS: clay, pit dug to remove saturated surface ~~site~~ silt. Approximate elevation of 628 (~25 ft. below surface) N = 274259.84 E = 2730237.50

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
	C=4.5	80		Tan CLAY (CH) homogeneous structure, iron nodules	ST			23.8	58	37		
	TWS	TWS			TWS							
	C=4.5	75		tan & gray @ 4 ft	ST			19.2				93.7
	C=4.5	75			ST			18.9				
	C=3.25	75		remnant bedding planes w/ oxidized surfaces @ 8 ft	ST							
10												
				Tan severely weathered CLAY-SHALE; dry, fine grained, well sorted, weak quartzite cement, thin bedding planes (<0.03 ft), flat bedded		NONE						
	7/50-5				SS			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. Hassett CHECKED BY

DATE 12/17/93

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	
	SAMPLING METHOD: 1.5" dia. Split-spoon (SS) and 3" dia. Shelby tube (SP)	Sheet 1 of 1	
		DRILLING	
		START	FINISH
	WATER LEVEL	TIME	TIME
	TIME	15:00	16:00
	DATE	DATE	DATE
DATUM: ft. MSL ELEVATION: 630.77	CAVE DEPTH	9/22/93	9/25/93

DRILL RIG: Mobil Drill B-61

SURFACE CONDITIONS: N = 274147.83, E = 2730251.18

ANGLE: Vertical BEARING: ---

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	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
				Brown SANDY SILT				23.6	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. Hassett CHECKED BY LB

DATE 09/22/93

ROCK BOREHOLE LOG

SITE NAME AND LOCATION: Muskogee Community Landfill 2801 S. 54 Street W., Muskogee,Ok RUST Project # 88251	BORING NUMBER: P-4/B138
DRILLING METHOD: air-Rotary	Sheet 1 of 4
SAMPLING METHOD: 3" ID X 5.25" OD 10 foot core barrel	
DATUM: Ft. MSL	ELEVATION: 630.77

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME	TIME
TIME					15:00	18:00
DATE					DATE	DATE
CASING DEPTH					9/22/93	9/25/93

DRILL RIG: Failing 1500

SURFACE CONDITIONS:

ANGLE: 0 BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 274147.83 E = 2730251.18

DRILLING CONTRACTOR A. N. Pool Clinton, Oklahoma

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	TEST RESULTS: PERMEABLITY CM/SEC
25			1	8>8"	80	37	gray severly 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 - 20° angular fractures w/ oxidation, potentially transmissive zones						
30															
35			2	8>8"	100	55	Gray unweathered CLAY-SHALE.		thin beds, flat bedded 20° angular fracture w/ cement infilling potentially transmissive zones @ 30.5 - 35.1 ft, 38.6 - 38.8 ft, weathered w/clay infilling						
40									- few fractures from 40 - 43.8 ft						
45			3	4>8"	70	54			potentially transmissive zone w/ secondary cementation in fractures @ 43.8 to 44.5 ft.						
50															
55			4	2>8"	100	58	gray SHALEY-LIMESTONE		Dry, finely crystalline, argellaceous matrix strong calcareous cement, thin beds,ripple to gnarly						

weathered friable zones 53

LOGGED BY D. Smith/G. Hassett CHECKED BY G. Hassett

DATE 09/22/93

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
DATUM: Ft. MSL	ELEVATION: 830.77	

					START	FINISH
WATER LEVEL					TIME	TIME
TIME					15:00	16:00
DATE					DATE	DATE
CASING DEPTH					9/22/93	9/25/93

DRILL RIG: Failing 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: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TO	PERMEABILITY CM/SEC
60			4	2>6"	100	58	Gray LIMEY-SHALE		fine grained, well sorted, strong calcareous cement, thin beds, ripple bedded to flat bedded, interbedded w/ broken, weathered, friable zones.						
65							SHALEY-LIMESTONE		- interbedded w/ weathered friable zones 5 @ 0.01 to 0.4 ft thick fossiliferous						
							COAL		highly fractured, vertical & horizontal.						
			5	1>6"	79	53	Gray LIMEY-SHALE		fine grained, well sorted, strong calcareous cement, thin beds, flat bedded - weathered potentially transmissive clayey zones @ 65.7 - 66.3'; 66.8 - 67.1'; 67.5 - 71'						
70									- vertical fracture @ 70.9 to 71 ft						
75									- calcite infilling between bedding planes 73 to 83 ft.						
			6	5>6"	100	31			- weathered friable zones @ 74.1 - 76';77.3 - 78';79 - 83'						
80															
85									- weathered friable zones @ 85 - 86.6';90.9 - 93'						
			7	4>6"	98	54									
90															

DRILLING CONTRACTOR A. N. Pool, Clinton, Oklahoma

LOGGED BY D. Smith/G. Hassell CHECKED BY G. Hassell

DATE 09/22/93

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, 10 foot core barrel	Sheet 3 of 4
DATUM: Ft. MSL	ELEVATION: 630.77	

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING	START	FINISH
TIME	15:00	18:00
DATE	9/22/93	9/25/93

DRILL RIG: Failing 1500

ANGLE: 0 BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

SURFACE CONDITIONS:

N = 274147.83 E = 2730251.18

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	PERMEABLITY CM/SEC
			7	4>6"	98	54									
95									- weathered friable zones @ 95 - 96.4'						
			8	3>6"	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 - weathered friable zones @ 97.5 - 98.9'						
100															
105															
			9	7>6"	100	87			thin (0.01 to 0.04 ft) interbedded sandstone @ 108 to 109 ft.						
110							Gray SANDSTONE		fine to medium grained,well sorted,strong quartzite cement, thin (<0.01) to medium (0.3); flat to ripple bedded 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						
115			10	6>6"	97	70			- 70° angle fault, offst 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 hairline fracture @ 117.5 to 118 ft - friable zones @ 118 - 118.6'						
120							LIMESTONE Gray SHALE		SHALE & LIMESTONE rip-up clasts @ 120.3 to 120.4 ft						
			11						wet, fine grained, well sorted, weak quartzite cement, thin beds, flat bedded - friable zones @						
125															

DRILLING CONTRACTOR Clinton, Oklahoma A. W. Pool

LOGGED BY D. Smith/G. Hassell CHECKED BY G. Hassell

DATE 09/22/93

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:	Muskogee Community Landfill 2801 S. 54 Street W., Muskogee,Ok RUST Project # 86251
DATUM: Ft. MSL	ELEVATION: 630.77
DRILLING METHOD:	air-Rotary
SAMPLING METHOD:	3" ID X 5.25" OD 10 foot core barrel
BORING NUMBER:	P-4/B13B
	Sheet 4 of 4

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING	START	FINISH
TIME	15:00	18:00
DATE	9/22/93	9/25/93

DRILL RIG: Failing 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: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	PERMEABLITY CM/SEC
			11												
							TD @ 128 FT		TD @ 128 ft						
130															
135															
140															
145															
150															
155															
160															

DRILLING CONTRACTOR A. N. Pool Clinton, Oklahoma

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

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	BORING NUMBER: P-5/B-14
	SAMPLING METHOD: Split-spoon (SS) with 2' drives and Shelby tube (ST)	Sheet 1 of 2

WATER LEVEL	dry				DRILLING START	FINISH
TIME	18:11				TIME 08:15	TIME 09:40
DATE	9/18/93				DATE 9/17/93	DATE 9/17/93
CAVE DEPTH	Cave @ 12 ft					

DATUM: ft. MSL ELEVATION: 630.47

DRILL RIG: Mobil Drill B-61 — SURFACE CONDITIONS: natural surface – sandy

ANGLE: Vertical BEARING: --- — N = 274121.25, 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	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
		100		Brown SILTY-SAND, dry fine grained, well sorted	CME							
				Tan CLAY (CL),dry,homogeneous structure,iron nodules,roots				17.4	50	34		
		100			CME			17.1				
				– remnant vertical fracture or shrinkage crack infilled with a black oxidized mineral (<0.01 ft) recent bioturbation @ 8 to 10 ft				23.5			2.97	
10		100			CME	NONE						
								18.0				
				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								
15		95			CME			13.1	35	14		
				– thin (<0.01ft) vertical fractures; intermixed w/ residual clay soil				14.3				
20		100		– claystone and water at 20 and 21 ft.	CME							
				– gray at 21.5 ft.				11.9				
25		100			CME							
				– wet at 27 to 29.5 ft.				15.4				
30		100			CME							

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

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	BORING NUMBER: P-5/B-14
	SAMPLING METHOD: Split-spoon (SS) with 2' drives and Shelby tube (ST)	Sheet 2 of 2
DATUM: ft. MSL; ELEVATION: 630.47		

WATER LEVEL	dry			
TIME	18:11			
DATE	9/18/93			
CAVE DEPTH	Cave @ 12 ft			

DRILLING	START	FINISH
TIME	08:15	09:40
DATE	9/17/93	9/17/93

DRILL RIG: Mobil Drill B-61
SURFACE CONDITIONS: natural surface - sandy
ANGLE: Vertical BEARING: ---
N = 274121.25, 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	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
		100		- wet at 32 to 35.5 ft.	CME							
		100			CME							
				Gray unweathered CLAY-SHALE: (dry, fine-grained, good sorting, strong clacareous cement, thin beds, flat-bedded								
				Discontinue Hollow-stem operations at 37 ft.								
40												
45												
50												
55												
60												

DRILLING CONTRACTOR A. N. Pool, Clinton, Ok.

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

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- 67 ft)	BORING NUMBER: P-5/B14
	SAMPLING METHOD: 5 foot CME continuous sampler (0-37ft); 10 foot core barrel; 3" ID X 5.25" OD	Sheet 1 of 1
DATUM: Ft. MSL	ELEVATION: 630.47	DRILLING START: TIME 16:00, DATE 9/27/93; FINISH: TIME 09:30, DATE 9/28/93

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILL RIG: Badger 1250
ANGLE: 0 BEARING: -
SAMPLE HAMMER TORQUE: ft.-lbs.
SURFACE CONDITIONS:
N = 274121.25 E = 2730239.37

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS DEPTH IN FEET FROM	TO	PERMEABILITY CM/SEC
							Grey unweathered CLAY-SHALE		dry, fine grained, well sorted, strong calcareous cement, thin beds flat bedded						
40			1	1>6"	83	20	Gray LIMEY-SHALE		- broken crumbly zones @37.5 to 38.1, 38.5 to 41, & 41.3 to 42.4 ft - wet @ 37.5 to 38.1 ft & damp @ 38.5 to 41.0 ft						
45															
									- broken zone @ 48.7 to 49.1						
50							COAL		- @ 49.8 to 50.1						
							GLAUCONITIC SHALE		- @ 50.1 to 50.7						
			2	3>6"	88	34	Fossiliferous LIMESTONE		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						
							Gray SILTY CLAY								
55							Gray SHALEY-LIMESTONE		finely crystalline, argillaceous matrix strong calcareous cement, thin beds, gnarly to flat bedded						
60									- broken zones @ 60.2 to 60.6, 61.3 to 61.7, 62.9 to 63.3 & 63.7 to 65.2 ft						
			3	5>6"	100	63									
65							COAL		COAL @ 65.2 to 65.5						
							SHALEY-LIMESTONE								
							Total Depth @ 67.5 ft.								
70															

DRILLING CONTRACTOR A. N. Pool, Clinton, Oklahoma

LOGGED BY G. Hassell CHECKED BY

DATE 09/28/93

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

WATER LEVEL	dry			
TIME	18:11			
DATE	9/18/93			
CAVE DEPTH	Cave @ 12 ft			

DRILLING	
START	FINISH
TIME 08:15	TIME 09:40
DATE 9/17/93	DATE 9/17/93

DATUM: ft. MSL ELEVATION: 832.5

DRILL RIG: Mobil Drill B-61

ANGLE: Vertical BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

SURFACE CONDITIONS: natural surface - sandy, approximate elevation of 832.5 ft. Boring was slightly offset to drill on level ground N = 273775.17, E = 2730257.84

DRILLING CONTRACTOR: W. Pool, Clinton, Ok.

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
		80		Brown SILTY SAND, dry fine grained, well sorted	ST	NONE	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			6.51	
	C=4.25	69		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				
10												
	31/50-4.5"			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		
15												
	18/31/50-3"			- thin (<0.01ft) vertical fractures; intermixed w/ residual clay soil	SS							
20				discontinue hollowstem augering @ 19.5 ft. resume w/ rotary operations @ 20 ft								
25												
30												

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
DATUM: Ft. MSL	ELEVATION: 632.5	

WATER LEVEL	5.5	8.1		
TIME	10:45	18:02		
DATE	9/23/93	9/23/93		
CASING DEPTH				

DRILLING	START	FINISH
TIME	10:30	14:10
DATE	9/22/93	9/22/93

DRILL RIG: Failing 1500

ANGLE: 0 BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

SURFACE CONDITIONS: natural surface - sandy southwest toe of stockpile

N = 2737754.17 E = 2730257.64

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TO	PERMEABILITY CM/SEC
20–25			1	25<6"	100	0	Tan and gray severly weathered CLAY-SHALE		wet (20 to 23.8 ft);fine grained,well sorted, weak quartzitic cement thin bedding (<0.03 ft) flat bedded, angular fractures of 30° to 45° w/ oxidized surfaces, intermixed & interbeddded w/ residual clay soils						
25–30			2	4>6"	100	80			grey @ 25 ft severly weathered potentially transmissive zone @ 25.4 to 25.5 ft & 29.4 to 29.5 ft. angular fractures from 15° to 80° (, 0.01 ft); vertical fracture infilled w/ secondary mineralization (0.01 ft)						
30–35			3	5<6"	23	0	Gray unweathered CLAY-SHALE		damp,fine grained,well sorted, firm quartzitic cement,thin bedding flat bedded						
35–40			4	4>6"	100	83	Gray LIMEY-SHALE		damp,fine grained,well sorted, firm calcareous cement,thin bedding (< 0.03 ft) flat bedded; angular fractures 30° to 45° w/ secondary mineralization						
40–45			5	1>6"	60	13	COAL		coal seam @ 41.7 - 41.9 ft.						
							Gray SHALEY-LIMESTONE		Dry to damp,finely crystalline; firm calcareous cement, thin bedding (<0.030 ft),flat bedded; interbedded w/ a GLAUCONITIC CLAY-SHALE						
45							TD @ 45 ft								
50															
55															

DRILLING CONTRACTOR Clinton, Oklahoma A. W. Pool

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 # 86251

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

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

BORING NUMBER: B-16

Sheet 1 of 1

WATER LEVEL	10.9			
TIME	10:10			
DATE	9/18/93			
CAVE DEPTH	Cave @ 11.3 ft			

DRILLING	
START	FINISH
TIME	TIME
15:55	17:15
DATE	DATE
9/17/93	9/17/93

DATUM: ft. MSL ELEVATION: 830.5

DRILL RIG: Mobil Drill B-61

ANGLE: Vertical BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

SURFACE CONDITIONS: natural surface - sandy, approximate elevation of 830.5 ft. Boring was slightly offset to drill on level ground, N = 273275.35 E = 2730270.72

DRILLING CONTRACTOR J. N. Pool Clinton, Ok.

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
	c=4.25	54		Brown and tan CLAY (CH) moist, homogeneous structure, iron nodules	ST			19.8				
				- sandy clay pockets (from bioturbation) from 2 - 8 ft.								
	c=2.75	80			ST			21.7	47	32		
	c=2.5	58			ST							
				- interbedded w/ fossils (crinoid fronds, bivalves), iron staining								
	C=2.5	79			ST			18.8				
10	THS				THS	NONE						
				- wet at 11.0'								
		100		Tan severely weathered CLAY-SHALE; dry, thin bedding planes, 30 - 40° fractures with oxidized surfaces.	SS							
15												
	35/50-5"				SS							
				discontinue hollowstem augering @ 19 ft. resume w/ rotary operations @ 20 ft								
20												
25												
30												

LOGGED BY D. Smith
DATE 01/06/94
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 SAMPLING METHOD: 5 foot core 3" ID X 5.25" OD	BORING NUMBER: **B-16** *Sheet 1 of 1*
DATUM: Ft. MSL	ELEVATION: 830.5	

					START	FINISH
					DRILLING	
WATER LEVEL	3.7	3.7			TIME	TIME
TIME	10:37	15:46			07:30	10:30
DATE	9/23/93	9/23/93			DATE	DATE
CASING DEPTH					9/22/93	9/22/93

DRILL RIG: Failing 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/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	PERMEABLITY CM/SEC
			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.						
25									highly weathered friable zone @ 25.4 to 26.8 ft						
			2		95	0									
30															
			3	2>8"	100	22	Gray unweathered CLAY-SHALE		damp,fine grained,well sorted, weak quartzitic cement angular fractures of 30°						
35									core came up at 1 to 2" pieces						
			4	36<8"	88	0									
40															
			5	1>6"	30	38	COAL CLAY Gray LIMESTONE		coal seam @ 42.3 to 42.6 ft; clay from 42.6 to 42.9 ft finely crystalline; fine calcareous cement, argillaceous matrix fossiliferous						
45			5	3<6"											
							TD @ 47 ft								
50															
55															

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

LOGGED BY *D. Smith* CHECKED BY

DATE *09/22/93*

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-17
	SAMPLING METHOD: 1.5" dia.Split-spoon (SS) and 3" dia. Shelby tube (ST)	Sheet 1 of 1
DATUM: ft. MSL ELEVATION: 833.38		DRILLING

WATER LEVEL	DRY				START	FINISH
TIME	10:13				TIME 14:00	TIME 15:40
DATE	9/18/93				DATE 9/17/93	DATE 9/17/93
CAVE DEPTH	Cave @ 12.2 ft					

DRILL RIG: Mobil Drill B-61 — SURFACE CONDITIONS: natural surface - sandy

ANGLE: Vertical — BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs. — N = 272830.40 E = 2730278.21

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
	c=4.5+			Brown and tan CLAY (CH) damp, homogeneous structure, roots	ST			20.6				
				- gray @ 2 ft with sand streaks				25.6	55	37		
	c=1.5	82			ST							
	c=1.5	70			ST			22.2			3.72	
				- slickensided cleavage planes, blocky structure & iron nodules @ 8 ft.								
	C=2.0	8			ST							94.9
	c=2.75	68			ST	NONE		20.7				
10												
								21.3	52	35		
	c=2.75	68			ST							
15				- slickensided cleavage planes @ 15 ft.								
	50 for 5"			Tan severely weathered CLAY-SHALE	SS			12.0				
				discontinue hollowstem augering @ 19 ft. resume w/ rotary operations @ 20 ft								
20												
25												
30												

DRILLING CONTRACTOR A. W. Pool Clinton, Ok.

LOGGED BY D. Smith CHECKED BY

DATE 09/17/93

ROCK BOREHOLE LOG

SITE NAME AND LOCATION: Muskogee Community Landfill 2801 S. 54 Street W., Muskogee, Ok RUST Project # 86251	DRILLING METHOD: air-Rotary - 20 to 25 ft wet-rotary - 25 to 45 ft SAMPLING METHOD: 5 foot core 3" ID X 5.25" OD	BORING NUMBER: B-17 Sheet 1 of 1
DATUM: Ft. MSL ELEVATION: 633.38		

WATER LEVEL	17			
TIME	10:15			
DATE	9/27/93			
CASING DEPTH	cave @ 27 ft			

DRILLING	
START	FINISH
TIME 10:45	TIME 14:00
DATE 9/24/93	DATE 9/24/93

DRILL RIG: Failing 1500

SURFACE CONDITIONS: clay

ANGLE: 0   BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272830.40 E = 2730278.21

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	PERMEABLITY CM/SEC
			1	2 >6"	92	23	gray LIMESTONE Tan & gray weathered CLAY-SHALE red LIMESTONE Gray weathered CLAY-SHALE		Finely crystalline; argillaceous matrix, fine calcareous cement, fossiliferous Tan to grey, slightly weathered wet zone @ 21.3 - 23.0 Homogeneous structure, oxidized thin bedding planes, vertical fracture from 23.9 to 24.9 ft. core run #2 - highly weathered w/ iron staining						
			2		96	0									
30			3	2>6"	92	33	Gray unweathered CLAY-SHALE		damp, fine grained, well sorted, quartzite cement, angular fractures at 30° to 45° w/ oxidized surfaces, vertical fracture w/ oxide staining from 30 to 31 ft.						
35			4	2>6"	83	58									
40			5	1>6"	58	47			one fracture @ 80° from horiz approx. 0.8 ft long infilled w/ secondary mineralization						
45							TD @ 45 ft								
50															

DRILLING CONTRACTOR A. W. Pool, Clinton, Oklahoma

LOGGED BY D. Smith   CHECKED BY

DATE 09/24/93   DATE

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
	SAMPLING METHOD: 1.5" dia.Split-spoon (SS) and 3" dia. Shelby tube (ST)	*Sheet 1 of 1*
DATUM: ft. MSL **ELEVATION:** 628.85		

WATER LEVEL				
TIME				
DATE				
CAVE DEPTH				

DRILLING	START	FINISH
TIME	13:40	13:50
DATE	9/18/93	9/18/93

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/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 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	65			ST		CL	19.0	47	31	3.80	
	TWS	NR			TWS							
10	C=4.5	50		Tan CLAY (CL):damp, homogeneous structure, abundant iron nodules	ST	NONE	CL	20.5	34	20		
15	C=2.5	65		- no iron nodules, blocky structure, slicken-sided cleavage planes from 13 to 15 ft	ST		CL	18.8				
	38/50-3"			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. W. Pool, Clinton, Ok.

LOGGED BY G. Hassell CHECKED BY

DATE 01/06/94

ROCK BOREHOLE LOG

SITE NAME AND LOCATION: Muskogee Community Landfill, 2801 S. 54 Street W., Muskogee, Ok, RUST Project # 86251	DRILLING METHOD: air Rotary 20 - 25 ft; wet rotary 25 - 45 ft. with potable water	BORING NUMBER: B-18	
	SAMPLING METHOD: coring w/ 5.25" OD X 3" ID core barrel	Sheet 1 of 1	
		DRILLING	
		START	FINISH

WATER LEVEL	4.95	4.9			TIME	TIME
TIME	13:41	17:12			07:45	09:43
DATE	9/23/93	9/23			DATE	DATE
CASING DEPTH	41.9				9/23/93	9/23/93

DATUM: Ft. MSL ELEVATION: 628.85

DRILL RIG: Failing 1500 — SURFACE CONDITIONS:

ANGLE: 0 BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs. — N = 27240158 E = 2730290.32

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TO	PERMEABILITY CM/SEC
20–25			1	3>6"	100	35	Tan severly weathered CLAY-SHALE		wet (20 to 22 ft),fine-grained, well sorted, weak quartzitic cement, thin bedding (<0.01ft), ripple laminated, bioturbation, fractures 60° to vertical w/ oxidized surfaces; - friable @ 25 to 26 ft.						
25–30			2	1>6"	100	52	Gray unweathered CLAY-SHALE		Damp, fine-grained, well sorted, firm calcareous cement, thin bedding planes (< 0.03 ') flat bedded						
30							COAL		COAL seam @ 29.5 to 29.7 ft						
30–35			3	2>6"	100	75	Gray CLAY-SHALE		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						
35–40			4	2>6"	100	27									
40–45			5		88	51			- Claystone @ 41 ft						
45							TD @ 45 feet								
50															
55															

DRILLING CONTRACTOR A. N. Pool, Clinton, Oklahoma

LOGGED BY G. Hassett CHECKED BY

DATE 09/23/93

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
	SAMPLING METHOD: CME continuous sampler 0 – 12 ft; Shelby tube (ST) 12 – 24 ft	Sheet 1 of 1
DATUM: ft. MSL		
ELEVATION: 638.56		

WATER LEVEL				
TIME				
DATE				
CAVE DEPTH				

DRILLING	START	FINISH
TIME	10:30	13:15
DATE	10/18/93	10/18/93

DRILL RIG: Mobil Drill B-61

SURFACE CONDITIONS: clay

ANGLE: Vertical BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 271707.818 E = 2730467.610

DRILLING CONTRACTOR A. N. Pool Clinton, Ok.

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
	2/2	100		Fill, tan clay	CME							
	5/5	100			CME							
10	5/5	100			CME							
	C=2.5				ST	NONE						
15	C=0.75				ST							
	C=0.50			- wet at 18 ft.	ST							
	C=0.25				ST							
20	C=2.5			Tan and gray CLAY (CH); damp, common to abundant iron nodules	ST		CL	22.1				
	C=2.0				ST		CL	21.5			3.05	
25				Gray severely weathered CLAYSTONE and SHALE								
				Discontinue Hollow-stem augering at 26' resume with rotary to completion depth								
30												

LOGGED BY G. Hassell CHECKED BY LB

DATE 10/18/93

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:	DRILLING METHOD: Air-Rotary	BORING NUMBER: B-19
Muskogee Community Landfill 2801 S. 54 Street W., Muskogee, Ok RUST Project # 86251	SAMPLING METHOD: 3" ID X 5.25" OD core barrel	Sheet 1 of 2

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME	TIME
TIME					09:45	12:30
DATE					DATE	DATE
CASING DEPTH					10/23/93	10/23/93

DATUM: Ft. MSL ELEVATION: 838.56

DRILL RIG: Badger 1250 | SURFACE CONDITIONS:

ANGLE: 0 BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	TEST RESULTS: PERMEABILITY CM/SEC
							Tan weathered CLAY-SHALE		Wet; fine-grained, good sorting; thin beds; flat-bedded; numerous fractures with oxidation						
			1	2>8"	73	58	Black CLAY (CL)		wet, fine grained, good sorting, thin beds, flat-bedded, interbedded with organic clay-shale - Coal seam @ 28.4 to 28.5 ft - Limestone @ 28.8 to 28.9 ft						
35							Gray moderately weathered CLAY-SHALE		- Coal seams @ 28.9 to 29.1, 29.7 to 29.8, 31.0 to 31.1, and 31.8 to 31.9 ft. Dry; fine-grained; good sorting; weak quartzitic cement, thin beds; flat to ripple-bedded						
			2	3>6"	90		Gray LIMESTONE, fossiliferous		Fine to medium crystalline; thin beds; ripple-bedded; abundant fossils; carbonate material along bedding planes						
							COAL		Thin vertical fracture, hairline, thin to medium beds						
40							Gray SHALEY-LIMESTONE		finely crystalline; strong calcareous cement; thin beds; flat-bedded to ripple-bedded, trace fossils - Clay-shale at 40.6 to 40.7 ft.						
45															
			3	4>8"	90	57	Gray LIMEY-SHALE		Fine-grained; good sorting; thin beds; flat to ripple bedded; strong calcareous cement - Clay weathering at 47 to 48 ft.						
50							Gray SHALEY-LIMESTONE		Finely crystalline; strong calcareous cement; thin-beds, ripple-bedded, some fossils - fossiliferous at 48 to 51.9 ft.						
							Gray CLAY w/ interbedded CLAY-SHALE		Damp; fine-grained, good sorting, weak quartzitic cement; thin beds; ripple-bedded						
55															

DRILLING CONTRACTOR A. W. Pool Clinton, Oklahoma

LOGGED BY G Hassell CHECKED BY LB

DATE 10/23/93

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:
Muskogee Community Landfill
2801 S. 54 Street W., Muskogee, Ok
RUST Project # 86251

DATUM: Ft. MSL   ELEVATION: 638.56

DRILLING METHOD: Air-Rotary	BORING NUMBER: B-19
SAMPLING METHOD: 3" ID X 5.25" OD core barrel	Sheet 2 of 2

WATER LEVEL					DRILLING START	DRILLING FINISH
TIME					TIME 09:45	TIME 12:30
DATE					DATE 10/23/93	DATE 10/23/93
CASING DEPTH						

DRILL RIG: Badger 1250   SURFACE CONDITIONS:
ANGLE: 0   BEARING: -
SAMPLE HAMMER TORQUE: ft.-lbs.

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TO	PERMEABILITY CM/SEC
			3	4>6"	90	57	Gray SHALEY-LIMESTONE		Dry; finely crystalline; strong calcareous cement; thin-beds; ripple-bedded; abundant fossils and carbonate between beds						
			4		100	85	Gray LIMEY-SHALE		Damp; fine-grained; strong calcareous cement; thin beds; ripple-bedded; common fossils, 1-45° fracture with pyrite crystals along plane						
							Gray CLAY-SHALE		Damp; fine-grained; good sorting; strong quartzitic cement, thin beds; flat-bedded						
							Total Depth at 61 ft.								
65															
70															
75															
80															
85															

DRILLING CONTRACTOR A. W. Pool
Clinton, Oklahoma

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

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. SAMPLING METHOD: 1.5" dia.Split-spoon (SS) and 3" dia. Shelby tube (ST)	BORING NUMBER: **B-20A** Sheet 1 of 1	
DATUM: ft. MSL	ELEVATION: 832.43		

WATER LEVEL	1.8			
TIME	18:17			
DATE	9/18/93			
CAVE DEPTH	22.5'			

DRILLING	
START	FINISH
TIME	TIME
15:25	17:10
DATE	DATE
9/18/93	9/18/93

DRILL RIG: Mobil Drill B-61
SURFACE CONDITIONS: clay
ANGLE: Vertical BEARING: ---
SAMPLE HAMMER TORQUE: ft.-lbs.
N = 272151.22 E = 2730203.50

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
	C=4.5	85		Tan CLAY (CL);dry, homogeneous structure, iron nodules	ST.		CL	14.0				
	C=4.5	10			ST		CL	18.6	54	37		
	C=3.0	85			ST			21.5			1.48	
	C=3.5	85		- blocky structure, clayey sand pockets due to bioturbation @ 6-8 ft	ST		CL					
10	C=4.0	70		Tan and gray CLAY (CH);damp, homogeneous, blocky structure, slicken-sided cleavage planes	ST			19.6				92.9
15	C=3.5	85		- iron nodules @ 13 ft from 13 to 15 ft	ST	NONE						
20	1/24/30			Tan and gray CLAY (CL);damp, remnant bedding planes (<0.03ft) with oxidized surfaces, vertical fractures (<0.01ft) with stained oxidized surfaces - COAL seam W/ H_2O @ 21 ft	SS							
25	8/41/50			- red, gray, and tan CLAY, fractures of 30° to 70° with oxidized surfaces @ 23 ft.	SS		CL	19.8				
30				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 Total Depth at 28.5 ft.				17.7				

DRILLING CONTRACTOR A. W. Pool Clinton, Ok.

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

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:
Muskogee Community Landfill
2801 S. 54 Street W., Muskogee,Ok
RUST Project # 88251

DRILLING METHOD: air-Rotary

SAMPLING METHOD: 3" ID X 5.25" OD
10 foot core barrel

BORING NUMBER: P-8/B208

Sheet 1 of 5

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING	
START	FINISH
TIME	TIME
13:15	13:30
DATE	DATE
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 = 272155.28 E = 2730185.25

DRILLING CONTRACTOR A. W. Pool Clinton, Oklahoma

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	PERMEABILITY CM/SEC
0–18 (5, 10, 15)							FILL; tan, clay								
18–25 (20, 25)							Tan and gray CLAY								
25–32 (30)			1	1>6"	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.						
32–34.5			2		100	39	Severly weathered CLAY-SHALE		Dark gray to maroon CLAY-SHALE interbedded w/ residual clay, slicken-sided cleavage planes						
34.5–35 (35)							Gray unweathered CLAY		[illegible]						

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

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:	DRILLING METHOD: air-Rotary	BORING NUMBER: P-8/B20B
Muskogee Community Landfill 2801 S. 54 Street W., Muskogee,Ok RUST Project # 88251	SAMPLING METHOD: 3" ID X 5.25" OD 10 foot core barrel	Sheet 2 of 5

WATER LEVEL					DRILLING START	DRILLING FINISH
TIME					TIME 13:15	TIME 13:30
DATE					DATE 9/21/93	DATE 9/24/93
CASING DEPTH						

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 = 272155.28 E = 2730185.25

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	TEST RESULTS: PERMEABILITY CM/SEC
40			2		100	39	Gray unweathered SILTY CLAY-SHALE		weak cementation, structureless						
45			3	4>6"	81	52	Gray unweathered CLAY-SHALE		Thin bedding planes, strong quartzite cement						
							Gray SANDSTONE		Medium grained, fine quartzite cement, well sorted, 43 to 43.2 ft.						
							Gray CLAY-SHALE		- interbedded w/ thin (<0.02") stringers of SS, fossiliferous, cross-stratification @ base						
							gray LIMESTONE								
							Dark gray SHALE								
50							LIMEY-SHALE		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						
55			4	50<6"	71	0	Med gray CLAY-SHALE		thin horizontal bedding, fissil						
60															
65			5	4>6"	94	78	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 63.8 ft vertical fracture w/ pyrite crystals @ 64.6 to 67.3						
70															

DRILLING CONTRACTOR A. W. Pool Clinton, Oklahoma

LOGGED BY D. Smith/G. Hassett CHECKED BY G. Hassett

DATE 09/24/93

ROCK BOREHOLE LOG

SITE NAME AND LOCATION:
Muskogee Community Landfill
2801 S. 54 Street W., Muskogee,Ok
RUST Project # 86251

DATUM: Ft. MSL ELEVATION: 841.47

DRILLING METHOD: air-Rotary

SAMPLING METHOD: 3" ID X 5.25" OD
10 foot core barrel

BORING NUMBER: P-8/B20B

Sheet 3 of 5

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING	START	FINISH
TIME	13:15	13:30
DATE	9/21/93	9/24/93

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

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

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TO	PERMEABILITY CM/SEC
			5	4>6"	94	76								
75			6	6>6"	83	71								
80							COAL seams	LIMEY-SHALE w/ interbedded COAL seams						
							Gray SHALEY-LIMESTONE	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 @ 89.6 to 89.7 & 90.2 to 90.3 ft						
85			7	4>6"	100	59								
90							Gray LIMEY-SHALE	fine grained, well sorted, strong calcareous cement, thin beds, flat to ripple bedded - weathered, friable SHALE @ 93.5 to 94.9 ft						
95			8	3>6"	100	44	Gray SHALEY-LIMESTONE	fine crystalline, argellaceous and fossil matrix medium beds, flat bedded						
							COAL							
							Gray SILTY-CLAY	potentially transmissive, interbedded w/ SHALE						
							Gray SHALEY-LIMESTONE	Finely crystalline, argellaceous 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 - weathered friable SHALE @ 104.3 to 108.6 ft						
			9	3>6"	95	41								
105														

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

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, 10-foot core barrel	Sheet 4 of 5
		DRILLING — START TIME 13:15, DATE 9/21/93; FINISH TIME 13:30, DATE 9/24/93
DATUM: Ft. MSL ELEVATION: 841.47	WATER LEVEL / TIME / DATE / CASING DEPTH	
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/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS DEPTH IN FEET FROM	TO	PERMEABILITY CM/SEC
			9	3>8"	95	41									
110									- interbedded, weathered, friable SHALE @ 109.3 to 111 ft						
									- weathered, friable zones @ 112.5 to 112.9 & 115.4 to 118.8 ft						
115			10	4>8"	77	35									
120									- weathered, friable zones @ 121 to 122.9						
									- interbedded, weathered friable zone @ 123 to 127 ft						
125			11		95	35									
							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)						
130															
135			12	3>8"	100	100									
140															

DRILLING CONTRACTOR A. W. Pool, Clinton, Oklahoma

LOGGED BY D. Smith/G. Hassell   CHECKED BY G. Hassell

DATE 09/24/93

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/B208**	
	SAMPLING METHOD: 3" ID X 5.25" OD, 10 foot core barrel	*Sheet 5 of 5*	
		DRILLING	
		START	FINISH
		TIME	TIME
		13:15	13:30
		DATE	DATE
DATUM: Ft. MSL — ELEVATION: 641.47		9/21/93	9/24/93

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

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: RUN NO.	NO. AND SIZE OF CORE PIECES	% RECOVERY	RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TO	PERMEABILITY CM/SEC
			12	3>8"	100	100									
145			13	7>8"	100	79			– occasional trace fossils (vertical burrows) – occasional interbedded SHALE (<0.01 to 0.4 ft thick) – occasional rip-up clasts						
150									– rip-up clasts@ 151.4 to 151.6 ft						
155			14		100	33									
160									– interbedded, broken, weathered SHALES & SS, friable @ 156.8 to 157, 158.2 to 158.7, and 158.9 to 159.2 ft – coarse grained @ 159.7 to 160.7 ft						
							SHALEY-LIMESTONE		Finely crystaline, argellaceous matrix, strong calcareous cement, thin beds,ripple laminated, interbedded w/ SHALE, LS rip-up clasts w/in shale						
165			15				Dark gray SHALE		Fine grained, well sorted, weak calcareous cement, thin beds, flat bedded weathered & interbedded w/ clay, transmissive						
							Gray SHALEY-LIMESTONE		Finely crystaline, argellaceous matrix, strong calcareous cement, thin beds, ripple laminated, w/ shale, mud clasts w/in shale						
170							Dark gray SHALE		Fine grained, well sorted, strong quartzitic cement, thin beds, ripple bedded weathered friable zone @ 168 to 171 ft.						
							TD @ 171 FT		TD @ 171 ft						
175															

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

LOGGED BY *D. Smith/G. Hassett* CHECKED BY *G. Hassett*

DATE *09/24/93*

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-8/B21	
	SAMPLING METHOD: CME Continuous Sampler					Sheet 1 of 2	
						DRILLING	
						START	FINISH
	WATER LEVEL					TIME	TIME
	TIME					14:25	09:30
	DATE					DATE	DATE
DATUM: ft. MSL ELEVATION: 842.32	CAVE DEPTH					10/28/93	10/29/93

DRILL RIG: Mobil Drill B-61

SURFACE CONDITIONS: Fill

ANGLE: Vertical BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272117.160, E = 2730181.790

DRILLING CONTRACTOR A. N. Pool Clinton, Ok.

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
0–17				FILL - Clay								
17–22		100		Tan and gray CLAY, damp, homogeneous blocky structure, slickensided cleavage planes	CME							
22–26		100			CME							
26–30		100		Tan severely weathered CLAY-SHALE: interbedded with clay (from ~28)	CME							

Depth scale: 10, 15, 20, 25, 30

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. SAMPLING METHOD: CME Continuous Sampler	BORING NUMBER: P-9/B21 — Sheet 2 of 2

						DRILLING START	DRILLING FINISH
WATER LEVEL						TIME	TIME
TIME						14:25	09:30
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: Fill

ANGLE: Vertical BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs. N = 272117.160, E = 2730181.790

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
		100		COAL	CME							
		70		Gray CLAY (CL); wet, homogeneous structure; very soft	CME							
35				Gray unweathered CLAY-SHALE								
				Discontinue Hollow-stem auger at 37 ft.								
40												
45												
50												
55												
60												

DRILLING CONTRACTOR A. W. Pool, Clinton, Ok.

LOGGED BY D. Smith CHECKED BY LB

DATE 10/28/93

ROCK BOREHOLE LOG

SITE NAME AND LOCATION: Muskogee Community Landfill 2801 S. 54 Street W., Muskogee, Ok RUST Project # 86251	**DRILLING METHOD:** Air rotary (37-85 ft) **SAMPLING METHOD:** CME continuous sampler 3" ID X 5.25" OD 10 ft core barrel (37-85 ft)	**BORING NUMBER:** P-9/B21 Sheet 1 of 2

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING	START	FINISH
TIME	14:25	09:30
DATE	9/28/93	9/29/93

DATUM: Ft. MSL ELEVATION: 642.32

DRILL RIG: Mobil Drill B-61/Badger 1250

SURFACE CONDITIONS: Fill

ANGLE: 0 BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272117.18 E = 2730181.79

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TEST RESULTS: DEPTH IN FEET TO	PERMEABILITY CM/SEC
							Gray unweathered CLAY-SHALE		Fine grained, well sorted, damp, strong quartzitic cement, thin beds, flat bedded, interbedded w/ LIMEY-SHALE interbeds						
40									- broken zone @ 37.5 to 43.5 ft						
			1	3>6"	95	20									
45															
									- fossiliferous shaley LS @ 48.2 to 49.2 ft - broken zones @ 48 to 48.1, 48.4 to 48.5, 48.9 to 49, 49.8 to 50.1						
50									- LS w/ fossils @ 51.4 to 51.6 ft & 51.8 to 52.1 ft						
			2	5>6"	87	44									
55															
									- vertical fracture w/ secondary crystallization @ 57 to 57.8 ft						
60															
			3		83				- 20° fracture w/ secondary crystallization @ 62.8 to 62.9 ft - 30° fracture w/ secondary crystallization @ 63.4 to 63.5 ft - CLAYSTONE w/ calcite infilled burrows @ 63.1 to 3.3 ft						
65															
			4	1>6"	64	33			- broken zones @ 68.7 to 69.4 ft						
70															

DRILLING CONTRACTOR A. N. Pool Clinton, Oklahoma

LOGGED BY G. Hassett CHECKED BY G. Hassett

DATE 12/21/93

ROCK BOREHOLE LOG

SITE NAME AND LOCATION: Muskogee Community Landfill, 2801 S. 54 Street W., Muskogee, Ok, RUST Project # 86251	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
DATUM: Ft. MSL	ELEVATION: 842.32	

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING	START	FINISH
TIME	14:25	09:30
DATE	9/28/93	9/29/93

DRILL RIG: Mobil Drill B-61/Badger 1250

SURFACE CONDITIONS: Fill

ANGLE: 0 BEARING: -

SAMPLE HAMMER TORQUE: ft.-lbs.

N = 272117.18 E = 2730181.79

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	CORES: RUN NO.	CORES: NO. AND SIZE OF CORE PIECES	CORES: % RECOVERY	CORES: RQD	SOIL DESCRIPTION OR ROCK LITHOLOGY	SYMBOL	ROCK STRUCTURE	SAMPLER/BIT	CASING TYPE	BLOWS/FT ON CASING	TEST RESULTS: DEPTH IN FEET FROM	TO	PERMEABILITY CM/SEC
			4	1>6"	84	33			- broken zones @ 72 to 82 ft						
75			5	2>6"	96	10									
80															
			6				Interbedded COAL & SHALE		@ 82 to 82.4 ft						
							Gray fossiliferous LIMESTONE		@ 82.4 to 83.2 ft						
							Glauconitic CLAY		@ 83.2 to 84.1 ft						
							Silty LIMEY-SHALE		Fine grained, well sorted, strong calcite cement						
85							TD @ 85.1								
90															
95															
100															
105															

DRILLING CONTRACTOR A. W. Pool, Clinton, Oklahoma

LOGGED BY G. Hassell CHECKED BY G. Hassell

DATE 12/21/93

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: P-3
	SAMPLING METHOD: CME 5-foot Continuous sampler	Sheet 1 of 1
DATUM: ft. MSL	ELEVATION: 629.22	

WATER LEVEL					DRILLING	
					START	FINISH
TIME					TIME 07:55	TIME 08:25
DATE					DATE 10/27/93	DATE 10/27/93
CAVE DEPTH						

DRILL RIG: Mobil Drill B-61	SURFACE CONDITIONS: clay
ANGLE: Vertical BEARING: ---	N = 272568.879, E = 2731412.400
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	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
				Tan silty CLAY interbedded w/ brown silty fill	CME		CL		52	38		
					CME							
				- tan & gray w/ iron oxide nodules								
				- slickensided cleavage planes								
10					CME							
				- relect bedding, iron oxide staining								
				TD @ 13.5 ft								
15												
20												
25												
30												

DRILLING CONTRACTOR A. W. Pool Clinton, Ok.

LOGGED BY D. Smith CHECKED BY

DATE 10/27/93

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
	SAMPLING METHOD: CME 5 foot continuous sampler	Sheet 1 of 1

WATER LEVEL					DRILLING START	DRILLING FINISH
TIME					TIME 13:20	TIME 14:08
DATE					DATE 10/26/93	DATE 10/26/93
CAVE DEPTH						

DATUM: ft. MSL ELEVATION: 630.29

DRILL RIG: Mobil Drill B-61 SURFACE CONDITIONS: clay

ANGLE: Vertical BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs. N = 274148.56 E = 2730241.03

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
		100		Brown SANDY SILT Tan, SILTY-CLAY;	CME							
		100		Tan, SANDY-CLAY; iron oxide staining - gray @ 4 ft - slickensided cleavage planes @ 6 ft	CME		CL		39	19		
10		100			CME							
				Severely weathered CLAY-SHALE; thin relect bedding, iron oxide stain- ing along bedding planes		NONE						
15		100		- interbedded w/ moderately weathers clays - color change to green gray @ 16 ft	CME							
20		100		- moist, tin bedded,iron oxide concretions @ 17 ft - shells, calite crystals wet @ base of core; transmissive zone coarse grained broken iron oxide concretions	CME							
		100			CME							
25				TD @ 23 ft								
30												

DRILLING CONTRACTOR A. N. Pool Clinton, Ok.

LOGGED BY D. Smith CHECKED BY

DATE 10/26/93

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
	SAMPLING METHOD: CME 5-foot Continuous sampler	Sheet 1 of 1
DATUM: ft. MSL	ELEVATION: 841.83	

WATER LEVEL				
TIME				
DATE				
CAVE DEPTH				

DRILLING	START	FINISH
TIME	15:50	16:45
DATE	10/26/93	10/26/93

DRILL RIG: Mobil Drill B-61
SURFACE CONDITIONS: clay
ANGLE: Vertical
BEARING: ---
SAMPLE HAMMER TORQUE: ft.-lbs.
N = 272134.05 E = 2730184.58

DRILLING CONTRACTOR A. W. Pool, Clinton, Ok.

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
		100		FILL: tan and gray silty clay	CME							
		100		- damp	CME							
10		100			CME							
15		100		- dark gray	CME							
				Base of FILL @ 18.5 ft, wet								
20		100		Tan & gray SILTY CLAY, iron oxide nodules, root structures	CME							
				LIMONITE beds @ 21.7 to 22.2 ft. orange to dark red iron concretions								
		100		Severely weathered CLAY-SHALE, thin relect bedding, oxide staining, vertical fracture	CME							
25				Tan to gray to brown CLAY-SHALE, slickensided cleavage planes, iron oxide nodules								
				TD @ 25.5 ft								
30												

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
DATUM: ft. MSL	WATER LEVEL / TIME / DATE / CAVE DEPTH	DRILLING START: TIME 08:00, DATE 10/18/93
ELEVATION: 628.99		DRILLING FINISH: TIME 08:35, DATE 10/18/93
DRILL RIG: Mobil Drill B-61	SURFACE CONDITIONS: clay	
ANGLE: Vertical	BEARING: ---	
SAMPLE HAMMER TORQUE: ft.-lbs.	N = 272448.24 E = 2730767.80	

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
		100		Tan & gray CLAY (CH); damp, blocky, homogeneous structure, iron nodules & staining, slicken-sided cleavage planes	CME		CL		48	32		
		100			CME							
10		100		-H_2O @ 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/ intermittant weathered shale	CME	NONE						
15		90		- red CLAYSTONE w/ oxidation @ 18.1 to 18.2 ft	CME							
20		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							
				TD @ 21.6 ft								
25												
30												

DRILLING CONTRACTOR A. W. Pool, Clinton, Ok.

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

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:	DRILLING METHOD: Hollow Stem Auger with 3.25"ID x 7.25"OD augers.	BORING NUMBER: P-12
Muskogee Community Landfill 2801 S 54th Street W., Muskogee, Ok RUST Project # 86251	SAMPLING METHOD: CME 5-foot Continuous sampler	Sheet 1 of 1

WATER LEVEL				
TIME				
DATE				
CAVE DEPTH				

DRILLING	START	FINISH
TIME	10:50	11:30
DATE	10/17/93	10/17/93

DATUM: ft. MSL ELEVATION: 627.92

DRILL RIG: Mobil Drill B-61 SURFACE CONDITIONS: clay

ANGLE: Vertical BEARING: ---

SAMPLE HAMMER TORQUE: ft.-lbs. N = 272907.07 E = 2730775.85

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
		100		Tan & gray CLAY (CH);damp, homogeneous blocky structure,slicken-sided cleavage planes, carbonaceous material	CME	NONE	CL		41	25		
		100		Tan & gray CLAY w/ sand (CL); damp, homogeneous blocky structure, sand partings, pockets & stringers	CME							
10		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							
15		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	CME							
20		100		- water @ 17.5 ft	CME							
				TD @ 22.7 ft								
25												
30												

DRILLING CONTRACTOR A. W. Pool Clinton, Ok.

LOGGED BY G. Hassell CHECKED BY

DATE 10/17/93

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. SAMPLING METHOD: CME 5 foot continuous sampler	BORING NUMBER: P-13 — Sheet 1 of 1
DATUM: ft. MSL — ELEVATION: 825.33	WATER LEVEL / TIME / DATE / CAVE DEPTH	DRILLING: START TIME 15:00, DATE 10/17/93; FINISH TIME 15:40, DATE 10/17/93
DRILL RIG: Mobil Drill B-61	SURFACE CONDITIONS: clay	
ANGLE: Vertical — BEARING: ---		
SAMPLE HAMMER TORQUE: ft.-lbs.	N = 273280.04 E = 2730783.35	

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

DEPTH IN FEET (ELEVATION)	BLOWS/6" ON SAMPLER	RECOVERY	SYMBOL	DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	LABORATORY CLASSIFICATION	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
		100		Tan & gray CLAY (CL) damp, homogeneous structure, bioturbation infill ed 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							
10		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						
15		100		- abundant to vertical to 45° fractures w/ heavy oxidation @ 12 to 17 ft (sample is too disturbed to note frequency) - H_2O @ 12 ft	CME							
		100		- H_2O @ 17 ft	CME							
20				Total Depth at 19.3 ft.								
25												
30												

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. SAMPLING METHOD: CME 5 foot continuous sampler.	BORING NUMBER: P-14
DATUM: ft. MSL ELEVATION: 629.72		Sheet 1 of 1

WATER LEVEL					DRILLING	
					START	FINISH
TIME					TIME 10:15	TIME 11:10
DATE					DATE 10/19/93	DATE 10/19/93
CAVE DEPTH						

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	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
		100		Brown SILTY SAND (SM), damp Tan SILTY SAND (SM), damp	CME	NONE						
		100		Tan & gray SILTY CLAY (CL) damp, iron nodules, homogeneous structure, occasional sand pockets, occasional crawfish bioturbation	CME							
10		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							
20		100		- tan & gray @ 17 ft - extensive vertical fracturing @ 17 to 22 ft (sample is too disturbed to note frequency) heavy oxidation along bedding & fracture planes - wet @ 17 to 19 ft	CME							
		100		- wet @ 22 ft - moderately weathered CLAY-SHALE, gray	CME							
25				TD @ 24.7 ft								
30												

DRILLING CONTRACTOR A. N. Pool Clinton, Ok.

LOGGED BY G. Hassett CHECKED BY
DATE 10/19/93 DATE

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
	SAMPLING METHOD: CME 5 foot continuous sampler	Sheet 1 of 1
DATUM: ft. MSL	ELEVATION: 624.39	

						DRILLING START	DRILLING FINISH
WATER LEVEL						TIME	TIME
TIME						09:15	10:25
DATE						DATE	DATE
CAVE DEPTH						10/27/93	10/27/93

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	WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	(-)200 SEIVE
		100		Brown SILTY SAND Tan & gray SILTY CLAY (CL), homogeneous structure, damp, iron nodules	CME	NONE						
		100			CME		CL		48	33		
10		100			CME							
15		70		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	CME							
20		100		- interbedded CLAY @ 20 to 22 ft	CME							
25		100		- interbedded COAL w/ CLAY @ 22.3 to 22.5 ft - CLAYSTONE @ 22.8 to 23.2 ft - Wet @ 22.8 ft in claystone - interbedded clay w/ shale @ 23.2 to 24.5 ft - clay soils @ 24.5 to 25.5 ft - interbedded CLAYSTONE w/ SHALE @ 25.5 to 27 ft	CME							
30				TD @ 27.2 ft								

DRILLING CONTRACTOR A. W. Pool, Clinton, Ok.

LOGGED BY G. Hassell CHECKED BY

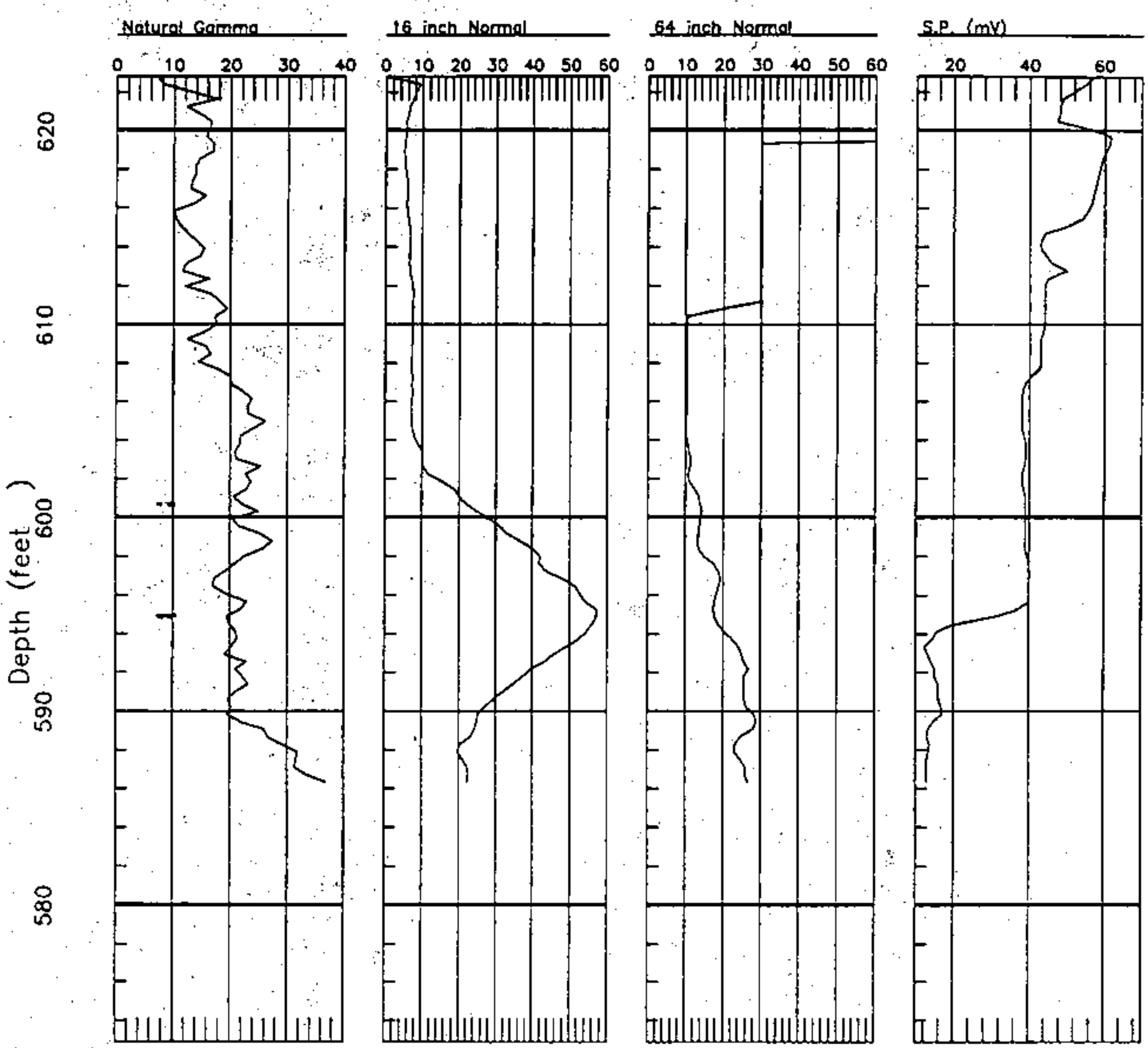
DATE 10/27/93

APPENDIX E

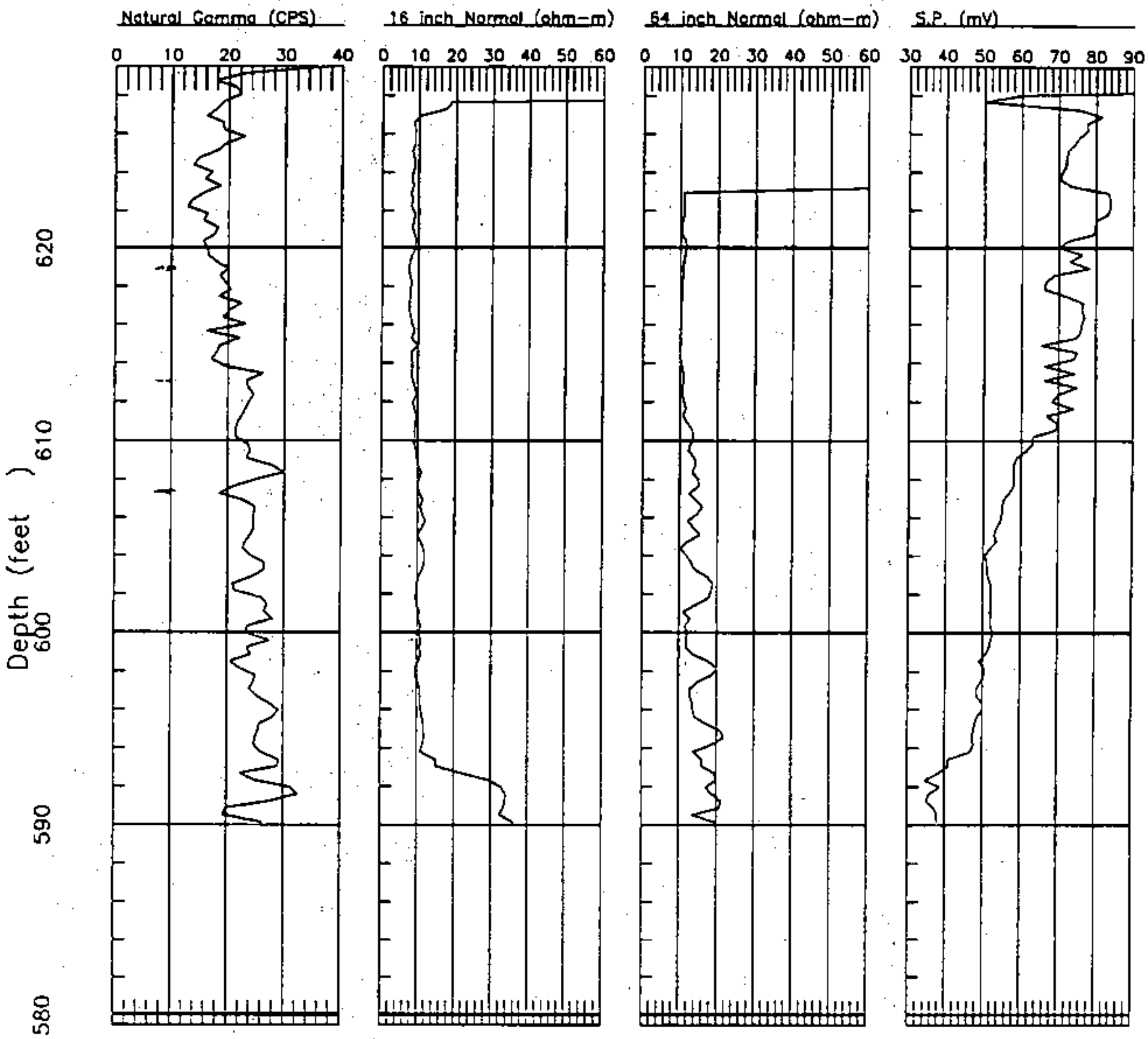
GEOPHYSICAL DATA

Muskogee\86251do2.3rd

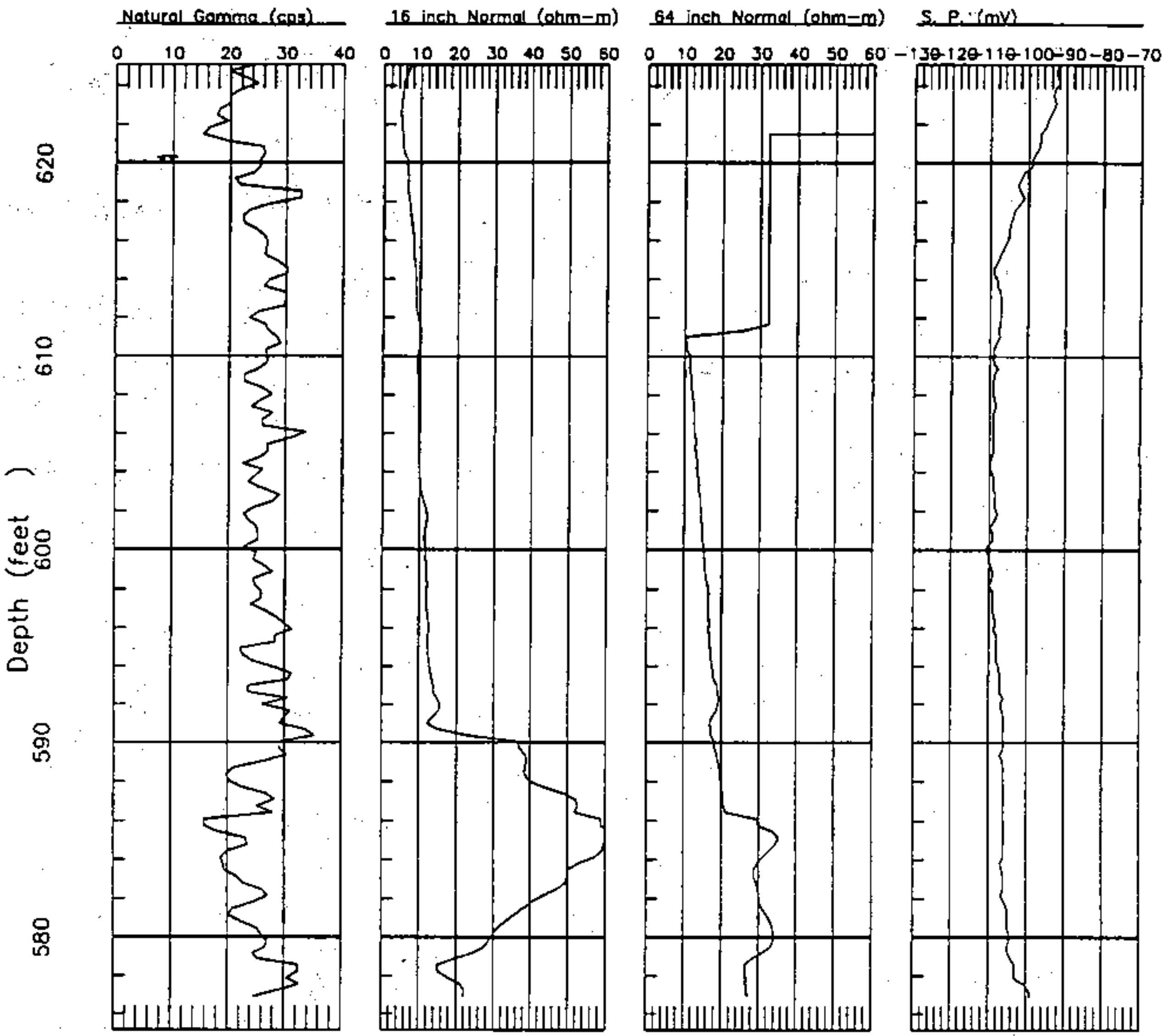
Well Name: B-1
File Name: EDITA01
Location: Muskogee Community Landfill
Elevation: 0 Reference: Sea Level



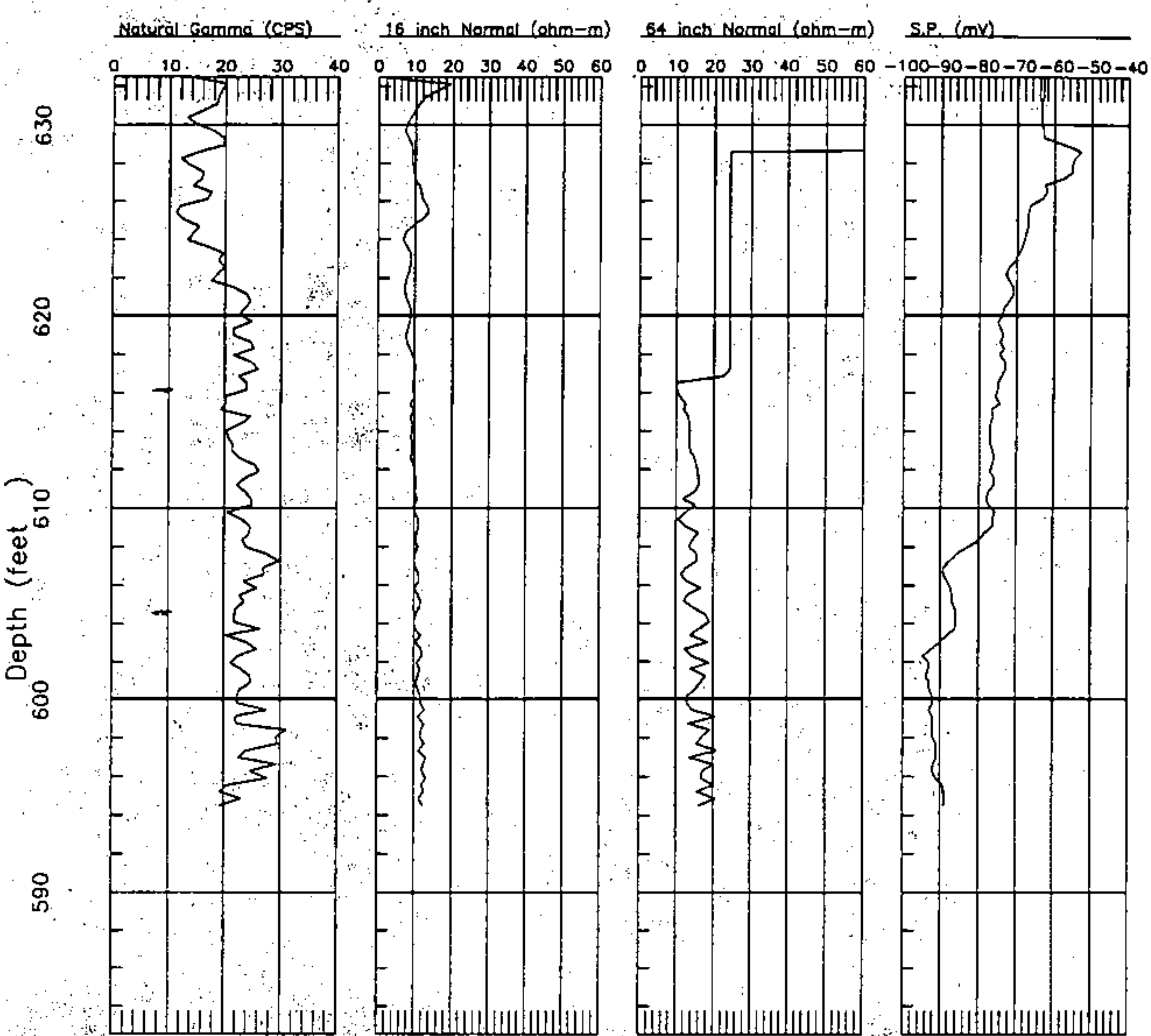
Well Name: B-8
File Name: EDITA208
Location: Muskogee Community Landfill
Elevation: 0 Reference: Sea Level



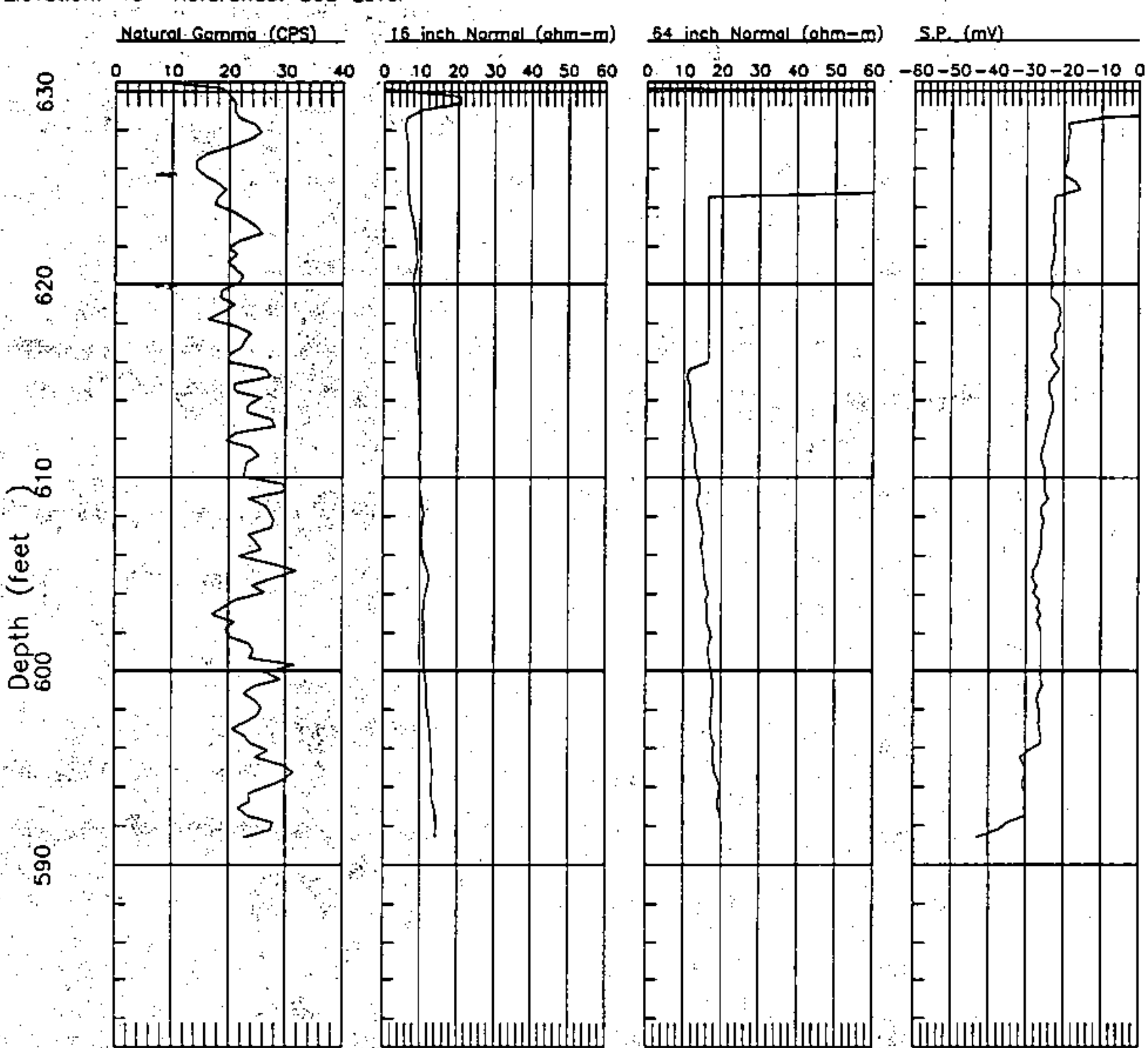
Well Name: B - 9
File Name: ED~~VT~~A009
Location: Muskogee Community Landfill
Elevation: 0 Reference: Sea Level



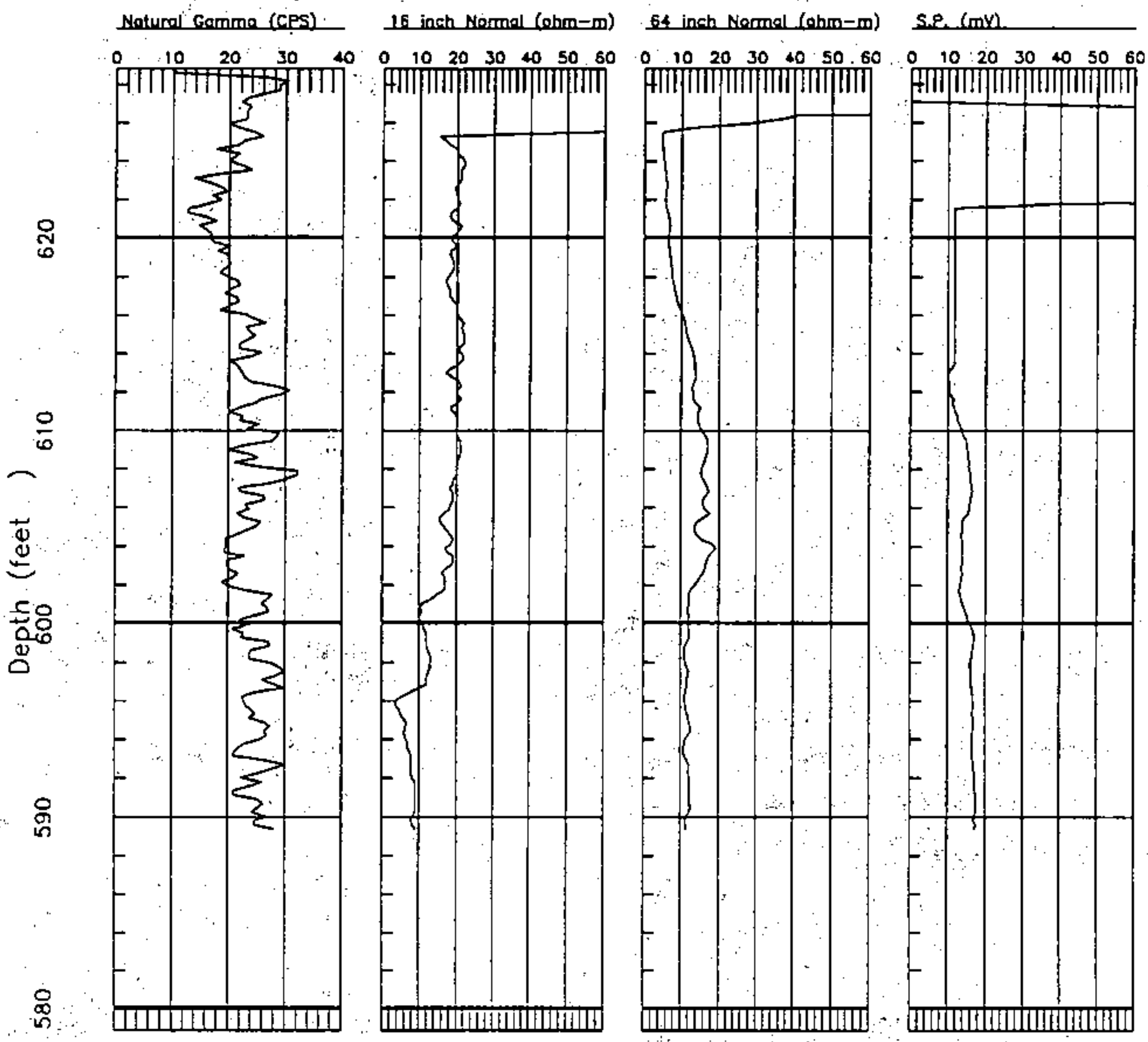
Well Name: b-15
File Name: EDITA215
Location: Muskogee Community Landfill
Elevation: 0 Reference: Sea Level



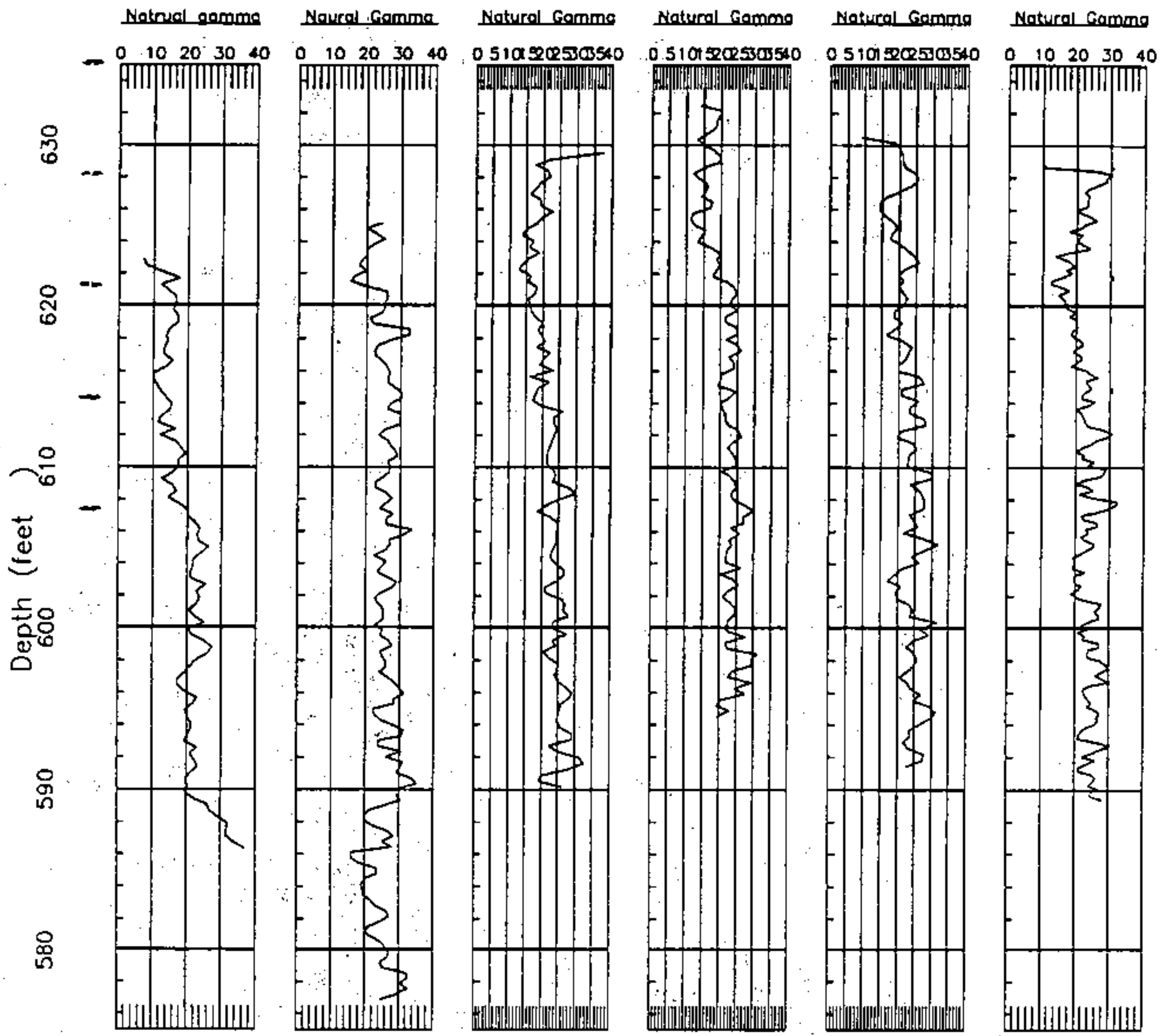
Well Name: B-16
File Name: EDITA216
Location: Muskogee Community Landfill
Elevation: 0 Reference: Sea Level



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

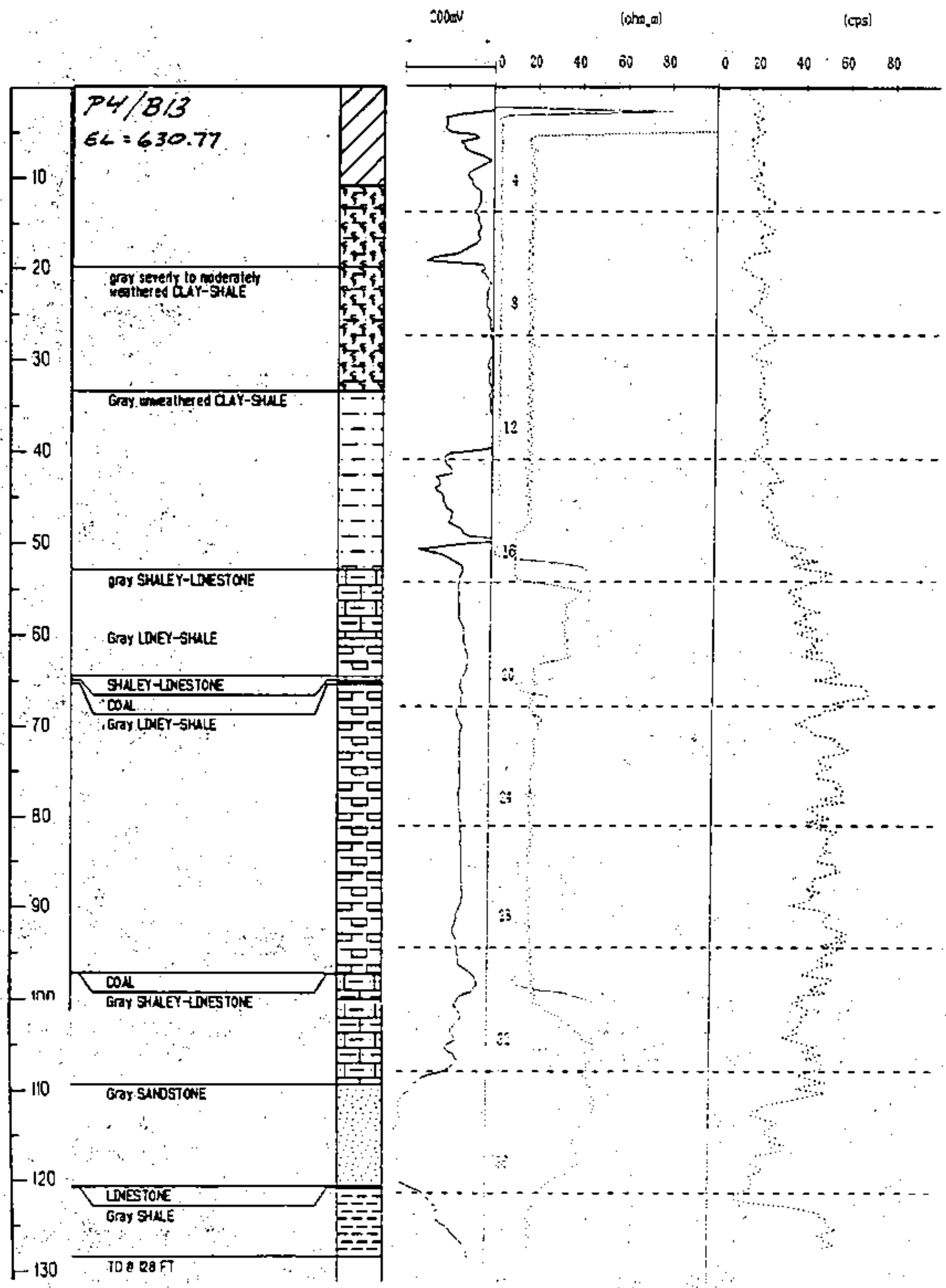


GEOPHYSICAL LOG
BORING # B13/P4
DEPTH (m) 38

DRAFT

FIELD :
ID NO. :413
DATE 25-10-93
TIME 04:11:46 PM

GAMMA :
SHORT NORMAL:
LONG NORMAL :
SP :

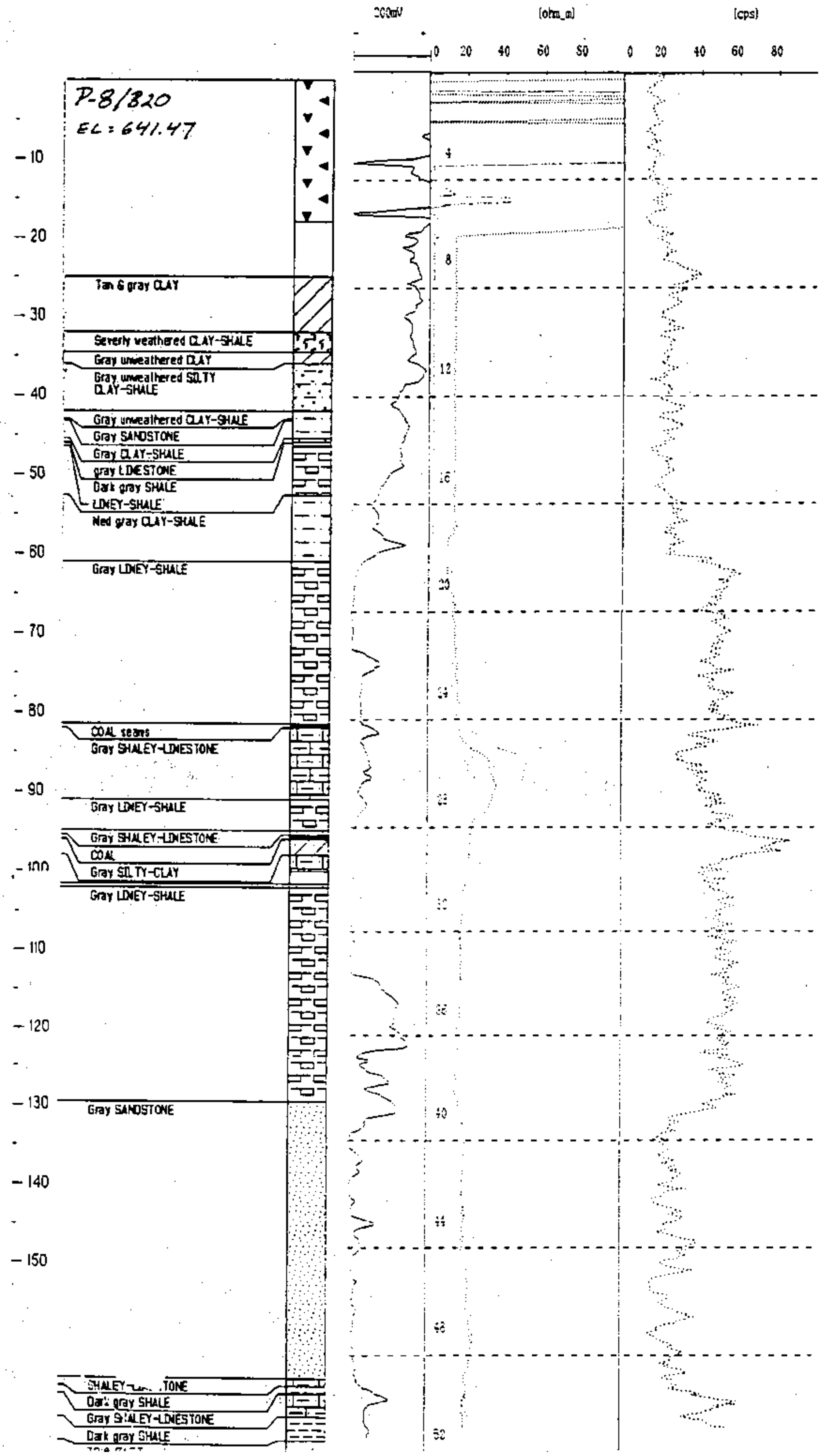


DRAFT

GEOPHYSICAL LOG
BORING # 320/RB
DEPTH (m) 51.3

FIELD :
ID NO. :620
DATE 24-10-93
TIME 02:19:12 PM

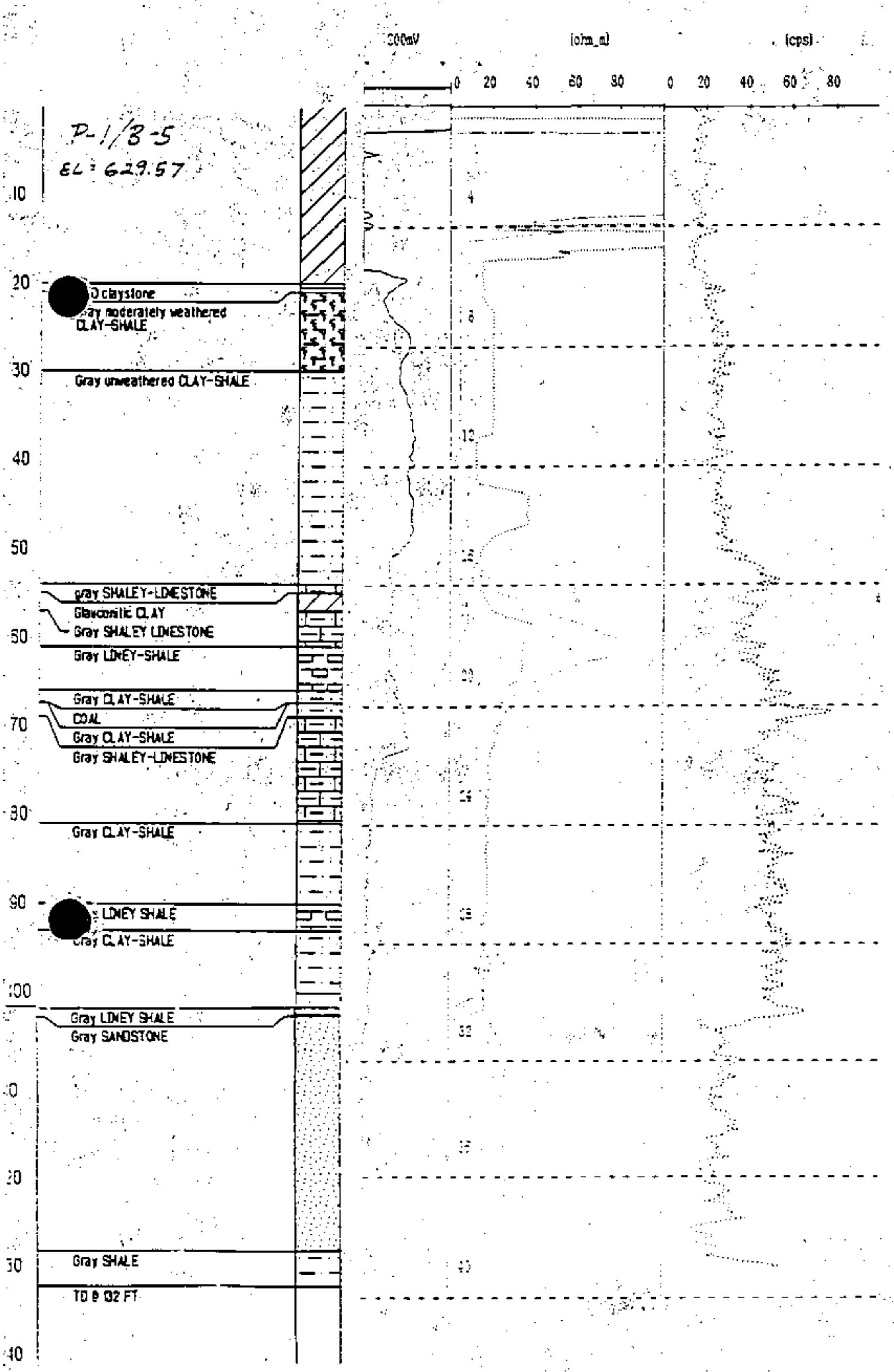
GAMMA :
SHORT NORMAL:
LONG NORMAL :
SP :



DRAFT

GEOPHYSICAL LOG
BORING # B-5/R-1
DEPTH (m) 39

FIELD :		GAMMA	:············
ID NO. :605		SHORT NORMAL	:———
DATE 22-10-93		LONG NORMAL	:········
TIME 03:11:05 PM		SP	:———



ANLINE LOGGING
(918) 652-4925

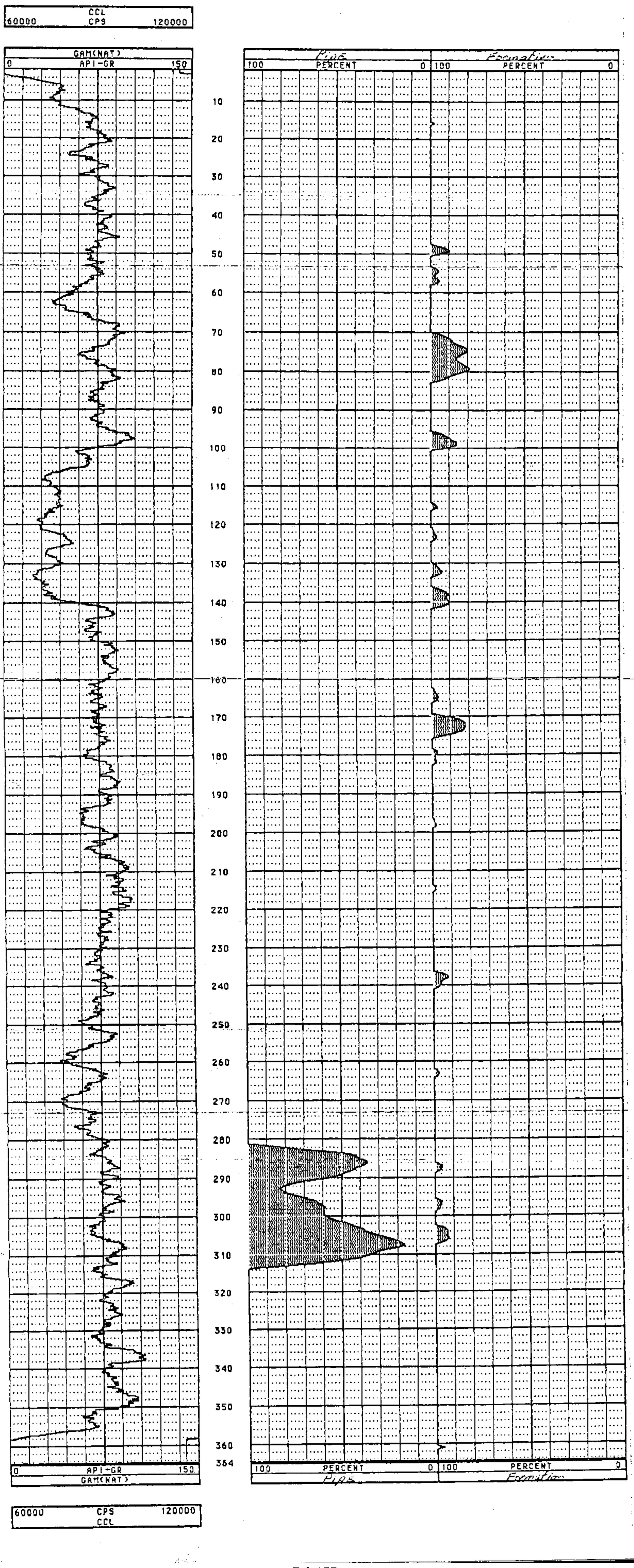
CEMENT BOND LOG

COMPANY	: MUSKOGEE LANDFILL	OTHER SERVICES	
WELL	: WRIGLEY #3		
FIELD	:		
COUNTY	: MUSKOGEE		
STATE	: OK		
NATION	: USA		
LOCATION	: NE-1/4		
SECTION	: 6	TOWNSHIP : 14N	RANGE : 18E

PERMANENT DATUM	: GL	ELEVATIONS	
ELEV. PERM. DATUM	:	KB	:
LOG MEASURED FROM	: GL	DF	:
DRLG. MEASURED FROM	: GL	GL	:

DATE	: 10/1/93	BOREHOLE FLUID	: H20		
DEPTH-DRILLER	:	FLUID WT/VIS	:		
DEPTH-LOGGER	: 350	SAMPLE SOURCE	:		
LOG BOTTOM	: 350	RM	:	@	F
LOG TOP	: 0	RMF	:	@	F
TOOL TYPE	:	RMC	:	@	F
		RM @ BHT	:	@	F
		CIRC STOPPED	:		
CASING-DRILLER	:	LOGGING UNIT	: 7670		
CASING-LOGGER	:	FIELD OFFICE	: HEN		
CASING TYPE	:	RECORDED BY	: D. ANDREWS		
CASING WEIGHT	:	WITNESSED BY	: MR. MC QUEEN		
BIT SIZE	:				
DEPTH	:				
REMARKS	: PHONE (918)652-4925				

ALL SERVICES PROVIDED SUBJECT TO CGC STANDARD TERMS AND CONDITIONS



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

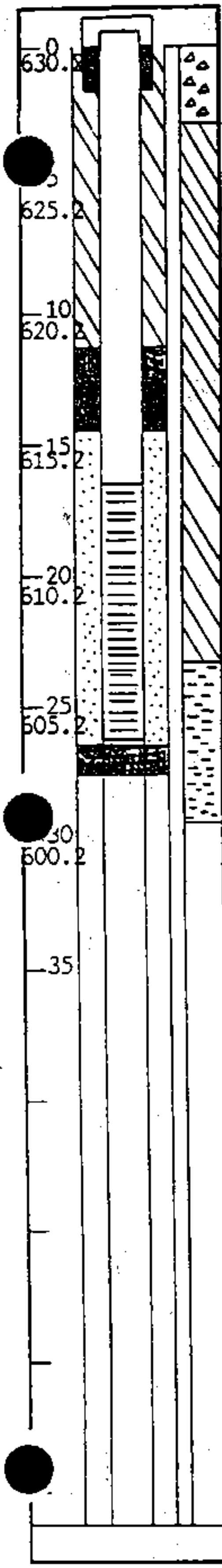
Prior to the initiation of the exploration program, the proposed locations of all boreholes and piezometers were staked in the field by a professional surveyor licensed in the State of Oklahoma. The actual locations were dependent on accessibility and were adjusted in the field with the permission of 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-01R

Boring No. X-Ref: B-1

MONITOR WELL CONSTRUCTION SUMMARY



Survey Coords: N272500.8 E2731415.1

Elevation Ground Level 630.2 ft

Top of Casing 633.01 ft

Drilling Summary:

Total Depth 29.25 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) 3¼-inch I.D. x 7-inch O.D. hollow-stem augers

Drilling Fluid None

Protective Casing 6-inch anodized aluminum

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish 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 Design & Specifications

Basis: Geologic Log X 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: ½-inch bentonite pellets 11.5 to 14.5 ft

Well Development: B-K Hand Pump

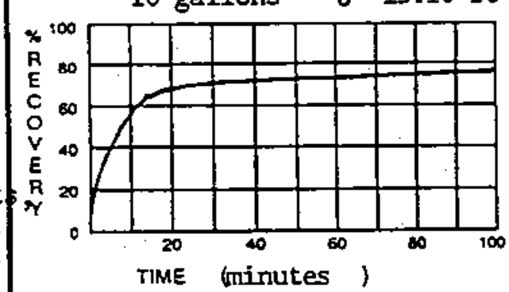
Initial H_2O level = 15.10 feet
TOC/Well volume = 1.7 gallons
Amount developed = 10 gallons or 5.8 well volumes

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 S_o= 15.10 ft



SITE NAME Muskogee Landfill

LOCATION Muskogee, Oklahoma

SUPERVISED BY Greg Hassett

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.

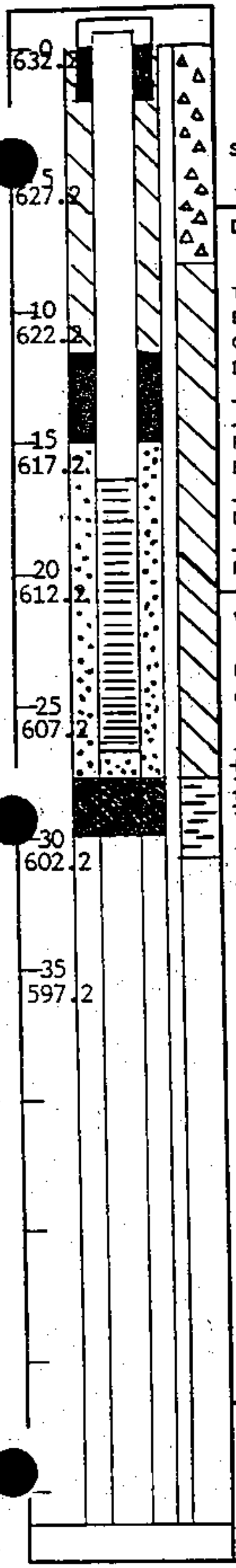
Note: Added fill soil from elevation 627.7 to 630.2 ft prior to completion of MW01R concrete pad. Adjusted depth and dimensions from the MW01R field report accordingly.

Printed on recycled paper.

Well No. MW02R

Boring No. X-Ref: B-2

MONITOR WELL CONSTRUCTION SUMMARY



Survey Coords: N271744.8
E2731158.9

Elevation Ground Level 632.2 ft
Top of Casing 635.24 ft

SITE NAME Muskogee Landfill

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) 3¼-inch I.D. x 7 inch O.D.
hollow-stem augers
Drilling Fluid None
Protective Casing 6-inch anodized aluminum

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish 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 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 grout 2 to 12 feet

Bentonite Seal: ¼-inch bentonite pellets, 12 to 15 feet

Well Development:

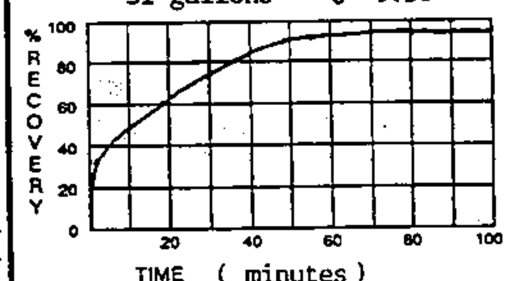
B-K Hand Pump Initial H_2O level (estimated) = 9.50 ft, TOC/well volume = 3.5 gallons
Amount developed = 31 gallons or 8.8 well volumes

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 S_o= 9.50



SUPERVISED BY Greg Hassett

Comments: Borehole collapse and settlement of fines 28 to 30 feet. Centralizers (stainless steel) at 3 feet and 25 feet from ground surface.

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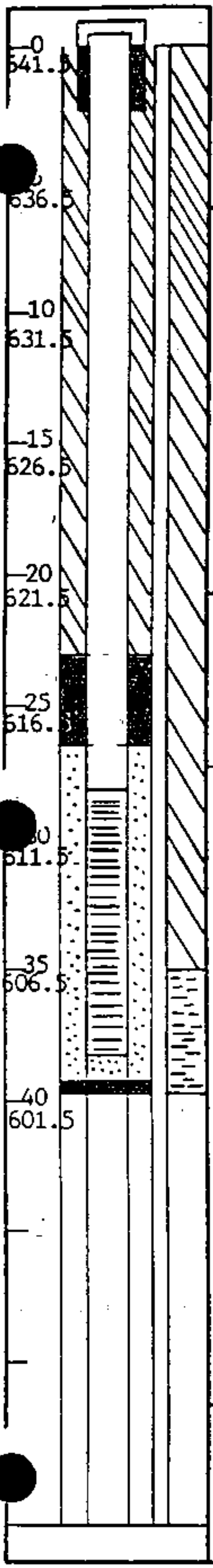


Well No. MW-03R

Boring No. X-Ref: B-3

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: N272179.4
E2730189.7

Elevation 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) 3½-inch I.D. x 7-inch O.D.
hollow-stem augers
Drilling Fluid None

Protective Casing 6-inch anodized aluminum

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish 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 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
C2

Screen: S1 2-inch schedule 40 PVC
flush-jointed with O-rings
S2 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: ½-inch bentonite pellets
23.1 to 26.1 ft

Well Development: B-K Hand Pump

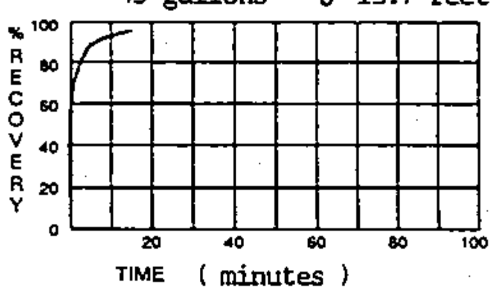
Initial H_2O level = 13.7
TOC/Well volume = 4.5 gallons
Amount developed = 45 gallons or
10 well volumes

Stabilization Test Data: Inoperable Meter

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= 45 gallons S_o= 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 Landfill
LOCATION Muskogee, Oklahoma
WIC 02240

SUPERVISED BY Greg Hassett
DATE 11/19/92

Printed on recycled paper.

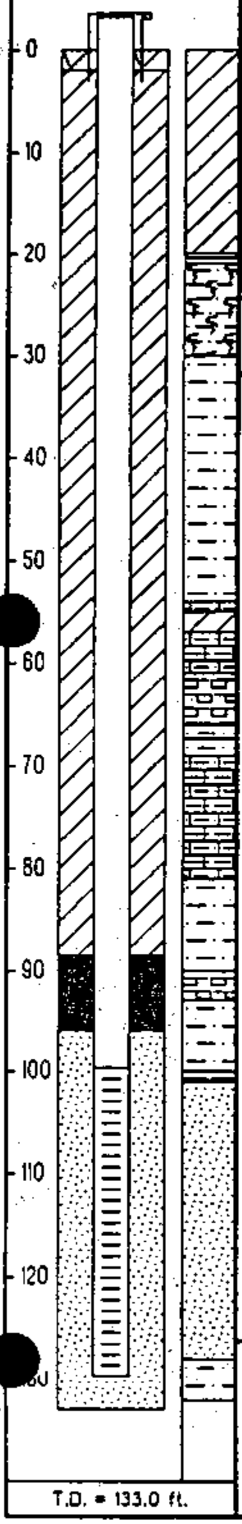
WELL No. P-1

Boring No X-Ref. B-5

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords E=2731409.770, N=272591.360 Elevation Ground Level (MSL) 629.50

Top of Casing 632.78



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

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
-		-
-		-

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 88.5 ft.

Bentonite Seal: Bentonite Pellets
88.5 to 96 ft.

Filter Pack: 20 - 40 Colorado Silica Sand
96 to 133 ft.

Construction Time Log

Task	Start Date	Start Time	Finish Date	Finish 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 Development

Developed with QED 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 = S_0 =

SITE NAME Muskogee Community Landfill
LOCATION Muskogee, Oklahoma

SUPERVISED BY G. Hassell CHECKED BY D. Smith
DATE 10/22/93

Comments

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling. NOTE: For recovery data, see permeability data.

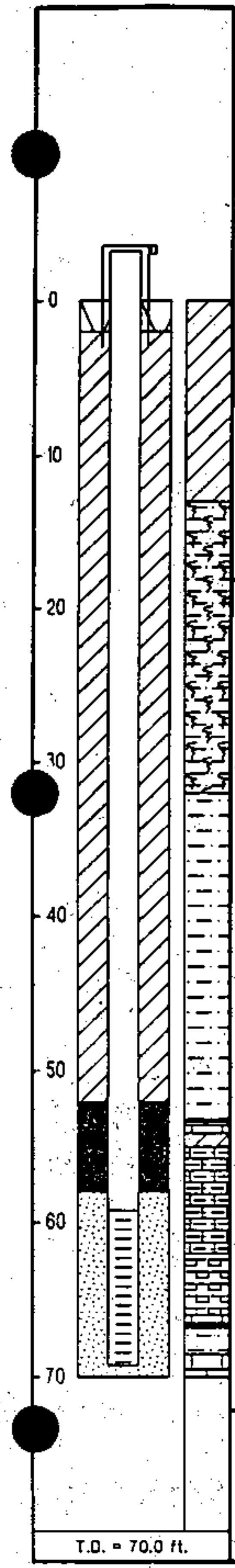
WELL No. P-2

Boring No X-Ref. B-6

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords E=2731414.180, N=272535.731 Elevation Ground Level (MSL) 629.71

Top 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 Date	Start Time	Finish Date	Finish 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 Data

Q = S_0 =

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

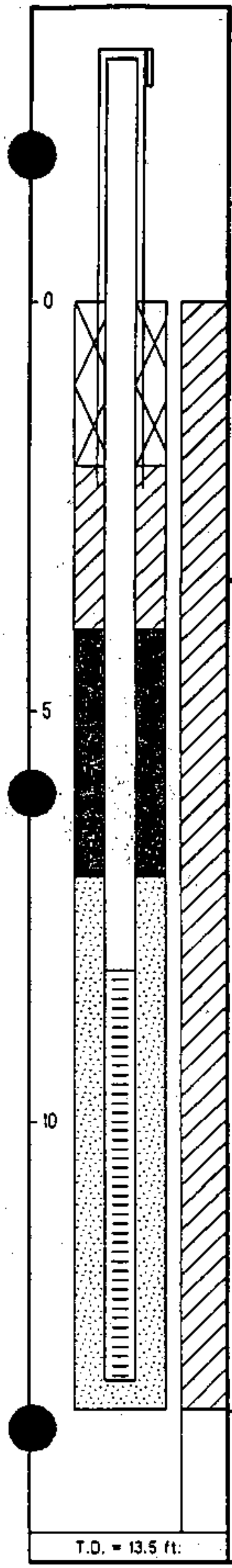
WELL No. P-3

Boring No X-Ref. P-3

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords E=2731412.400, N=272568.879 Elevation Ground Level 629.22

Top of Casing 632.27



Drilling Summary

Total Depth: (ft) 13.5
Borehole Diameter: 7.25"
Casing Stickup Height: 3.05 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

Construction Time Log

Task	Start Date	Start Time	Finish Date	Finish 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 & Specifications

Basis: 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 Data

Q = S_0 =

Comments

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling.

SITE NAME Muskogee Community Landfill
LOCATION Muskogee, Oklahoma

WL 00129

SUPERVISED BY D. Smith CHECKED BY G. Hassett
DATE 10/27/93

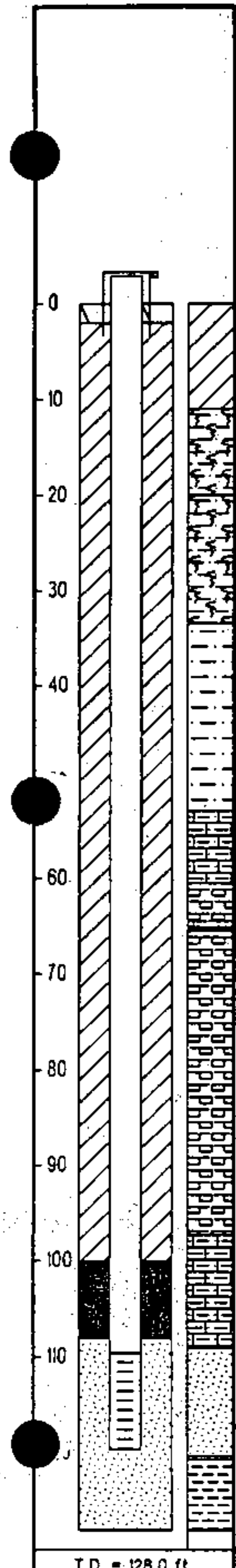
WELL No. P-4

Boring No X-Ref. B-13

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords E=2730251.180, N=274147.832 Elevation Ground Level (MSL) 830.77

Top 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

Construction Time Log

Task	Start Date	Start Time	Finish Date	Finish 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	0816	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 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	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.

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	16.0
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 Data

Q = S_0 =

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. Hassett* CHECKED BY *D. Smith*
DATE *10/26/93*

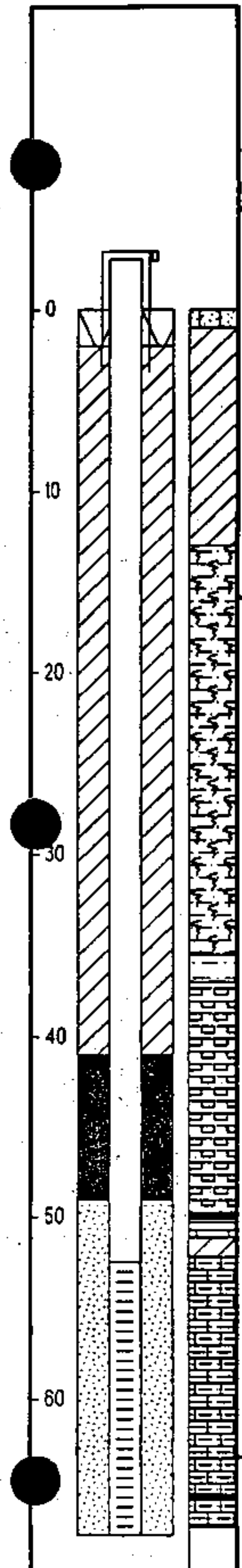
WELL No. P-5

Boring No X-Ref. B-14

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords E=2730239.370, N=274121.253 Elevation Ground Level (MSL) 630.47

Top of Casing 633.32



T.D. = 67.5 ft.

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

Well Design & Specifications

Basis: 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.

Construction Time Log

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling :				
0 - 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 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_0 =

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 *D. Smith* CHECKED BY *G. Hassett*

DATE *10/28/93*

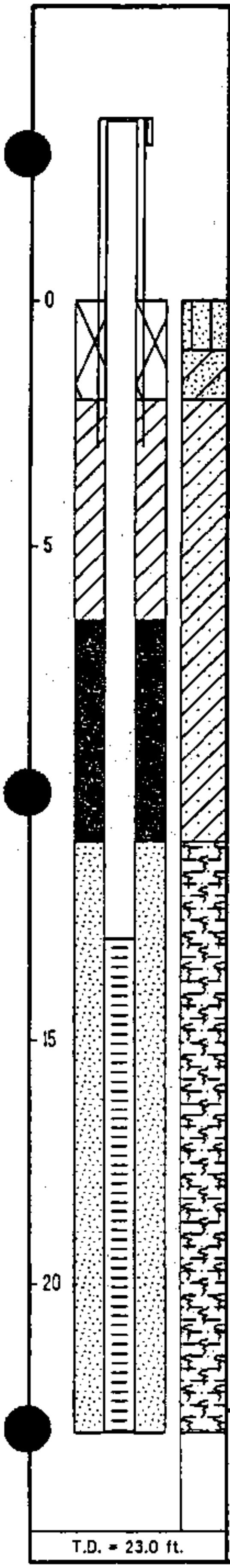
WELL No. P-6

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

Construction Time Log

Task	Start Date	Start Time	Finish Date	Finish 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 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 6.5 ft.

Bentonite Seal: Bentonite Pellets
6.5 to 11.0 ft.

Filter Pack: 20 - 40 Colorado Silica Sand
11 to 23 ft.

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 = S_0 =

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 D. Smith CHECKED BY G. Hassell
DATE 10/26/93

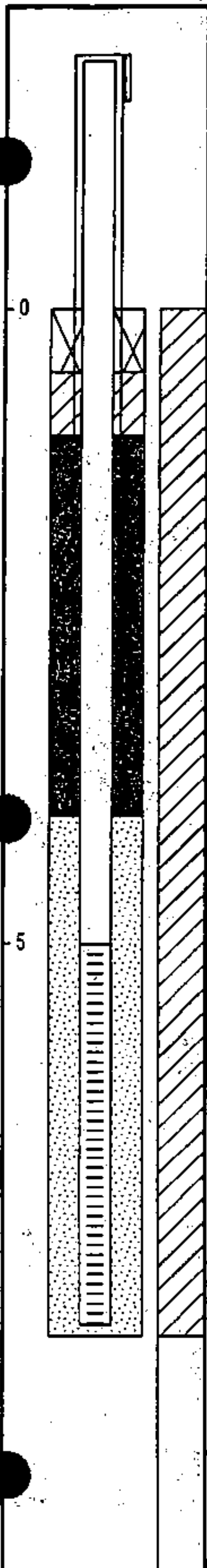
WELL No. P-7

Boring No X-Ref. B-13

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords E=2730249.800, N=274120.820 Elevation Ground Level (MSL) 830.23

Top of Casing 833.70



T.D. = 8.10 ft.

Drilling Summary

Total Depth (ft): 8.10
Borehole Diameter: 7.25"
Casing Stickup Height: 3.47 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 Augers

Drilling Fluid: None

Protective Casing: Anodized Aluminium

Construction Time Log

Task	Start Date	Start Time	Finish Date	Finish 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:	10/29	1545	10/29	1550
Development:				

Well Design & Specifications

Basis: 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 =

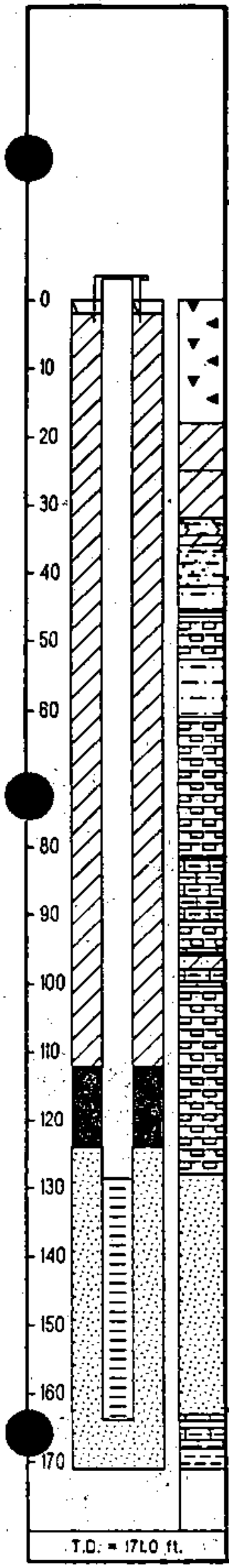
S_o =

Comments

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling.

SITE NAME Muskogee Community Landfill
LOCATION Muskogee, Oklahoma

SUPERVISED BY G. Hassett CHECKED BY D. Smith
DATE 11/29/93



WELL No. P-8

Boring No X-Ref. B-20

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords E=2730185.250, N=272155.268 Elevation Ground Level (MSL) 641.47

Top of Casing 634.62

SITE NAME Muskogee Community Landfill

LOCATION Muskogee, Oklahoma

Drilling Summary

Total Depth (ft): 171.0
Borehole Diameter: 5.0"
Casing Stickup Height: 3.15 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 Date	Start Time	Finish Date	Finish 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 & Specifications

Basis: 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 = S_o =

SUPERVISED BY G. Hassett CHECKED BY D. Smith

DATE 10/24/93

Comments

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling. NOTE: For recovery data, see permeability data.

WELL No. P-9

Boring No X-Ref. B-21

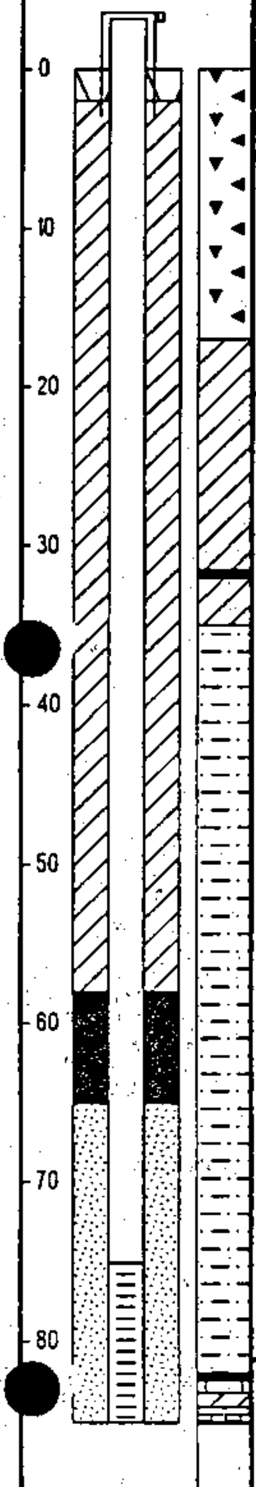
PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords E=2730181.790, N=272117.160 Elevation Ground Level (MSL) 842.32

Top of Casing 845.57

SITE NAME Muskogee Community Landfill

LOCATION Muskogee, Oklahoma



T.D. = 85.1 ft.

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

Construction Time Log

Task	Start Date	Start Time	Finish Date	Finish 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 Design & Specifications

Basis: 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.

Well Development

Developed with QED 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 Data

Q = S_0 =

SUPERVISED BY D. Smith CHECKED BY G. Hassell

DATE 10/29/93

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.

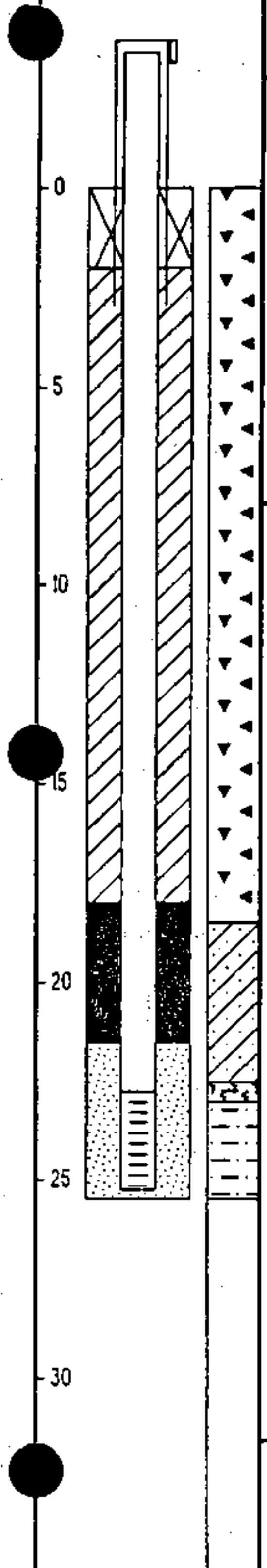
WELL No. P-10

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



T.D. = 25.5 ft.

Drilling Summary

Total Depth (ft): 25.5
Borehole Diameter: 7.25"
Casing Stickup 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

Construction Time Log

Task	Start Date	Start Time	Finish Date	Finish 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:	10/26	1700	10/26	1705
Development:				

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.

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 =

S_0 =

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.

SITE NAME Muskogee Community Landfill
LOCATION Muskogee, Oklahoma

SUPERVISED BY D. Smith CHECKED BY G. Hassett
DATE 10/26/93

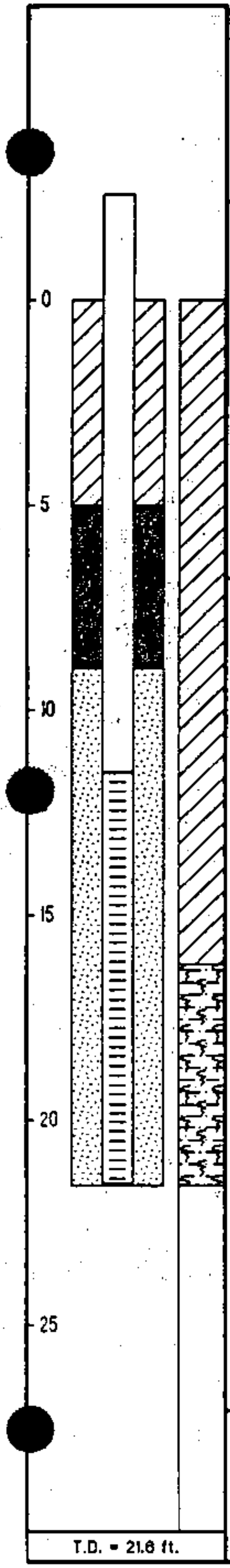
WELL No. P-11

Boring No X-Ref. P-11

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords E=2730787.800, N=272448.236 Elevation Ground Level (MSL) 626.99

Top of Casing 629.57



Drilling Summary

Total Depth (ft): 21.6

Borehole Diameter: 7.25"

Casing Stickup Height: 2.58 ft.

Driller: A. W. Pool, Inc.

Andy Zavasky, Driller

Rig: Mobile Drill B-51

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 Date	Start Time	Finish Date	Finish 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 & Specifications

Basis: 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 = S_0 =

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. Hassett CHECKED BY G. Hassett

DATE 10/18/93

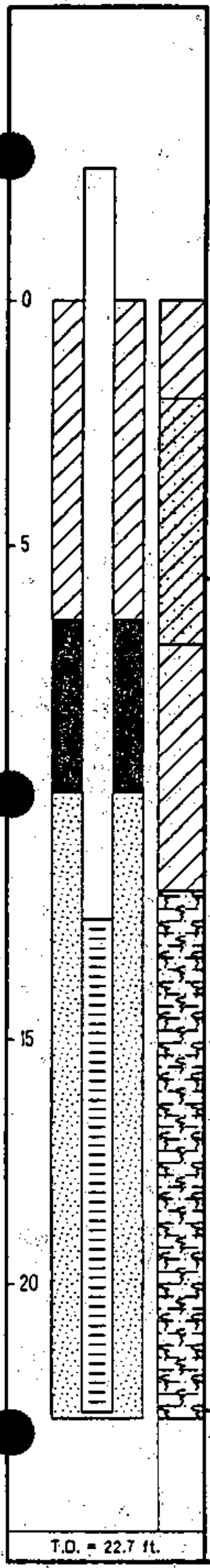
WELL No. P-12

Boring No X-Ref. P-12

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords E=2730775.850, N=272907.074 Elevation Ground Level (MSL) 627.92

Top of Casing 630.61



Drilling Summary

Total Depth (ft): 22.7
Borehole Diameter: 7.25"
Casing Stickup Height: 2.69 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 Date	Start Time	Finish Date	Finish Time
Drilling :				
0 - 21.6	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 & Specifications

Basis: 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 Waterra 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	6.62	>99000	17.3
1525	6.65	>99000	16.7

Recovery Data

Q = S_0 =

Comments

Drilling equipment was cleaned with hot water/high pressure washer prior to drilling. NOTE: For recovery data, see permeability data.

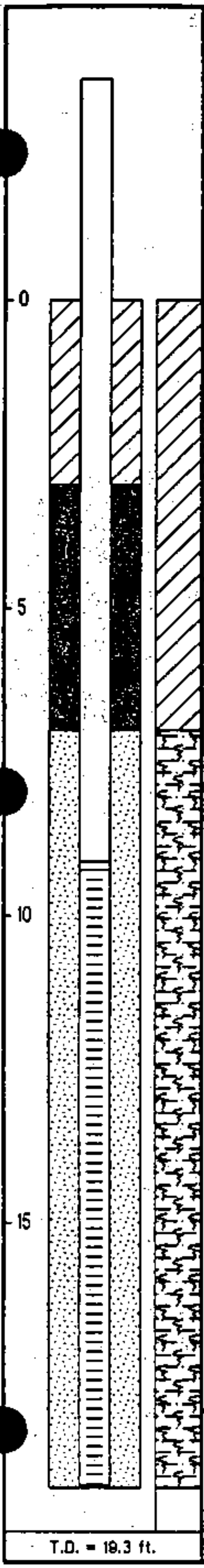
SITE NAME Muskogee Community Landfill
LOCATION Muskogee, Oklahoma

SUPERVISED BY G. Hassett CHECKED BY D. Smith
DATE 10/17/93

WELL No. P-13

Boring No X-Ref. P-13

PIEZOMETER CONSTRUCTION SUMMARY



Survey Coords E=2730184.580, N=272134.047 Elevation Ground Level (MSL) 625.33

Top of Casing 628.91

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-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 Date	Start Time	Finish Date	Finish 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 & Specifications

Basis: 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 =

S_o =

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. Hassell CHECKED BY D. Smith

DATE 10/17/93

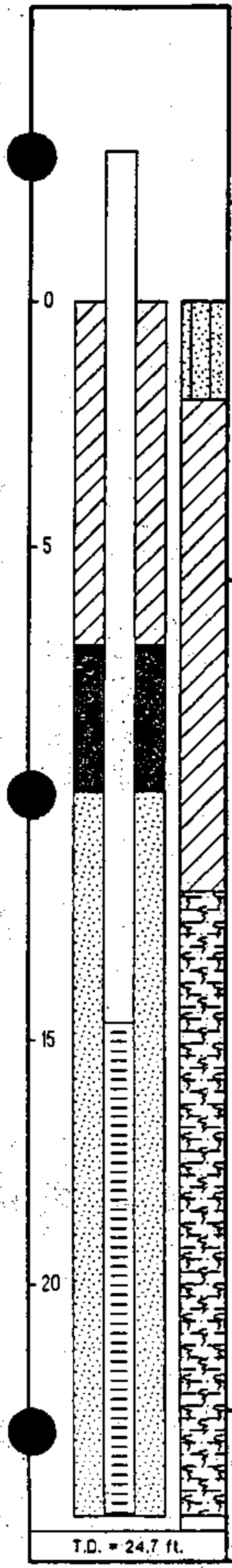
WELL No. P-14

Boring No X-Ref. P-14

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords E=2730728.780, N=273795.813 Elevation Ground Level (MSL) 629.72

Top of Casing 632.77



Drilling Summary

Total Depth (ft): 24.7
Borehole Diameter: 7.25"
Casing Stickup Height: 3.05 ft.
Driller: A. W. Pool, Inc.
Andy Zavasky, Driller

Rig: Mobile Drill B-51
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 Date	Start Time	Finish Date	Finish 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 & Specifications

Basis: 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 Data

Q = S_o =

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. Hassell CHECKED BY D. Smith
DATE 10/19/93

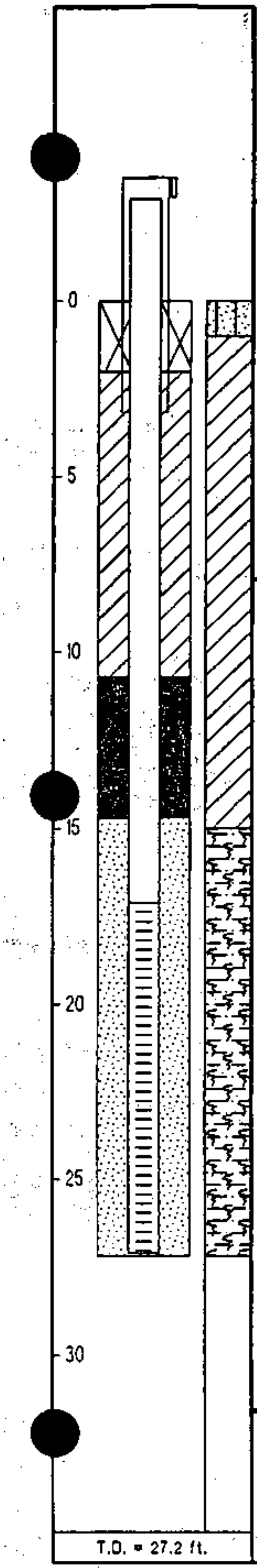
WELL No. P-15

Boring No X-Ref. P-15

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords E=2731378.100, N=274174.971 Elevation Ground Level (MSL) 824.39

Top 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

Construction Time Log

Task	Start Date	Start Time	Finish Date	Finish 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 Design & Specifications

Basis: Geologic Log ☒ Geophysical Log ☐
Casing String (s): C = Casing S = Screen

Depth (ft)	String (s)	Elevation (MSL)
+2.89 - 17.11	C_1	827.28 -807.28
17.11 - 27.11	S_1	807.28 -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 feet

Bentonite Seal: Bentonite Pellets
10.7 to 14.7 ft.

Filter Pack: 20 - 40 Colorado Silica Sand
14.7 to 27.2 ft.

Well Development

Developed with Waterra 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 Data

Q = S_0 =

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. Hassett* CHECKED BY *D. Smith*
DATE *10/27/93*

APPENDIX G

FIELD PERMEABILITY DATA

Muskogee\86251dp2.3rd

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PAGE ____ OF ____
PROJECT NO. ____________

CLIENT ____________ SUBJECT ____________ Prepared By ____ Date ____
PROJECT ____________ ____________ Reviewed By ____ Date ____
____________ ____________ Approved By ____ Date ____

P-1 Rising Head Test

Aquifer Thickness, $b = 27\,ft \times 12\,in/ft \times 2.54\,cm/in = 822.96\,cm$

Casing radius, $r_c = 1\,in$

H :
H_0 : } see data sheet
h :

$Tt/r_c^2 = 1$ $t = 4.7\,min$ @ $\alpha = 10^{-5}$

$T = r_c^2/t$

$= (1\,in)^2/4.7\,min \times (2.54\,cm/in)^2 \times min/60\,sec$

$T = 0.023\,cm^2/sec$

$K = T/b$

$= 0.023\,cm^2/sec \times 1/822.96\,cm$

$K = 2.78 \times 10^{-5}\,cm/sec$

w/ Aqtesolve Program

① $T = 6.024 \times 10^{-3}\,ft^2/min \times (12)^2\,in^2/ft^2 \times (2.54)^2\,cm^2/in^2 \times min/60\,sec$

$T = 9.33 \times 10^{-2}\,cm^2/sec$

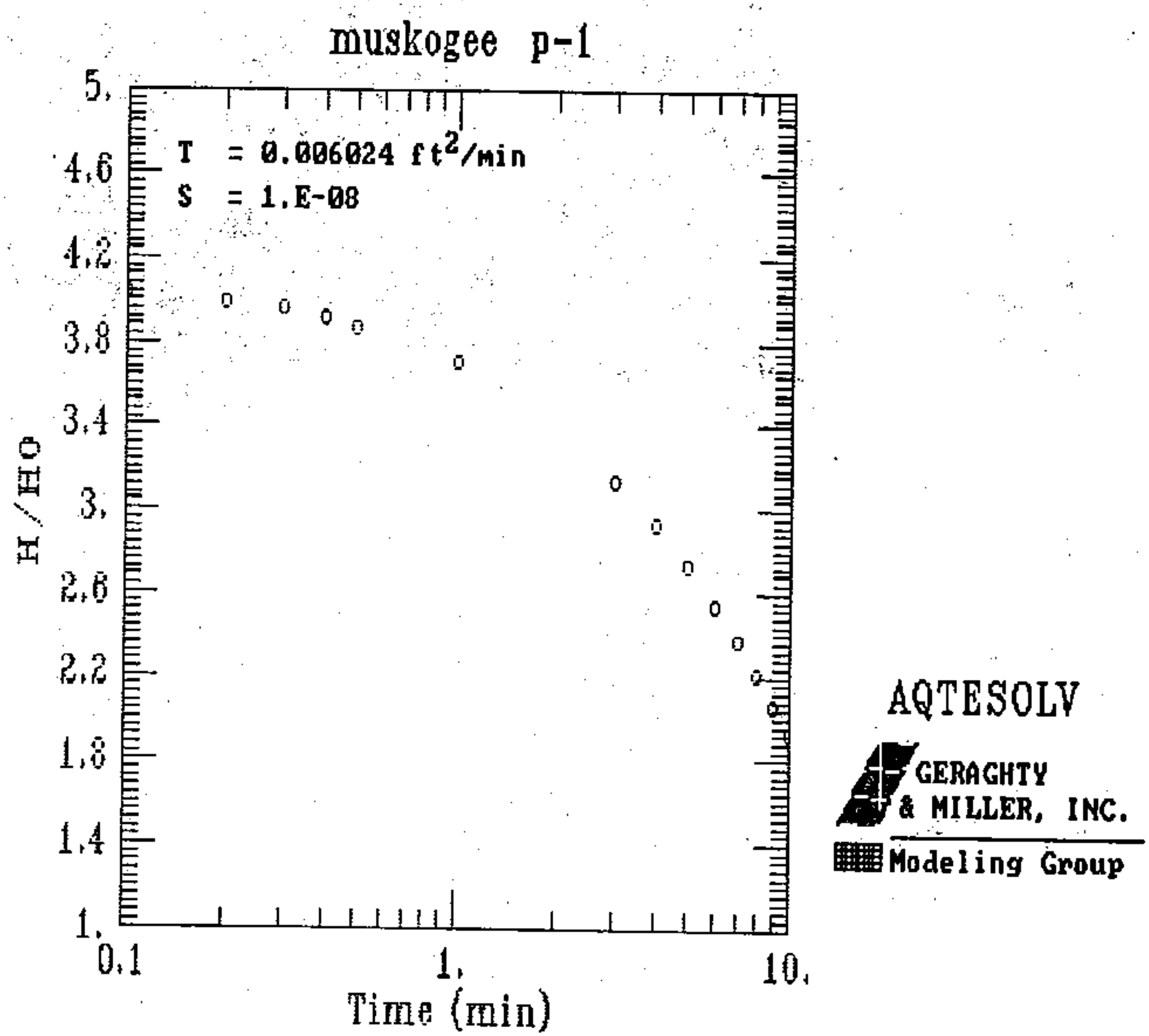
$K = T/b = 9.33 \times 10^{-2}\,cm^2/sec \times 1/822.96\,cm = 1.13 \times 10^{-4}\,cm/sec$

② $T = 5.567 \times 10^{-3}\,ft^2/min \times (12)^2\,in^2/ft^2 \times (2.54)^2\,cm^2/in^2 \times min/60\,sec$

$T = 8.62 \times 10^{-2}\,cm^2/sec$

$K = T/b$

$= 8.62 \times 10^{-2}\,cm^2/sec \times 1/822.96\,cm = 1.05 \times 10^{-4}\,cm/sec$

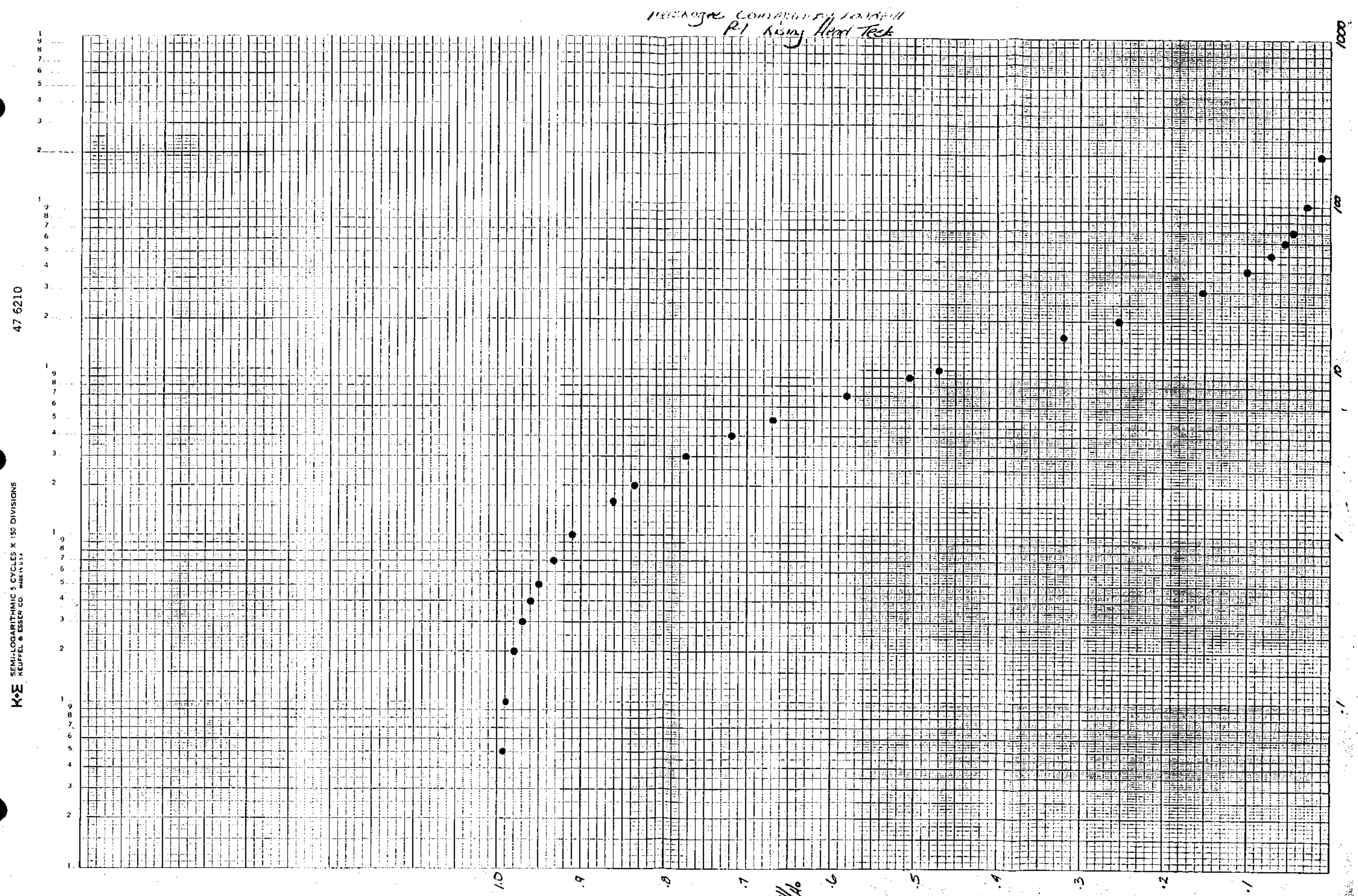

muskogee p-1
T = 0.006024 ft2/min
S = 1.E-08
5.
4.6
4.2
3.8
3.4
3.
2.6
2.2
1.8
1.4
1.
H / HO
0.1
1.
10.
Time (min)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

Muskogee Community Landfill
P1 Rising Head Test

Elapsed Time, min	H(t), ft	h, ft	Ho, ft	H(t)-h/Ho-h
0	12.313	62.58	12.313	1
0.0033	12.471	62.58	12.313	0.996857
0.0066	12.456	62.58	12.313	0.997155
0.01	12.487	62.58	12.313	0.996538
0.0133	12.503	62.58	12.313	0.99622
0.0166	12.519	62.58	12.313	0.995902
0.02	12.519	62.58	12.313	0.995902
0.0233	12.535	62.58	12.313	0.995584
0.0266	12.55	62.58	12.313	0.995285
0.03	12.582	62.58	12.313	0.994649
0.0333	12.598	62.58	12.313	0.99433
0.0366	12.629	62.58	12.313	0.993714
0.04	12.629	62.58	12.313	0.993714
0.0433	12.661	62.58	12.313	0.993077
0.0466	12.629	62.58	12.313	0.993714
0.05	12.677	62.58	12.313	0.992759
0.0533	12.645	62.58	12.313	0.993395
0.0566	12.708	62.58	12.313	0.992142
0.06	12.724	62.58	12.313	0.991824
0.0633	12.74	62.58	12.313	0.991505
0.0666	12.772	62.58	12.313	0.990869
0.07	12.772	62.58	12.313	0.990869
0.0733	12.803	62.58	12.313	0.990252
0.0766	12.788	62.58	12.313	0.99055
0.08	12.835	62.58	12.313	0.989615
0.0833	12.835	62.58	12.313	0.989615
0.0866	12.867	62.58	12.313	0.988979
0.09	12.882	62.58	12.313	0.98868
0.0933	12.882	62.58	12.313	0.98868
0.0966	12.914	62.58	12.313	0.988044
0.1	12.914	62.58	12.313	0.988044
0.1033	12.946	62.58	12.313	0.987407
0.1066	12.946	62.58	12.313	0.987407
0.11	12.977	62.58	12.313	0.986791
0.1133	12.993	62.58	12.313	0.986472
0.1166	13.009	62.58	12.313	0.986154
0.12	13.009	62.58	12.313	0.986154
0.1233	13.025	62.58	12.313	0.985836
0.1266	13.056	62.58	12.313	0.985219
0.13	13.072	62.58	12.313	0.984901
0.1333	13.072	62.58	12.313	0.984901
0.1366	13.088	62.58	12.313	0.984582
0.14	13.104	62.58	12.313	0.984264
0.1433	13.135	62.58	12.313	0.983647
0.1466	13.151	62.58	12.313	0.983329
0.15	13.135	62.58	12.313	0.983647
0.1533	13.151	62.58	12.313	0.983329
0.1566	13.199	62.58	12.313	0.982374
0.16	13.214	62.58	12.313	0.982076
0.1633	13.23	62.58	12.313	0.981757
0.1666	13.246	62.58	12.313	0.981439
0.17	13.246	62.58	12.313	0.981439
0.1733	13.325	62.58	12.313	0.979868
0.1766	13.293	62.58	12.313	0.980504
0.18	13.293	62.58	12.313	0.980504
0.1833	13.309	62.58	12.313	0.980186
0.1866	13.325	62.58	12.313	0.979868
0.19	13.341	62.58	12.313	0.979549
0.1933	13.357	62.58	12.313	0.979231
0.1966	13.388	62.58	12.313	0.978614
0.2	13.388	62.58	12.313	0.978614
0.2033	13.404	62.58	12.313	0.978296
0.2066	13.42	62.58	12.313	0.977978
0.21	13.436	62.58	12.313	0.977659
0.2133	13.452	62.58	12.313	0.977341
0.2166	13.467	62.58	12.313	0.977043
0.22	13.483	62.58	12.313	0.976724
0.2233	13.499	62.58	12.313	0.976406
0.2266	13.515	62.58	12.313	0.976088
0.23	13.531	62.58	12.313	0.975769
0.2333	13.546	62.58	12.313	0.975471
0.2366	13.562	62.58	12.313	0.975153
0.24	13.578	62.58	12.313	0.974834
0.2433	13.594	62.58	12.313	0.974516
0.2466	13.61	62.58	12.313	0.974198
0.25	13.625	62.58	12.313	0.973899
0.2533	13.641	62.58	12.313	0.973581
0.2566	13.657	62.58	12.313	0.973263
0.26	13.673	62.58	12.313	0.972944
0.2633	13.689	62.58	12.313	0.972626
0.2666	13.705	62.58	12.313	0.972308
0.27	13.72	62.58	12.313	0.972009
0.2733	13.736	62.58	12.313	0.971691
0.2766	13.752	62.58	12.313	0.971373
0.28	13.768	62.58	12.313	0.971055
0.2833	13.784	62.58	12.313	0.970736
0.2866	13.799	62.58	12.313	0.970438
0.29	13.815	62.58	12.313	0.97012
0.2933	13.831	62.58	12.313	0.969801
0.2966	13.847	62.58	12.313	0.969483
0.3	13.863	62.58	12.313	0.969165

Elapsed Time, min	H(t), ft	h, ft	Ho, ft	H(t)-h/Ho-h
0.3033	13.878	62.58	12.313	0.968866
0.3066	13.894	62.58	12.313	0.968548
0.31	13.91	62.58	12.313	0.96823
0.3133	13.91	62.58	12.313	0.96823
0.3166	13.942	62.58	12.313	0.967593
0.32	13.942	62.58	12.313	0.967593
0.3233	13.973	62.58	12.313	0.966976
0.3266	13.989	62.58	12.313	0.966658
0.33	13.989	62.58	12.313	0.966658
0.3333	14.005	62.58	12.313	0.96634
0.35	14.1	62.58	12.313	0.96445
0.3666	14.179	62.58	12.313	0.962878
0.3833	14.258	62.58	12.313	0.961307
0.4	14.337	62.58	12.313	0.959735
0.4166	14.432	62.58	12.313	0.957845
0.4333	14.511	62.58	12.313	0.956273
0.45	14.574	62.58	12.313	0.95502
0.4666	14.653	62.58	12.313	0.953449
0.4833	14.732	62.58	12.313	0.951877
0.5	14.811	62.58	12.313	0.950305
0.5166	14.89	62.58	12.313	0.948734
0.5333	14.954	62.58	12.313	0.947461
0.55	15.033	62.58	12.313	0.945889
0.5666	15.112	62.58	12.313	0.944317
0.5833	15.191	62.58	12.313	0.942746
0.6	15.254	62.58	12.313	0.941492
0.6166	15.333	62.58	12.313	0.939921
0.6333	15.412	62.58	12.313	0.938349
0.65	15.491	62.58	12.313	0.936778
0.6666	15.554	62.58	12.313	0.935524
0.6833	15.633	62.58	12.313	0.933953
0.7	15.697	62.58	12.313	0.932679
0.7166	15.776	62.58	12.313	0.931108
0.7333	15.839	62.58	12.313	0.929855
0.75	15.918	62.58	12.313	0.928283
0.7666	15.981	62.58	12.313	0.92703
0.7833	16.045	62.58	12.313	0.925756
0.8	16.124	62.58	12.313	0.924185
0.8166	16.187	62.58	12.313	0.922932
0.8333	16.25	62.58	12.313	0.921678
0.85	16.313	62.58	12.313	0.920425
0.8666	16.392	62.58	12.313	0.918853
0.8833	16.456	62.58	12.313	0.91758
0.9	16.519	62.58	12.313	0.916327
0.9166	16.582	62.58	12.313	0.915074
0.9333	16.645	62.58	12.313	0.91382
0.95	16.709	62.58	12.313	0.912547
0.9666	16.772	62.58	12.313	0.911294
0.9833	16.835	62.58	12.313	0.91004
1	16.883	62.58	12.313	0.909085
1.2	17.8	62.58	12.313	0.890843
1.4	18.511	62.58	12.313	0.876698
1.6	19.223	62.58	12.313	0.862534
1.8	19.903	62.58	12.313	0.849006
2	20.567	62.58	12.313	0.835797
2.2	21.215	62.58	12.313	0.822906
2.4	21.848	62.58	12.313	0.810313
2.6	22.465	62.58	12.313	0.798038
2.8	23.081	62.58	12.313	0.785784
3	23.666	62.58	12.313	0.774146
3.2	24.251	62.58	12.313	0.762508
3.4	24.821	62.58	12.313	0.751169
3.6	25.39	62.58	12.313	0.739849
3.8	25.928	62.58	12.313	0.729146
4	26.466	62.58	12.313	0.718444
4.2	27.004	62.58	12.313	0.707741
4.4	27.509	62.58	12.313	0.697694
4.6	28.016	62.58	12.313	0.687608
4.8	28.506	62.58	12.313	0.67786
5	28.996	62.58	12.313	0.668112
5.2	29.487	62.58	12.313	0.658344
5.4	29.961	62.58	12.313	0.648915
5.6	30.42	62.58	12.313	0.639784
5.8	30.879	62.58	12.313	0.630652
6	31.322	62.58	12.313	0.621839
6.2	31.764	62.58	12.313	0.613046
6.4	32.192	62.58	12.313	0.604532
6.6	32.619	62.58	12.313	0.596037
6.8	33.03	62.58	12.313	0.587861
7	33.441	62.58	12.313	0.579684
7.2	33.853	62.58	12.313	0.571488
7.4	34.248	62.58	12.313	0.56363
7.6	34.644	62.58	12.313	0.555752
7.8	35.039	62.58	12.313	0.547894
8	35.419	62.58	12.313	0.540335
8.2	35.798	62.58	12.313	0.532795
8.4	36.162	62.58	12.313	0.525554
8.6	36.542	62.58	12.313	0.517994
8.8	36.906	62.58	12.313	0.510753
9	37.254	62.58	12.313	0.50383

Elapsed Time, min	H(t), ft	h, ft	Ho, ft	H(t)-h/Ho-h
9.2	37.602	62.58	12.313	0.496907
9.4	37.934	62.58	12.313	0.490302
9.6	38.282	62.58	12.313	0.483379
9.8	38.614	62.58	12.313	0.476774
10	38.931	62.58	12.313	0.470468
12	41.921	62.58	12.313	0.410985
14	44.406	62.58	12.313	0.361549
16	46.494	62.58	12.313	0.320011
18	48.267	62.58	12.313	0.284739
20	49.818	62.58	12.313	0.253884
22	51.163	62.58	12.313	0.227127
24	52.302	62.58	12.313	0.204468
26	53.3	62.58	12.313	0.184614
28	54.154	62.58	12.313	0.167625
30	54.898	62.58	12.313	0.152824
32	55.563	62.58	12.313	0.139595
34	56.133	62.58	12.313	0.128255
36	56.639	62.58	12.313	0.118189
38	57.098	62.58	12.313	0.109058
40	57.494	62.58	12.313	0.10118
42	57.858	62.58	12.313	0.093938
44	58.175	62.58	12.313	0.087632
46	58.46	62.58	12.313	0.081962
48	58.713	62.58	12.313	0.076929
50	58.935	62.58	12.313	0.072513
52	59.14	62.58	12.313	0.068435
54	59.33	62.58	12.313	0.064655
56	59.489	62.58	12.313	0.061492
58	59.647	62.58	12.313	0.058348
60	59.79	62.58	12.313	0.055504
62	59.916	62.58	12.313	0.052997
64	60.027	62.58	12.313	0.050789
66	60.138	62.58	12.313	0.048581
68	60.248	62.58	12.313	0.046392
70	60.328	62.58	12.313	0.044801
72	60.423	62.58	12.313	0.042911
74	60.486	62.58	12.313	0.041658
76	60.581	62.58	12.313	0.039768
78	60.644	62.58	12.313	0.038514
80	60.708	62.58	12.313	0.037241
82	60.771	62.58	12.313	0.035988
84	60.818	62.58	12.313	0.035053
86	60.882	62.58	12.313	0.03378
88	60.929	62.58	12.313	0.032845
90	60.977	62.58	12.313	0.03189
92	61.04	62.58	12.313	0.030636
94	61.088	62.58	12.313	0.029682
96	61.119	62.58	12.313	0.029065
98	61.167	62.58	12.313	0.02811
100	61.214	62.58	12.313	0.027175
120	61.483	62.58	12.313	0.021823
140	61.674	62.58	12.313	0.018024
160	61.8	62.58	12.313	0.015517
180	61.895	62.58	12.313	0.013627
200	61.974	62.58	12.313	0.012056
220	62.038	62.58	12.313	0.010782
240	62.101	62.58	12.313	0.009529
260	62.148	62.58	12.313	0.008594
280	62.18	62.58	12.313	0.007958
300	62.212	62.58	12.313	0.007321
320	62.243	62.58	12.313	0.006704
340	62.275	62.58	12.313	0.006068
360	62.307	62.58	12.313	0.005431
380	62.323	62.58	12.313	0.005113
400	62.354	62.58	12.313	0.004496
420	62.37	62.58	12.313	0.004178
440	62.386	62.58	12.313	0.003859
460	62.402	62.58	12.313	0.003541
480	62.417	62.58	12.313	0.003243
500	62.433	62.58	12.313	0.002924
520	62.449	62.58	12.313	0.002606
540	62.465	62.58	12.313	0.002288
560	62.481	62.58	12.313	0.001969
580	62.497	62.58	12.313	0.001651
600	62.512	62.58	12.313	0.001353
620	62.528	62.58	12.313	0.001034
640	62.528	62.58	12.313	0.001034
660	62.544	62.58	12.313	0.000716
680	62.544	62.58	12.313	0.000716
700	62.544	62.58	12.313	0.000716
720	62.56	62.58	12.313	0.000398
740	62.56	62.58	12.313	0.000398
760	62.56	62.58	12.313	0.000398
780	62.56	62.58	12.313	0.000398
800	62.56	62.58	12.313	0.000398
820	62.56	62.58	12.313	0.000398
840	62.544	62.58	12.313	0.000716
860	62.544	62.58	12.313	0.000716
880	62.544	62.58	12.313	0.000716
900	62.528	62.58	12.313	0.001034
920	62.544	62.58	12.313	0.000716
940	62.56	62.58	12.313	0.000398


P-1 Rising Head Test
K+E SEMI-LOGARITHMIC 5 CYCLES X 150 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
47 6210
1.0
.9
.8
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H/Ho
.6
.5
.4
.3
.2
.1
1000
100
10
1
.1

PAGE ____ OF ____

SIRRINE
ENVIRONMENTAL CONSULTANTS

CALCULATION SHEET

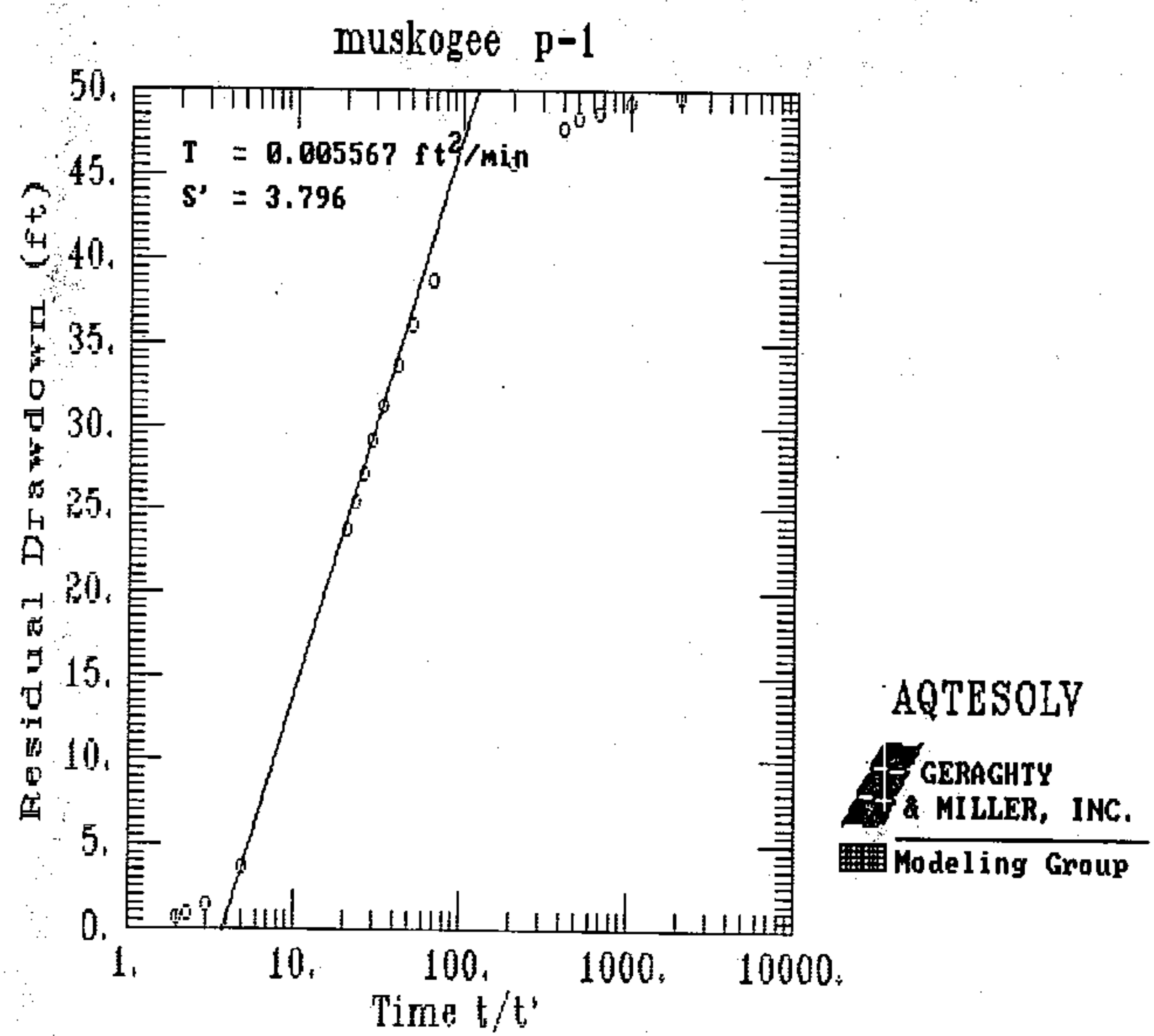
CLIENT ______ LOCATION ______ JOB NO. ______

SUBJECT ______

BY ______ DATE ______ CHECKED BY ______ DATE ______

$H_0 = 12.313$ $h = 62.58$ $S = 50.27$ $t = 0$

H_t	h	S	t
12.914	"	49.67	t=.1
13.38		49.20	.2
13.863		48.72	.3
14.337		48.24	.4
14.881		47.70	.5
16.883		45.70	1.
23.666		38.91	3.0
26.466		36.11	4.
28.996		33.58	5
31.322		31.258	6
33.441		29.14	7
35.419		27.16	8
37.254		25.33	9
38.931		23.65	10
		3.64	50
		1.37	100
		0.78	150
		0.61	200



muskogee p-1
T = 0.005567 ft²/min
S' = 3.796
Residual Drawdown (ft)
50.
45.
40.
35.
30.
25.
20.
15.
10.
5.
0.
1.
10.
100.
1000.
10000.
Time t/t'
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PAGE ___ OF ___
PROJECT NO. 86251

CLIENT WMO
SUBJECT Perm Test Results
Prepared By GH Date 12/10
PROJECT Muskogee Hydrogeo
Reviewed By ___ Date ___
Approved By ___ Date ___

w/ Aqtesolve Program (Theiss Recovery)

$T = 5.59 \times 10^{-3}\ ft^2/min \times (12)^2 in^2/ft^2 \times (2.54)^2 cm^2/in^2 \times min/60sec$

$K = T/b = 8.66 \times 10^{-2}\ cm^2/sec \times 1/365.76\ cm$

$K = 2.37 \times 10^{-4}\ cm/sec$

P-2

Aquifer Thickness, $b = 12ft$ (filter pack) $\times 12 in/ft \times 2.54 cm/in$
$= 365.76\ cm$

Note: H_2O level elev. = 612.15
Top of shale elev. 597.71

Casing radius, $r_c = 1in$, Initial H_2O Level $\hat{=}$ 21.23, from TOC
(h)

$H_0 = 66.30ft$
$h = 21.23\ ft$
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	55.98
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

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PAGE 2 OF ____
PROJECT NO. ____

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		

$Tt/r_c^2 = 1$, $\alpha = 10^{-7}$ @ $t = 6$ minutes

$T = r_c^2/t$

$= (1in)^2 / 6min$

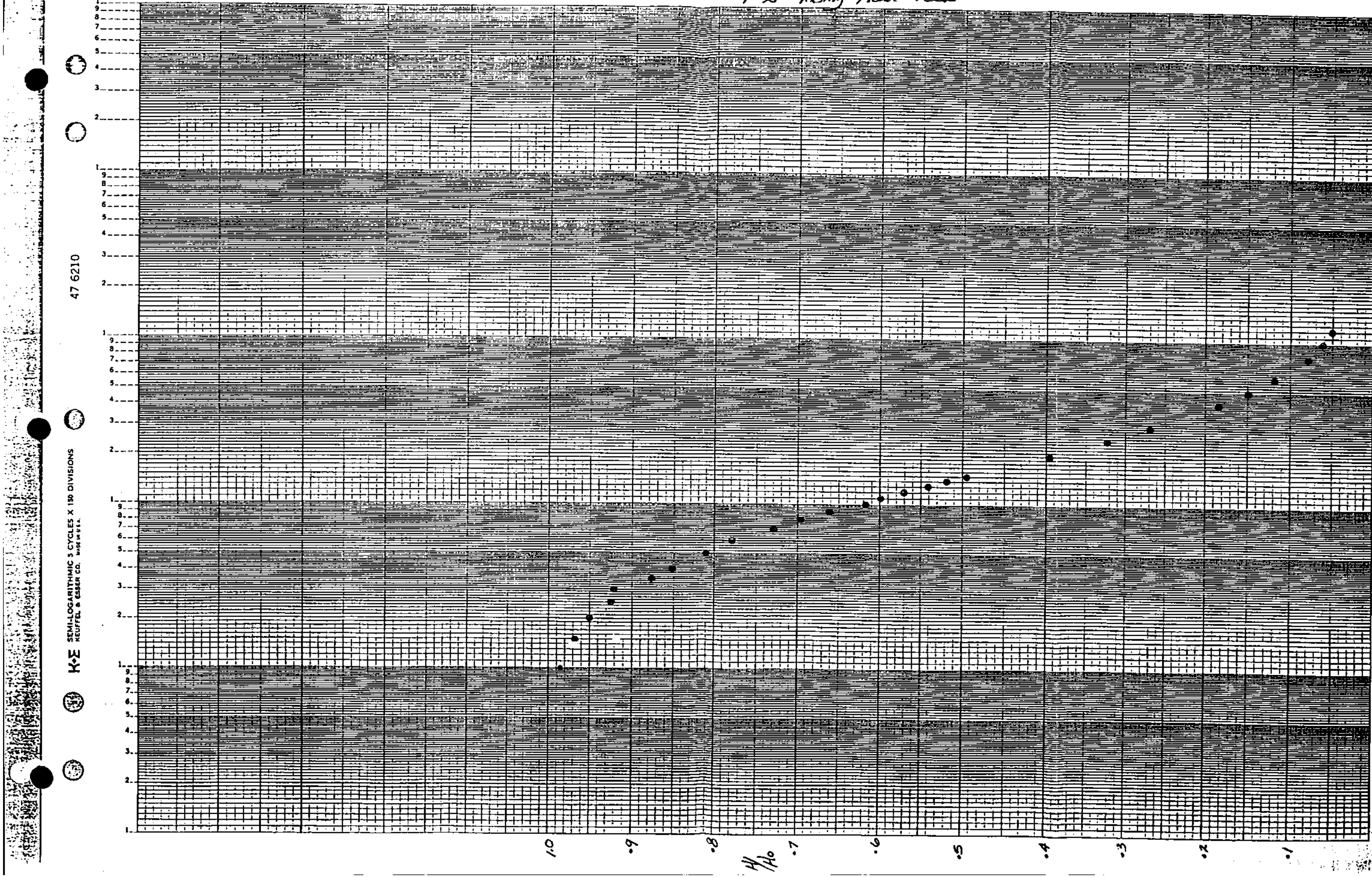
$= 0.167\ in^2/min \times (2.54cm/in)^2 \times min/60sec$

$T = 0.018\ cm^2/sec$

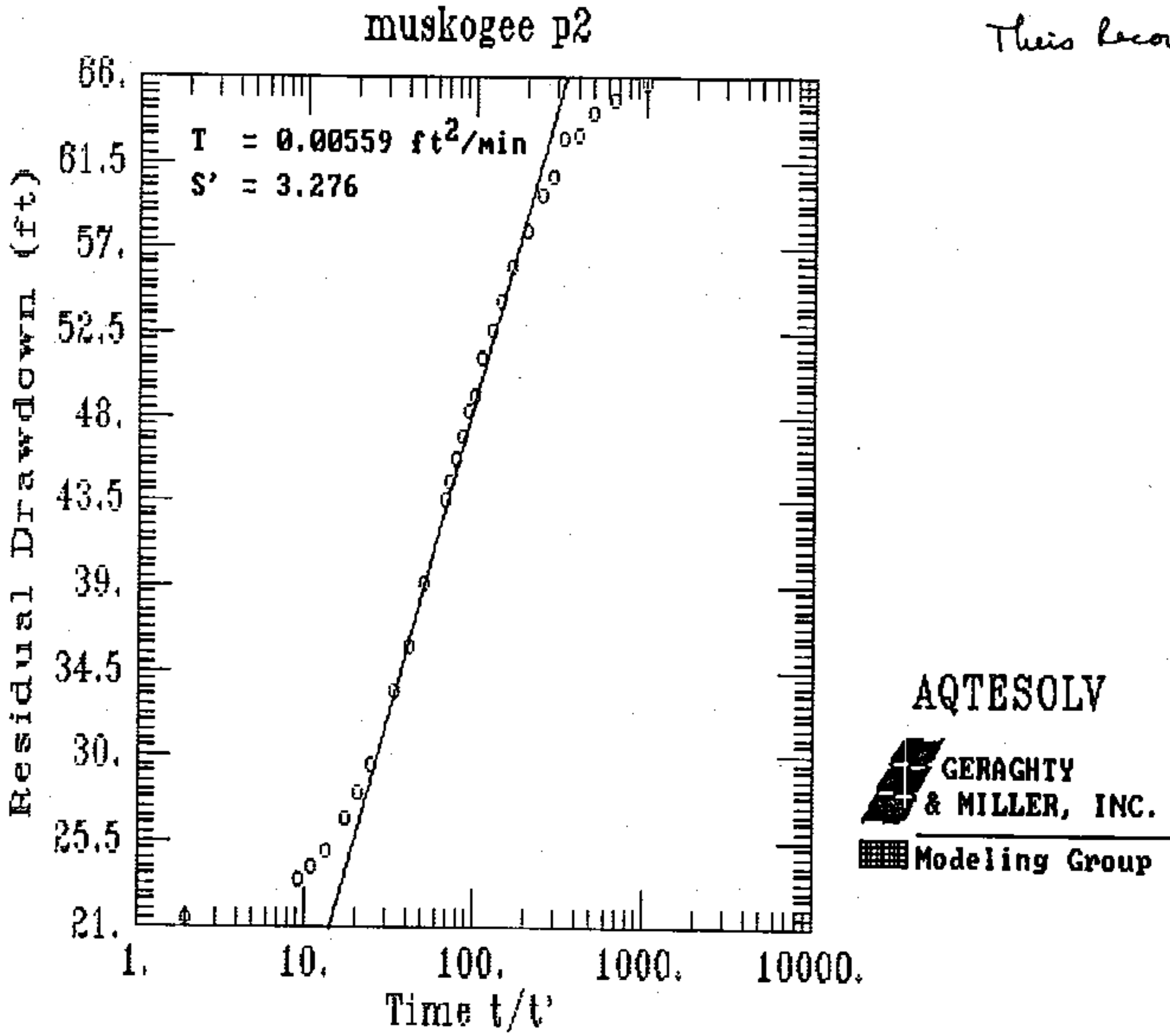
$K = T/b = 0.018\ cm^2/sec\ /\ 365.76\ cm$

$K = 4.90 \times 10^{-5}\ cm/sec$

P-2 Rising Head Test



T= 0.087 cm²/sec
Theis Recovery



RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

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CLIENT: WMO
SUBJECT: Perm Tests
Prepared By: GH Date: 12/3/93
PROJECT: Mick - Hydrogeo
Reviewed By ______ Date ____
Approved By ______ Date ____

P-3 Rising Head Test – Bouwer & Rice (modified)

$$K = \frac{r_c'^2 \ln(R_e/r_w)}{2 L_e} \frac{1}{t} \ln \frac{Y_0}{Y_t}$$

$$r_c' = [(1-n) r_c^2 + n r_w^2]^{1/2}$$

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 × ft/12 in
= .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_t = water level at time t
t = time since test began

H_0 = 15.53 ft
H = as per field notes
h = 11.16 ft

$$H-h / H_0 - h = H/H_0$$

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

$$= \left[\frac{1.1}{\ln(5.35/0.3)} + \frac{2.55 + 0.40 \ln[(21.85 - 5.35)/0.3]}{33.33} \right]^{-1}$$

$$\ln \frac{R_e}{r_w} = 1.93$$

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', TOC

RUST ENVIRONMENT & INFRASTRUCTURE

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Approved By ____ Date ____

P-3 Rising Head Test

$$r'c = [(1-n)rc^2 + nrw^2]^{1/2}$$
$$[(1-0.3)(0.08)^2 + 0.3(0.3)^2]^{1/2}$$
$$r'c = 0.17$$

$$K = \frac{r'c^2 \ln(Re/rw)}{2Le} \frac{1}{t} \ln \frac{Y_o}{Y_t} \quad , \quad Y_o = .81, \; Y_t = .74 \text{ @ } t = 500 \text{ min}$$

$$= \frac{(0.17)^2 (1.98)}{2(10)} \frac{1}{500} \ln(.81/.74)$$

$$K = 5.17 \times 10^{-7} \text{ ft/min} \times \underbrace{12 \text{ in/ft} \times 2.54 \text{ cm/in} \times \text{min}/60\text{sec}}_{.508 \text{ cm/sec}}$$

$$K = 2.63 \times 10^{-7} \text{ cm/sec}$$

w/ Aqtesolve Program

$$K = 1.461 \times 10^{-6} \text{ ft/min} \times 12\text{in/ft} \times \text{min}/60\text{sec} \times 2.54 \text{ cm/in}$$

$$K = 7.42 \times 10^{-7} \text{ cm/sec}$$

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P-3 Rising Head Test

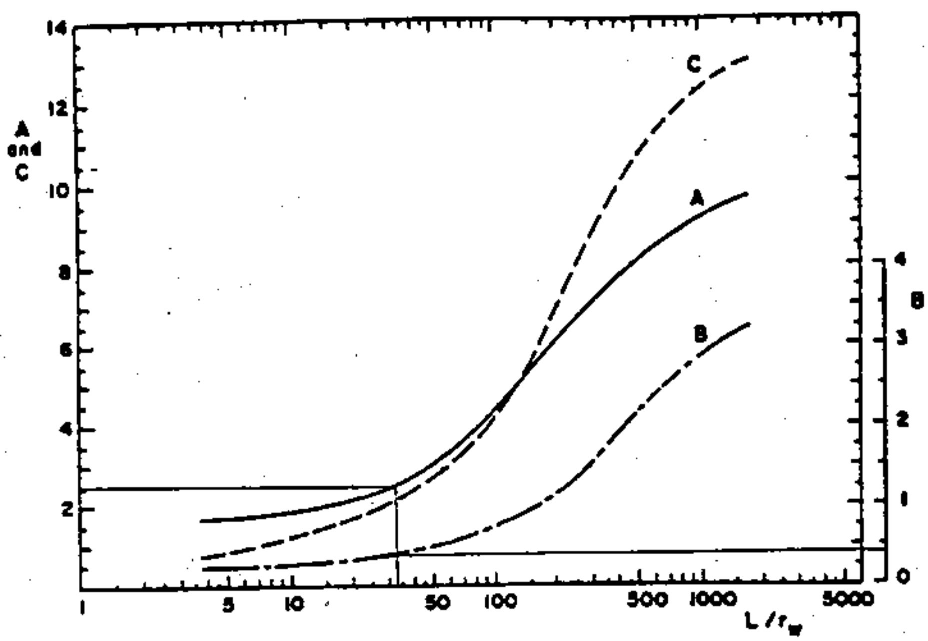
Time	H, ft	Time	H, ft
0.5	15.41	11.0	15.04
1.0	15.33	12.0	15.02
1.5	15.30	13.0	15.01
2.0	15.27	14.0	15.00
2.5	15.25	15.0	14.98
3.0	15.26	20.0	14.94
3.5	15.22	25.0	14.89
4.0	15.19	30.0	14.85
4.5	15.17	35.0	14.82
5.0	15.15	40.0	14.80
6.0	15.13	50.0	14.76
7.0	15.12	60.0	14.73
8.0	15.10	70.0	14.70 < 80.00 14.68
9.0	15.08	100.0	14.63
10.0	15.06	936.0	14.20
		2373.0	13.83

Time	H/Ho	Time	H/Ho	Time	H/Ho
0.5	.973	10.0	.892	80.0	.805
1.0	.954	11.0	.888	100.0	.794
1.5	.947	12.0	.883	936.0	.696
2.0	.941	13.0	.881	2373.0	.611
2.5	.936	14.0	.879		
3.0	.938	15.0	.874		
3.5	.929	20.0	.865		
4.0	.922	25.0	.854		
4.5	.918	30.0	.844		
5.0	.913	35.0	.838		
6.0	.908	40.0	.833		
7.0	.906	50 ~~45.0~~	.824		
8.0	.902	60.0	.817		
9.0	.897	70.0	.810		

	Muskogee Community Landfill			
	P3 Rising Head Test			
Elapsed Time,min	H(t),ft	h,ft	Ho,ft	H(t)-h/Ho-h
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

BOUWER AND RICE: GROUNDWATER HYDRAULICS

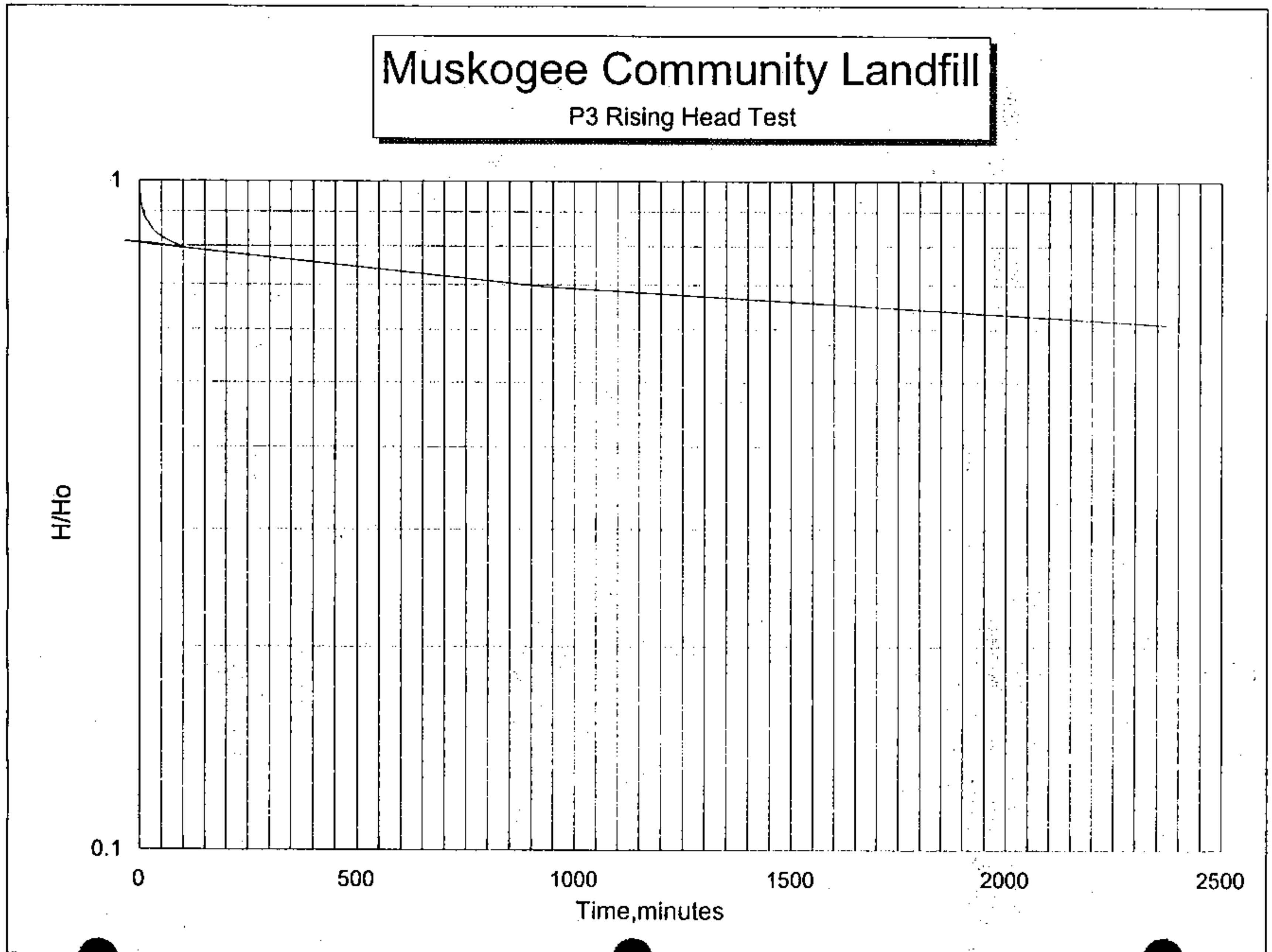


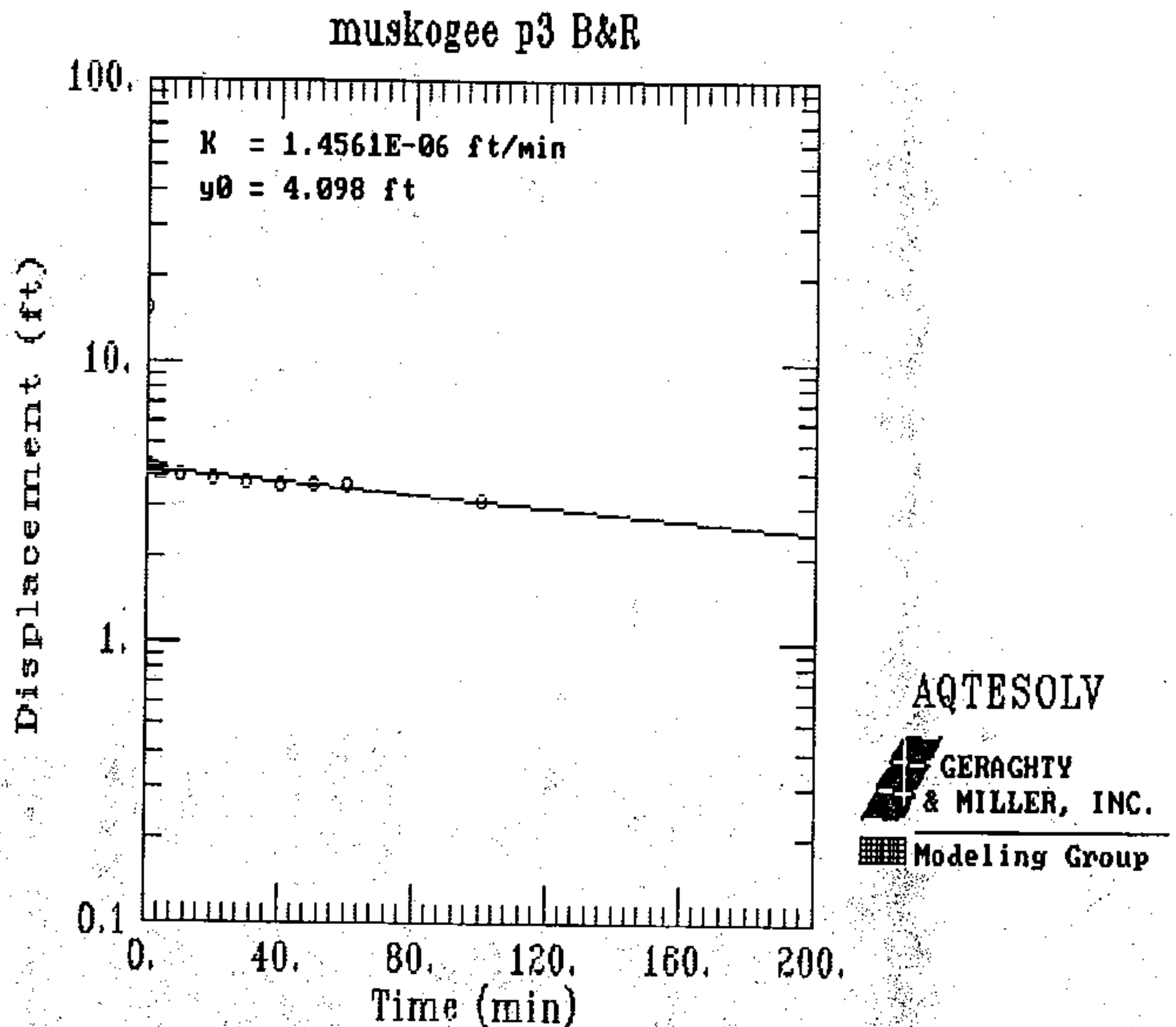
Curves relating coefficients A, B, and C to L/r_w.

$Le/r_w = 10/.3 = 33.33$

$A = 2.55$

$B = 0.40$


Muskogee Community Landfill
P3 Rising Head Test
1
0.1
H/Ho
0
500
1000
1500
2000
2500
Time,minutes


muskogee p3 B&R
K = 1.4561E-06 ft/min
y0 = 4.098 ft
Displacement (ft)
100.
10.
1.
0.1
0.
40.
80.
120.
160.
200.
Time (min)
AQTESOLV
GERAGHTY
& MILLER, INC.
Modeling Group

RUST ENVIRONMENT & INFRASTRUCTURE

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P-4 Rising Head Test

Aquifer Thickness, $b = 120 - 109 = 11 ft \times 12 in/ft \times 2.54 cm/in$

$b = 335.28\ cm$

Casing Radius, $r_c = 1 in$

$H_o =$

$h = 22.58 ft, TOC$

$H =$ as noted in field notes (transducer values)

$Tt/r_c^2 = 1 \quad \alpha = 10^{-6} \quad @\ t = 10 min$

$T = r_c^2/t$

$= (1 in)^2/10 min$

$= .1\ in^2/min \times (2.54\ cm/in)^2 \times min/60 sec$

$T = .011\ cm^2/sec$

$K = T/b$

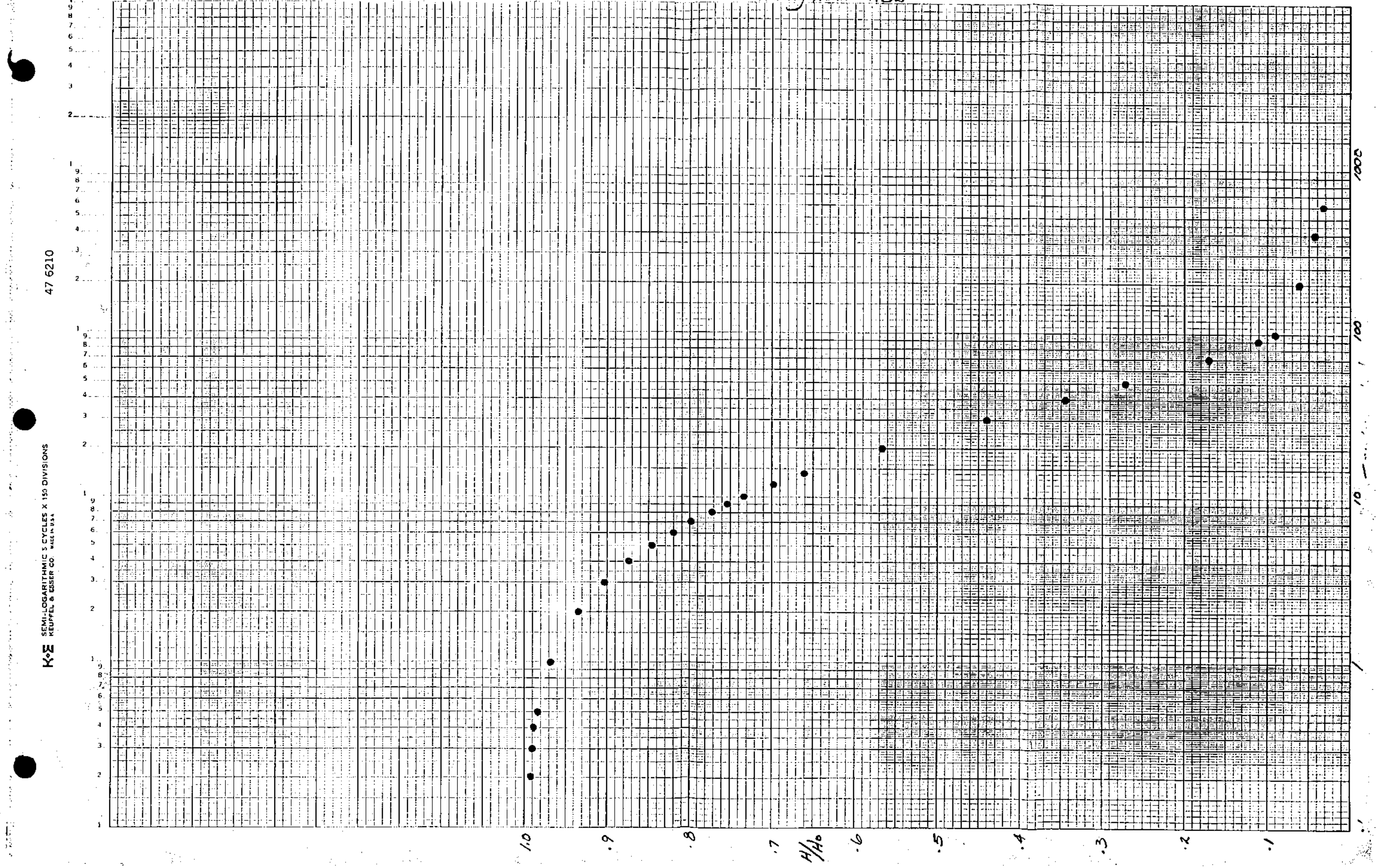
$= .011\ cm^2/sec \times 1/335.28\ cm$

$K = \cancel{3.21}\ 3.28 \times 10^{-5}\ cm/sec$

Muskogee Community Landfill
P4 Rising Head Test

psed ne,min	H(t),ft	h,ft	Ho	H(t)-h/Ho-h	Elapsed Time,min	H(t),ft	h,ft	Ho	H(t)-h/Ho-h	Elapsed Time,min	H(t),ft	h,ft	Ho	H(t)-h/Ho-h
0	0.774	70.88	0.774	1	0.3033	1.454	70.88	0.774	0.990298	9.2	18.29	70.88	0.774	0.750078
0.0033	0.774	70.88	0.774	1	0.3066	1.469	70.88	0.774	0.990084	9.4	18.575	70.88	0.774	0.746012
0.0066	0.79	70.88	0.774	0.999772	0.31	1.469	70.88	0.774	0.990084	9.6	18.843	70.88	0.774	0.742188
0.01	0.79	70.88	0.774	0.999772	0.3133	1.485	70.88	0.774	0.989855	9.8	19.128	70.88	0.774	0.738122
0.0133	0.806	70.88	0.774	0.999543	0.3166	1.485	70.88	0.774	0.989855	10	19.397	70.88	0.774	0.734284
0.0166	0.806	70.88	0.774	0.999543	0.32	1.501	70.88	0.774	0.989627	12	22.037	70.88	0.774	0.696616
0.02	0.821	70.88	0.774	0.999329	0.3233	1.501	70.88	0.774	0.989627	14	24.536	70.88	0.774	0.660959
0.0233	0.821	70.88	0.774	0.999329	0.3266	1.517	70.88	0.774	0.989399	16	26.877	70.88	0.774	0.627558
0.0266	0.837	70.88	0.774	0.999101	0.33	1.517	70.88	0.774	0.989399	18	29.091	70.88	0.774	0.595968
0.03	0.837	70.88	0.774	0.999101	0.3333	1.517	70.88	0.774	0.989399	20	31.179	70.88	0.774	0.566178
0.0333	0.853	70.88	0.774	0.998873	0.35	1.564	70.88	0.774	0.988728	22	33.141	70.88	0.774	0.538182
0.0366	0.853	70.88	0.774	0.998873	0.3666	1.612	70.88	0.774	0.988043	24	34.991	70.88	0.774	0.511788
0.04	0.869	70.88	0.774	0.998645	0.3833	1.643	70.88	0.774	0.987601	26	36.746	70.88	0.774	0.486718
0.0433	0.869	70.88	0.774	0.998645	0.4	1.675	70.88	0.774	0.987144	28	38.409	70.88	0.774	0.463017
0.0466	0.885	70.88	0.774	0.998416	0.4166	1.722	70.88	0.774	0.986474	30	39.991	70.88	0.774	0.440445
0.05	0.885	70.88	0.774	0.998416	0.4333	1.77	70.88	0.774	0.985789	32	41.476	70.88	0.774	0.419228
0.0533	0.9	70.88	0.774	0.998202	0.45	1.801	70.88	0.774	0.985347	34	42.888	70.88	0.774	0.399138
0.0566	0.9	70.88	0.774	0.998202	0.4666	1.833	70.88	0.774	0.98489	36	44.215	70.88	0.774	0.380176
0.06	0.9	70.88	0.774	0.998202	0.4833	1.88	70.88	0.774	0.984219	38	45.466	70.88	0.774	0.362328
0.0633	0.916	70.88	0.774	0.997974	0.5	1.912	70.88	0.774	0.983763	40	46.668	70.88	0.774	0.345176
0.0666	0.932	70.88	0.774	0.997746	0.5166	1.959	70.88	0.774	0.983092	42	47.808	70.88	0.774	0.32891
0.07	0.932	70.88	0.774	0.997746	0.5333	1.991	70.88	0.774	0.982636	44	48.884	70.88	0.774	0.313558
0.0733	0.948	70.88	0.774	0.997517	0.55	2.022	70.88	0.774	0.982193	46	49.913	70.88	0.774	0.298876
0.0766	0.948	70.88	0.774	0.997517	0.5666	2.07	70.88	0.774	0.981508	48	50.894	70.88	0.774	0.284879
0.08	0.964	70.88	0.774	0.997289	0.5833	2.102	70.88	0.774	0.981052	50	51.812	70.88	0.774	0.27178
0.0833	0.964	70.88	0.774	0.997289	0.6	2.149	70.88	0.774	0.980381	52	52.698	70.88	0.774	0.259139
0.0866	0.964	70.88	0.774	0.997289	0.6166	2.181	70.88	0.774	0.979925	54	53.537	70.88	0.774	0.247168
0.09	0.979	70.88	0.774	0.997075	0.6333	2.228	70.88	0.774	0.979254	56	54.328	70.88	0.774	0.235882
0.0933	0.979	70.88	0.774	0.997075	0.65	2.26	70.88	0.774	0.978797	58	55.072	70.88	0.774	0.225266
0.0966	0.995	70.88	0.774	0.996847	0.6666	2.291	70.88	0.774	0.978355	60	55.785	70.88	0.774	0.215093
0.1	0.995	70.88	0.774	0.996847	0.6833	2.339	70.88	0.774	0.97767	62	56.465	70.88	0.774	0.205391
0.1033	1.011	70.88	0.774	0.996618	0.7	2.37	70.88	0.774	0.977228	64	57.114	70.88	0.774	0.19613
0.1066	1.011	70.88	0.774	0.996618	0.7166	2.418	70.88	0.774	0.976543	66	57.718	70.88	0.774	0.187541
0.11	1.027	70.88	0.774	0.99639	0.7333	2.449	70.88	0.774	0.976101	68	58.302	70.88	0.774	0.17918
0.1133	1.027	70.88	0.774	0.99639	0.75	2.481	70.88	0.774	0.975644	70	58.84	70.88	0.774	0.171504
0.1166	1.043	70.88	0.774	0.996162	0.7666	2.528	70.88	0.774	0.974974	72	59.378	70.88	0.774	0.163827
0.12	1.043	70.88	0.774	0.996162	0.7833	2.56	70.88	0.774	0.974517	74	59.869	70.88	0.774	0.156822
0.1233	1.058	70.88	0.774	0.995948	0.8	2.607	70.88	0.774	0.973846	76	60.344	70.88	0.774	0.150044
0.1266	1.058	70.88	0.774	0.995948	0.8166	2.639	70.88	0.774	0.97339	78	60.803	70.88	0.774	0.143495
0.13	1.074	70.88	0.774	0.99572	0.8333	2.671	70.88	0.774	0.972933	80	61.214	70.88	0.774	0.137631
0.1333	1.074	70.88	0.774	0.99572	0.85	2.718	70.88	0.774	0.972263	82	61.628	70.88	0.774	0.131752
0.1366	1.09	70.88	0.774	0.995491	0.8666	2.75	70.88	0.774	0.971806	84	62.008	70.88	0.774	0.126331
0.14	1.09	70.88	0.774	0.995491	0.8833	2.797	70.88	0.774	0.971135	86	62.368	70.88	0.774	0.120909
0.1433	1.106	70.88	0.774	0.995263	0.9	2.829	70.88	0.774	0.970679	88	62.734	70.88	0.774	0.115943
0.1466	1.106	70.88	0.774	0.995263	0.9166	2.86	70.88	0.774	0.970237	90	63.067	70.88	0.774	0.111192
0.15	1.106	70.88	0.774	0.995263	0.9333	2.908	70.88	0.774	0.969552	92	63.383	70.88	0.774	0.106683
0.1533	1.122	70.88	0.774	0.995035	0.95	2.939	70.88	0.774	0.969109	94	63.684	70.88	0.774	0.102388
0.1566	1.137	70.88	0.774	0.994821	0.9666	2.971	70.88	0.774	0.968653	96	63.969	70.88	0.774	0.098322
0.16	1.137	70.88	0.774	0.994821	0.9833	3.018	70.88	0.774	0.967982	98	64.238	70.88	0.774	0.094484
0.1633	1.137	70.88	0.774	0.994821	1	3.05	70.88	0.774	0.967526	100	64.507	70.88	0.774	0.090646
0.1666	1.153	70.88	0.774	0.994592	1.2	3.556	70.88	0.774	0.960306	120	66.516	70.88	0.774	0.061952
0.17	1.153	70.88	0.774	0.994592	1.4	4.014	70.88	0.774	0.953771	140	67.785	70.88	0.774	0.043875
0.1733	1.169	70.88	0.774	0.994364	1.6	4.457	70.88	0.774	0.94745	160	68.592	70.88	0.774	0.03236
0.1766	1.169	70.88	0.774	0.994364	1.8	4.899	70.88	0.774	0.941144	180	69.131	70.88	0.774	0.02467
0.18	1.185	70.88	0.774	0.994136	2	5.342	70.88	0.774	0.934823	200	69.495	70.88	0.774	0.019476
0.1833	1.185	70.88	0.774	0.994136	2.2	5.789	70.88	0.774	0.92873	220	69.748	70.88	0.774	0.015866
0.1866	1.201	70.88	0.774	0.993907	2.4	6.211	70.88	0.774	0.922424	240	69.939	70.88	0.774	0.013141
0.19	1.201	70.88	0.774	0.993907	2.6	6.638	70.88	0.774	0.916331	260	70.081	70.88	0.774	0.011115
0.1933	1.216	70.88	0.774	0.993693	2.8	7.065	70.88	0.774	0.910239	280	70.176	70.88	0.774	0.009759
0.1966	1.216	70.88	0.774	0.993693	3	7.476	70.88	0.774	0.904375	300	70.271	70.88	0.774	0.008404
0.2	1.232	70.88	0.774	0.993465	3.2	7.887	70.88	0.774	0.89851	320	70.334	70.88	0.774	0.007505
0.2033	1.232	70.88	0.774	0.993465	3.4	8.298	70.88	0.774	0.892646	340	70.397	70.88	0.774	0.006606
0.2066	1.248	70.88	0.774	0.993237	3.6	8.709	70.88	0.774	0.886782	360	70.445	70.88	0.774	0.005921
0.21	1.248	70.88	0.774	0.993237	3.8	9.12	70.88	0.774	0.880918	380	70.493	70.88	0.774	0.005236
0.2133	1.248	70.88	0.774	0.993237	4	9.515	70.88	0.774	0.875282	400	70.54	70.88	0.774	0.004566
0.2166	1.264	70.88	0.774	0.993009	4.2	9.91	70.88	0.774	0.869646	420	70.572	70.88	0.774	0.004109
0.22	1.28	70.88	0.774	0.99278	4.4	10.305	70.88	0.774	0.86401	440	70.603	70.88	0.774	0.003867
0.2233	1.28	70.88	0.774	0.99278	4.6	10.701	70.88	0.774	0.85836	460	70.635	70.88	0.774	0.00321
0.2266	1.28	70.88	0.774	0.99278	4.8	11.096	70.88	0.774	0.852724	480	70.651	70.88	0.774	0.002982
0.23	1.296	70.88	0.774	0.992552	5	11.475	70.88	0.774	0.847318	500	70.683	70.88	0.774	0.002525
0.2333	1.296	70.88	0.774	0.992552	5.2	11.871	70.88	0.774	0.841668	520	70.699	70.88	0.774	0.002297
0.2366	1.311	70.88	0.774	0.992338	5.4	12.25	70.88	0.774	0.836258	540	70.73	70.88	0.774	0.001855
0.24	1.311	70.88	0.774	0.992338	5.6	12.598	70.88	0.774	0.831293	560	70.748	70.88	0.774	0.001627
0.2433	1.327	70.88	0.774	0.99211	5.8	12.93	70.88	0.774	0.826556	580	70.762	70.88	0.774	0.001398
0.2466	1.327	70.88	0.774	0.99211	6	13.293	70.88	0.774	0.821377	600	70.777	70.88	0.774	0.001184
0.25	1.343	70.88	0.774	0.991881	6.2	13.641	70.88	0.774	0.816411	620	70.793	70.88	0.774	0.000956
0.2533	1.343	70.88	0.774	0.991881	6.4	14.005	70.88	0.774	0.811218	640	70.793	70.88	0.774	0.000956
0.2566	1.359	70.88	0.774	0.991653	6.6	14.337	70.88	0.774	0.806481	660	70.809	70.88	0.774	0.000728
0.26	1.359	70.88	0.774	0.991653	6.8	14.669	70.88	0.774	0.801744	680	70.809	70.88	0.774	0.000728
0.2633	1.374	70.88	0.774	0.991439	7	15.001	70.88	0.774	0.797007	700	70.809	70.88	0.774	0.000728
0.2666	1.374	70.88	0.774	0.991439	7.2	15.333	70.88	0.774	0.792268	720	70.825	70.88	0.774	0.000499
0.27	1.39	70.88	0.774	0.991211	7.4	15.665	70.88	0.774	0.787532	740	70.825	70.88	0.774	0.000499
0.2733	1.39	70.88	0.774	0.991211	7.6	15.997	70.88	0.774	0.782795	760	70.825	70.88	0.774	0.000499
0.2766	1.39	70.88	0.774	0.991211	7.8	16.282	70.88	0.774	0.778729	780	70.825	70.88	0.774	0.000499
0.28	1.406	70.88	0.774	0.990983	8	16.582	70.88	0.774	0.774449	800	70.825	70.88	0.774	0.000499
0.2833	1.406	70.88	0.774	0.990983	8.2	16.883	70.88	0.774	0.770154	820	70.825	70.88	0.774	0.000499
0.2866	1.422	70.88	0.774	0.990754	8.4	17.167	70.88	0.774	0.766102	840	70.825	70.88	0.774	0.000499
0.29	1.422	70.88	0.774	0.990754	8.6	17.436	70.88	0.774	0.762264	860	70.825	70.88	0.774	0.000499
0.2933	1.438	70.88	0.774	0.990526	8.8	17.721	70.88	0.774	0.758197	880	70.825	70.88	0.774	0.000499
0.2966	1.438	70.88	0.774	0.990526	9	18.005	70.88	0.774	0.754145	900	70.825	70.88	0.774	0.000499
0.31	1.454	70.88	0.774	0.990298						920	70.809	70.88	0.774	0.000728
										940	70.841	70.88	0.774	0.000271

P-4 Rising Head Test



RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

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CLIENT ________
SUBJECT Musk. Hydro I / Perm Tests
PROJECT ________

Prepared By ____ Date ____
Reviewed By ____ Date ____
Approved By ____ Date ____

P-5 Rising Head Test

Aquifer Thickness, b = 67' - 49' = 18 ft (filter pack) × $\frac{12 \text{ in}}{\text{ft}}$ × $\frac{2.54 \text{ cm}}{\text{in}}$

= 548.64 cm

Note: H_2O Level Elev. = 617.95'
Top of Shale Elev. = 594.97'

Casing radius, r_c = 1 in

H_o = 62.02 ft
h = 15.37 ft
H = as per field notes

$H/H_o = H-h / H_o-h$

Time	H'	Time	H'	Time	H'
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	19.85		
8.0	50.00	70.0	18.88		
9.0	48.54	80.0	18.29		
10.0	47.10				

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P-5 Rising Head Test

Time	H/Ho	Time	H/Ho	Time,	H/Ho
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				

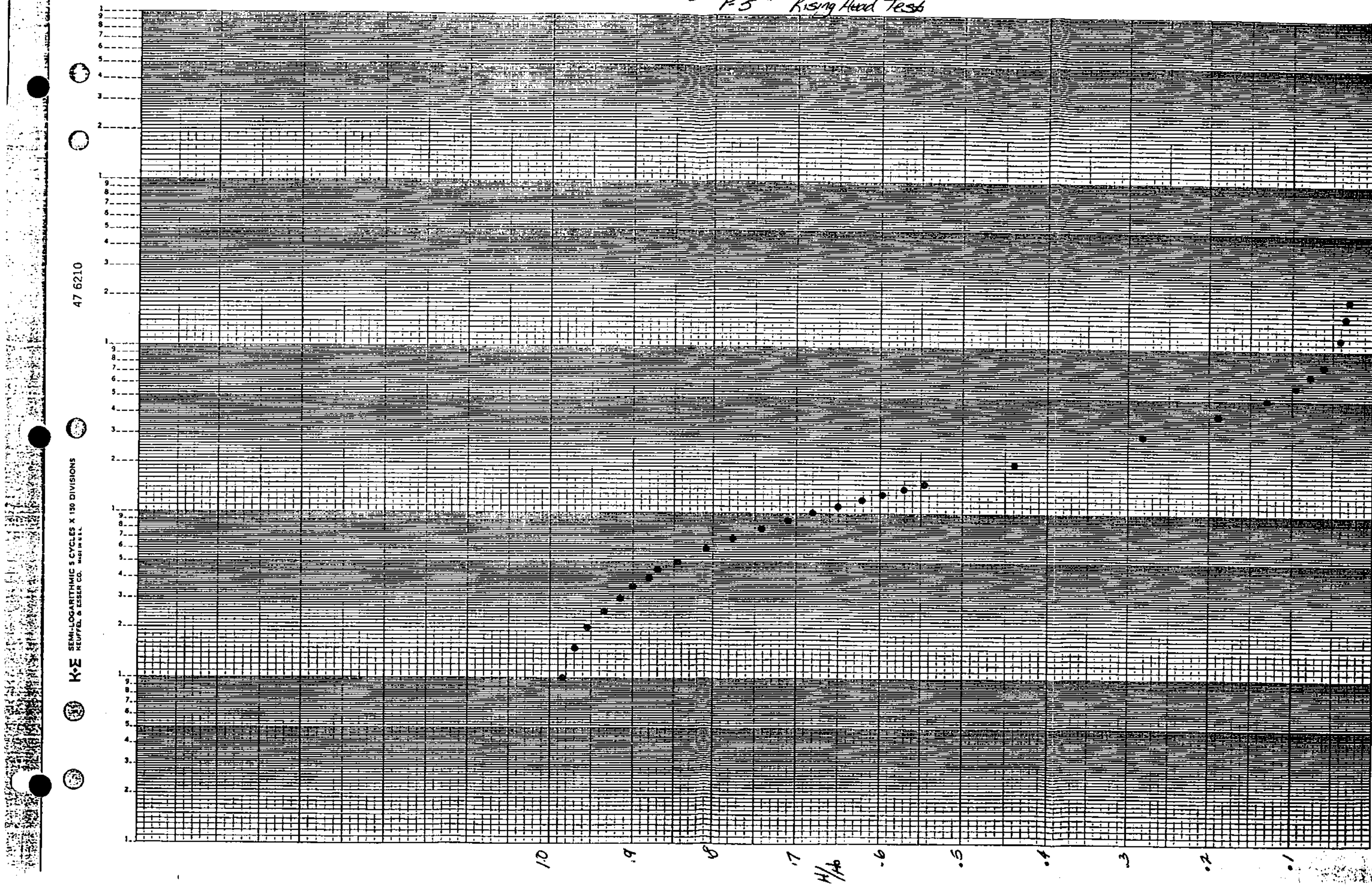
$Tt/r_c^2 = 1$ $\alpha = 10^{-7}$ @ $t = 6$ minutes

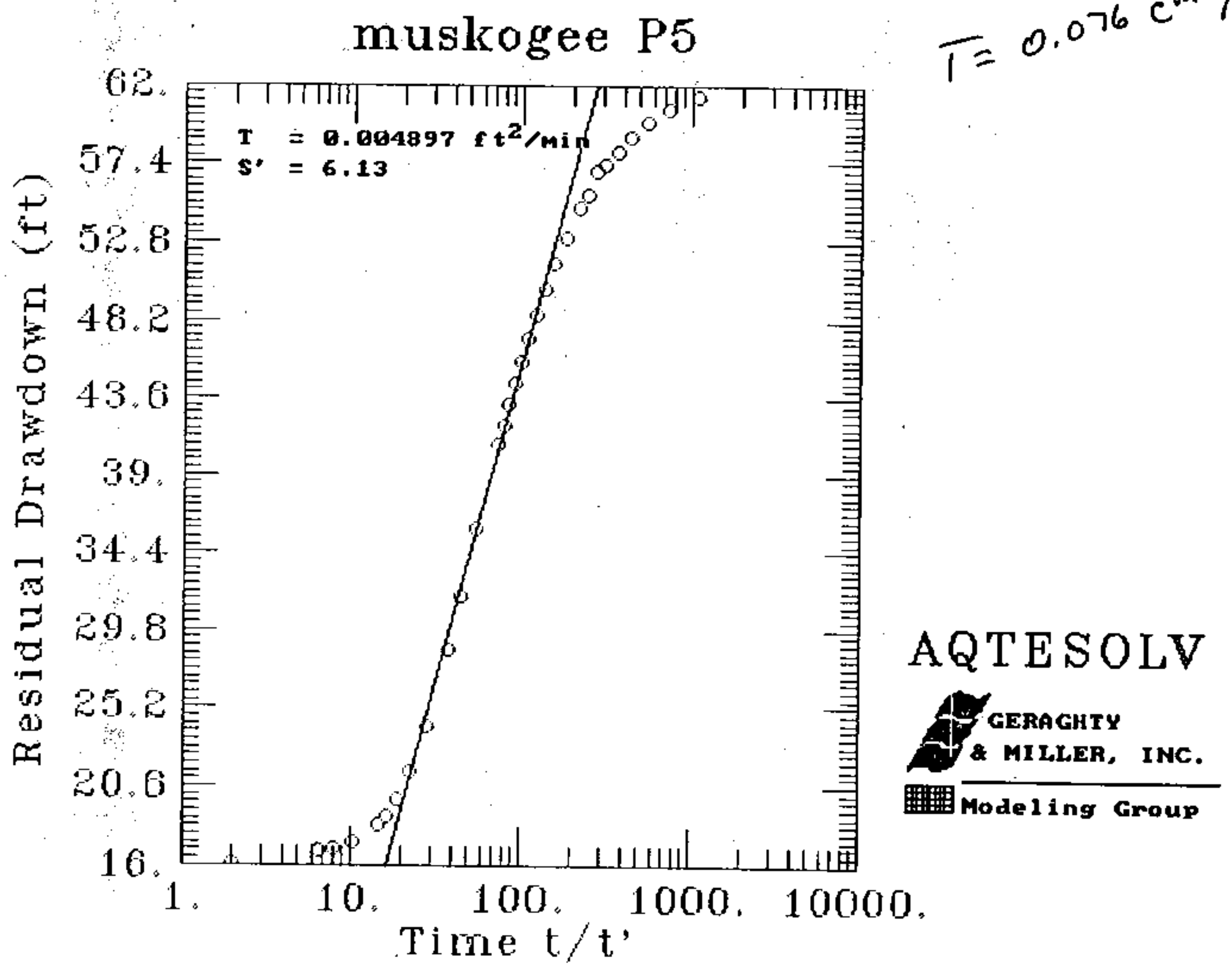
$T = r_c^2/t$
$= (1in)^2 / 6min$
$= .167\ in^2/min \times (2.54)^2 cm^2/in^2 \times min/60 sec$
$= 0.018\ cm^2/sec$
$K = T/b$
$= 0.018\ cm^2/sec \times 1/548.64\ cm$
$K = 3.27 \times 10^{-5}\ cm/sec$

w/ Aqtesolve Program (Theis Recovery)

$T = 4.891 \times 10^{-3}\ ft^2/min \times (12)^2 in^2/ft^2 \times (2.54)^2 cm^2/in^2 \times min/60 sec$
$T = 7.53 \times 10^{-2}\ cm^2/sec$
$K = T/b = 1.38 \times 10^{-4}\ cm^2/sec$

P-5 Rising Head Test




muskogee P5
T = 0.004897 ft²/min
S' = 6.13
Residual Drawdown (ft)
62.
57.4
52.8
48.2
43.6
39.
34.4
29.8
25.2
20.6
16.
1.
10.
100.
1000.
10000.
Time t/t'
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T= 0.076 cm²/s.

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PAGE 1 OF 1

PROJECT NO. 86251.150

CLIENT WMO

SUBJECT Perm Tests

Prepared By GH Date

PROJECT Muskogee Hydro

Reviewed By Date

Approved By Date

P-6 Rising Head Test

Aquifer Thickness, $b = 35.5 - 11 = 24.5 ft \times 12 in/ft \times 2.54 cm/ft$

$= 746.76$ cm for entire zone B

* Use just filter pack zone since well/piezometer is partially penetrating

$b = 23 - 11 = 12 ft \times 12 in/ft \times 2.54 cm/ft$

$b = 365.76$ cm

radius, $r_c = 1 in$

$H - h / H_0 - h = H/H_0$

$H_0 = 25.35 ft$

H = as per field notes

$h = 12.35 ft$

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	< 35.0	17.54
4.5	21.82	40.0	16.90		
5.0	21.49	50.0	15.45	< 60.	14.45
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		

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Time	H/Ho	Time	H/Ho
0.5	.923	11.0	.592
1.0	.862	12.0	.582
1.5	.831	13.0	.571
2.0	.810	14.0	.561
2.5	.793	15.0	.549
3.0	.781	20.0	.503
3.5	.766	25.0	.464
4.0	.752	30.0	.429
4.5	.728	35.0	.399
5.0	.703	40.0	.350
6.0	.673	50.0	.238
7.0	.655	60.0	.162
8.0	.645	70.0	.106
9.0	.631	80.0	.071
10.0	.605	90.0	.047
		100.0	.030
		179.0	0

$Tt/r_c^2 = 1$ $\quad q = 10^{-2}$ @ $t = 18$ min

$T = r_c^2/t$

$= (1\,in)^2/18\,min \times (2.54\,cm)^2/in^2 \times min/60\,sec$

$T = .006\ cm^2/sec$

$K = T/b$

$= .006\ cm^2/sec \times 365.76\ cm$

$K = 1.63 \times 10^{-5}\ cm/sec$

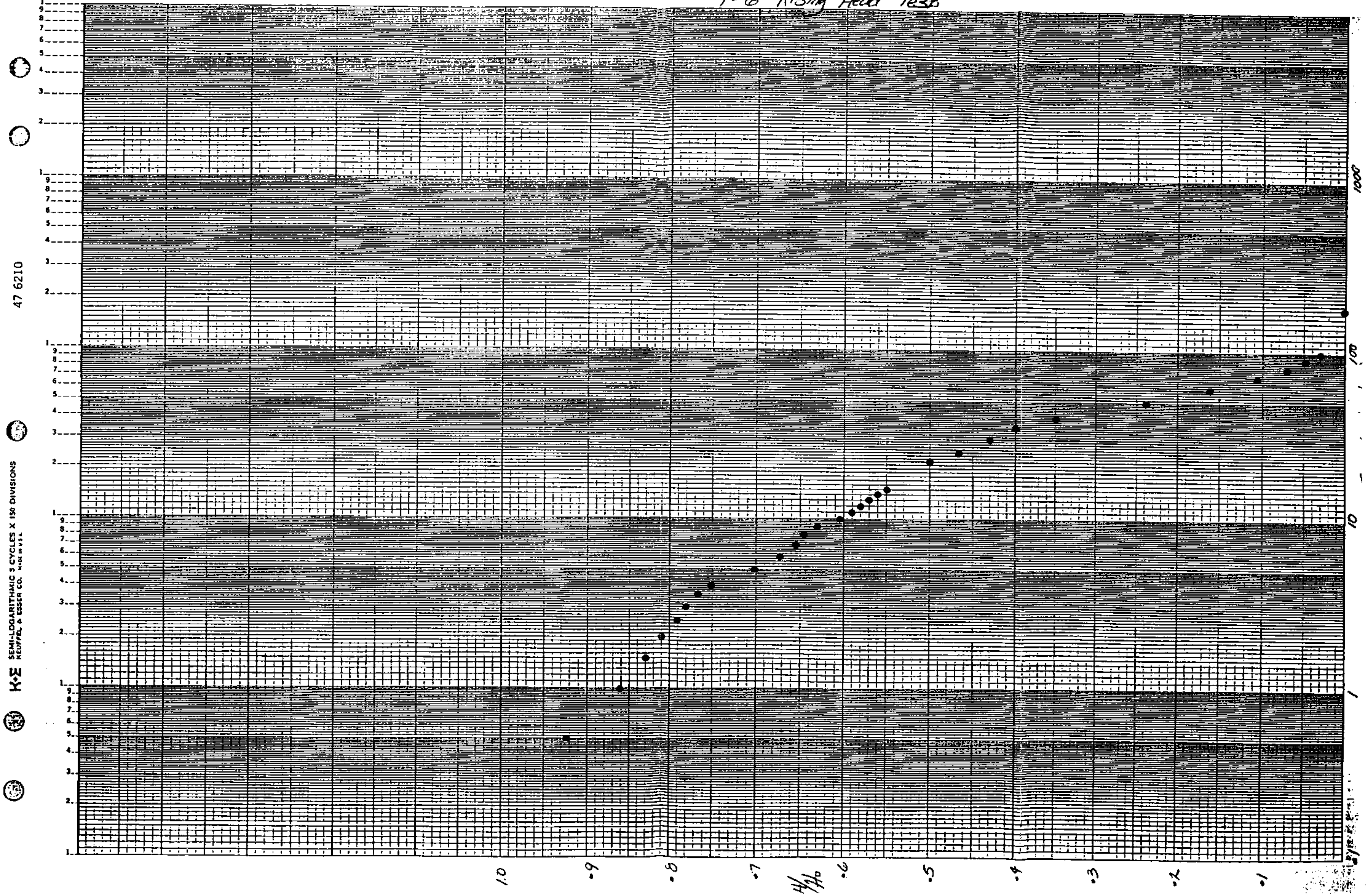
w/ Aqtesolve Program (Theiss Recovery)

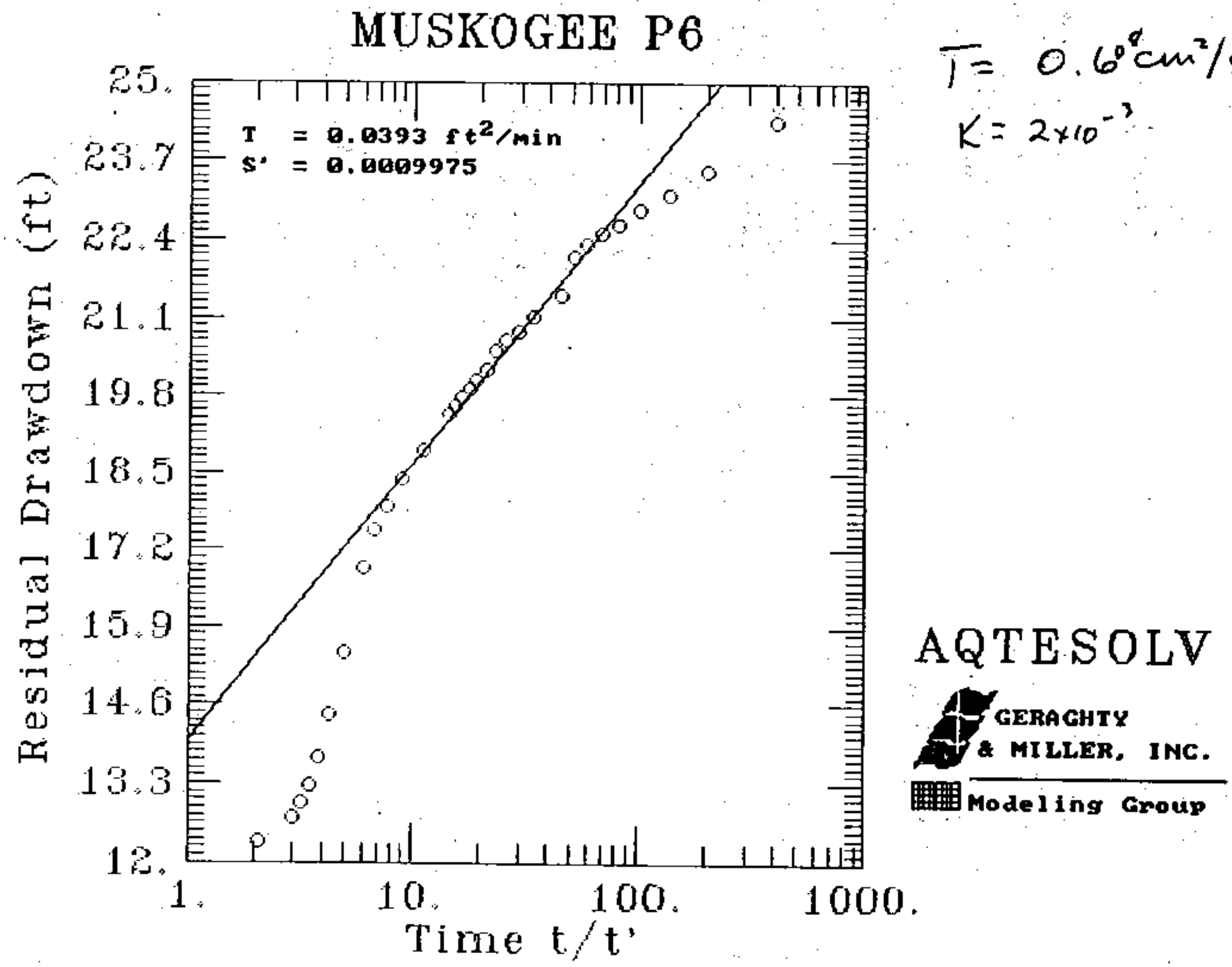
$T = 3.93 \times 10^{-2}\ ft^2/min \times min/60\,sec \times (12)^2 in^2/ft^2 \times (2.54)^2 cm^2/in^2$

$T = 6.09 \times 10^{-1}\ cm^2/sec$

$K = T/b = 1.66 \times 10^{-3}\ cm/sec$

Muskogee Community Landfill
P-6 Rising Head Test





T= 0.6 cm²/s
K= 2x10⁻³

RUST ENVIRONMENT & INFRASTRUCTURE

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P-9 Rising Head Test

Aquifer thickness, b = 85' - 65' = 20 ft (filter pack plus core) × 12 in/ft × 2.54 cm/in

= 609.60 cm

Casing radius, rc = 1 in

Ho = 83.65

H = As per field notes

h = 20.56

H/Ho = H-h/Ho-h

Time, min	H, ft
1.0	83.44
1.5	83.31
2.0	83.18
2.5	83.05
3.0	82.99
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	63.61
180.0	60.48
210.0	57.45
228.0	55.82
1321.0	23.90
2756.0	21.44

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P-9 Rising Head Test

Time	H/Ho	Time	H/Ho
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	.633
11.0	—	210.0	.585
12.0	.966	228.0	.559
13.0	.964	1321.0	.053
14.0	.962	2156.0	.014
15.0	.960		

$Tt/r_c^2 = 1$ @ $\alpha = 10^{-9}$ @ $t = 76$ min

$T = r_c^2/t$

$= (1in)^2/76min \times (2.54cm/in)^2 \times min/60sec$

$T = .001\ cm^2/sec$

$K = T/b$

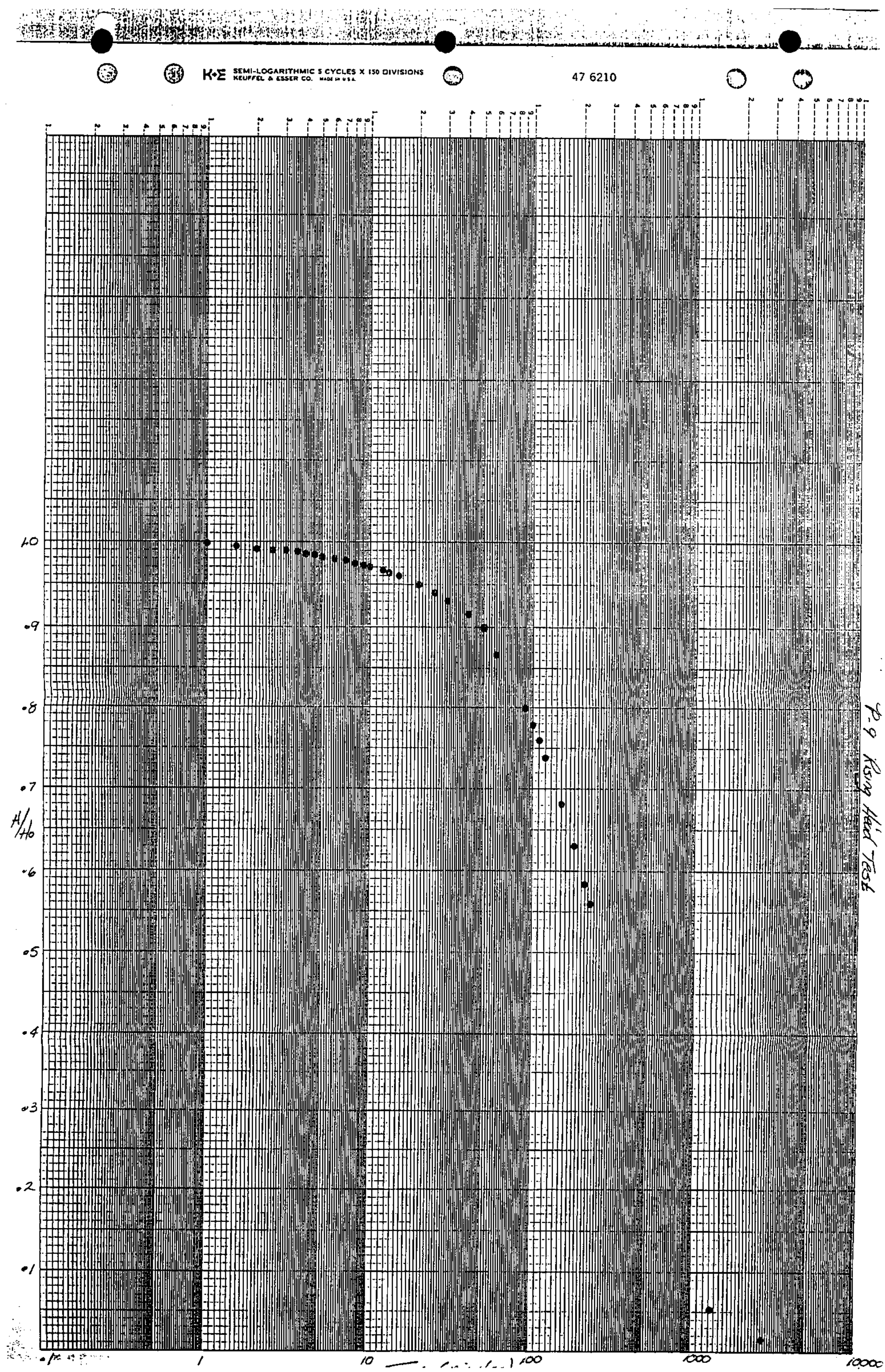
$= .001\ cm^2/sec \times 1/609.60\ cm$

$K = 2.32 \times 10^{-6}\ cm^2/sec$

w/ Aqtesolve

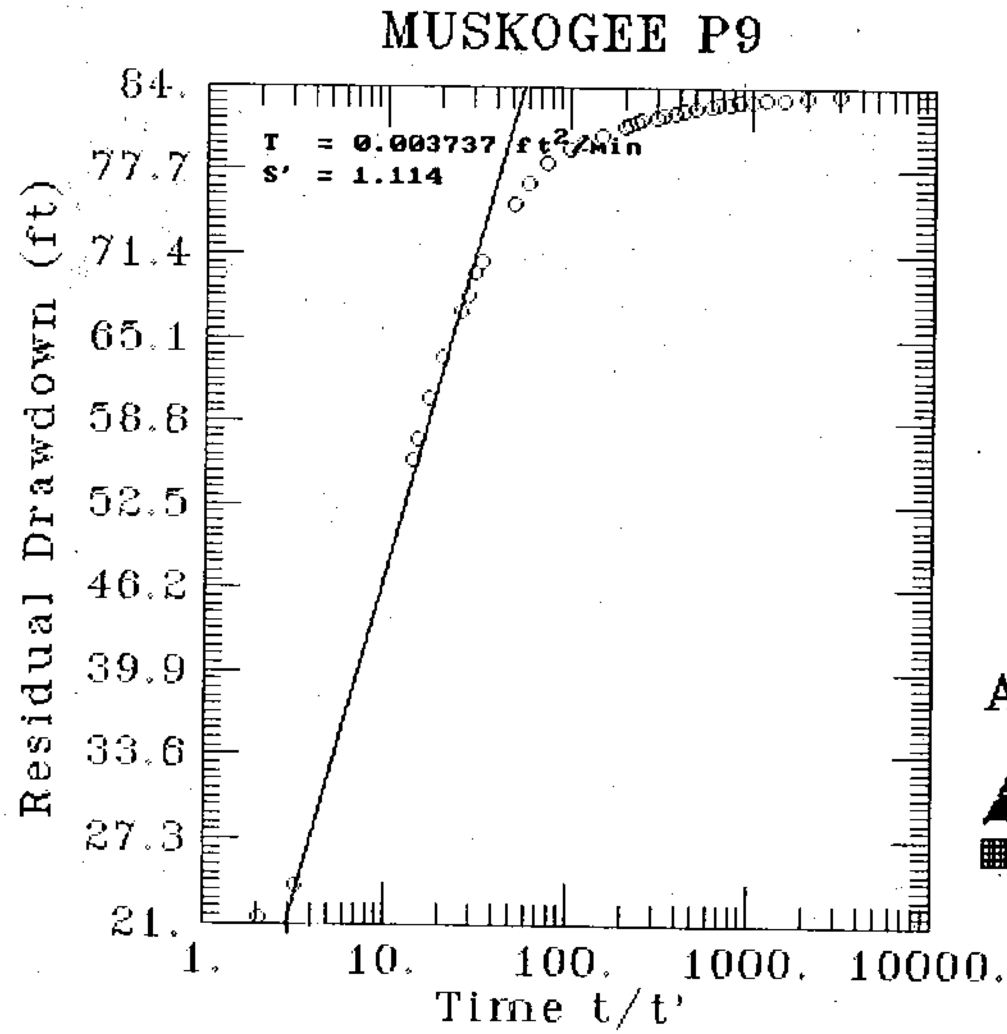
$T = 3.737 \times 10^{-3}\ ft^2/min \times (12in)^2/ft^2 \times (2.54)^2 cm^2/in^2 \times min/60sec$

$K = T/b = 5.79 \times 10^{-2}\ cm^2/sec / 609.60\ cm = 9.49 \times 10^{-5}\ cm/sec$



K·E SEMI-LOGARITHMIC 5 CYCLES X 150 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
47 6210
1.0
.9
.8
.7
H/Ho
.6
.5
.4
.3
.2
.1
1
10
100
1000
10,000
P-9 Rising Head Test

T= 6.0 x10 cm²/s
K= 9.49 x 10⁻⁵



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P-8 Rising Head Test

Aquifer Thickness, $b = 35 ft \times 12 in/ft \times 2.54 cm/in = 1066.80 cm$

Casing radius, $r_c = 1 in$.

H =
Ho = } see data sheet
h =

$Tt/r_c^2 = 1$ $t = 3.7 min$ @ $\alpha = 10^{-4}$

$T = r_c^2/t$
$= (1 in)^2 / 3.7 min \times (2.54 cm/in)^2 \times min/60 sec$
$T = 0.029 cm^2/sec$

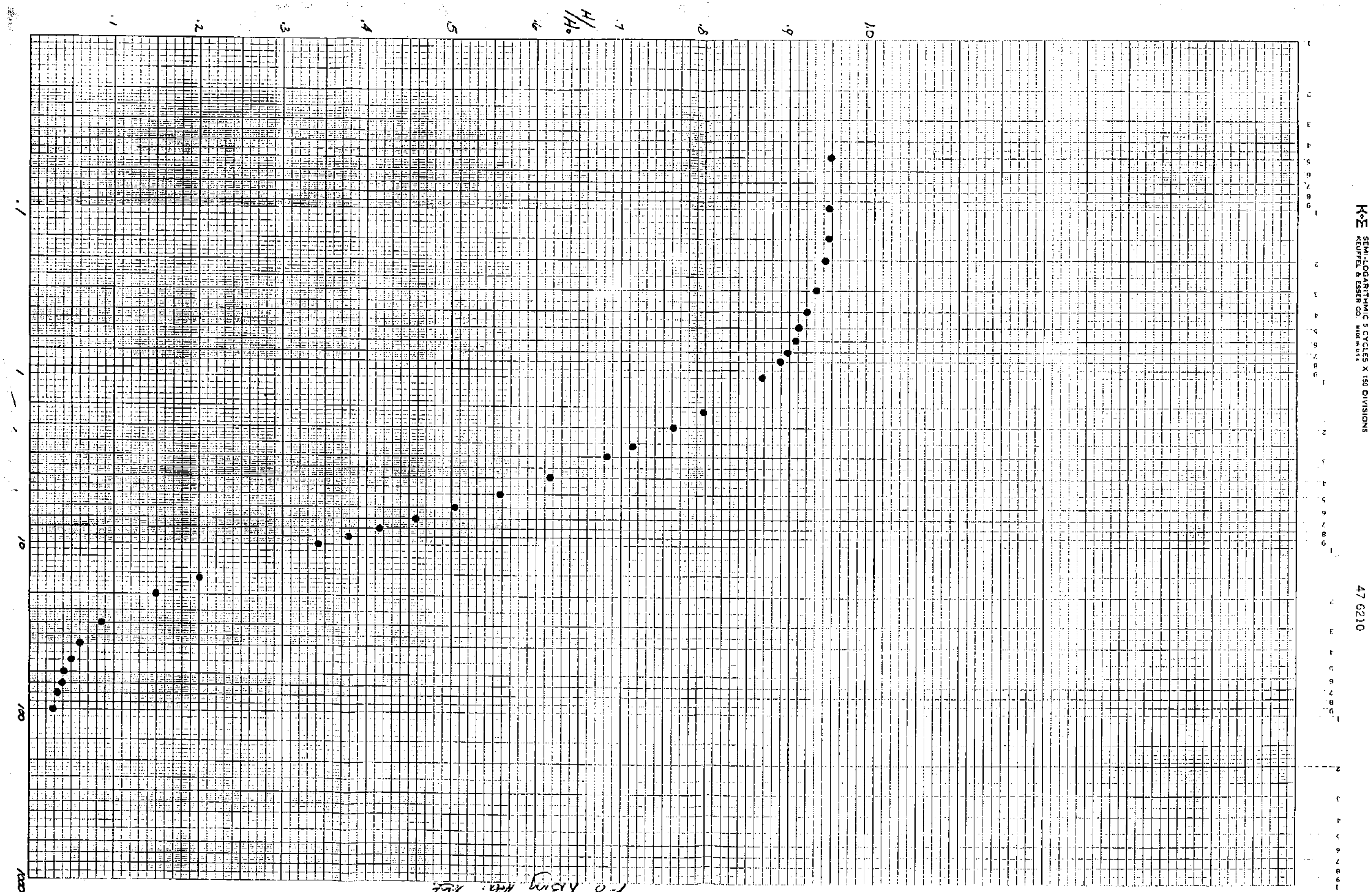
$K = T/b$
$= 0.029 cm^2/sec \times 1/1066.80 cm$
$K = 2.72 \times 10^{-5} cm/sec$

Muskogee Community Landfill
P8 Rising Head Test

Elapsed Time,min	H(t),ft	h,ft	Ho,ft	H(t)-h/Ho-h
0	39.58	95.91	34.548	0.917995
0.0033	37.903	95.91	34.548	0.945324
0.0066	36.479	95.91	34.548	0.968531
0.01	35.34	95.91	34.548	0.987093
0.0133	34.548	95.91	34.548	1
0.0166	35.577	95.91	34.548	0.983231
0.02	40.054	95.91	34.548	0.91027
0.0233	42.238	95.91	34.548	0.874678
0.0266	42.744	95.91	34.548	0.866432
0.03	40.655	95.91	34.548	0.900476
0.0333	39.374	95.91	34.548	0.921352
0.0366	37.428	95.91	34.548	0.953065
0.04	36.684	95.91	34.548	0.96519
0.0433	36.463	95.91	34.548	0.968792
0.0466	36.922	95.91	34.548	0.961312
0.05	37.728	95.91	34.548	0.948176
0.0533	38.314	95.91	34.548	0.938627
0.0566	38.82	95.91	34.548	0.93038
0.06	38.836	95.91	34.548	0.93012
0.0633	38.63	95.91	34.548	0.933477
0.0666	38.203	95.91	34.548	0.940435
0.07	37.855	95.91	34.548	0.946107
0.0733	37.602	95.91	34.548	0.95023
0.0766	37.539	95.91	34.548	0.951256
0.08	37.602	95.91	34.548	0.95023
0.0833	37.776	95.91	34.548	0.947394
0.0866	37.871	95.91	34.548	0.945846
0.09	37.997	95.91	34.548	0.943793
0.0933	37.966	95.91	34.548	0.944298
0.0966	37.95	95.91	34.548	0.944559
0.1	37.839	95.91	34.548	0.946367
0.1033	37.776	95.91	34.548	0.947394
0.1066	37.713	95.91	34.548	0.948421
0.11	37.681	95.91	34.548	0.948942
0.1133	37.76	95.91	34.548	0.947655
0.1166	37.681	95.91	34.548	0.948942
0.12	37.839	95.91	34.548	0.946367
0.1233	37.728	95.91	34.548	0.948176
0.1266	37.855	95.91	34.548	0.946107
0.13	37.728	95.91	34.548	0.948176
0.1333	37.808	95.91	34.548	0.946873
0.1366	37.697	95.91	34.548	0.948682
0.14	37.792	95.91	34.548	0.947133
0.1433	37.728	95.91	34.548	0.948176
0.1466	37.808	95.91	34.548	0.946873
0.15	37.776	95.91	34.548	0.947394
0.1533	37.823	95.91	34.548	0.946628
0.1566	37.839	95.91	34.548	0.946367
0.16	37.871	95.91	34.548	0.945846
0.1633	37.839	95.91	34.548	0.946367
0.1666	37.871	95.91	34.548	0.945846
0.17	37.871	95.91	34.548	0.945846
0.1733	37.918	95.91	34.548	0.94508
0.1766	37.934	95.91	34.548	0.944819
0.18	37.981	95.91	34.548	0.944053
0.1833	37.981	95.91	34.548	0.944053
0.1866	37.981	95.91	34.548	0.944053
0.19	38.029	95.91	34.548	0.943271
0.1933	37.997	95.91	34.548	0.943793
0.1966	38.029	95.91	34.548	0.943271
0.2	38.045	95.91	34.548	0.94301
0.2033	38.045	95.91	34.548	0.94301
0.2066	38.092	95.91	34.548	0.942244
0.21	38.077	95.91	34.548	0.942489
0.2133	38.14	95.91	34.548	0.941462
0.2166	38.14	95.91	34.548	0.941462
0.22	38.172	95.91	34.548	0.940941
0.2233	38.187	95.91	34.548	0.940696
0.2266	38.235	95.91	34.548	0.939914
0.23	38.235	95.91	34.548	0.939914
0.2333	38.266	95.91	34.548	0.939409
0.2366	38.298	95.91	34.548	0.938887
0.24	38.33	95.91	34.548	0.938366
0.2433	38.361	95.91	34.548	0.937861
0.2466	38.361	95.91	34.548	0.937861
0.25	38.393	95.91	34.548	0.937339
0.2533	38.393	95.91	34.548	0.937339
0.2566	38.409	95.91	34.548	0.937078
0.26	38.44	95.91	34.548	0.936573
0.2633	38.472	95.91	34.548	0.936052
0.2666	38.472	95.91	34.548	0.936052
0.27	38.551	95.91	34.548	0.934764
0.2733	38.551	95.91	34.548	0.934764
0.2766	38.599	95.91	34.548	0.933982
0.28	38.583	95.91	34.548	0.934243
0.2833	38.599	95.91	34.548	0.933982
0.2866	38.599	95.91	34.548	0.933982
0.29	38.646	95.91	34.548	0.933216
0.2933	38.662	95.91	34.548	0.922955
0.2966	38.709	95.91	34.548	0.932159

Elapsed Time,min	H(t),ft	h,ft	Ho,ft	H(t)-h/Ho-h
0.3	38.725	95.91	34.548	0.931929
0.3033	38.788	95.91	34.548	0.930902
0.3066	38.757	95.91	34.548	0.931407
0.31	38.82	95.91	34.548	0.93038
0.3133	38.788	95.91	34.548	0.930902
0.3166	38.852	95.91	34.548	0.929859
0.32	38.788	95.91	34.548	0.930902
0.3233	38.867	95.91	34.548	0.929614
0.3266	38.836	95.91	34.548	0.93012
0.33	38.931	95.91	34.548	0.928571
0.3333	38.899	95.91	34.548	0.929093
0.35	39.042	95.91	34.548	0.926762
0.3666	39.152	95.91	34.548	0.92497
0.3833	39.295	95.91	34.548	0.922639
0.4	39.39	95.91	34.548	0.921091
0.4166	39.406	95.91	34.548	0.92083
0.4333	39.564	95.91	34.548	0.918256
0.45	39.659	95.91	34.548	0.916707
0.4666	39.785	95.91	34.548	0.914654
0.4833	39.785	95.91	34.548	0.914654
0.5	39.898	95.91	34.548	0.912848
0.5166	39.959	95.91	34.548	0.911818
0.5333	40.023	95.91	34.548	0.910775
0.55	40.086	95.91	34.548	0.909749
0.5666	40.149	95.91	34.548	0.908722
0.5833	40.228	95.91	34.548	0.907435
0.6	40.26	95.91	34.548	0.906913
0.6166	40.371	95.91	34.548	0.905104
0.6333	40.45	95.91	34.548	0.903817
0.65	40.529	95.91	34.548	0.902529
0.6666	40.624	95.91	34.548	0.900981
0.6833	40.687	95.91	34.548	0.899954
0.7	40.782	95.91	34.548	0.898406
0.7166	40.861	95.91	34.548	0.897119
0.7333	40.94	95.91	34.548	0.895831
0.75	41.019	95.91	34.548	0.894544
0.7666	41.13	95.91	34.548	0.892735
0.7833	41.209	95.91	34.548	0.891447
0.8	41.304	95.91	34.548	0.889899
0.8166	41.399	95.91	34.548	0.888351
0.8333	41.51	95.91	34.548	0.886542
0.85	41.605	95.91	34.548	0.884994
0.8666	41.747	95.91	34.548	0.88268
0.8833	41.826	95.91	34.548	0.881392
0.9	41.969	95.91	34.548	0.879062
0.9166	42.064	95.91	34.548	0.877514
0.9333	42.174	95.91	34.548	0.875721
0.95	42.317	95.91	34.548	0.873391
0.9666	42.444	95.91	34.548	0.871321
0.9833	42.538	95.91	34.548	0.869789
1	42.681	95.91	34.548	0.867459
1.2	44.437	95.91	34.548	0.838842
1.4	45.782	95.91	34.548	0.816923
1.6	46.985	95.91	34.548	0.797318
1.8	48.061	95.91	34.548	0.779782
2	49.137	95.91	34.548	0.762247
2.2	50.166	95.91	34.548	0.745478
2.4	51.147	95.91	34.548	0.729491
2.6	52.113	95.91	34.548	0.713748
2.8	53.03	95.91	34.548	0.698804
3	53.933	95.91	34.548	0.684088
3.2	54.803	95.91	34.548	0.66991
3.4	55.658	95.91	34.548	0.655976
3.6	56.497	95.91	34.548	0.642303
3.8	57.304	95.91	34.548	0.629152
4	58.096	95.91	34.548	0.616245
4.2	58.871	95.91	34.548	0.603615
4.4	59.631	95.91	34.548	0.591229
4.6	60.359	95.91	34.548	0.579365
4.8	61.072	95.91	34.548	0.567746
5	61.752	95.91	34.548	0.556664
5.2	62.433	95.91	34.548	0.545568
5.4	63.098	95.91	34.548	0.534728
5.6	63.732	95.91	34.548	0.524396
5.8	64.365	95.91	34.548	0.51408
6	64.982	95.91	34.548	0.504025
6.2	65.584	95.91	34.548	0.494215
6.4	66.17	95.91	34.548	0.484665
6.6	66.756	95.91	34.548	0.475115
6.8	67.309	95.91	34.548	0.466103
7	67.864	95.91	34.548	0.457058
7.2	68.366	95.91	34.548	0.448551
7.4	68.924	95.91	34.548	0.439764
7.6	69.432	95.91	34.548	0.431505
7.8	69.939	95.91	34.548	0.423242
8	70.429	95.91	34.548	0.415257
8.2	70.92	95.91	34.548	0.407255
8.4	71.395	95.91	34.548	0.399514
8.6	71.87	95.91	34.548	0.391773
8.8	72.33	95.91	34.548	0.384277
9	72.773	95.91	34.548	0.377057

Elapsed Time,min	H(t),ft	h,ft	Ho,ft	H(t)-h/Ho-h
9.2	73.217	95.91	34.548	0.369822
9.4	73.644	95.91	34.548	0.362863
9.6	74.072	95.91	34.548	0.355888
9.8	74.484	95.91	34.548	0.349174
10	74.879	95.91	34.548	0.342737
12	78.474	95.91	34.548	0.28415
14	81.294	95.91	34.548	0.239193
16	83.543	95.91	34.548	0.201542
18	85.349	95.91	34.548	0.17211
20	86.791	95.91	34.548	0.14861
22	87.948	95.91	34.548	0.129755
24	88.883	95.91	34.548	0.114517
26	89.626	95.91	34.548	0.102409
28	90.229	95.91	34.548	0.092582
30	90.72	95.91	34.548	0.08458
32	91.116	95.91	34.548	0.078127
34	91.465	95.91	34.548	0.072439
36	91.75	95.91	34.548	0.067794
38	91.987	95.91	34.548	0.063932
40	92.194	95.91	34.548	0.060559
42	92.368	95.91	34.548	0.057723
44	92.526	95.91	34.548	0.055148
46	92.669	95.91	34.548	0.052818
48	92.78	95.91	34.548	0.051009
50	92.89	95.91	34.548	0.049216
52	92.986	95.91	34.548	0.047652
54	93.081	95.91	34.548	0.046103
56	93.16	95.91	34.548	0.044816
58	93.239	95.91	34.548	0.043529
60	93.303	95.91	34.548	0.042486
62	93.382	95.91	34.548	0.041198
64	93.445	95.91	34.548	0.040171
66	93.493	95.91	34.548	0.039389
68	93.557	95.91	34.548	0.038346
70	93.603	95.91	34.548	0.037597
72	93.651	95.91	34.548	0.036814
74	93.699	95.91	34.548	0.036032
76	93.747	95.91	34.548	0.03525
78	93.794	95.91	34.548	0.034484
80	93.826	95.91	34.548	0.033962
82	93.873	95.91	34.548	0.033196
84	93.921	95.91	34.548	0.032414
86	93.952	95.91	34.548	0.031909
88	93.984	95.91	34.548	0.031388
90	94.018	95.91	34.548	0.030866
92	94.047	95.91	34.548	0.030361
94	94.079	95.91	34.548	0.029839
96	94.111	95.91	34.548	0.029318
98	94.142	95.91	34.548	0.028813
100	94.174	95.91	34.548	0.028291
120	94.412	95.91	34.548	0.024413
140	94.602	95.91	34.548	0.021316
160	94.744	95.91	34.548	0.019002
180	94.871	95.91	34.548	0.016932
200	94.983	95.91	34.548	0.015107
220	95.061	95.91	34.548	0.013836
240	95.141	95.91	34.548	0.012532
260	95.22	95.91	34.548	0.011245
280	95.283	95.91	34.548	0.010218
300	95.299	95.91	34.548	0.009957
320	95.347	95.91	34.548	0.009175
340	95.394	95.91	34.548	0.008409
360	95.442	95.91	34.548	0.007627
380	95.49	95.91	34.548	0.006845
400	95.521	95.91	34.548	0.006339
420	95.553	95.91	34.548	0.005818
440	95.584	95.91	34.548	0.005313
460	95.616	95.91	34.548	0.004791
480	95.632	95.91	34.548	0.00453
500	95.664	95.91	34.548	0.004009
520	95.696	95.91	34.548	0.003488
540	95.711	95.91	34.548	0.003243
560	95.727	95.91	34.548	0.002982
580	95.758	95.91	34.548	0.002477
600	95.774	95.91	34.548	0.002216
620	95.79	95.91	34.548	0.001956
640	95.806	95.91	34.548	0.001695
660	95.822	95.91	34.548	0.001434
680	95.838	95.91	34.548	0.001173
700	95.838	95.91	34.548	0.001173
720	95.854	95.91	34.548	0.000913
740	95.854	95.91	34.548	0.000913
760	95.87	95.91	34.548	0.000652
780	95.87	95.91	34.548	0.000652
800	95.886	95.91	34.548	0.000391
820	95.886	95.91	34.548	0.000391
840	95.886	95.91	34.548	0.000391
860	95.886	95.91	34.548	0.000391



H/H₀
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1
10
100
1000
K+E SEMI-LOGARITHMIC 5 CYCLES X 150 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
47 6210

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PAGE ____ OF ____
PROJECT NO. ________

CLIENT ________ SUBJECT ________ Prepared By ____ Date ____

PROJECT ________ ________ Reviewed By ____ Date ____

________ ________ Approved By ____ Date ____

P-10 Rising Head Test

$L_w = 14.17$
$H = 23.42$

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

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

$$= \left[\frac{1.1}{\ln(14.17/.3)} + \frac{1.75 + 0.35\ln[(23.42 - 14.17)/.3]}{8.33}\right]^{-1}$$

$$\ln R_e/r_w = 1.56$$

Note: water level used for calculation of L_w and H taken on 12/22/93

$$r_c = [(1-.3)(.08)^2 + (.3)(.3)^2]^{1/2}$$
$$= 0.17$$

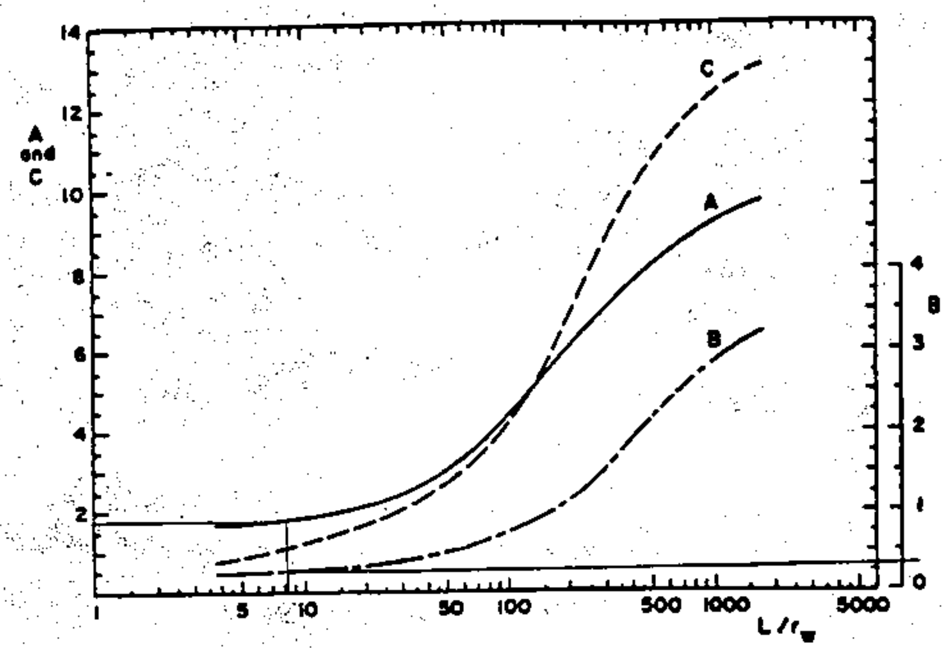
$$K = \frac{r_c^2 \ln(R_e/r_w)}{2L_e} \frac{1}{t} \ln \frac{Y_0}{Y_t}$$

$$= \frac{(0.17)^2(1.56)}{2(2.5)} \frac{1}{500} \ln\left(\frac{0.96}{.89}\right)$$

$K = 1.37 \times 10^{-6}$ ft/min $\times$ 12 in/ft $\times$ 2.54 cm/in $\times$ min/60 sec

$K = 6.94 \times 10^{-7}$ cm/sec

P-10 Rising Head Test

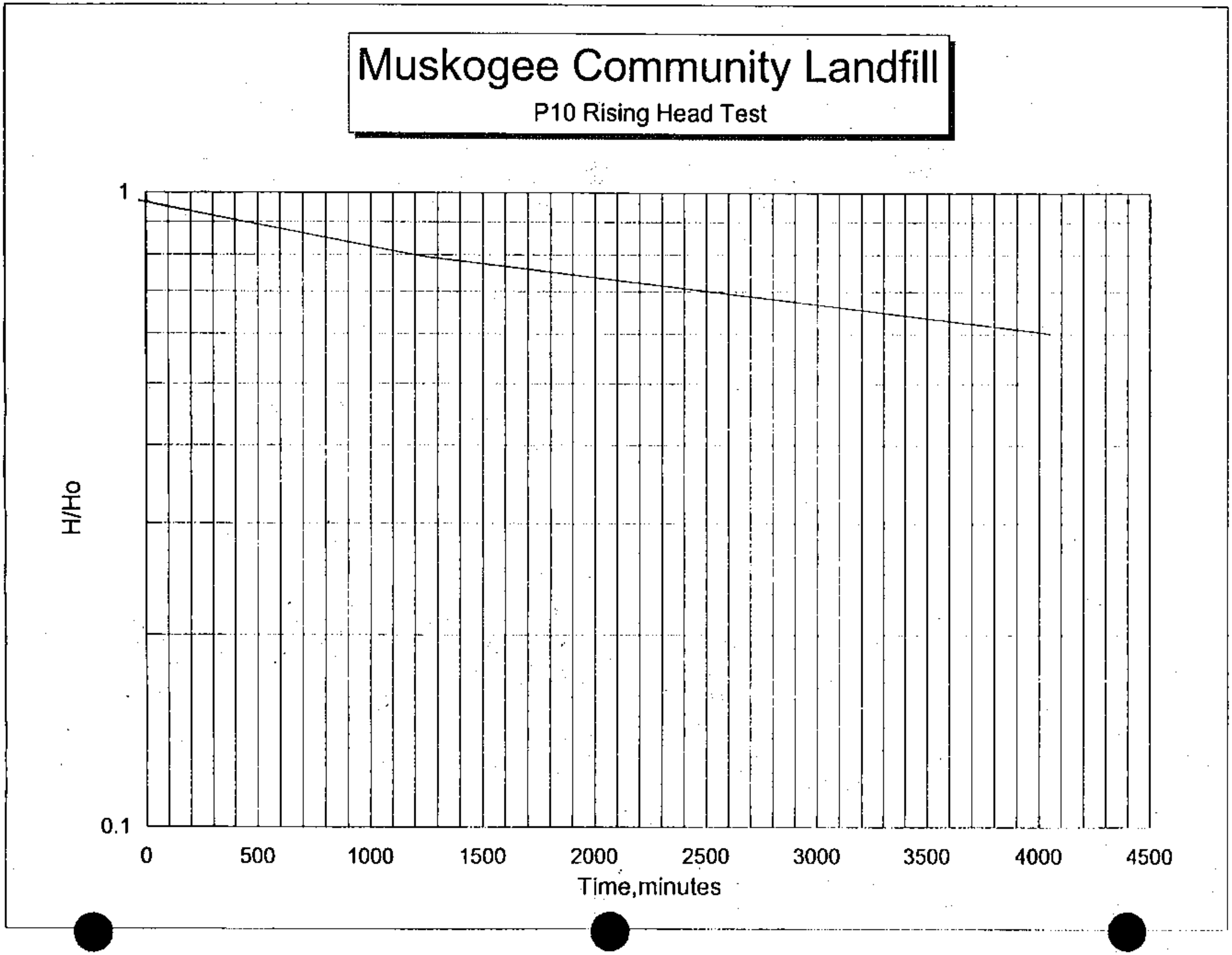


Curves relating coefficients A, B, and C to L/r_w.

$L_e/r_w = 2.5/.3 = 8.33$

$A = 1.75$

$B = 0.35$


Muskogee Community Landfill
P10 Rising Head Test
1
0.1
H/Ho
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Time,minutes

	Muskogee Community Landfill			
	P10 Rising Head Test			
Elapsed	H(t),ft	h,ft	Ho,ft	H(t)-h/Ho-h
Time,min				
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

RUST ENVIRONMENT & INFRASTRUCTURE

CALCULATION SHEET

PAGE ____ OF ____
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CLIENT ____ SUBJECT ____ Prepared By ____ Date ____
PROJECT ____ Reviewed By ____ Date ____
Approved By ____ Date ____

P-11 Rising Head Test - Modified Bouwer & Rice

$H = 21.54$
$Lw = 18.07$

$$\ln \frac{Re}{rw} = \left[\frac{1.1}{\ln(Lw/rw)} + \frac{A + B \ln [(H - Lw)/rw]}{Le/rw} \right]$$

$$= \left[\frac{1.1}{\ln(18.07/.3)} + \frac{2.55 + 0.4 \ln [(21.54 - 18.07)/.3]}{33.33} \right]^{-1}$$

$$\ln \frac{Re}{rw} = 2.67$$

$$r'c = [(1-n)rc^2 + n\,rw^2]^{1/2}$$
$$= [(1-.3)(.08)^2 + (.3)(.3)^2]^{1/2}$$
$$= 0.17$$

$$K = \frac{r'c^2 \ln(Re/rw)}{2Le} \frac{1}{t} \ln\left(\frac{y_0}{y_t}\right)$$
$$= \frac{(.17)^2 (2.67)}{2(10)} \frac{1}{200} \ln\left(\frac{.74}{.49}\right)$$

$K = 7.95 \times 10^{-6}$ ft/min × 12 in/ft × 2.54 cm/in × min/60 sec

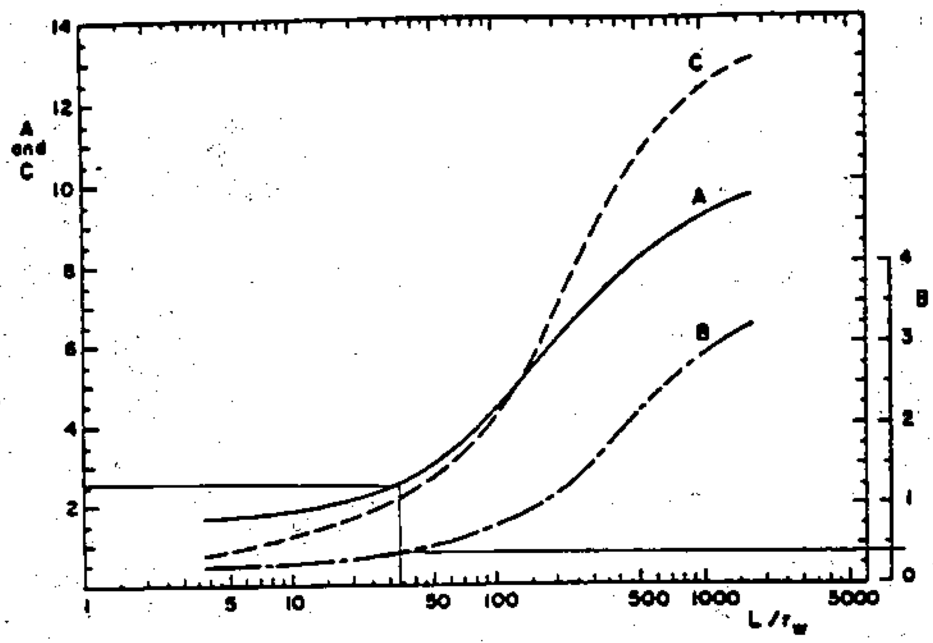
$K = 4.04 \times 10^{-6}$ cm/sec

w/ Aqtesolve Program

$K = 5.41 \times 10^{-5}$ ft/min × 12 in/ft × 2.54 cm/in × min/60 sec
$= 2.75 \times 10^{-5}$ cm/sec

P-11 Rising Head Test

BOUWER AND RICE: GROUNDWATER HYDRAULICS

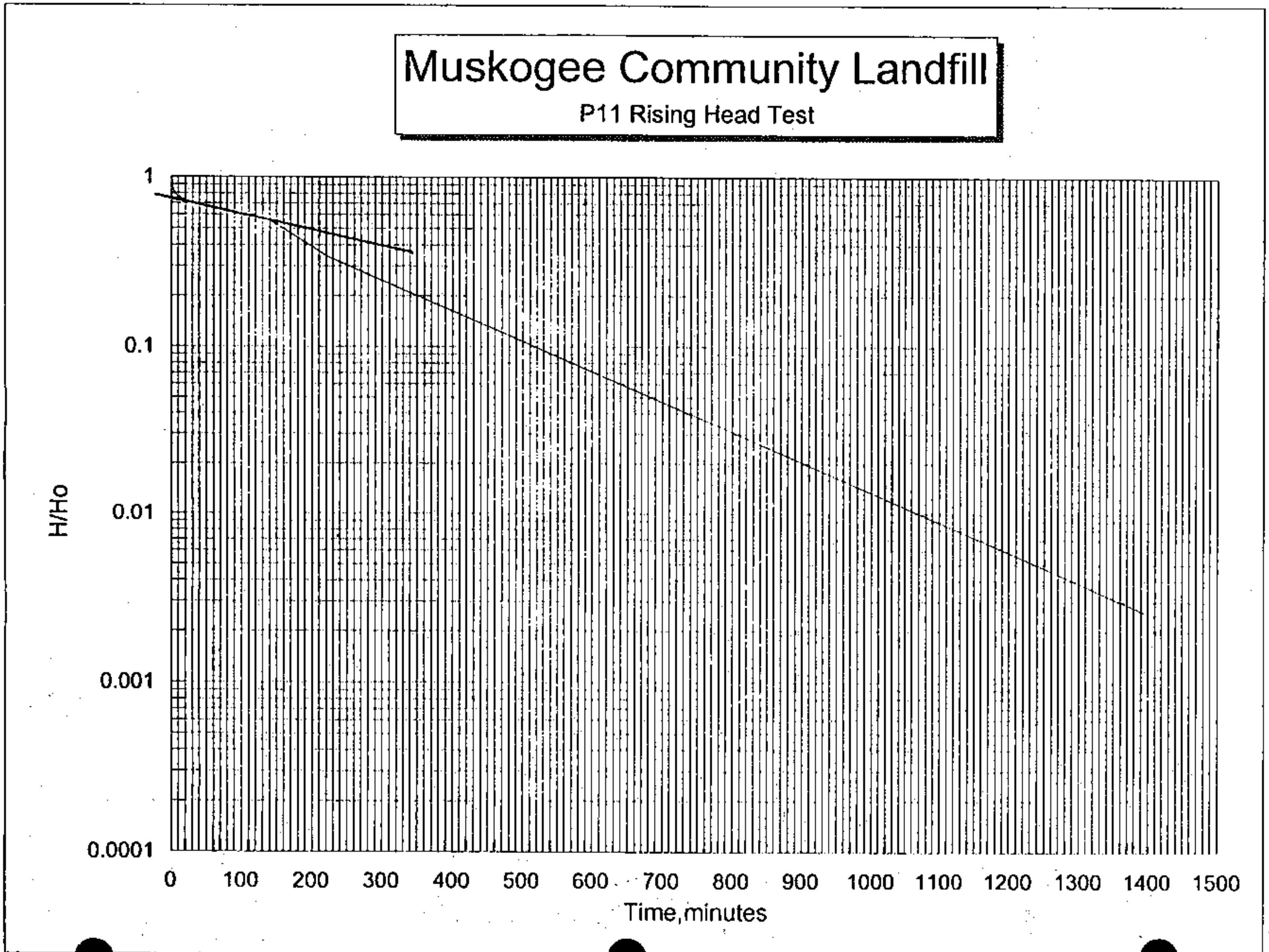


Curves relating coefficients A, B, and C to L/r_w.

$L_e/r_w = 10/.3 = 33.33$

$A = 2.55$

$B = 0.40$



Muskogee Community Landfill
P11 Rising Head Test
H/Ho
1
0.1
0.01
0.001
0.0001
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
Time,minutes

	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

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PROJECT Misc. Hydro-geo
Reviewed By ____ Date ____
Approved By ____ Date ____

P-11 Rising Head Test

Aquifer Thickness, $b = 21.6' - 9' = 12.6 \text{ (filter pack) } ft \times \frac{12 in}{ft} \times \frac{2.54 cm}{in}$

$= 384.05 \text{ cm}$

Casing Radius, $r_c = 1 in$

$H_o = 21.60 ft$ $\qquad H/H_o = H-h/H_o-h$

$H =$ As per field notes

$h = 6.18 ft$

Time,	H, ft	Time,	H, ft
1.0	20.94	20.0	17.41
1.5	20.34	25.0	17.22
2.0	19.86	30.0	17.07
2.5	19.50	40.0	16.78
3.0	19.14	50.0	16.52
3.5	18.91	60.0	16.29
4.0	18.76	70.0	16.07
4.5	18.63	80.0	15.84
5.0	18.53	90.0	15.66
6.0	18.36	100.0	15.46
7.0	18.23	139.0	14.78
8.0	18.13	157.0	13.98
9.0	18.04	222.0	11.42
10.0	17.95	1396.0	~~6.05~~ 6.22
11.0	17.88		
12.0	17.81		
13.0	17.74		
14.0	17.68		
15.0	17.63		

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P-11 Rising Head Test

Time	H/Ho	Time	H/Ho
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	220.0	.340
10.0	.763	1396.0	~~0~~ 0.003
11.0	.759		
12.0	.754		
13.0	.750		
14.0	.746		
15.0	.743		

Cooper et. al

$Tt/r_c^2 = 1$ $\alpha = 10^{-8}$ @ $t = 45$ minutes

$T = r_c^2/t$

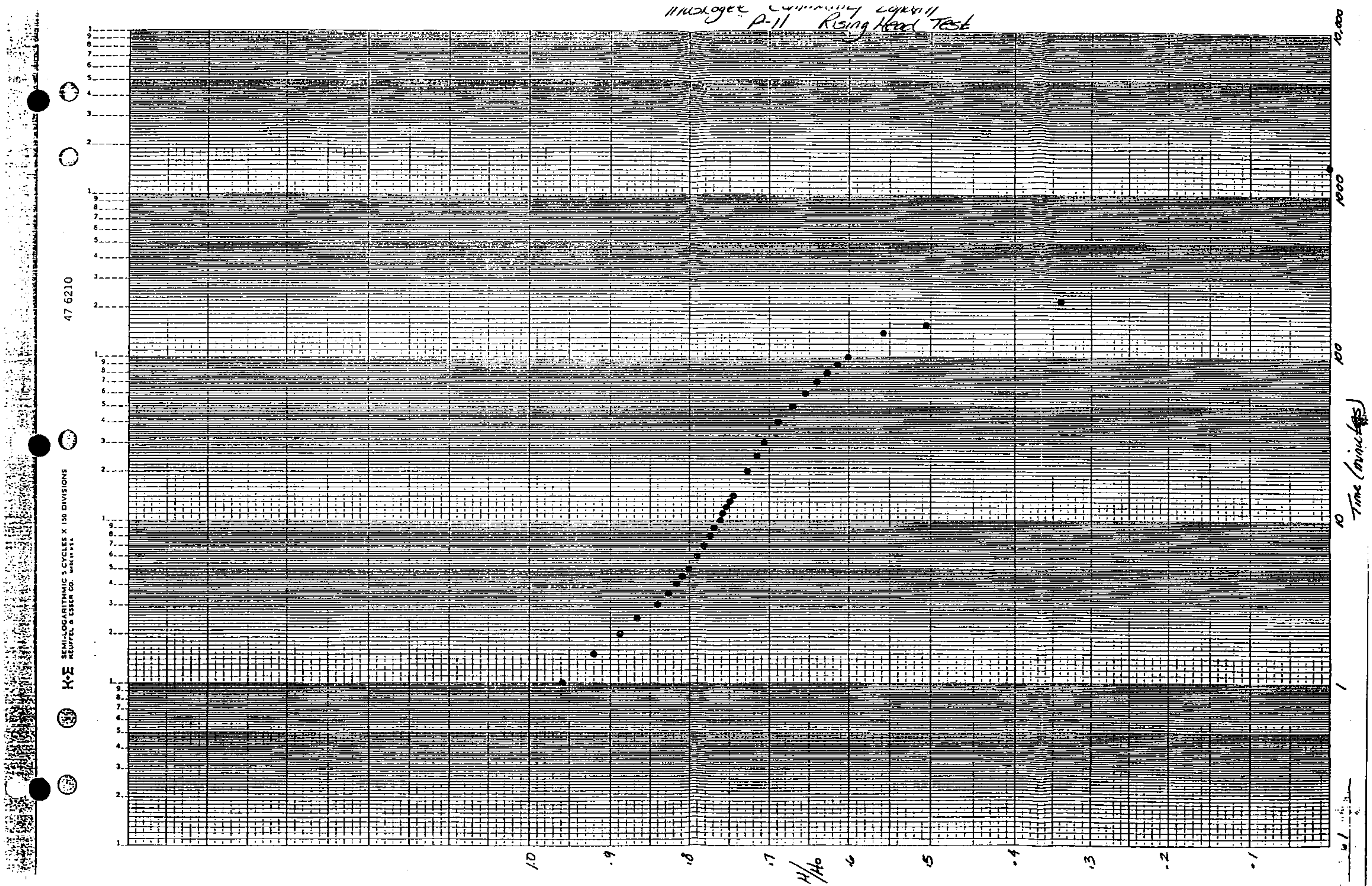
$= (1 in)^2/45 min \times (2.54 cm)^2/in^2 \times min/60 sec$

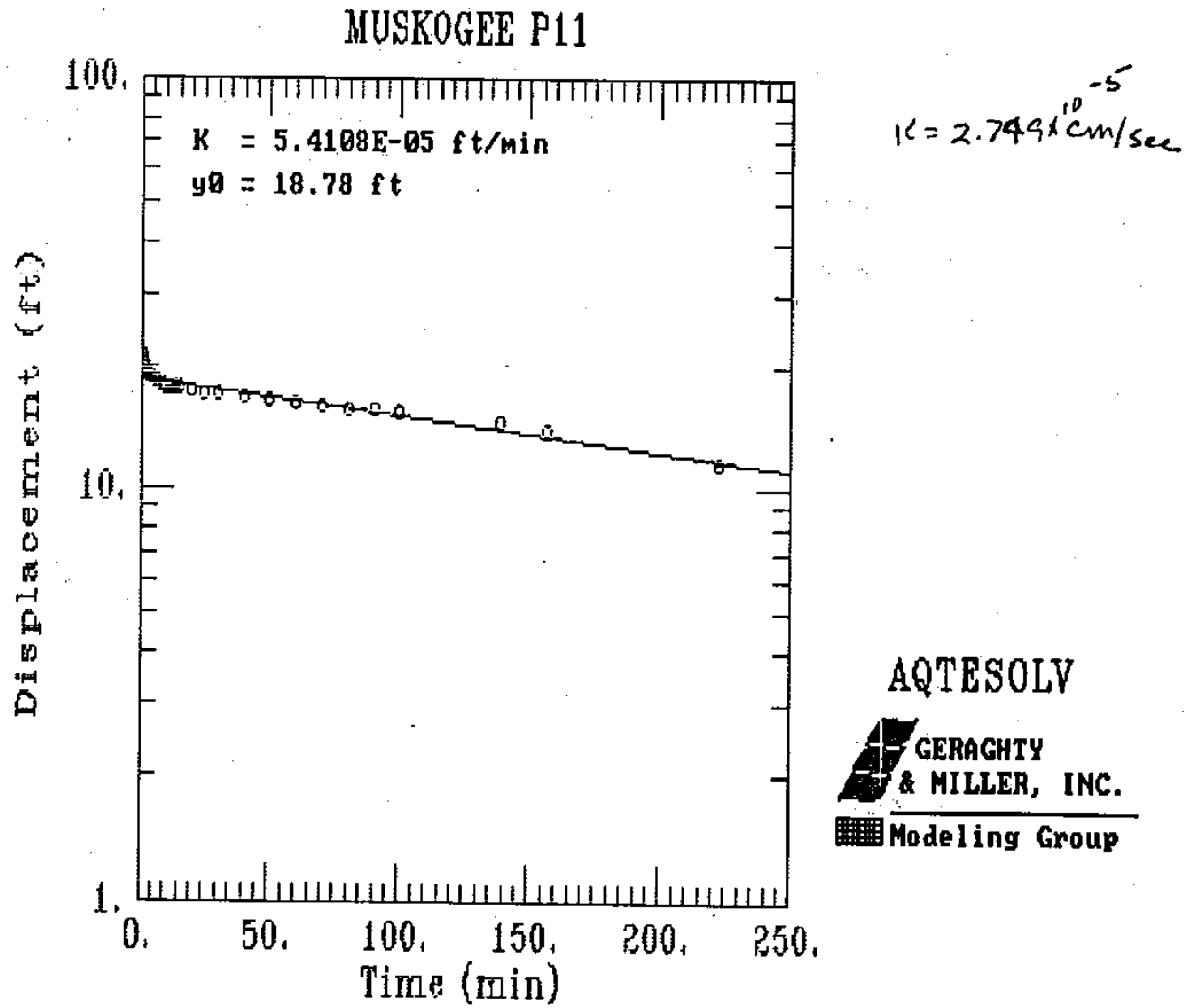
$T = .002 cm^2/sec$

$K = T/b$

$= .002 cm^2/sec \times 1/384.05 cm$

$K = 6.22 \times 10^{-6} cm/sec$


P-11 Rising Head Test
Time (minutes)
H/Ho
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
1
10
100
1000
10,000
47 6210
K•E SEMI-LOGARITHMIC 5 CYCLES X 150 DIVISIONS
KEUFFEL & ESSER CO.



MUSKOGEE P11
K = 5.4108E-05 ft/min
y0 = 18.78 ft
Displacement (ft)
Time (min)
100.
10.
1.
0.
50.
100.
150.
200.
250.
K = 2.749x10^-5 cm/sec
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Modeling Group

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PROJECT Musk. Hydrogeo
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Approved By ____ Date ____

P-12 Rising Head Test

Aquifer Thickness, $b = 22.7 - 10\,ft = 12.7\,ft$ (filter pack) $\times 12\,in/ft \times 2.54\,cm/in$

$b = 387.10$ cm

Casing Radius, $r_c = 1$ in

$H_o = 23.7$ ft
H = As per field notes
$h = 7.01$ ft

$H-h / H_o-h = H/H_o$

Time	H, ft	Time,	H, ft
0.5	23.49	20.0	22.76
1.0	23.41	25.0	22.65
1.5	23.36	30.0	22.54
2.0	23.33	40.0	22.34
2.5	23.30	50.0	22.12
3.0	23.28	60.0	21.94
3.5	23.25	90.0	21.32
4.0	23.23	120.0	20.30
4.5	23.21	1033.0	10.18
5.0	23.19	1204.0	9.60
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	22.84		

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P-12 Rising Head Test

Time	H/Ho	Time	H/Ho
0.5	.987	11.0	.959
1.0	.983	12.0	.956
1.5	.980	13.0	.954
2.0	.978	14.0	.953
2.5	.976	15.0	.951
3.0	.975	20.0	.945
3.5	.973	25.0	.937
4.0	.972	30.0	.930
4.5	.971	40.0	.919
5.0	.969	50.0	.905
6.0	.967	90.0	.857
7.0	.965	120.0	.796
8.0	.963	1033.0	.190
9.0	.962	1204.0	.155
10.0	.960		

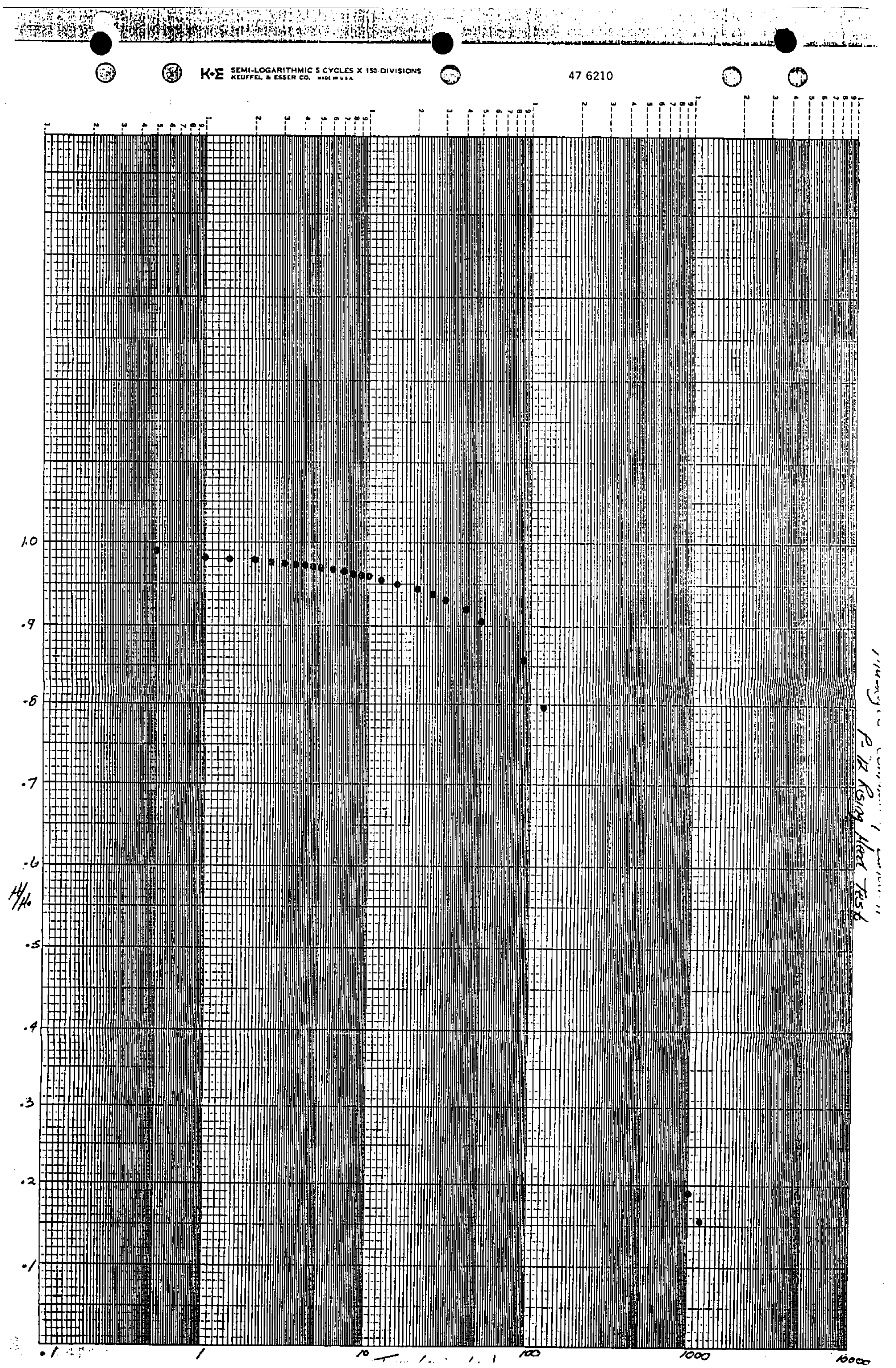
$Tt/rc^2 = 1$ $\alpha = 10^{-7}$ @ $t = 140$ min

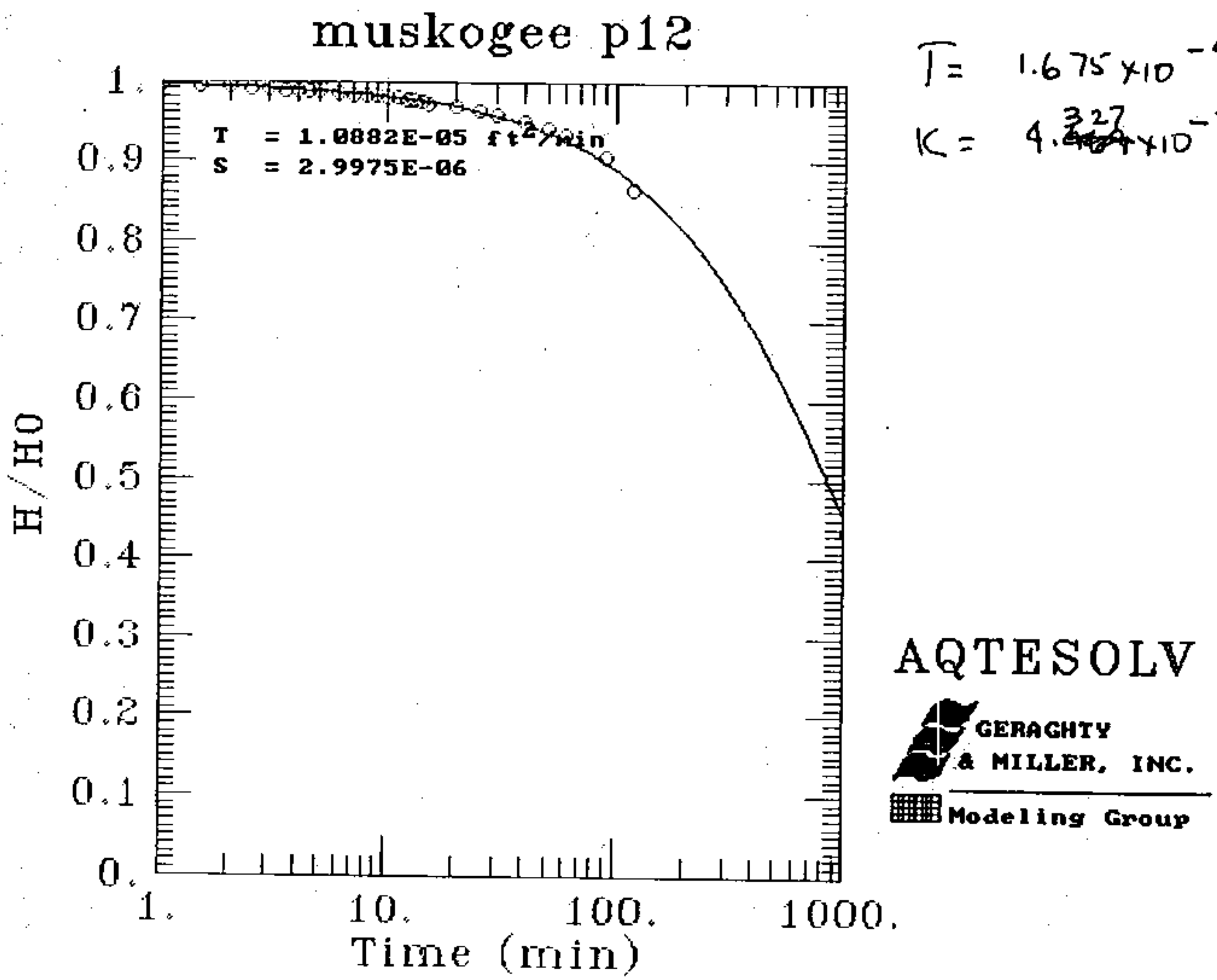
$T = rc^2/t$
$= (1\,in)^2 / 140\,min \times (2.54\,cm)^2/in^2 \times min/60\,sec$
$T = 0.001\ cm^2/sec$

$K = T/b$
$= 0.001\ cm^2/sec \times 1/387.10\ cm$
$K = \cancel{1.9}\ 2.58 \times 10^{-6}\ cm/sec$

w/ Aqtesolve Program

$T = 1.0882 \times 10^{-5}\ ft^2/min \times (12\,in)^2/ft^2 \times (2.54\,cm)^2/in^2 \times min/60\,sec$
$T = 1.68 \times 10^{-4}\ cm^2/sec$, $K = T/b = 4.35 \times 10^{-7}\ cm/sec$


K·E SEMI-LOGARITHMIC 5 CYCLES X 150 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
47 6210
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
H/Ho
.1
1
10
100
1000
10000
P-12 Rising Head Test



T= 1.675 x10^{-4} cm²/s
K = 4.~~484~~ 327 x10^{-7} cm/s

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PROJECT Musk. Hydrogeo
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Approved By ____ Date ____

P-13 Rising Head Test

Aquifer Thickness, $b = 19.3 - 7$ ft $= 12.3$ ft (filter pack) $\times 12$ in/ft $\times 2.54$ cm/in

$b = 374.90$ cm

Casing Radius, $r_c = 1$ in

$H_0 = 21.15$ ft $\quad H-h/H_0-h = H/H_0$
H = as per field notes
$h = 6.46$ ft

Time	H, ft	Time	H, ft
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

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P-13 Rising Head Test

Time	H/Ho	Time	H/Ho
0.5	.956	20.0	.432
1.0	.934	25.0	.337
1.5	.894	30.0	.263
2.0	.864	35.0	.204
2.5	.826	40.0	.160
3.0	.796	50.0	.099
3.5	.779	60.0	.061
4.0	.764	70.0	.038
4.5	.749	80.0	.026
5.0	.735	100.0	.014
6.0	.704	120.0	.008
7.0	.664	140.0	.002
8.0	.643	166.0	.001
9.0	.625	241.0	0
10.0	.607		
11.0	.590		
12.0	.569		
13.0	.555		
14.0	.543		
15.0	.527		

$Tt/r_c^2 = 1$ $\qquad q = 10^{-2}$ @ $t = 18$ min

$T = r_c^2/t$

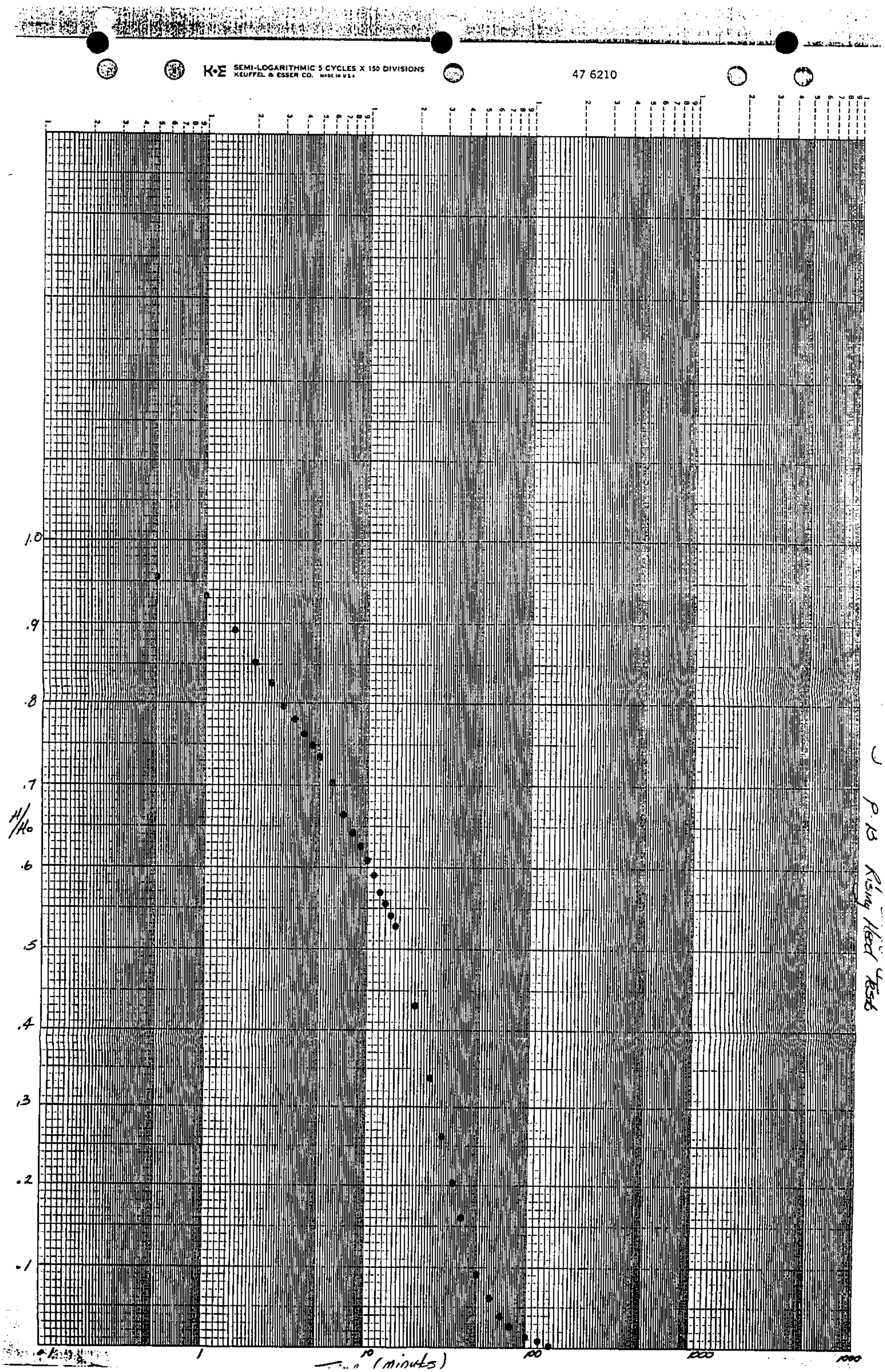
$= (1\,in)^2 / 18\,min \times (2.54\,cm)^2/in^2 \times min/60\,sec$

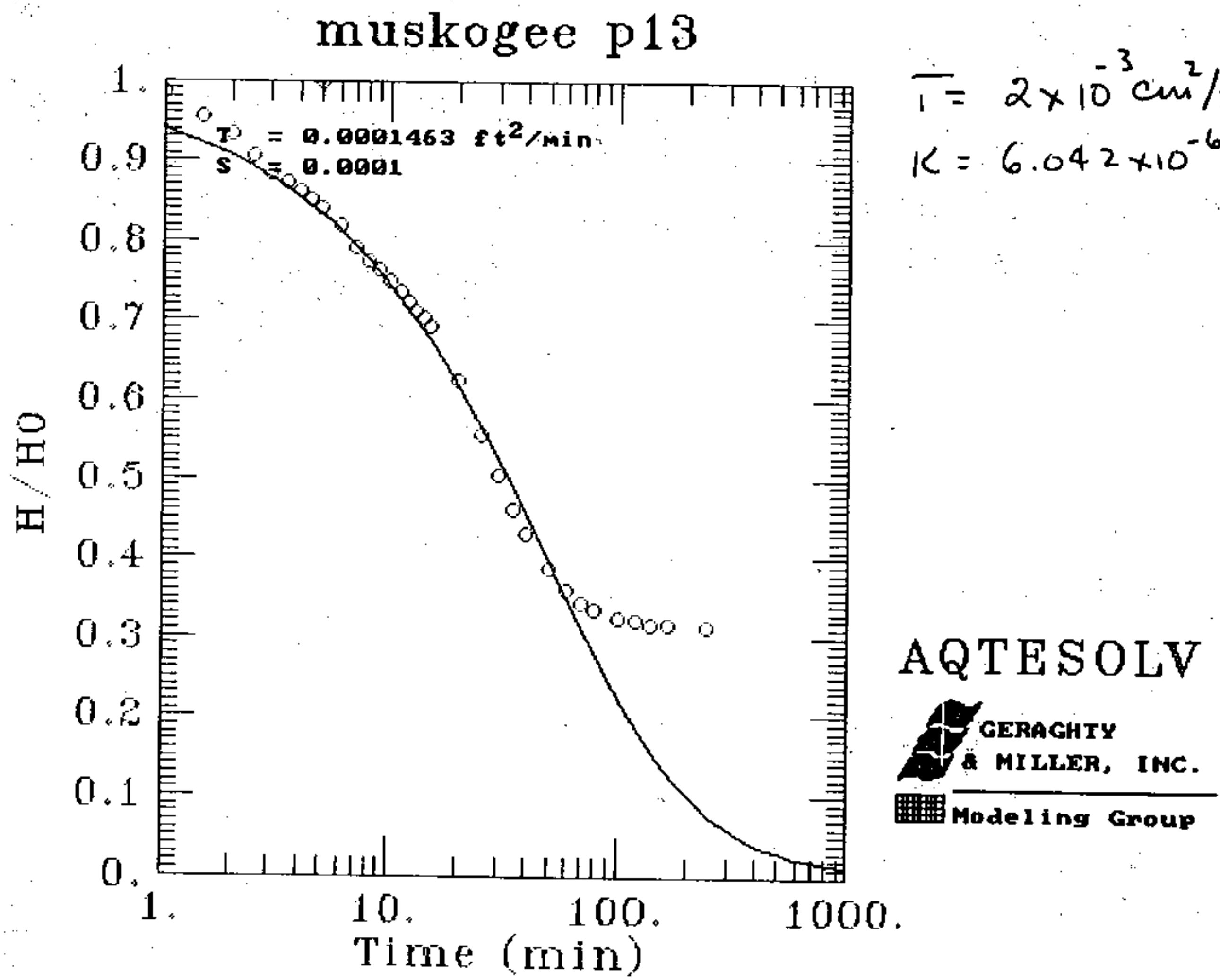
$T = .006\ cm^2/sec$

$K = T/b$

$= .006\ cm^2/sec \times 1/374.9\ cm$

$K = 1.59 \times 10^{-5}\ cm/sec$


K•E SEMI-LOGARITHMIC 5 CYCLES X 150 DIVISIONS KEUFFEL & ESSER CO. MADE IN U.S.A.
47 6210
1.0
.9
.8
.7
H/Ho
.6
.5
.4
.3
.2
.1
1
10 (minutes)
100
1000
P.13 Rising Head Test



$T = 2 \times 10^{-3}$ cm²/s

$K = 6.042 \times 10^{-6}$ cm/s

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P-14 Rising Head Test - Modified Bower & Rice

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

$H = 22.9$
$L_w = 15.64$

$$= \left[\frac{1.1}{\ln(15.64/.3)} + \frac{2.55 + 0.4 \ln[(22.9 - 15.64)/.3]}{33.33} \right]^{-1}$$

$$\ln R_e/r_w = 2.55$$

Note: water level for calculation of L_w & H taken on 12/22/93 = 12.06' TOC

$$r_c' = [(1-n)r_c^2 + n r_w^2]^{1/2}$$
$$= [(1-.3)(.08)^2 + .3(.3)^2]^{1/2}$$
$$= .17$$

$$K = \frac{r_c'^2 \ln(R_e/r_w)}{2L_e} \frac{1}{t} \ln \frac{Y_0}{Y_t}$$

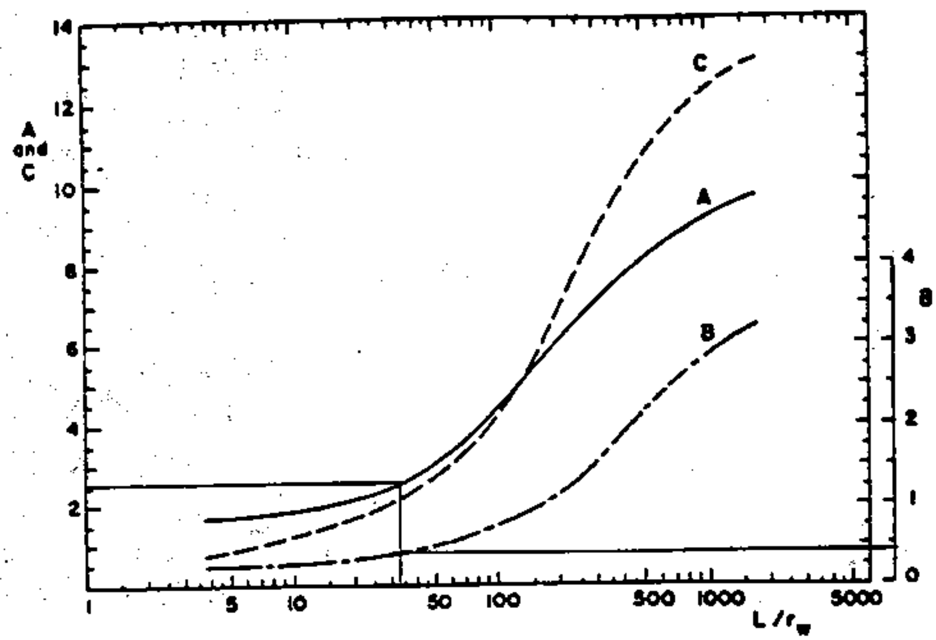
$$= \frac{(.17)^2 (2.55)}{2(10)} \frac{1}{150} \ln\left(\frac{1.0}{.07}\right)$$

$K = 6.5 \times 10^{-5}$ ft/min × 12 in/ft × 2.54 cm/in × min/60 sec

$K = 3.32 \times 10^{-5}$ cm/sec

P-14 Rising Head Test

BOUWER AND RICE: GROUNDWATER HYDRAULICS



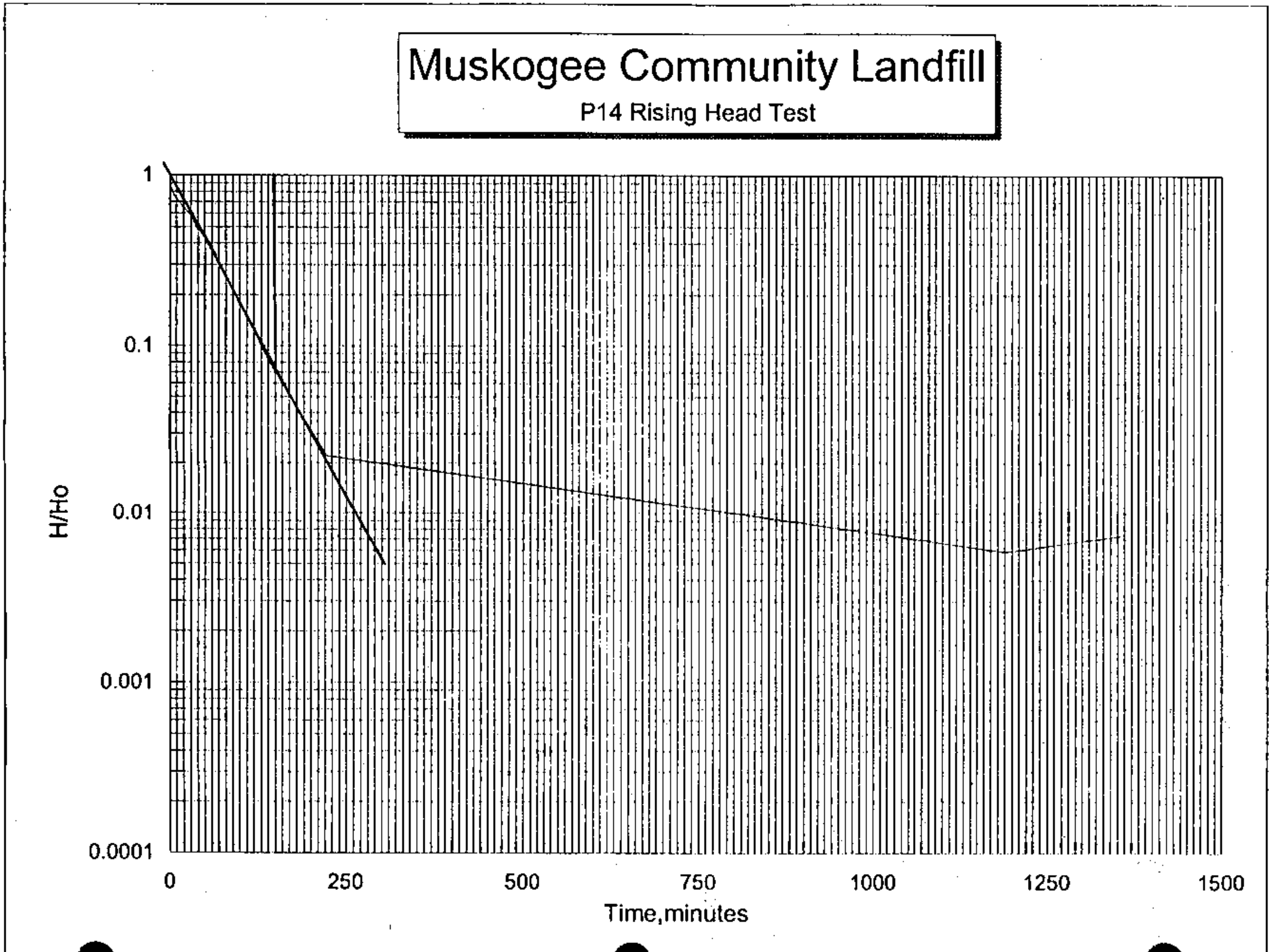
Curves relating coefficients A, B, and C to L/r_w.

$L_e/r_w = 10/.3 = 33.33$

$A = 2.55$

$B = 0.40$

	Muskogee Community Landfill			
	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
H/Ho
1
0.1
0.01
0.001
0.0001
0
250
500
750
1000
1250
1500
Time,minutes

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P-14 Rising Head Test

Aquifer Thickness, b = 24.7 - 10 = 14.7 ft (filter pack) x 12 in/ft x 2.54 cm/in

= 448.06

Casing radius rc = 1 in

Ho = 25.5'
H = As per field notes
h = 11.92'

H/Ho = H-h/Ho-h

Time	H, ft	Time	H, ft
		14.0	21.34
1.0	24.7	15.0	21.22
1.5	23.74	20.0	20.69
2.0	23.38	25.0	20.25
2.5	23.20	30.0	19.85
3.0	23.0	40.0	18.48
3.5	22.86	50.0	17.86
4.0	22.75	60.0	16.94
4.5	22.65	70.0	16.05
5.0	22.56	80.0	15.36
6.0	22.35	100.0	14.30
7.0	22.17	120.0	13.59
8.0	22.09	140.0	13.05
9.0	21.95	222.0	12.22
10.0	21.83	1191.0	12.00
11.0	21.70	1355.0	12.02
12.0	21.58		
13.0	21.46		

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P-14 Rising Head Test

Time	H/Ho	Time	H/Ho
		14.0	.694
1.0	.941	15.0	.685
1.5	.870	20.0	.646
2.0	.844	25.	.613
2.5	.831	30.0	.584
3.0	.816	40.0	.483
3.5	.806	50.0	.437
4.0	.797	60.0	.370
4.5	.790	70.0	.304
5.0	.784	80.0	.253
6.0	.768	100.0	.175
7.0	.755	120.0	.123
8.0	.749	140.0	.083
9.0	.739	222.0	.022
10.0	.730	1191.0	.006
11.0	.720	1355.0	.007
12.0	.711		
13.0	.703		

$Tt/r_c^2 = 1$ $\qquad \alpha = 10^{-4}$, $t = 22.5$ minutes

$T = r_c^2/t$

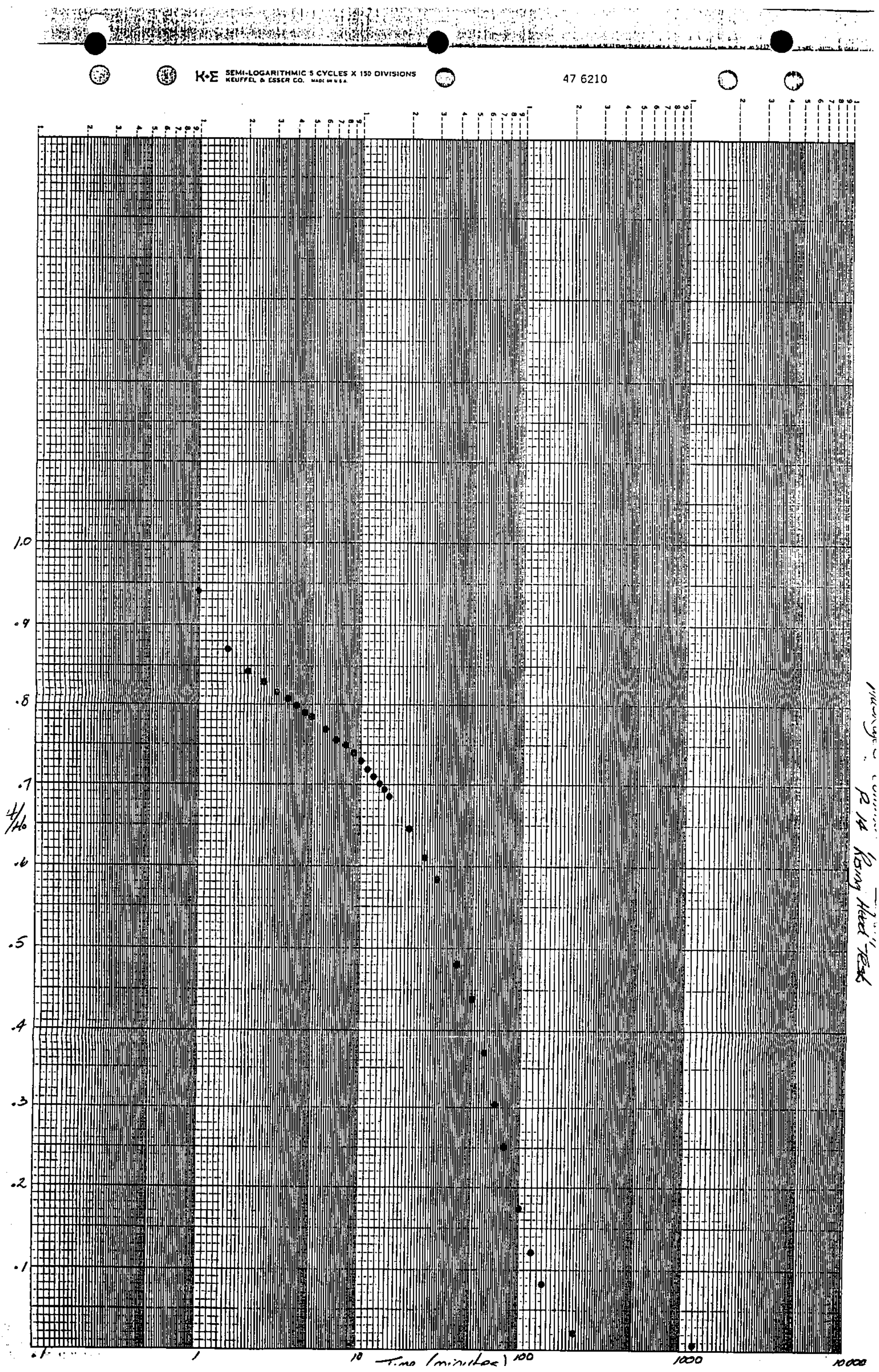
$= (1\,in)^2/22.5\,min \times (2.54\,cm)^2/in^2 \times min/60\,sec$

$T = .005\ cm^2/sec$

$K = T/b$

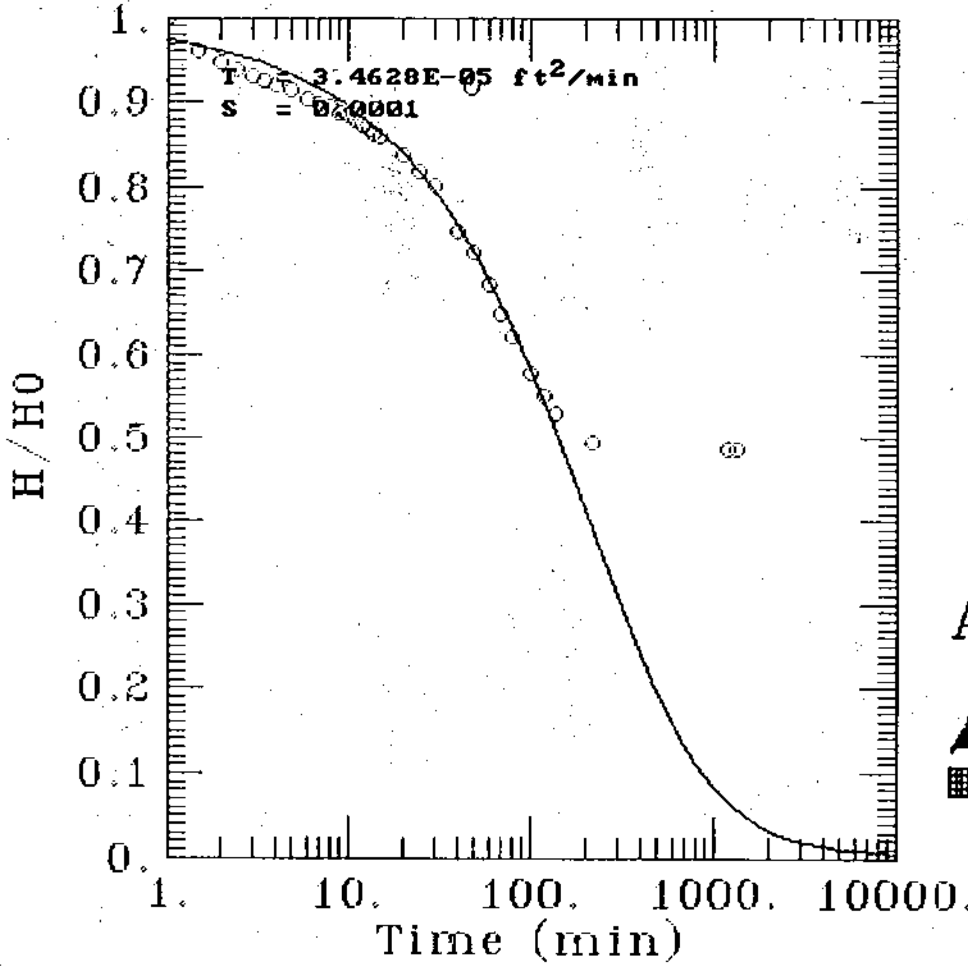
$= .005\ cm^2/sec \times 1/448.06\,cm$

$K = 1.07 \times 10^{-5}\ cm/sec$


K+E SEMI-LOGARITHMIC 5 CYCLES X 150 DIVISIONS
KEUFFEL & ESSER CO.
47 6210
1.0
.9
.8
.7
H/H_0
.6
.5
.4
.3
.2
.1
.1
1
10
Time (minutes)
100
1000
10000
P 14 Rising Head Test

P-14

$T = 1 \times 10^{-3}$ cm²/s
$K = 1.197 \times 10^{-6}$ cm/s



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P-15 Rising Head Test - Modified Bouwer & Rice

$$\ln R_e/r_w = \left[\frac{1.1}{\ln(L_w/r_w)} + \frac{A + B\ln[(H-L_w)/r_w]}{L_e/r_w}\right]^{-1} \qquad H = 23.71 \quad L_w = 18.82$$

$$= \left[\frac{1.1}{\ln(18.82/.3)} + \frac{2.55 + 0.40\ln[(23.71-18.82)/.3]}{33.33}\right]^{-1}$$

$$\ln R_e/r_w = 2.66$$

$$r'c = [(1-n)rc^2 + n r_w^2]^{1/2}$$
$$= [(1-.3)(.08)^2 + .3(.3)^2]^{1/2}$$
$$r'c = .17$$

$$K = \frac{r_c'^2 \ln(R_e/r_w)}{2L_e} \frac{1}{t} \ln y_0/y_t$$

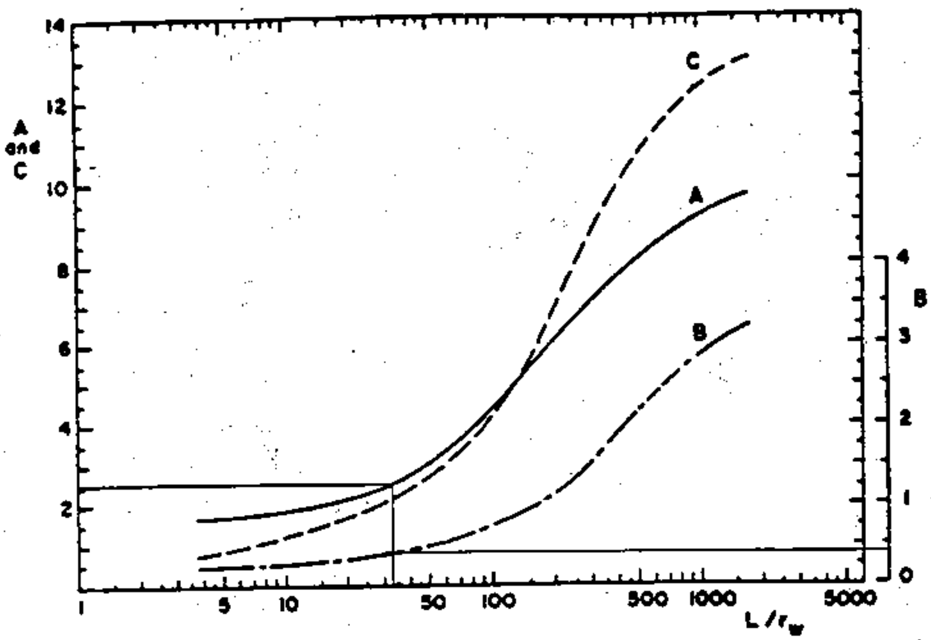
$$= \frac{(.17)^2(2.66)}{2(15)} \frac{1}{20} \ln(.024/.007)$$

$K = 2.37 \times 10^{-4}$ ft/min × 12 in/ft × 2.54 cm/in × min/60 sec

$K = 1.20 \times 10^{-4}$ cm/sec

P-15 Rising Head Test

BOUWER AND RICE: GROUNDWATER HYDRAULICS



Curves relating coefficients *A*, *B*, and *C* to L/r_w.

$Le/rw = 10/3 = 33.33$

$A = 2.55$

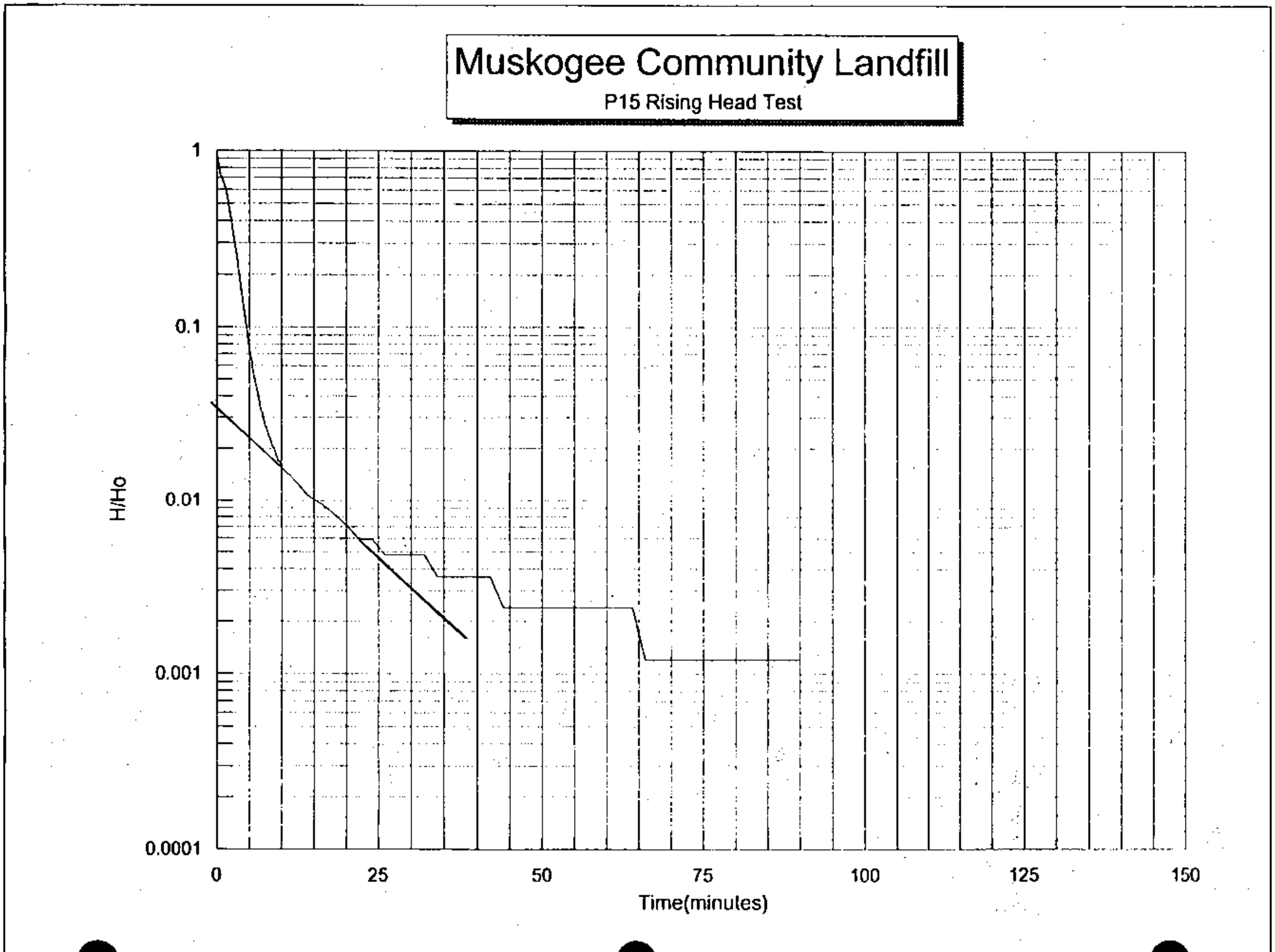
$B = 0.40$

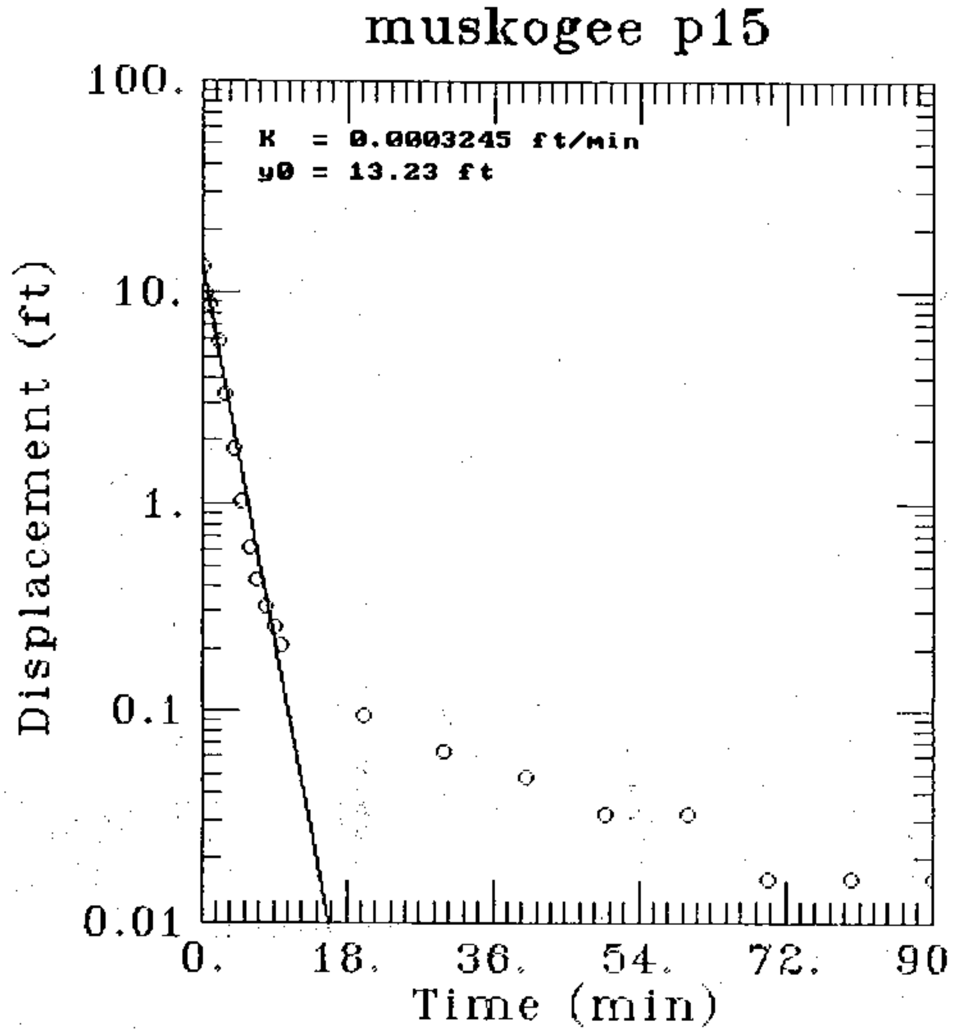
Muskogee Community Landfill
P15 Rising Head Test

Elapsed Time(min)	H(t),ft	Ho,ft	h,ft	H(t)-h/Ho-h	Elapsed Time(min)	H(t),ft	Ho,ft	h,ft	H(t)-h/Ho-h	Elapsed Time(min)	H(t),ft	Ho,ft	h,ft	H(t)-h/Ho-h
0	5.01	5.01	18.29	1	0.2566	6.749	5.01	18.29	0.869051	4	16.456	5.01	18.29	0.138102
0.0033	5.041	5.01	18.29	0.997666	0.26	6.764	5.01	18.29	0.867922	4.2	16.661	5.01	18.29	0.122666
0.0066	5.057	5.01	18.29	0.996461	0.2633	6.796	5.01	18.29	0.865512	4.4	16.851	5.01	18.29	0.108358
0.01	5.089	5.01	18.29	0.994051	0.2666	6.812	5.01	18.29	0.864307	4.6	16.993	5.01	18.29	0.097668
0.0133	5.105	5.01	18.29	0.992846	0.27	6.828	5.01	18.29	0.863102	4.8	17.136	5.01	18.29	0.086898
0.0166	5.136	5.01	18.29	0.990512	0.2733	6.859	5.01	18.29	0.860768	5	17.262	5.01	18.29	0.07741
0.02	5.152	5.01	18.29	0.989307	0.2766	6.875	5.01	18.29	0.859563	5.2	17.373	5.01	18.29	0.069051
0.0233	5.184	5.01	18.29	0.986898	0.28	6.891	5.01	18.29	0.858358	5.4	17.452	5.01	18.29	0.063102
0.0266	5.199	5.01	18.29	0.985768	0.2833	6.922	5.01	18.29	0.856024	5.6	17.547	6.01	18.29	0.055949
0.03	5.231	5.01	18.29	0.983358	0.2866	6.938	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	6.954	5.01	18.29	0.853614	6	17.673	5.01	18.29	0.048451
0.0366	5.279	5.01	18.29	0.979744	0.2933	6.97	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	0.036898
0.0466	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	0.033358
0.05	5.373	5.01	18.29	0.972666	0.3066	7.065	5.01	18.29	0.845256	7	17.863	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
0.0566	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
0.0666	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	0.023795
0.07	5.516	5.01	18.29	0.961898	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
0.0766	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	0.817922	9	18.037	5.01	18.29	0.019051
0.0866	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	18.068	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	18.068	5.01	18.29	0.016717
0.0966	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	0.015512
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
0.1066	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	0.010693
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	8.329	5.01	18.29	0.750075	18	18.179	5.01	18.29	0.008358
0.1166	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	0.936898	0.55	8.503	5.01	18.29	0.736973	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
0.1266	5.895	5.01	18.29	0.933358	0.5833	8.63	5.01	18.29	0.72741	26	18.226	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	18.226	5.01	18.29	0.004819
0.1366	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
0.1466	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	8.946	5.01	18.29	0.703614	42	18.242	5.01	18.29	0.003614
0.1566	6.1	5.01	18.29	0.917922	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
0.1666	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
0.1766	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
0.1866	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	0.676205	66	18.274	5.01	18.29	0.001205
0.1966	6.369	5.01	18.29	0.897666	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
0.2066	6.432	5.01	18.29	0.892922	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
0.2166	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	11.096	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
0.2266	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	0.359563	90	18.274	5.01	18.29	0.001205
0.2366	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
0.2466	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	18.29	0.176205	120	18.29	5.01	18.29	0
					3.8	16.218	5.01	18.29	0.156024	140	18.29	5.01	18.29	0

Muskogee Community Landfill
P15 Rising Head Test

Ho,ft	h,ft	H(t)-h/Ho-h	D-B	Elapsed Time(min)	H(t),ft	Ho,ft	h,ft	H(t)-h/Ho-h		Elapsed Time(min)	H(t),ft	Ho,ft	h,ft	H(t)-h/Ho-h	
5.01	18.29	1	13.28	0.2566	6.749	5.01	18.29	0.869051	11.541	4	16.456	5.01	18.29	0.138102	1.834
5.01	18.29	0.997666	13.249	0.26	6.764	5.01	18.29	0.867922	11.526	4.2	16.661	5.01	18.29	0.122666	1.629
5.01	18.29	0.996461	13.233	0.2633	6.796	5.01	18.29	0.865512	11.494	4.4	16.851	5.01	18.29	0.108358	1.439
5.01	18.29	0.994051	13.201	0.2666	6.812	5.01	18.29	0.864307	11.478	4.6	16.993	5.01	18.29	0.097666	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	0.860768	11.431	5	17.262	5.01	18.29	0.07741	1.028
5.01	18.29	0.989307	13.138	0.2766	6.875	5.01	18.29	0.859563	11.415	5.2	17.373	5.01	18.29	0.069051	0.917
5.01	18.29	0.986898	13.106	0.28	6.891	5.01	18.29	0.858358	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	0.856024	11.368	5.6	17.547	5.01	18.29	0.055949	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	0.853614	11.336	6	17.673	5.01	18.29	0.046461	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	0.042846	0.569
5.01	18.29	0.978614	12.996	0.2966	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	12.964	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	0.847666	11.257	6.8	17.847	5.01	18.29	0.033358	0.443
5.01	18.29	0.972666	12.917	0.3066	7.065	5.01	18.29	0.845256	11.225	7	17.863	5.01	18.29	0.032154	0.427
5.01	18.29	0.971461	12.901	0.31	7.081	5.01	18.29	0.844051	11.209	7.2	17.895	5.01	18.29	0.029744	0.395
5.01	18.29	0.969051	12.869	0.3133	7.096	5.01	18.29	0.842922	11.194	7.4	17.926	5.01	18.29	0.02741	0.364
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	12.806	0.3233	7.16	5.01	18.29	0.838102	11.13	8	17.974	5.01	18.29	0.023795	0.316
5.01	18.29	0.961898	12.774	0.3266	7.175	5.01	18.29	0.836973	11.115	8.2	17.989	5.01	18.29	0.022666	0.301
5.01	18.29	0.960768	12.759	0.33	7.191	5.01	18.29	0.835768	11.099	8.4	18.005	5.01	18.29	0.021461	0.285
5.01	18.29	0.959563	12.743	0.3333	7.223	5.01	18.29	0.833358	11.067	8.6	18.021	5.01	18.29	0.020256	0.269
5.01	18.29	0.957154	12.711	0.35	7.334	5.01	18.29	0.825	10.956	8.8	18.021	5.01	18.29	0.020256	0.269
5.01	18.29	0.954744	12.679	0.3666	7.428	5.01	18.29	0.817922	10.862	9	18.037	5.01	18.29	0.019051	0.253
5.01	18.29	0.953614	12.664	0.3833	7.523	5.01	18.29	0.810768	10.767	9.2	18.053	5.01	18.29	0.017846	0.237
5.01	18.29	0.95241	12.648	0.4	7.634	5.01	18.29	0.80241	10.656	9.4	18.068	5.01	18.29	0.016717	0.222
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	0.016717	0.222
5.01	18.29	0.948795	12.6	0.4333	7.839	5.01	18.29	0.786973	10.451	9.8	18.068	5.01	18.29	0.016717	0.222
5.01	18.29	0.946461	12.569	0.45	7.95	5.01	18.29	0.778614	10.34	10	18.084	5.01	18.29	0.015512	0.206
5.01	18.29	0.945256	12.553	0.4666	8.045	5.01	18.29	0.771461	10.245	12	18.116	5.01	18.29	0.013102	0.174
5.01	18.29	0.942846	12.521	0.4833	8.14	5.01	18.29	0.764307	10.15	14	18.148	5.01	18.29	0.010693	0.142
5.01	18.29	0.941717	12.506	0.5	8.234	5.01	18.29	0.757229	10.056	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	0.005949	0.079
5.01	18.29	0.934563	12.411	0.5666	8.567	5.01	18.29	0.732154	9.723	24	18.211	5.01	18.29	0.005949	0.079
5.01	18.29	0.933358	12.395	0.5833	8.63	5.01	18.29	0.72741	9.66	26	18.226	5.01	18.29	0.004819	0.064
5.01	18.29	0.930949	12.363	0.6	8.693	5.01	18.29	0.722666	9.597	28	18.226	5.01	18.29	0.004819	0.064
5.01	18.29	0.929819	12.348	0.6166	8.74	5.01	18.29	0.719127	9.55	30	18.226	5.01	18.29	0.004819	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	0.004819	0.064
5.01	18.29	0.926205	12.3	0.65	8.819	5.01	18.29	0.713178	9.471	34	18.242	5.01	18.29	0.003614	0.048
5.01	18.29	0.92387	12.269	0.6666	8.851	5.01	18.29	0.710768	9.439	36	18.242	5.01	18.29	0.003614	0.048
5.01	18.29	0.922666	12.253	0.6833	8.883	5.01	18.29	0.708358	9.407	38	18.242	5.01	18.29	0.003614	0.048
5.01	18.29	0.921461	12.237	0.7	8.914	5.01	18.29	0.706024	9.376	40	18.242	5.01	18.29	0.003614	0.048
5.01	18.29	0.919051	12.205	0.7166	8.946	5.01	18.29	0.703614	9.344	42	18.242	5.01	18.29	0.003614	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	9.009	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	0.696461	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	9.186	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	0.905949	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	9.278	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	0.897666	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	0.896461	11.905	0.95	9.373	5.01	18.29	0.671461	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	0.670256	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	0.638178	8.475	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	0.594127	7.89	80	18.274	5.01	18.29	0.001205	0.016
5.01	18.29	0.886973	11.779	1.6	11.096	5.01	18.29	0.541717	7.194	82	18.274	5.01	18.29	0.001205	0.016
5.01	18.29	0.884563	11.747	1.8	11.76	5.01	18.29	0.491717	6.53	84	18.274	5.01	18.29	0.001205	0.016
5.01	18.29	0.883358	11.731	2	12.376	5.01	18.29	0.445331	5.914	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	0.40128	5.329	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	0.359563	4.775	90	18.274	5.01	18.29	0.001205	0.016
5.01	18.29	0.878614	11.668	2.6	14.037	5.01	18.29	0.320256	4.253	92	18.29	5.01	18.29	0	0
5.01	18.29	0.876205	11.636	2.8	14.511	5.01	18.29	0.284563	3.779	94	18.29	5.01	18.29	0	0
5.01	18.29	0.875	11.62	3	14.938	5.01	18.29	0.25241	3.352	96	18.29	5.01	18.29	0	0
5.01	18.29	0.87387	11.605	3.2	15.317	5.01	18.29	0.22387	2.973	98	18.29	5.01	18.29	0	0
5.01	18.29	0.872666	11.589	3.4	15.649	5.01	18.29	0.19887	2.641	100	18.29	5.01	18.29	0	0
5.01	18.29	0.870256	11.557	3.6	15.95	5.01	18.29	0.176205	2.34	120	18.29	5.01	18.29	0	0
				3.8	16.218	5.01	18.29	0.156024	2.072	140	18.29	5.01	18.29	0	0
									0						0
									0						0


Muskogee Community Landfill
P15 Rising Head Test
1
0.1
0.01
0.001
0.0001
H/Ho
0
25
50
75
100
125
150
Time(minutes)



K = 1.65 x 10^{-4} 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 the 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 Rood, DEQ
Carey Bell, Muskogee County DEQ

(FILE: GROUNDWATER ELEVATION DATA) (MUSK\GWEL1193.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\GWNOV93.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

Mark Daniels, P.E.
Environmental Engineer

Enclosure

cc: Dan Gibson
Mike McCloud
Raymond DeBose
Fenton Rood, DEQ
Carey Bell, Muskogee County DEQ

(FILE: GROUNDWATER ELEVATION DATA) (MUSK\GWEL1093.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\GWOCT93.WK1)

APPENDIX I

ANALYTICAL GROUND-WATER DATA

Muskogee\86251dp2.3rd

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

METLAB

MLTS 83-3576

Table I

Summary of Chemical Analysis of Five (5) Muskogee Water Samples
Tested for M.R. McComas and Associates, Inc.

Constituents	Units	MW-1	MW-2	MW-3	Abd. Well	Cody Creek
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 °
1	- -	- -	- -	- -
2	5.6	4,100	100	16.[illegible]
3	5.8	4,000	820	18.[illegible]
4	5.1	10,000	20,000	17.[illegible]
5	- -	- -	- -	- -
6	6.0	800	50	18.[illegible]
7	5.4	10,000	3,700	19.[illegible]
8	- -	- -	- -	- -
9	- -	- -	- -	- -
10	6.4	1,300	25	17.[illegible]
11	6.2	1,200	50	17.[illegible]
12	5.9	2,600	500	18.[illegible]
13	6.0	1,600	150	17.[illegible]
14	5.6	10,000	825	17.[illegible]
15	6.1	1,400	250	16.[illegible]
MW1	5.7	3,100	- -	16.[illegible]
MW2	5.8	10,000	- -	- -
MW3	6.0	1,650	- -	- -

SAMPLES ANALYZED IN FIELD BY WM. BULLER, M. SCHMIDT

WMI ENVIRONMENTAL MONI[illegible]NG LABORATORIES, INC.

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: 92-13344
MP: 852921
Rev / Task: 00 / 01
Sample Type: WELL
Reported: 23-DEC-1992

Analyte	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
Sample Point: / Sample Number: / Sampled:							
FIELD DATA:							
COLOR	NA		LT. YELLOW		LT. BROWN		
DEPTH TO WATER FROM TOP OF CASING	NA		15.90		8.70		FT
FIELD DISSOLVED OXYGEN	NA		NA		NA		MG/L
GROUNDWATER ELEV.	NA		627.04		~~NA~~ 624.31 M. Daniels		FT MSL
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 73111-0000

ENS: 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

NA = Not Analyzed ND = Not Detected TBK = Trip Blank a = EML Subcontract Data

WMI ENVIRONMENTAL MON[illegible]NG LABORATORIES, INC.

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: 92-13344
MP: 852921
Rev / Task: 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		
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~~ 625.64 M. Daniels		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 ND = Not Detected TBK = Trip Blank s = EML Subcontract Data

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: 92-13344
MP: 852921
Rev / Task: 00 / 01
Sample Type: WELL
Reported: 23-DEC-1992

Analyte	Sample Point: 852-MW02 Sample Number: AG1341 Sampled: 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

NA = Not Analyzed   ND = Not Detected   TBK = Trip Blank   s = EML Subcontract Data

WMI ENVIRONMENTAL MON NG LABORATORIES, INC.

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: 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~~ 630.66 [illegible]		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	316000	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   a = EML Subcontract Data

WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

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	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 a = EML Subcontract Data

WMI ENVIRONMENTAL MONI NG LABORATORIES, INC.

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: 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

NA = Not Analyzed   ND = Not Detected   TBK = Trip Blank   s = EML Subcontract Data

WMI ENVIRONMENTAL MONI[illegible]NG LABORATORIES, INC.

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: 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

NA = Not Analyzed   ND = Not Detected   TBK = Trip Blank   s = EML Subcontract Data

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WMI ENVIRONMENTAL MONIT[illegible]NG LABORATORIES, INC.

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: 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

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) 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,

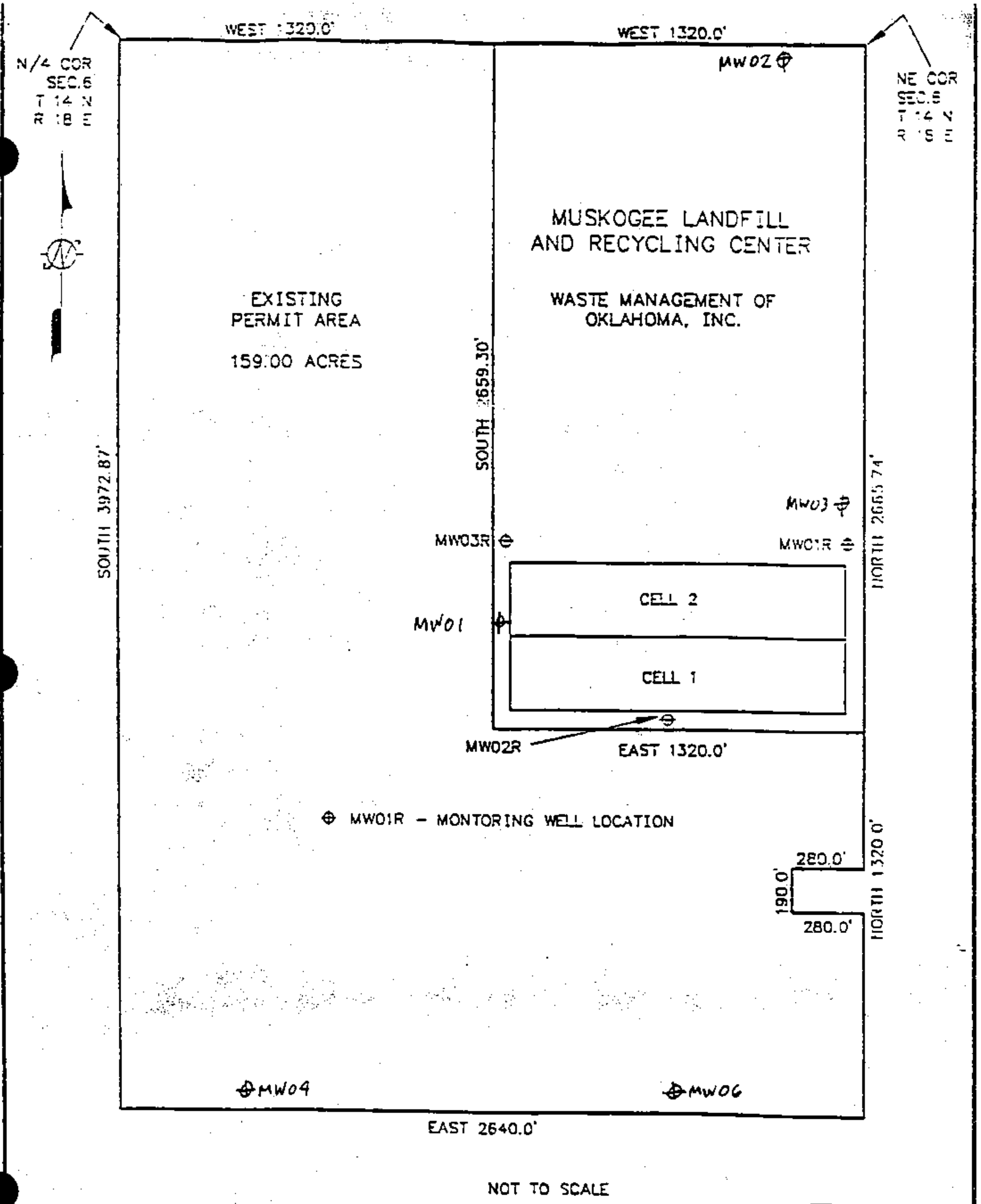
WASTE MANAGEMENT OF OKLAHOMA, INC.

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\93GW1Q.LTR)



ATTACHMENT 2

SEC DONOHUE
Environment & Infrastructure

MUSKOGEE LANDFILL AND
RECYCLING CENTER

MONITORING WELL LOCATION ...

WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

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: 93-10497
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 TBK - Trip Blank s - EML Subcontract Data

WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

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: 93-10497
MP: 852931
Rev / Task: 00 / 01
Sample Type: WELL
Reported: 12-MAR-1993

Analyte	Sample Point: 852-01FB Sample Number: AG5211 Sampled: 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
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.

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000

ENS: 93-10497
MP: 852931
Rev / Task: 00 / 01
Sample Type: WELL
Reported: 12-MAR-1993

Analyte	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
Sample Point: / Sample Number: / Sampled:							
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	670	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	239000	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 TBK = Trip Blank a EML Subcontract Data

Page 4

WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000

ENS: 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 a = EML Subcontract Data

WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

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: 93-10497
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 MONI[illegible]NG LABORATORIES, INC.

EVENT SUMMARY REPORT

Site: 852 - MUSKOGEE LANDFILL

2801 S. 54TH STREET WEST
MUSKOGEE OK 73111-0000

ENS: 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
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 a = 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,

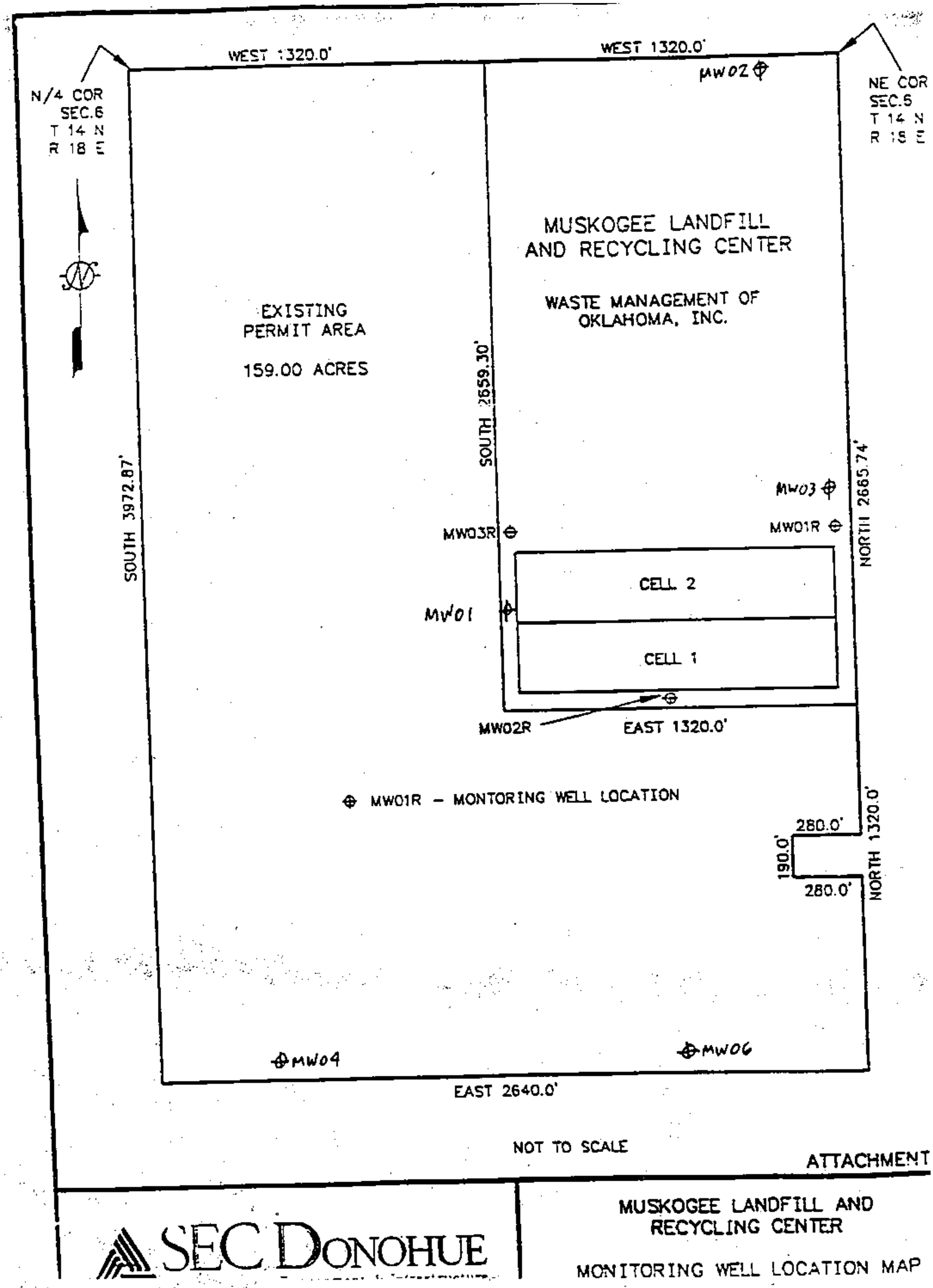
WASTE MANAGEMENT OF OKLAHOMA, INC.

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\2Q93H2O.LTR)


WEST 1320.0'
WEST 1320.0'
N/4 COR
SEC.6
T 14 N
R 18 E
NE COR
SEC.5
T 14 N
R 18 E
MW02
MUSKOGEE LANDFILL
AND RECYCLING CENTER
WASTE MANAGEMENT OF
OKLAHOMA, INC.
EXISTING
PERMIT AREA
159.00 ACRES
SOUTH 2659.30'
SOUTH 3972.87'
NORTH 2665.74'
MW03
MW03R
MW01R
CELL 2
MW01
CELL 1
MW02R
EAST 1320.0'
MW01R – MONTORING 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
MONITORING WELL LOCATION MAP

WMI ENVIRONMENTAL MONITO[...]S LABORATORIES, INC.

Page

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:)	852-01FB 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

WMI ENVIRONMENTAL MONITO[illegible]G LABORATORIES, INC.

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	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

WMI ENVIRONMENTAL MONITO[illegible]G LABORATORIES, INC.

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:	852-01FB 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

WMI ENVIRONMENTAL MONITO[illegible] LABORATORIES, INC.

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-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~~ 626.74 H. Daniel		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	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

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-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
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

NA = Not Analyzed ND = Not Detected [illegible]

WMI ENVIRONMENTAL MONITO G LABORATORIES, INC.

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
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

Page

WMI ENVIRONMENTAL MONITO LABORATORIES, INC.

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
IELD 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
HEMICAL 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

NA = Not Analyzed ND = Not Detected

WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

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
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

WMI ENVIRONMENTAL MONITO[illegible] LABORATORIES, INC.

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   ND = Not Detected   TBK = Trip Blank   s = EML Subcontract Data

WMI ENVIRONMENTAL MONITO[illegible] LABORATORIES, INC.

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: TBK-MW03R Sample Number: AH0586 Sampled: 27-APR-1993	EML RL					Units
FIELD DATA:							
COLOR							
DEPTH TO WATER FROM TOP OF CASING							FT
FIELD DISSOLVED OXYGEN							MG/L
GROUNDWATER ELEV.							FT MSL
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,BICARBONATE							MG/L
ANTIMONY-TOTAL							UG/L
ARSENIC-TOTAL							UG/L
BARIUM-TOTAL							UG/L
BERYLLIUM-TOTAL							UG/L
BORON-TOTAL							UG/L
CADMIUM-TOTAL							UG/L
CALCIUM-TOTAL							UG/L
CHLORIDE							MG/L
CHROMIUM-TOTAL							UG/L
COBALT-TOTAL							UG/L
COPPER-TOTAL							UG/L
FLUORIDE							MG/L
IRON-TOTAL							UG/L
LEAD-TOTAL							UG/L
MAGNESIUM-TOTAL							UG/L
MANGANESE-TOTAL							UG/L
MERCURY-TOTAL							UG/L
NICKEL-TOTAL							UG/L
POTASSIUM-TOTAL							UG/L
SELENIUM-TOTAL							UG/L
SILVER-TOTAL							UG/L
SODIUM-TOTAL							UG/L
SULFATE							MG/L
THALLIUM-TOTAL							UG/L

WMI ENVIRONMENTAL MONITO G LABORATORIES, INC.

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: TBK-MW03R Sample Number: AH0586 Sampled: 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 = Trip Blank

WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

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: TBK-MW03R Sample Number: AH0586 Sampled: 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   TBK = Trip Blank   s = 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,

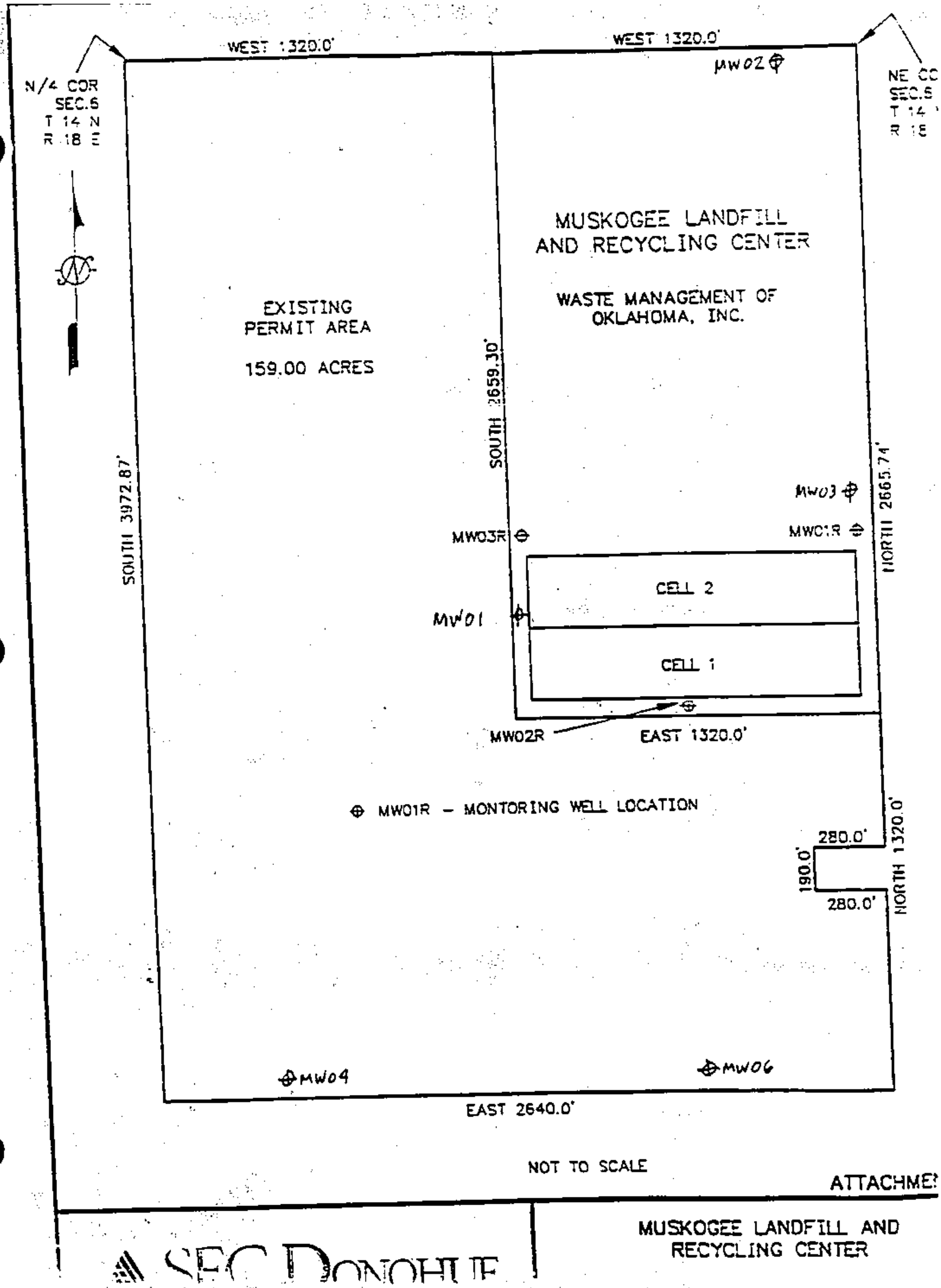
WASTE MANAGEMENT OF OKLAHOMA, INC.

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\3093H2O.LTR)


WEST 1320.0'
WEST 1320.0'
N/4 COR
SEC.6
T 14 N
R 18 E
NE CC
SEC.6
MW02
MUSKOGEE LANDFILL
AND RECYCLING CENTER
WASTE MANAGEMENT OF
OKLAHOMA, INC.
EXISTING
PERMIT AREA
159.00 ACRES
SOUTH 2659.30'
SOUTH 3972.87'
NORTH 2665.74'
MW03
MW03R
MW01R
CELL 2
CELL 1
MW01
MW02R
EAST 1320.0'
MW01R - MONTORING WELL LOCATION
280.0'
190.0'
280.0'
NORTH 1320.0'
MW04
MW06
EAST 2640.0'
NOT TO SCALE
ATTACHME
MUSKOGEE LANDFILL AND
RECYCLING CENTER
SEC DONOHUE

WMX ENVIRONMENTAL MONI[illegible]NG LABORATORIES, INC. Pa[illegible]

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 74401

ENS: 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 MSL
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
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-CHLOROETHYLVINYL 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   TBK = Trip Blank   * = EML Subcontract Data

WMX ENVIRONMENTAL MONI[illegible]NG LABORATORIES, INC.

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 74401

ENS: 93-13150
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 8-SEP-1993

Analyte	Sample Point: 852-01FB Sample Number: AH8842 Sampled: 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 # = EML Subcontract Data

WMX ENVIRONMENTAL MONI[illegible]NG LABORATORIES, INC.

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 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
FIELD DATA:							
COLOR	LT BROWN		NONE		NONE		
GROUNDWATER ELEV.	615.76		656.23	627.63	623.51		FT MSL
ODOR	NO		NO		NO		
PH FIELD	7.01		6.97	DPG	7.32		PH UNITS
SPECIFIC CONDUCTANCE FIELD	4340		3240		1561		UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS	23.1		25.3	9/27/93	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-CHLOROETHYLVINYL 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   TBK = Trip Blank   [illegible]

WMX ENVIRONMENTAL MONI[illegible]NG LABORATORIES, INC.

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 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

NA = Not Analyzed   ND = Not Detected   TBK = Trip Blank   s = EML Subcontract Data

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

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 74401

ENS: 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
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		15.8	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
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.	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-CHLOROETHYLVINYL 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

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WMX ENVIRONMENTAL MON[illegible]ING LABORATORIES, INC.

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 74401

ENS: 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

NA = Not Analyzed   ND = Not Detected   TBK = Trip Blank   s = EML Subcontract Data

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

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 74401

ENS: 93-13150
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 8-SEP-1993

Analyte	Sample Point: TBK-MW02R Sample Number: AH8837 Sampled: 17-AUG-1993	EML RL					Units
FIELD DATA:							
COLOR							
GROUNDWATER ELEV.							FT MSL
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
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
1,3-DICHLOROBENZENE	ND	10.					UG/L
1,4-DICHLOROBENZENE	ND	10.					UG/L
2-BUTANONE	ND	10.					UG/L
2-CHLOROETHYLVINYL ETHER	ND	20.					UG/L
2-HEXANONE	ND	10.					UG/L
4-METHYL-2-PENTANONE	ND	10.					UG/L

NA = Not Analyzed   ND = Not Detected   TBK = Trip Blank   s = EML Subcontract Out

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

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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: TBK-MW02R Sample Number: AH8837 Sampled: 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

NA = Not Analyzed   ND = Not Detected   TBK = Trip Blank   a = EML Subcontract Data

WMX ENVIRONMENTAL MON[illegible]ING LABORATORIES, INC.

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 74401

ENS: 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

NA = Not Analyzed   ND = Not Detected   TBK = Trip Blank   s = EML Subcontract Data

WMX ENVIRONMENTAL MONI[illegible]NG LABORATORIES, INC.

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 74401

ENS: 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
CADMIUM-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

NA = Not Analyzed   ND = Not Detected   TBK = Trip Blank   s = EML Subcontract Data

WMX ENVIRONMENTAL MONI[illegible]ING LABORATORIES, INC.

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 74401

ENS: 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) 682-7284
(918) 682-2867 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,

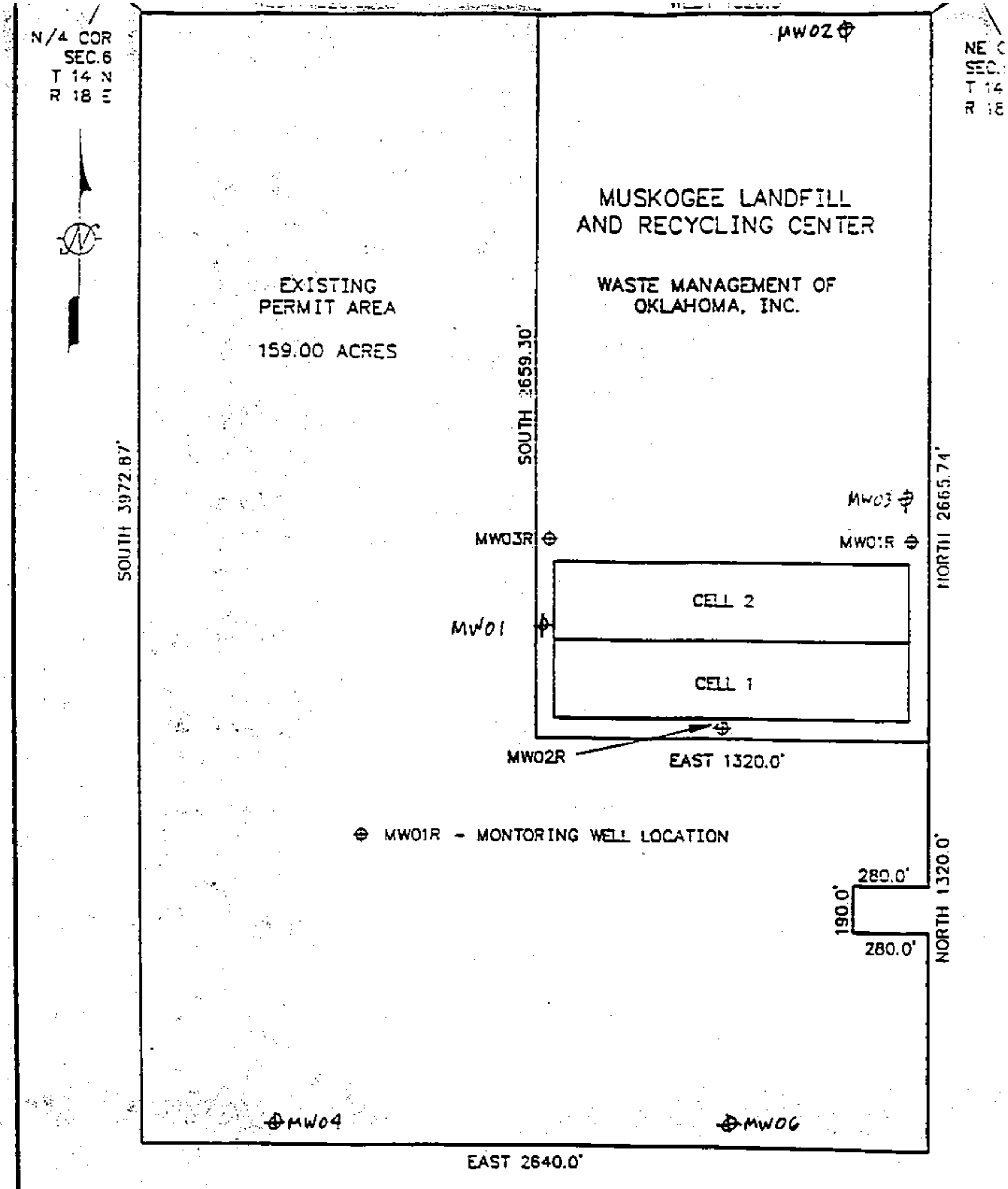
WASTE MANAGEMENT OF OKLAHOMA, INC.

Dan P. Gibson
Staff Engineer

Enclosure

cc: Larry Cohn
Mark Daniels
Mike McCloud
John Wickersham, TCCHD
Walter Beckham, City of Muskogee

(MUSK\4Q93H2O.LTR)



ATTACHMENT

SEC DONOHUE
Environment & Infrastructure

MUSKOGEE LANDFILL AND
RECYCLING CENTER

MONITORING WELL LOCATION MAP

WMX ENVIRONMENTAL MON[illegible]ING LABORATORIES, INC.

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 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 AI5684 09-NOV-1993	EML RL	852-MW01R AI5682 09-NOV-1993	EML RL	852-MW02 AI5681 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	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-CHLOROETHYLVINYL ETHER	ND	20.	ND	20.	ND	20.	UG/L
BENZENE	ND	5.	ND	5.	ND	5.	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 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-1,3-DICHLOROPROPENE	ND	5.	ND	5.	ND	5.	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.

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 AI5684 09-NOV-1993	EML RL	852-MW01R AI5682 09-NOV-1993	EML RL	852-MW02 AI5681 09-NOV-1993	EML 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

WMX ENVIRONMENTAL MO[illegible]RING LABORATORIES, INC. : 3

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 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 AI5683 09-NOV-1993	EML RL	852-MW03R AI5680 09-NOV-1993	EML RL	852-MW04 AI5679 09-NOV-1993	EML RL	Units
FIELD DATA:							
GROUNDWATER ELEV.	~~657.24~~	628.64	631.83		645.14		FT MSL
PH FIELD	6.95	i) [illegible]	6.06		6.66		PH UNITS
SPECIFIC CONDUCTANCE FIELD	2480		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	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-CHLOROETHYLVINYL 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

NA : Not Analyzed

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

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 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
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 a = EML Subcontract Data

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

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 74401

ENS: 93-14416
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 6-DEC-1993

Analyte	Sample Point: / Sample Number: / Sampled: 852-MW06 AI5678 09-NOV-1993	EML RL	TBK-MW02 AI5681 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
VOLATILE 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-CHLOROETHYLVINYL 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   TBK = Trip Blank

WMX 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-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

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WMX ENVIRONMENTAL MO[illegible]ORING LABORATORIES, INC. e: 1

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 74401

ENS: 93-14417
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 8-DEC-1993

Analyte / Sample Point: / Sample Number: / Sampled:	852-01FB / AI5691 / 09-NOV-1993	EML RL	852-MW01R / AI5689 / 09-NOV-1993	EML RL	852-MW02 / AI5688 / 09-NOV-1993	EML 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	25.0	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	16.0	UG/L
NICKEL-TOTAL	ND	40.0	65.3	40.0	ND	40.0	UG/L
SELENIUM-DISSOLVED	ND	5.0	ND	5.0	ND	40.0	UG/L
SELENIUM-TOTAL	ND	5.0	ND	5.0	ND	5.0	UG/L
SILVER-DISSOLVED	ND	25.0	ND	25.0	ND	16.0	UG/L
SILVER-TOTAL	ND	25.0	ND	25.0	ND	25.0	UG/L
THALLIUM-DISSOLVED	ND	10.0	ND	25.0	ND	25.0	UG/L
THALLIUM-TOTAL	ND	10.0	ND	10.0	ND	10.0	UG/L
VANADIUM-DISSOLVED	ND	50.0	ND	10.0	ND	16.0	UG/L
VANADIUM-TOTAL	ND	50.0	ND	50.0	ND	50.0	UG/L
ZINC-DISSOLVED	ND	20.0	20.3	50.0	ND	50.0	UG/L
ZINC-TOTAL	ND	20.0	30.7	20.0	ND	20.0	UG/L
				20.0		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	5.	ND	5.	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	10.	ND	10.	UG/L
1,2-DICHLOROPROPANE	ND	5.	ND	5.	ND	5.	UG/L
1,4-DICHLOROBENZENE	ND	10.	ND	5.	ND	5.	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
				10.		10.	UG/L

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

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 74401

ENS: 93-14417
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 8-DEC-1993

Analyte	Sample Point: 852-01FB Sample Number: AI5691 Sampled: 09-NOV-1993	EML RL	852-MW01R AI5689 09-NOV-1993	EML RL	852-MW02 AI5688 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	7.73	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   s = EML Subcontract Data

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 74401

ENS: 93-14417
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 8-DEC-1993

Analyte	Sample Point: / Sample Number: / Sampled:	852-MW02R AI5690 09-NOV-1993	EML RL	852-MW03R AI5687 09-NOV-1993	EML RL	852-MW04 AI5686 09-NOV-1993	EML 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	5.	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	10.	ND	10.	UG/L
1,2-DICHLOROPROPANE		ND	5.	ND	5.	ND	5.	UG/L
1,4-DICHLOROBENZENE		ND	10.	ND	5.	ND	5.	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. Page: 4

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: WELL
Reported: 8-DEC-1993

Analyte / Sample Point: / Sample Number: / Sampled:	852-MW02R AI5690 09-NOV-1993	EML RL	852-MW03R AI5687 09-NOV-1993	EML RL	852-MW04 AI5686 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 TBK = Trip Blank s = EML Subcontract Data

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

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 74401

ENS: 93-14417
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 8-DEC-1993

Analyte	Sample Point: 852-MW06 Sample Number: AI5685 Sampled: 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

WMX ENVIRONMENTAL MON[illegible]RING LABORATORIES, INC.

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 74401

ENS: 93-14417
MP: 852931
Rev / Task: 02 / 01
Sample Type: WELL
Reported: 8-DEC-1993

Analyte	Sample Point: 852-MW06 Sample Number: AI5685 Sampled: 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   TBK = Trip Blank   s = EML Subcontract Data

APPENDIX J
GEOTECHNICAL LABORATORY DATA

Muskogee\86251dp2.3rd

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.	ATTERBERG 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	Grey 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			Moisture Content	Organics	Compression	%	Cation Exchange Meq	Dry Density		Pocket	ATTERBERG LIMIT		
Hole #	Depth	Material Description	%	%	ksf	Strain	Na/100g	pcf	pH	pen.	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 Nodule	21.4										
B-8	13-14	Light Brown & Yellow Brown Shaley Cla	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 Sl Cl 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 Hole #	Depth	Material Description	Moisture Content %	Organics %	Compression ksf	% Strain	Cation Exchange Meq Na/100g	Dry Density pcf	pH	Pocket pen.	ATTERBERG LIMIT 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 Cla	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 to 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						

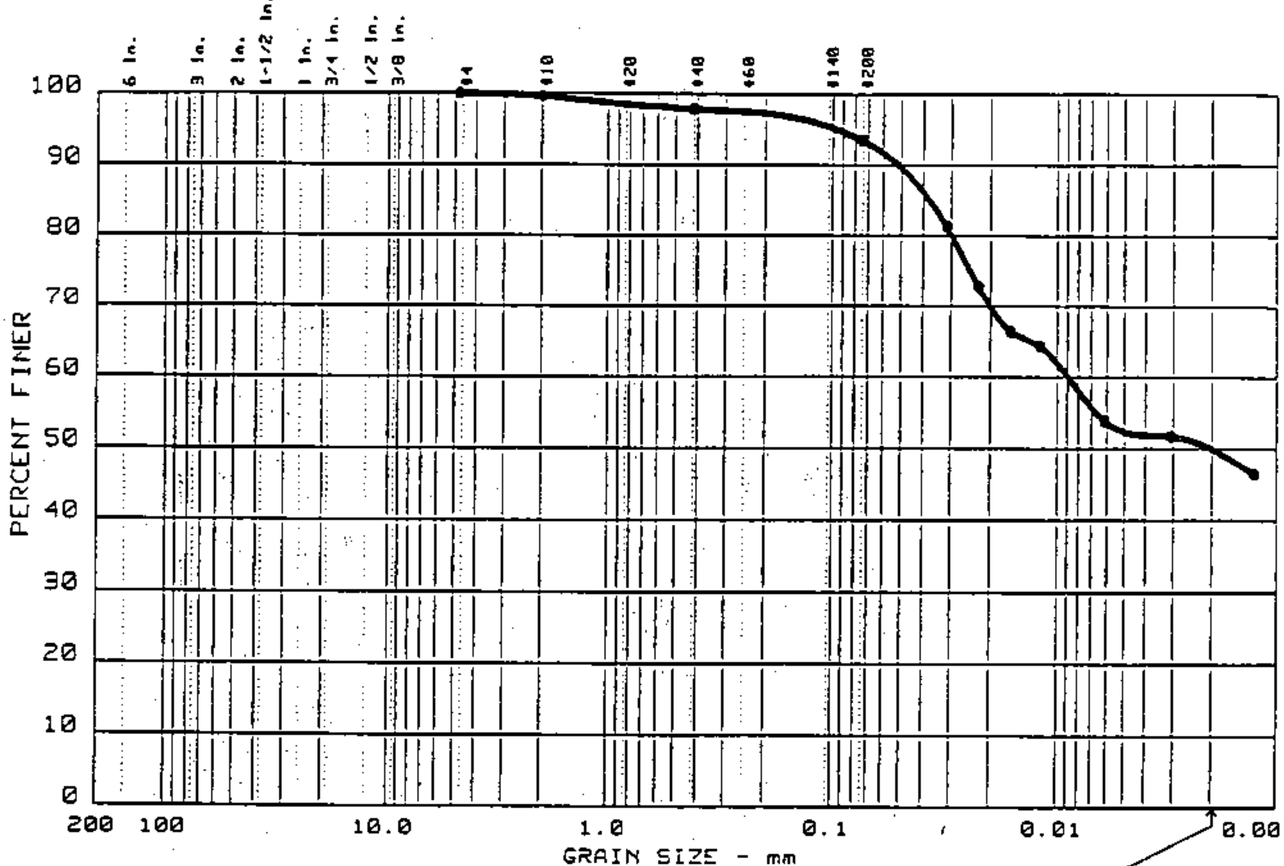
LAW ENGINEERING, INC.

SUMMARY OF TEST DATA
TRACT A

RUST E & I MUSKOGEE LANDFILL

Sample Identification												ATTERBERG LIMIT		
Hole #	Depth	Material Description	Moisture Content %	Organics %	Compression ksf	% Strain	Cation Exchange Meq Na/100g	Dry Density pcf	pH	Pocket pen.	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		1.46	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

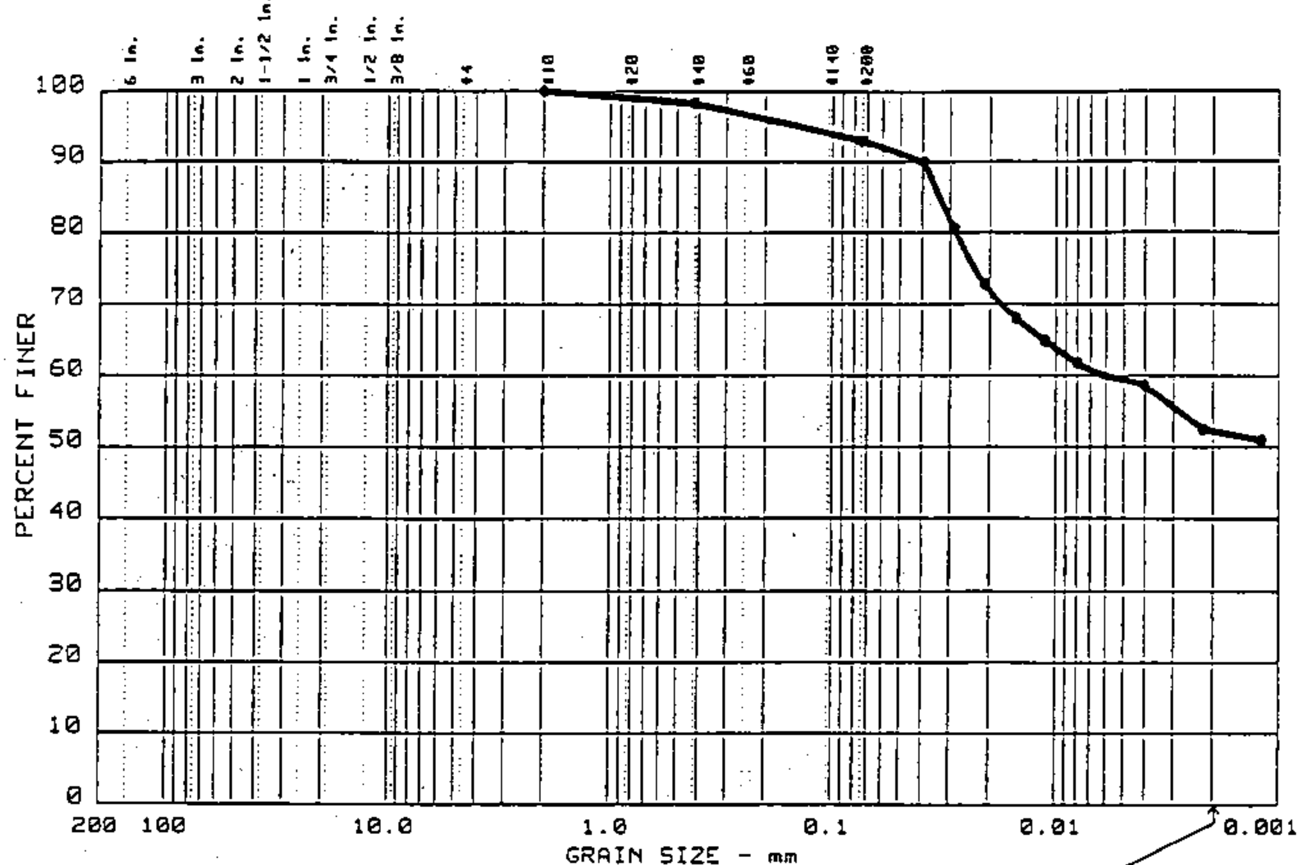
Date: 01-09-94

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
●	10	0.0	0.0	7.0	40.8	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

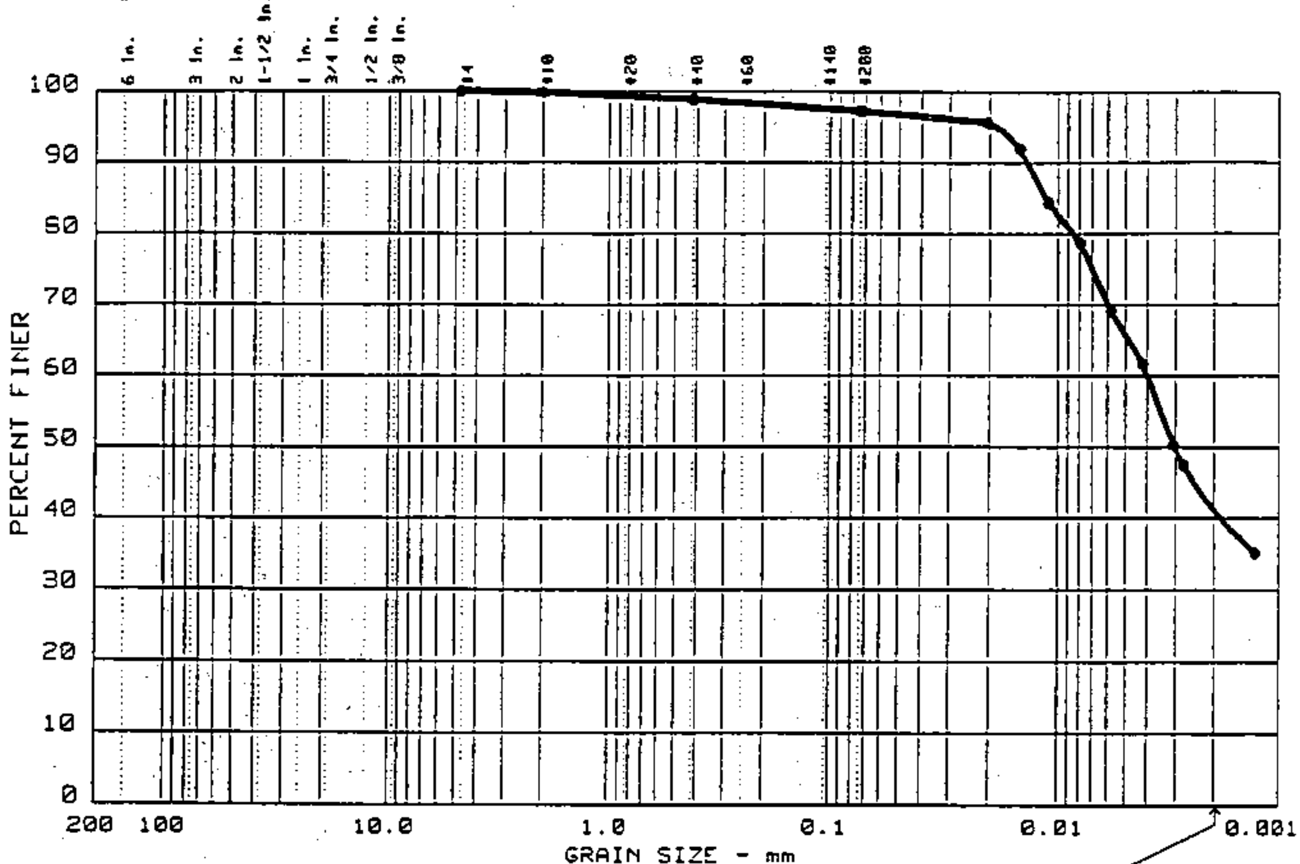
Date: 01-09-94

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
●	9	0.0	0.0	2.7	56.2	41.1

	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 BROWN SILTY CLAY w/FERROUS NODULES		

Project No.: 396-01402-01
Project: RUST ENVIRONMENTAL MUSKOGEE LANDFILL
● Location: HOLE NO. B-9 4.0'-6.0' TRACT A

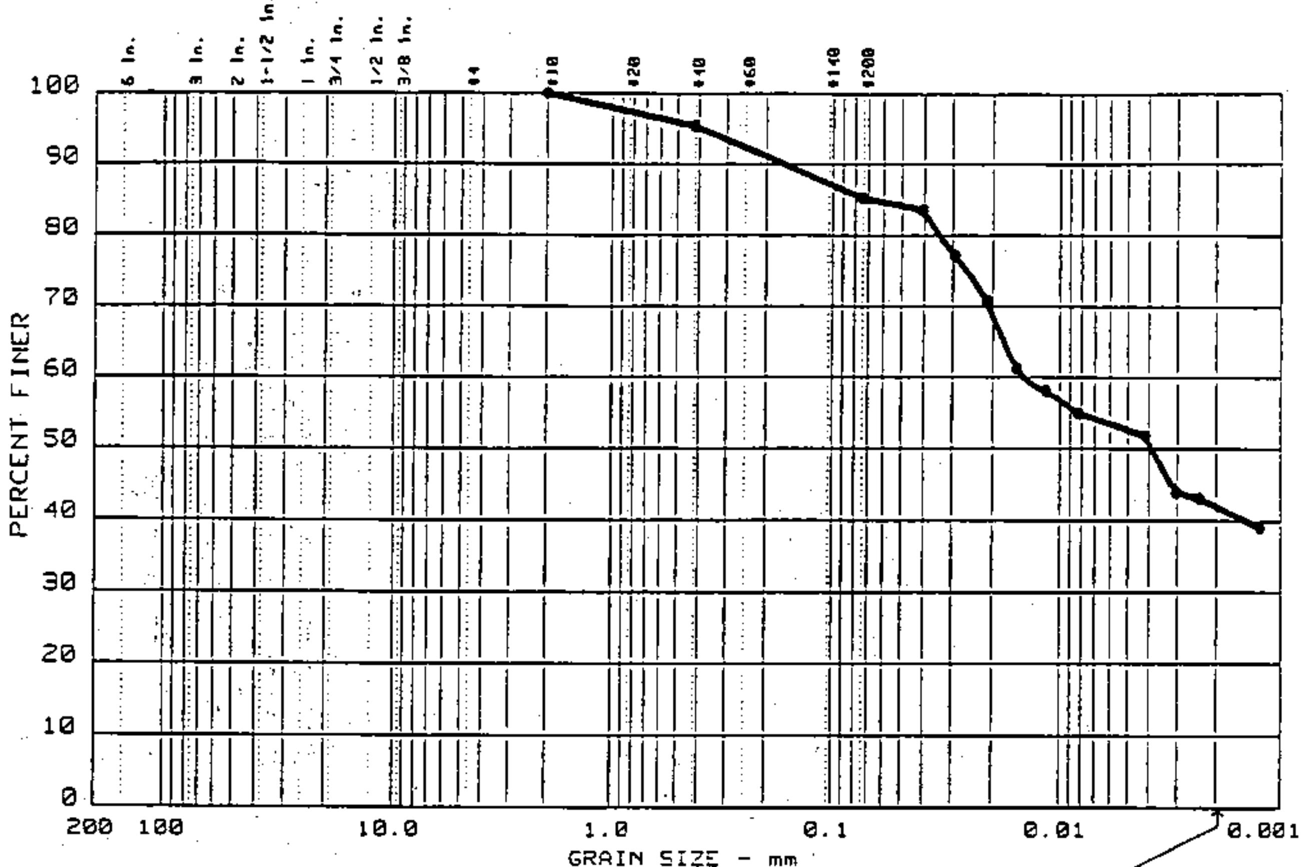
Date: 01-09-94

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
●	11	0.0	0.0	14.8	43.3	41.9

	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		

Project No.: 396-01402-01
Project: RUST ENVIRONMENTAL MUSKOGEE LANDFILL
● Location: HOLE NO. B-11 4.0'-6.0' TRACT A

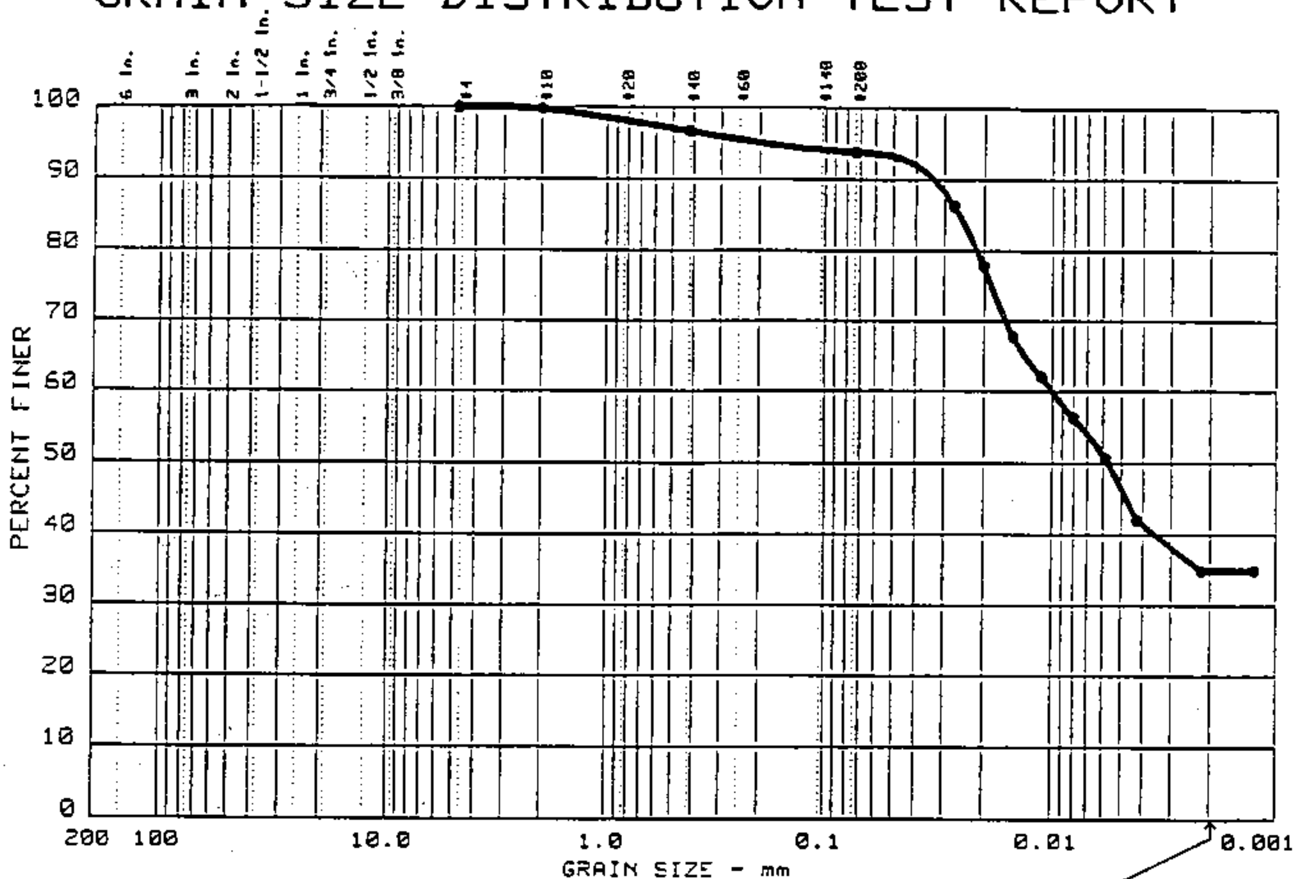
Date: 01-09-94

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Remarks:
SPECIFIC GRAVITY ASSUMED

Figure No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	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

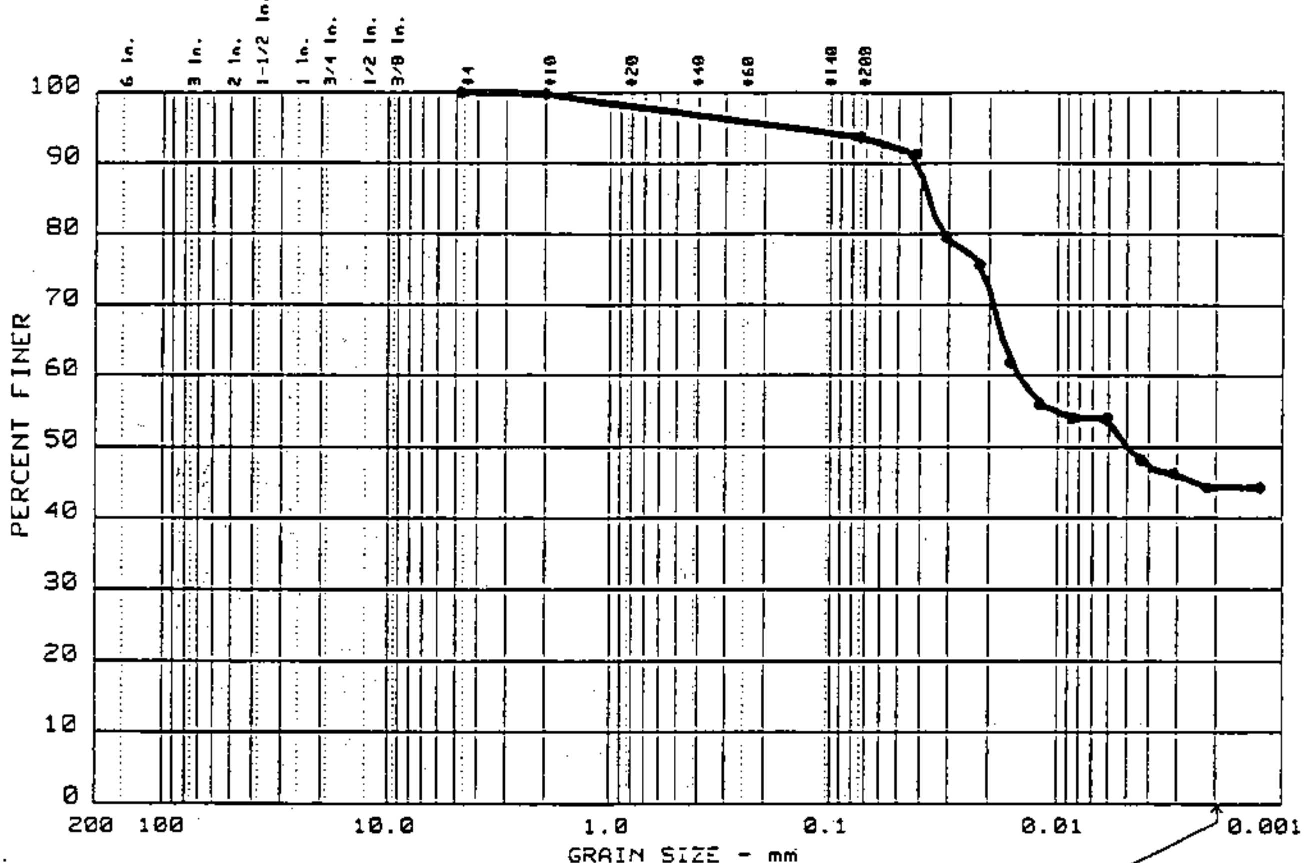
Date: 01-09-94

Remarks:
SPECIFIC GRAVITY ASSUMED

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Figure No.

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_{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		

Project No.: 396-01402-01
Project: RUST ENVIRONMENTAL MUSKOGEE LANDFILL
● Location: HOLE NO. B-13 4.0'-6.0' TRACT A

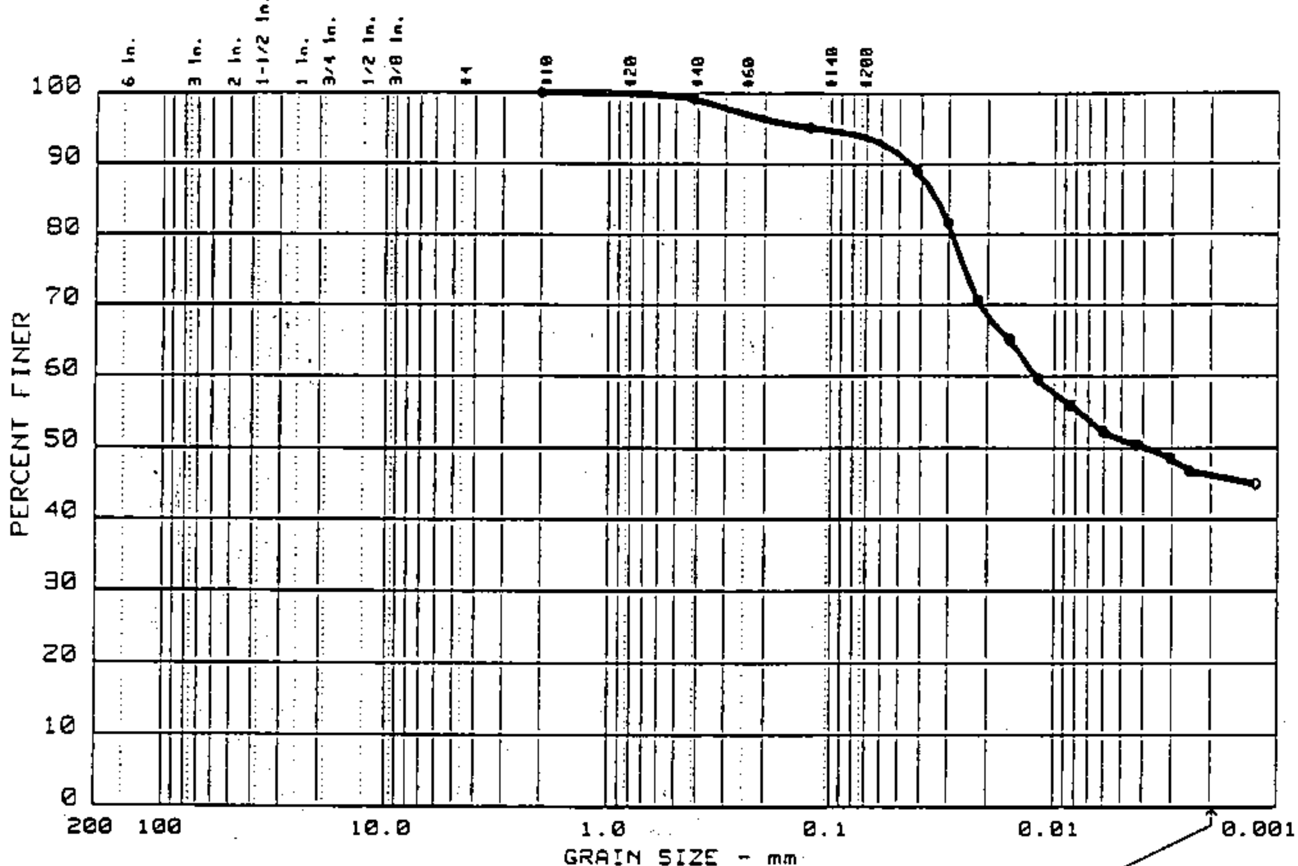
Date: 01-09-94

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

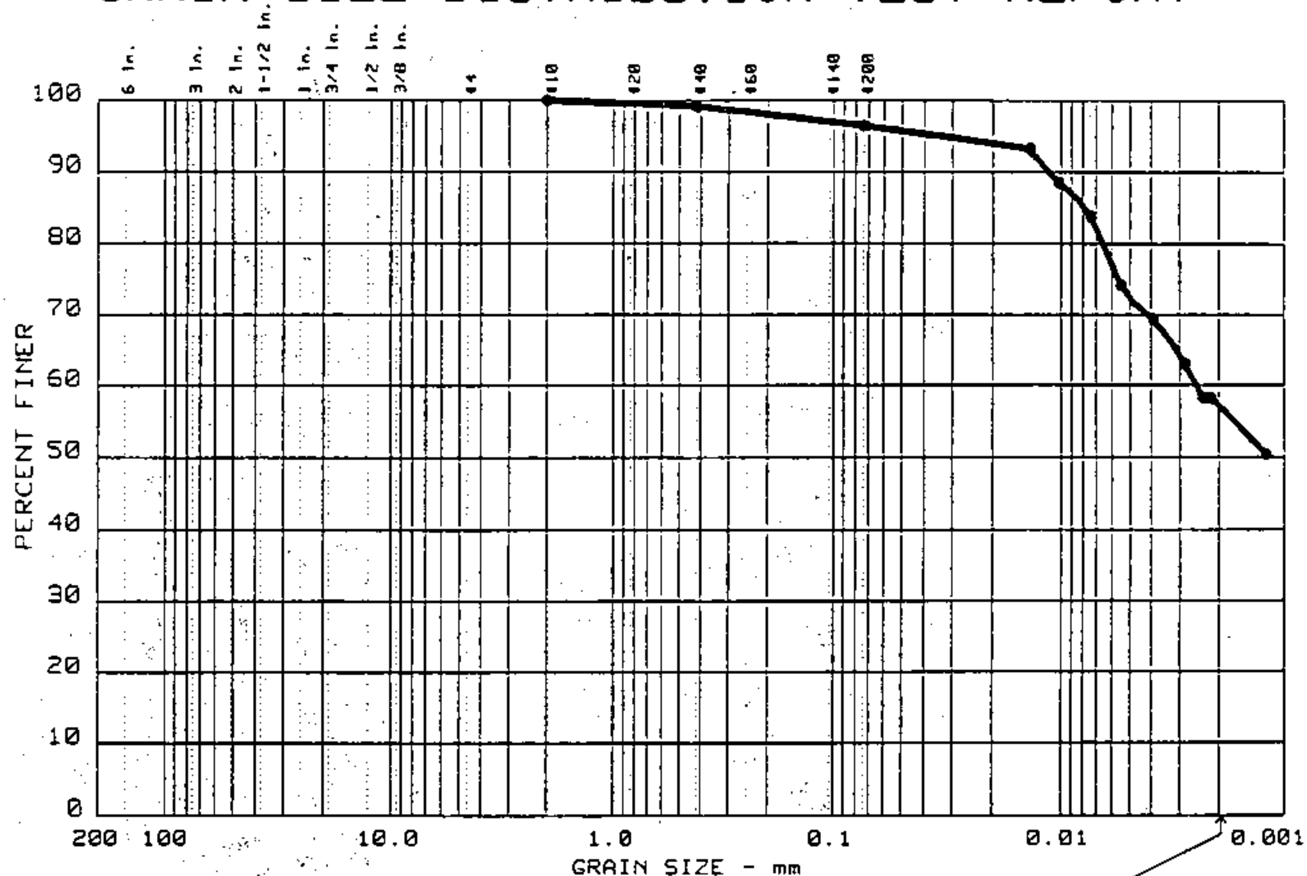
Date: 01-09-94

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Remarks:
SPECIFIC GRAVITY ASSUMED

Figure No.

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

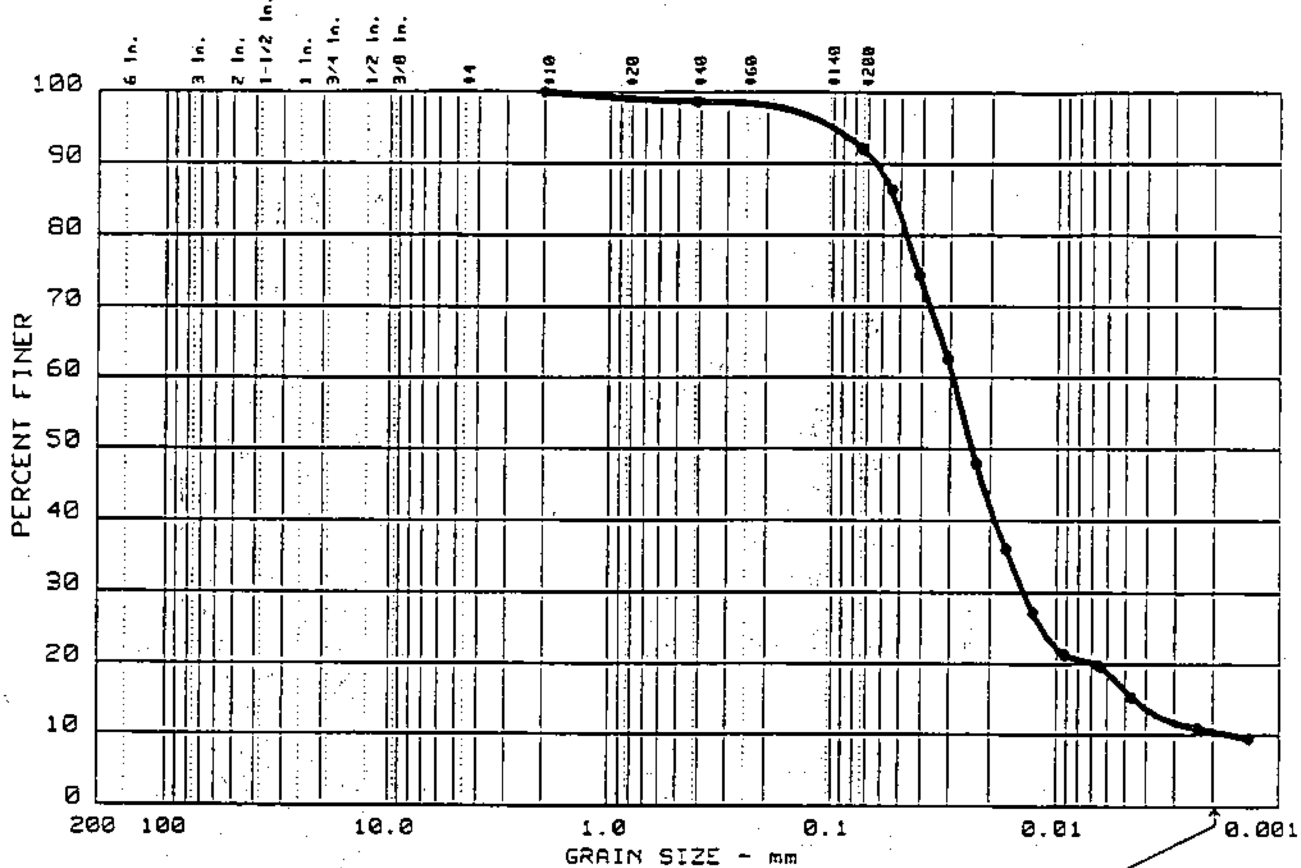
Date: 01-09-94

Remarks:
SPECIFIC GRAVITY ASSUMED

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Figure No.

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

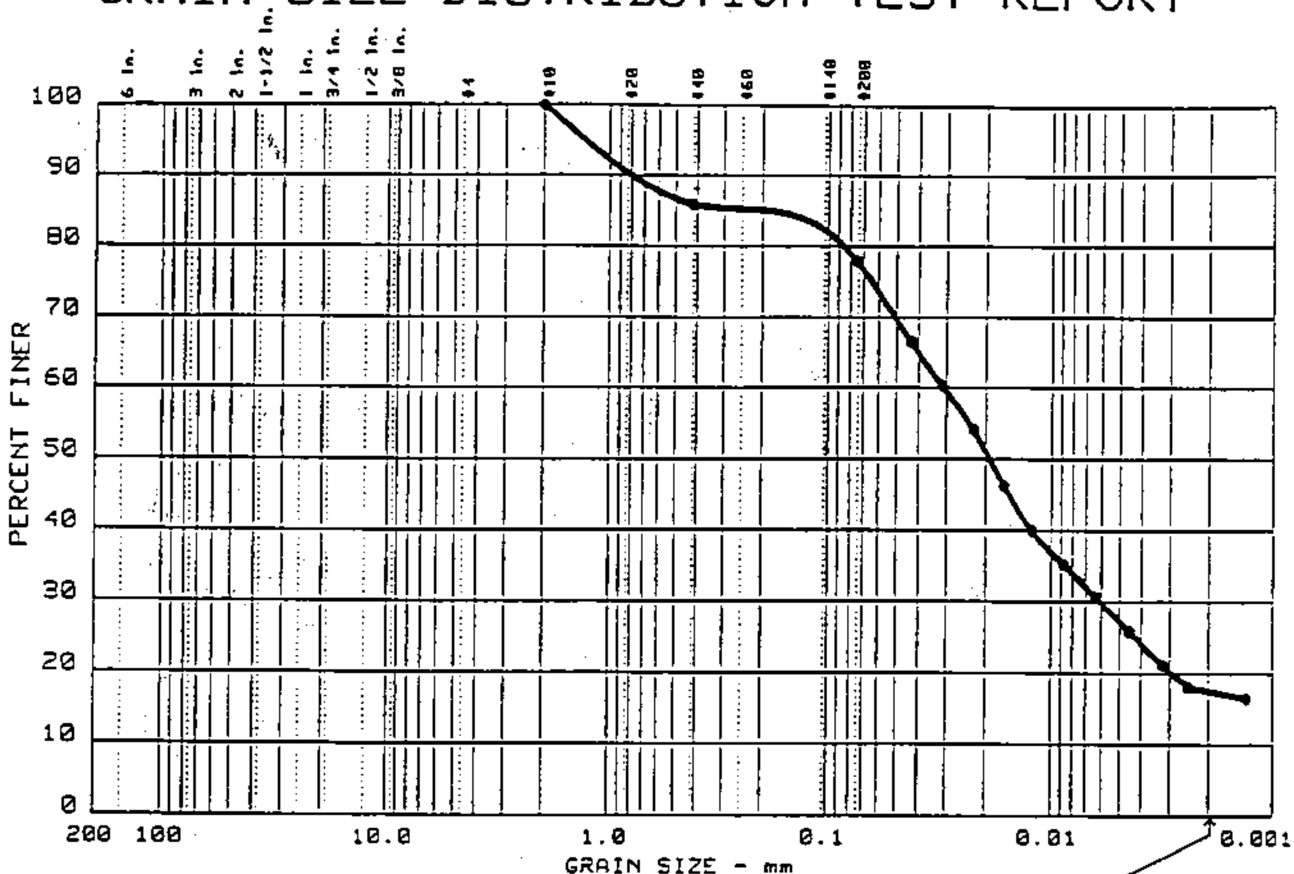
Date: 01-09-94

Remarks:
SPECIFIC GRAVITY ASSUMED

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Figure No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	18	0.0	0.0	22.2	60.3	17.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.19		0.02	0.006				

MATERIAL DESCRIPTION	USCS	AASHTO
● TAN SILTY CLAY		

Project No.: 396-01402-01
Project: RUST ENVIRONMENTAL MUSKOGEE LANDFILL
● Location: HOLE NO. B-16 6.0'- 8.0' TRACT A

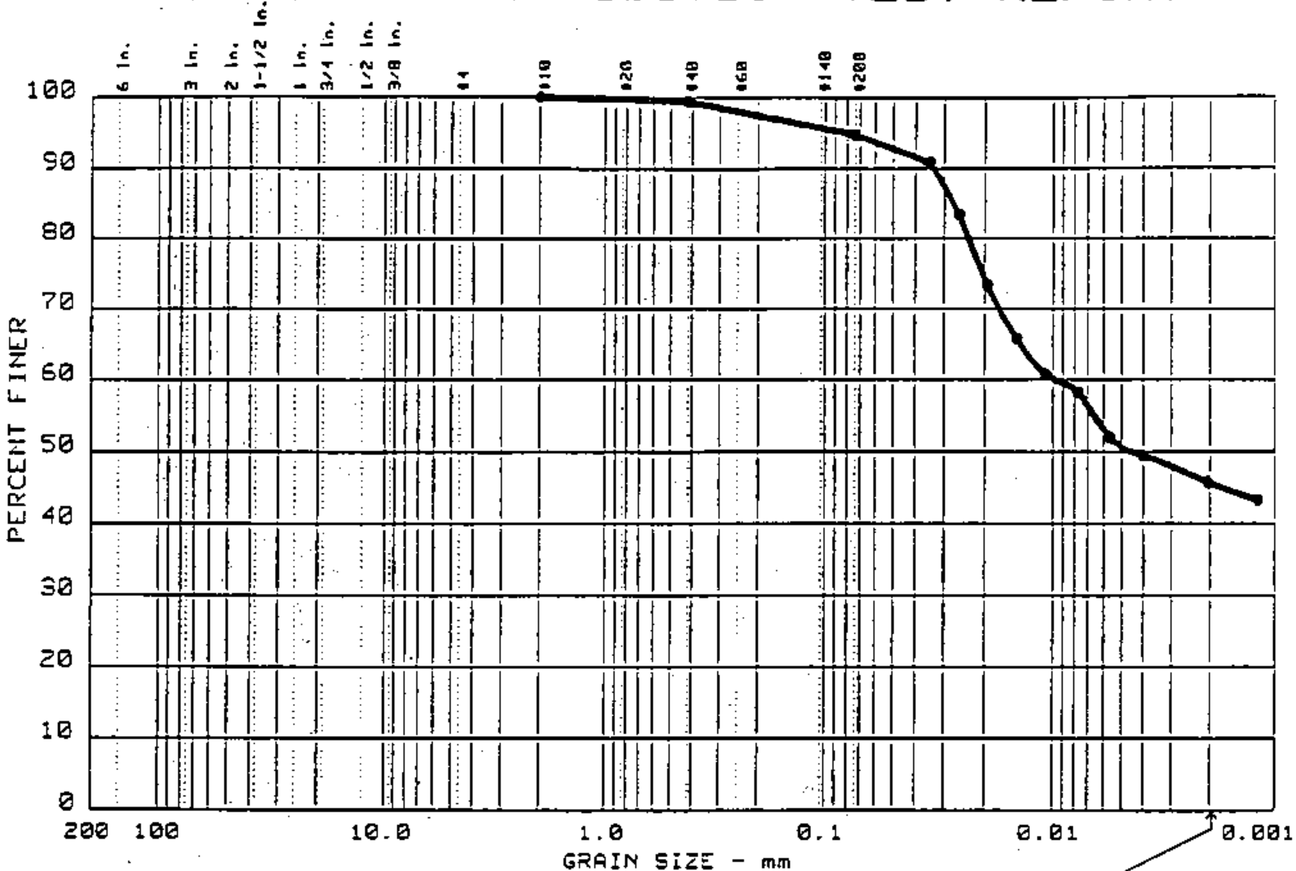
Date: 01-09-94

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
●	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

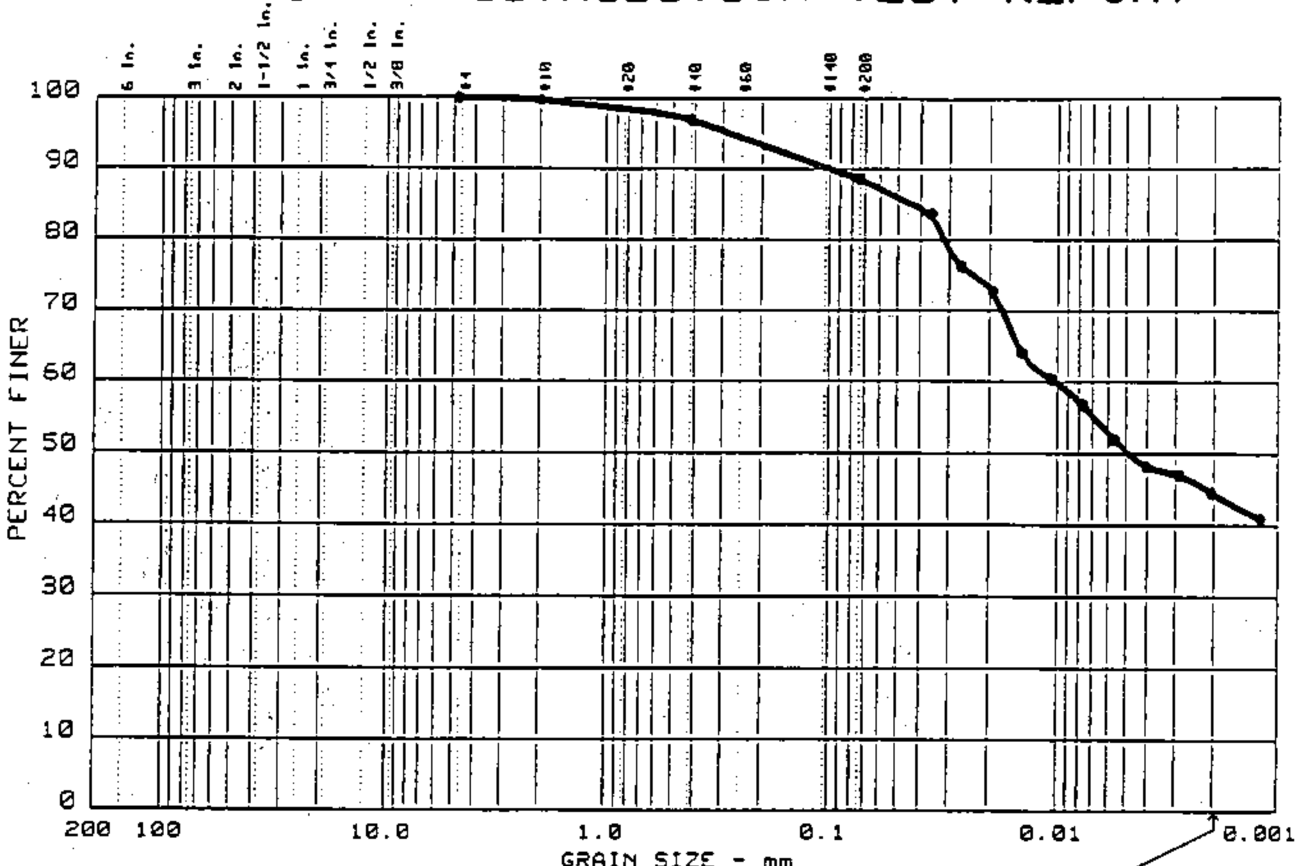
Date: 01-09-94

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
●	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

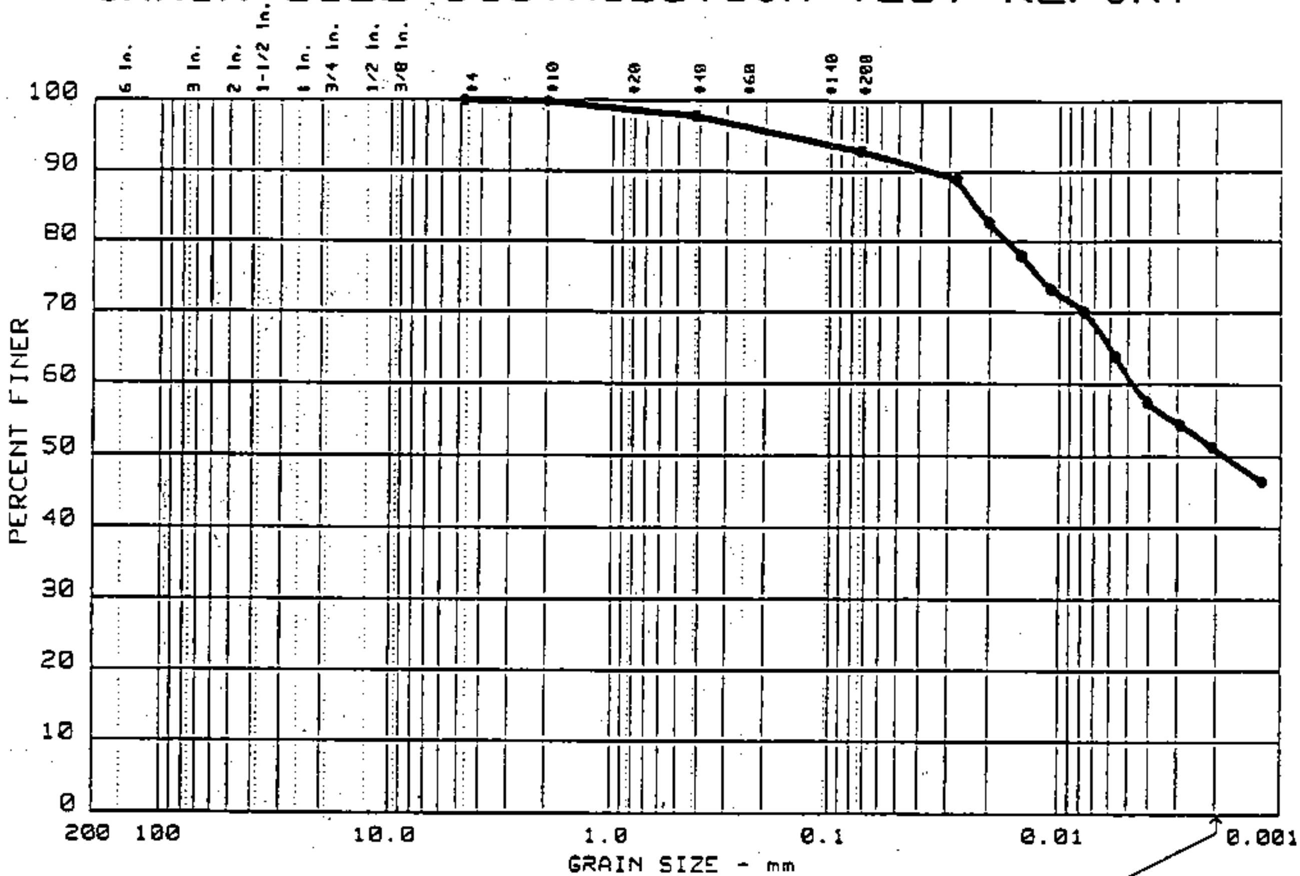
Date: 01-09-94

Remarks:
SPECIFIC GRAVITY ASSUMED

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Figure No.

GRAIN SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 8	0.0	0.0	7.1	42.1	50.8

	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 SILTY CLAY		

Project No.: 396-01402-01
Project: RUST ENVIRONMENTAL MUSKOGEE LANDFILL
● Location: HOLE NO. B-20 8.0'-10.0' TRACT A

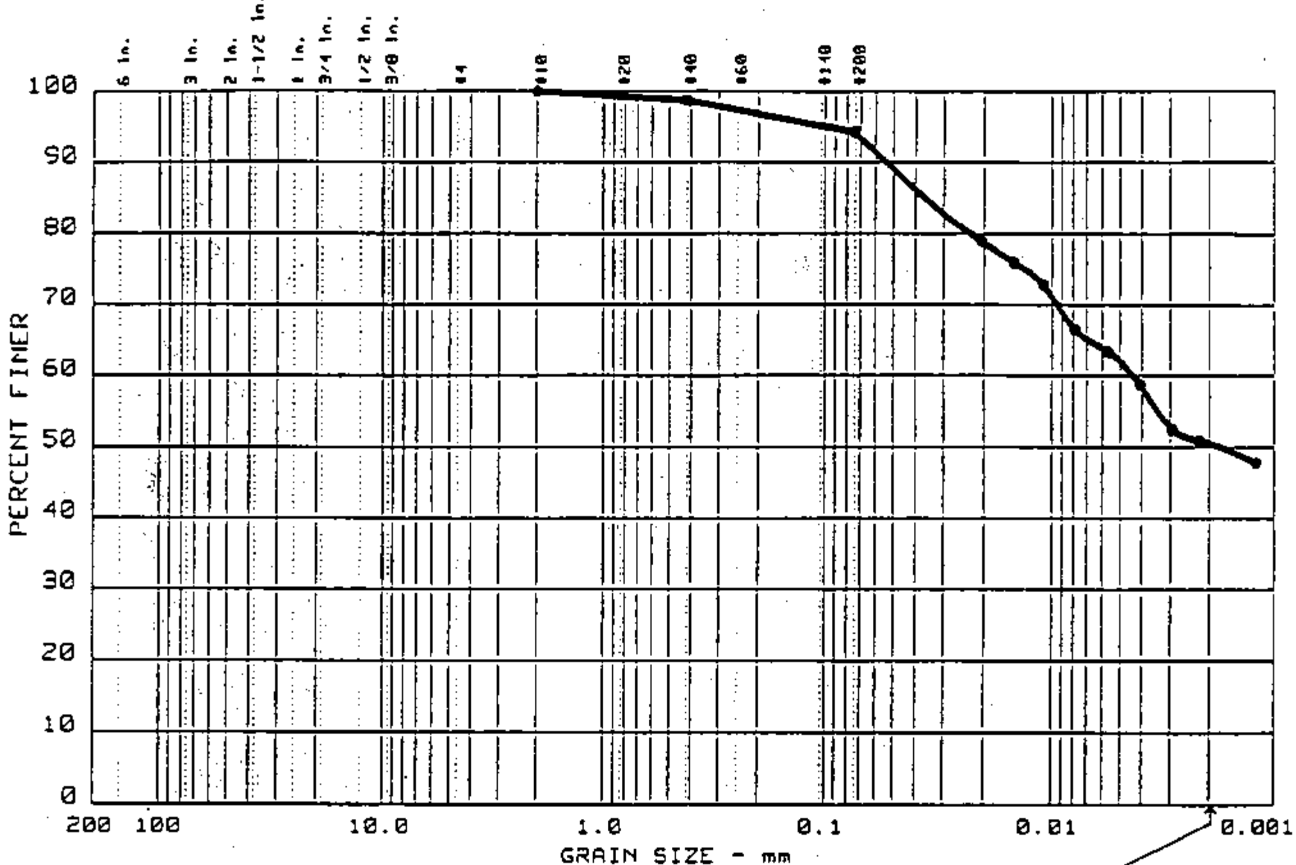
Date: 01-09-94

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Remarks:
SPECIFIC GRAVITY ASSUMED

Figure No.

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	14	0.0	0.0	5.7	43.8	50.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	49	33			0.00					

MATERIAL DESCRIPTION	USCS	AASHTO
● TAN & GRAY SILTY CLAYEY SHALE	CL	

Project No.: 396-01402-01
Project: RUST ENVIRONMENTAL MUSKOGEE LANDFILL
● Location: HOLE NO. B-21 17.0'-19.0' TRACT A

Date: 01-09-94

Remarks:
SPECIFIC GRAVITY ASSUMED

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Figure No.

LAW ENGINEERING
GEOTECHNICAL, ENVIRONMENTAL & CONSTRUCTION MATERIALS CONSULTANTS

1540 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

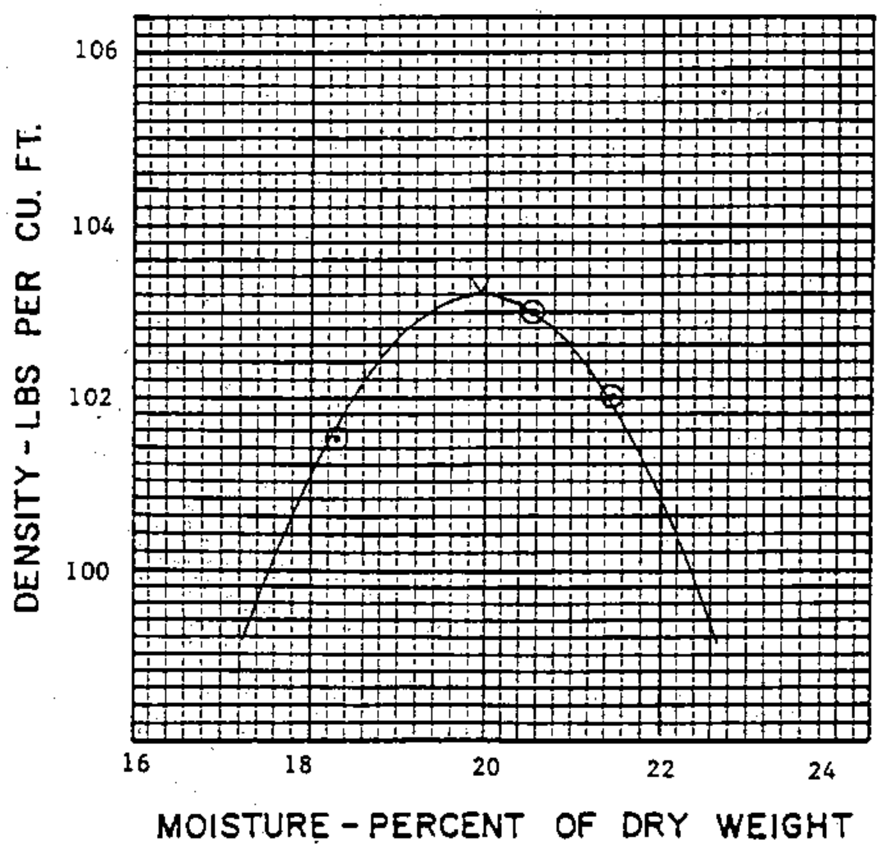
MATERIAL SOURCE: Tract A B-3 0'-2'

TEST RESULTS

METHOD OF TEST ASTM D-698

MAXIMUM 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 CONSULTANTS

1540 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

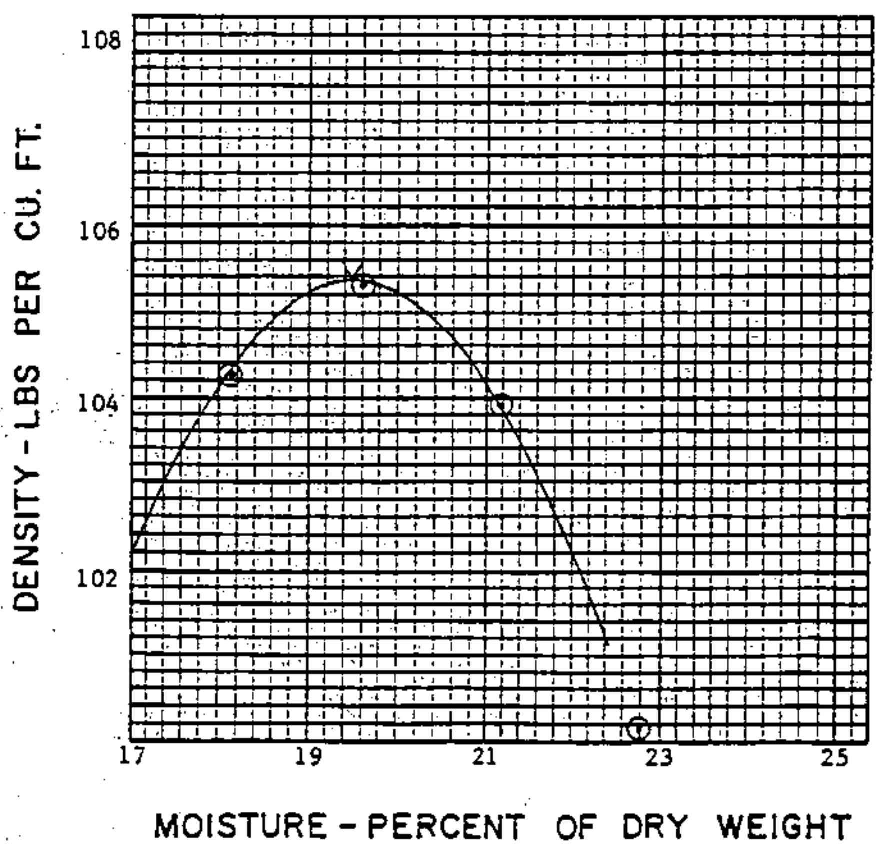
MATERIAL SOURCE: Tract A B-16 0'-2'

TEST RESULTS

METHOD OF TEST ASTM D-698

MAXIMUM 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 CONSULTANTS
1540 NORTH 107TH EAST AVENUE
TULSA, OKLAHOMA 74116
PHONE: 918-834-4700
FAX: 918-835-2545

REPORT NO.____
DATE: 11-29-93
396-01402-02

MOISTURE - DENSITY CURVE

CLIENT: Rust Environmental

PROJECT: Muskogee Landfill

MATERIAL: Yellowish tan silty clay

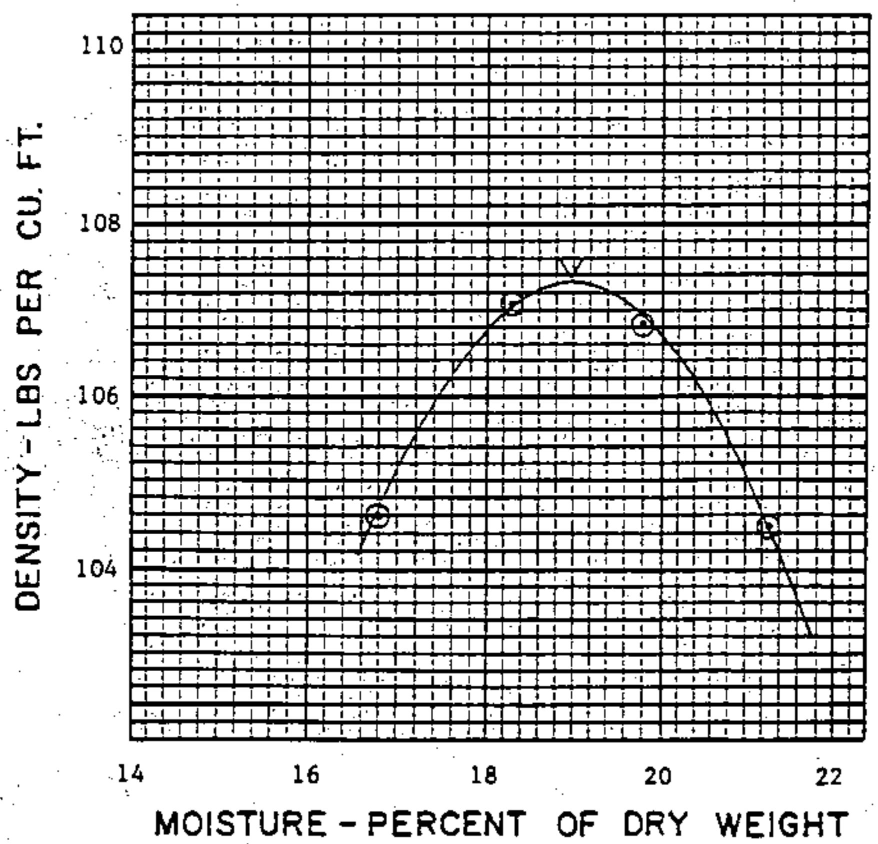
MATERIAL SOURCE: Tract A B-18 0'-2'

TEST RESULTS

METHOD OF TEST ASTM D-698

MAXIMUM 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
CONSULTANTS

1540 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

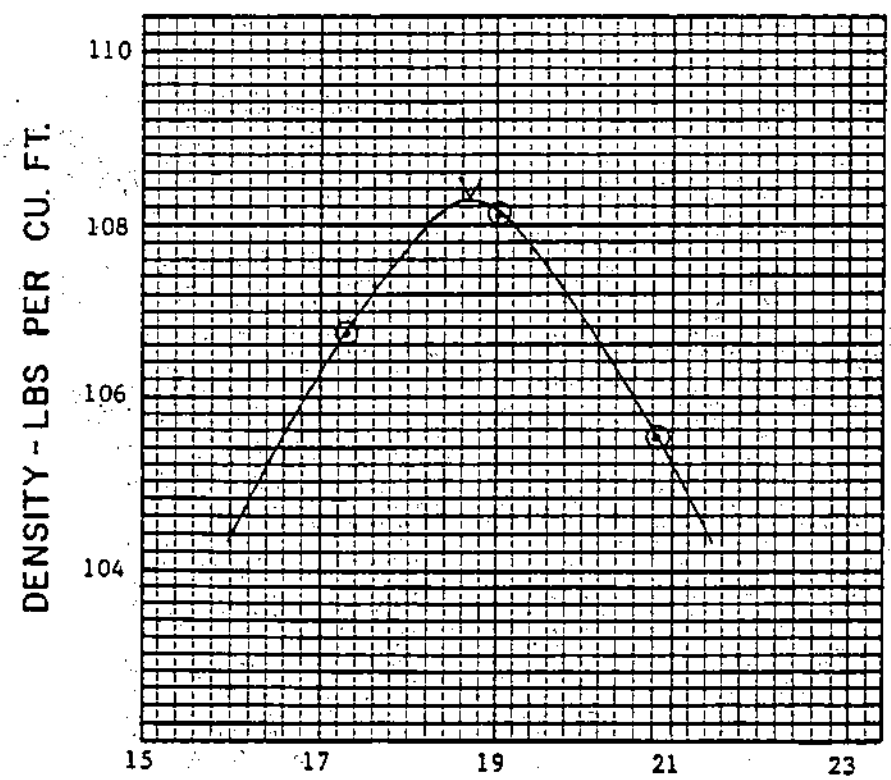
MATERIAL SOURCE: Tract A P-11 0'-2'

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 CONSULTANTS

1540 NORTH 107TH EAST AVENUE
TULSA, OKLAHOMA 74116
PHONE: 918-834-4700
FAX: 918-835-2545

REPORT NO.____
DATE: November 8, 199[illegible]
396-01402-01

MOISTURE - DENSITY CURVE

CLIENT: Rust Environmental

PROJECT: Muskogee Landfill

MATERIAL: Tan and light brown silty clay

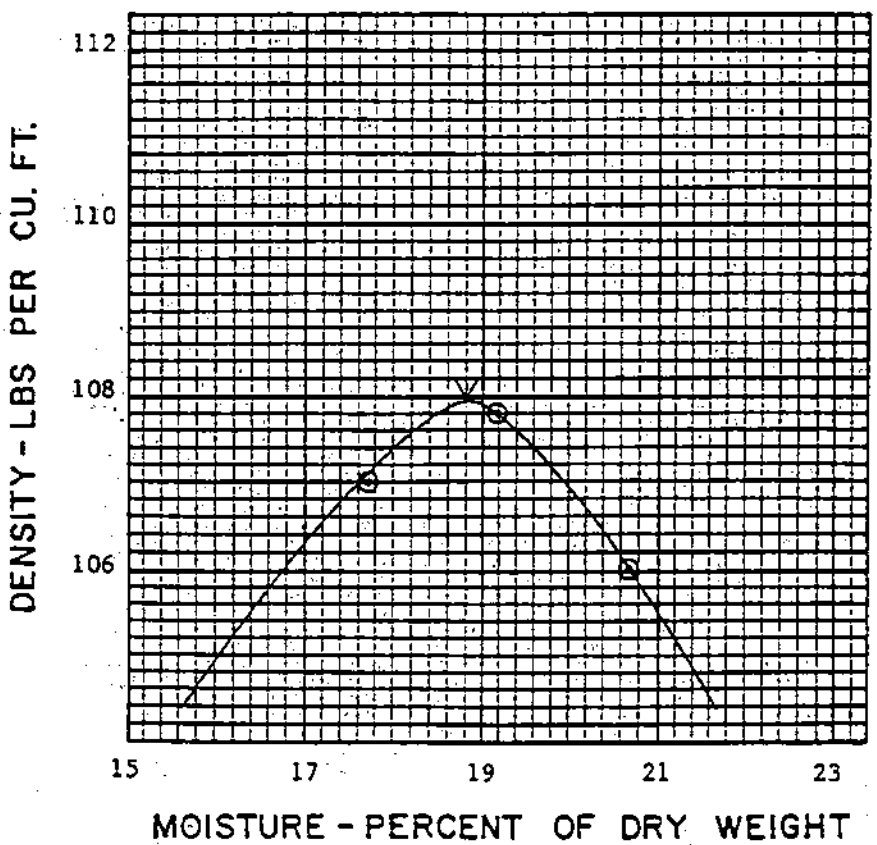
MATERIAL SOURCE: Tract A P-12 0'-2'

TEST RESULTS

METHOD OF TEST ASTM D-698

MAXIMUM 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 CONSULTANTS
1540 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

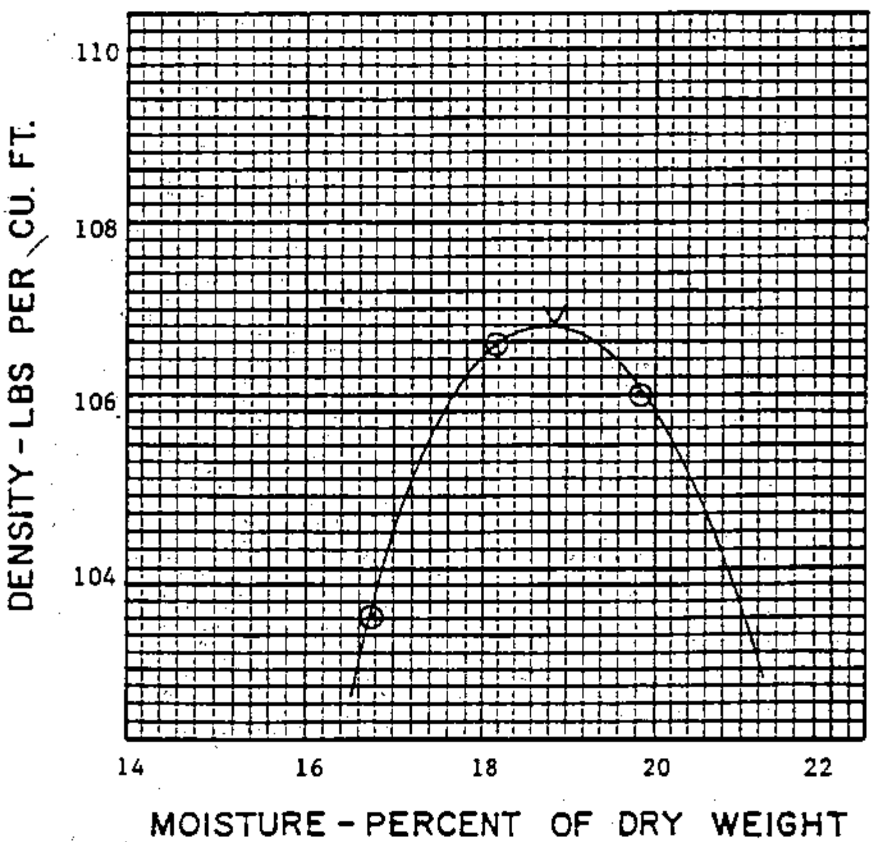
MATERIAL SOURCE: Tract A P-15 2'-7'

TEST RESULTS

METHOD OF TEST ASTM D-698

MAXIMUM DRY DENSITY = 106.8 LBS PER CU. FT.

OPTIMUM MOISTURE CONTENT = 18.8 %



PHYSICAL PROPERTIES

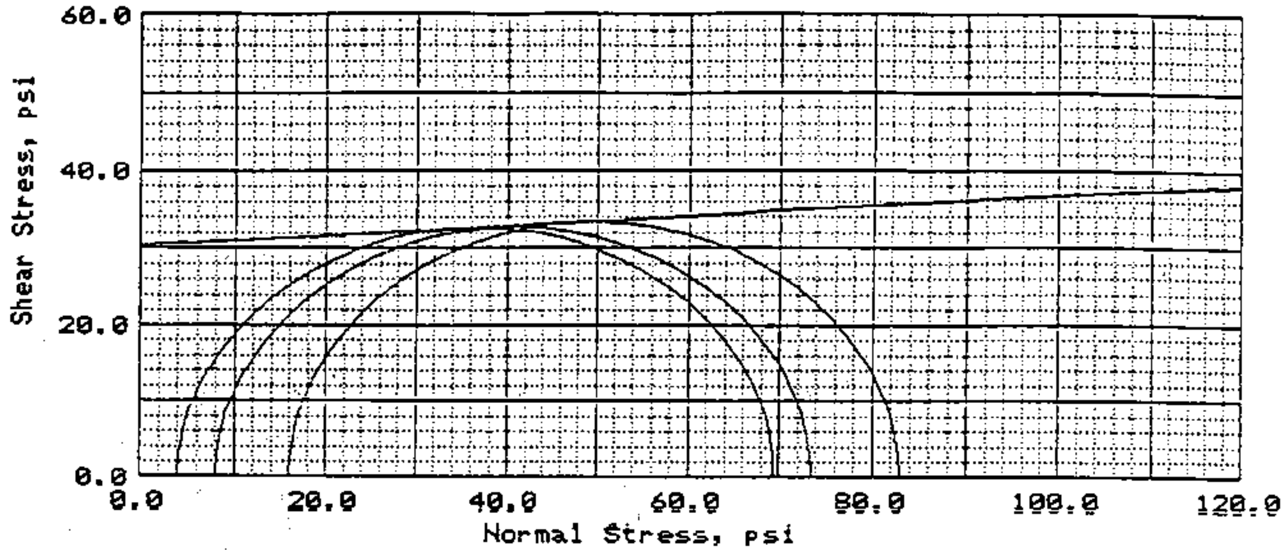
LIQUID LIMIT = 48 %

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	Saturation	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	TAN & GRAY SILTY CLAY
Strength intercept, c=	30.3 psi	LL= PI=
Friction angle, ϕ =	3.7 deg	
Tangent ϕ =	0.06	

CLIENT: RUST ENVIRONMENT AND INFRASTRUCTURE
PROJECT: MUSKOGEE LANDFILL TRACT A

LOCATION: HOLE NO. B-5 6.0'-8.0'

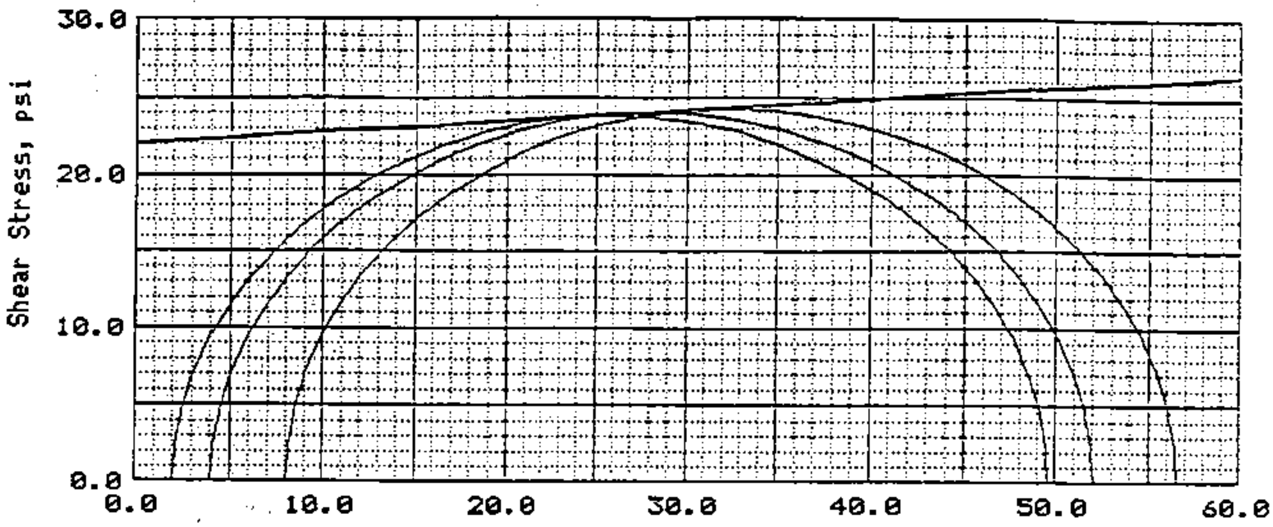
DATE: 01-14-94
File: RUST56-8
REMARKS:
RUN BY J.ALEXANDER

MULTIPLE-STAGE

TRIAXIAL SHEAR TEST REPORT
LAW ENGINEERING, INC.

Proj. No.: 3960140201
Fig. No. 2

TRIAXIAL SHEAR TEST REPORT



Type of Test: Unconsolidated undrained   Sample Type: INDISTURBED

No.	FLUID PRESS. psi Cell	Back	MAX. STRENGTH psi Deviator	Pore	ULT. STRENGTH psi Deviator	Pore	PRINCIPAL STRESSES AT FAILURE psi 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

Total
Strength intercept, c= 22.0 psi
Friction angle, φ = 4.2 deg
Tangent φ = 0.07

MATERIAL DESCRIPTION

TAN & GRAY SILTY CLAY
LL=   PI=

CLIENT: RUST ENVIRONMENT AND INFRASTRUCTURE
PROJECT: MUSKOGEE LANDFILL   TRACT A

LOCATION: HOLE NO. B-7   4.0'-6.0'

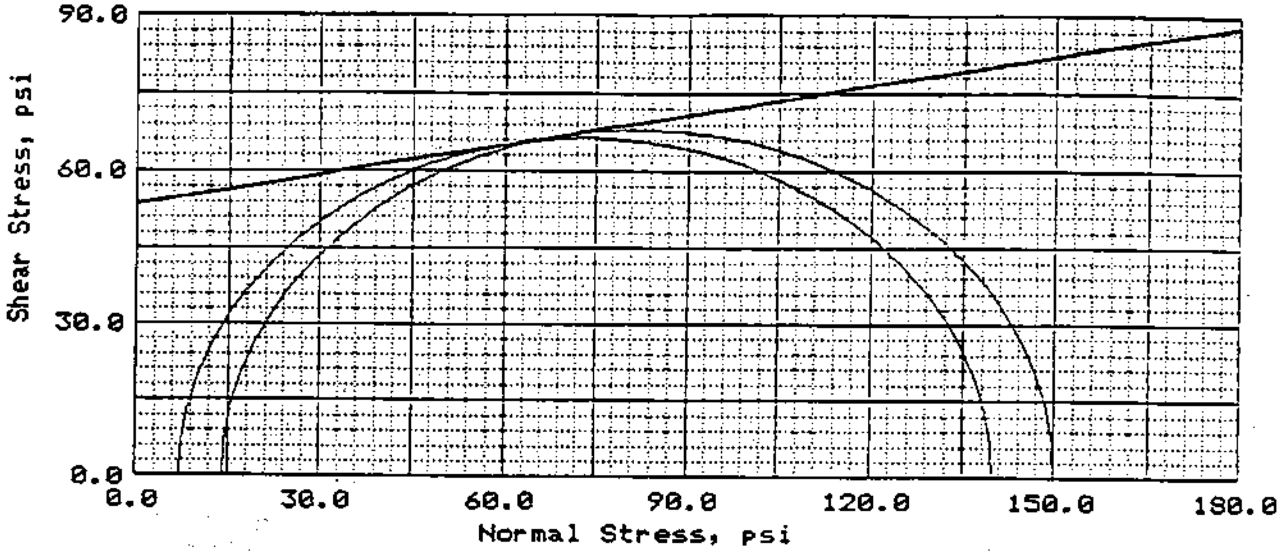
DATE: 01-14-94
File: RUST74-6
REMARKS:
RUN BY J.ALEXANDER

MULTIPLE-STAGE

TRIAXIAL SHEAR TEST REPORT
LAW ENGINEERING, INC.

Proj. No.: 3960140201
Fig. No. 4

TRIAXIAL SHEAR TEST REPORT



Type of Test: Unconsolidated undrained   Sample Type: UNDISTURBED

No.	FLUID PRESS. psi Cell	Back	MAX. STRENGTH psi Deviator	Pore	ULT. STRENGTH psi Deviator	Pore	PRINCIPAL STRESSES AT FAILURE psi 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

SAMPLE PARAMETERS

No.	% 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

	Total
Strength intercept, c=	53.6 psi
Friction angle, ϕ =	10.8 deg
Tangent ϕ =	0.19

MATERIAL DESCRIPTION

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'

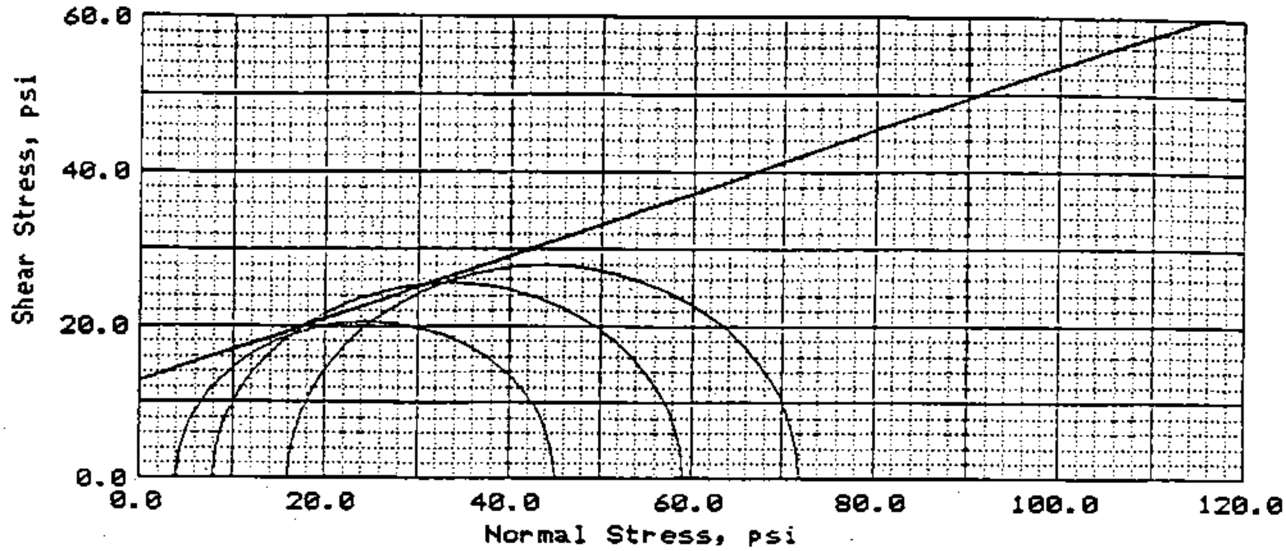
DATE: 01-14-94
File: RUST16
REMARKS:
RUN BY J.ALEXANDER

MULTIPLE-STAGE

TRIAXIAL SHEAR TEST REPORT
LAW ENGINEERING, INC.

Proj. No.: 3960140201
Fig. No. 3

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	Saturation	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

	Total
Strength intercept, c=	12.8 psi
Friction angle, ϕ =	22.2 deg
Tangent ϕ =	0.41

MATERIAL DESCRIPTION

TAN & GRAY SILTY
CLAY w/FERROUS NODULES
LL=   PI=

CLIENT: RUST ENVIRONMENT AND
INFRASTRUCTURE
PROJECT: MUSKOGEE LANDFILL   TRACT A

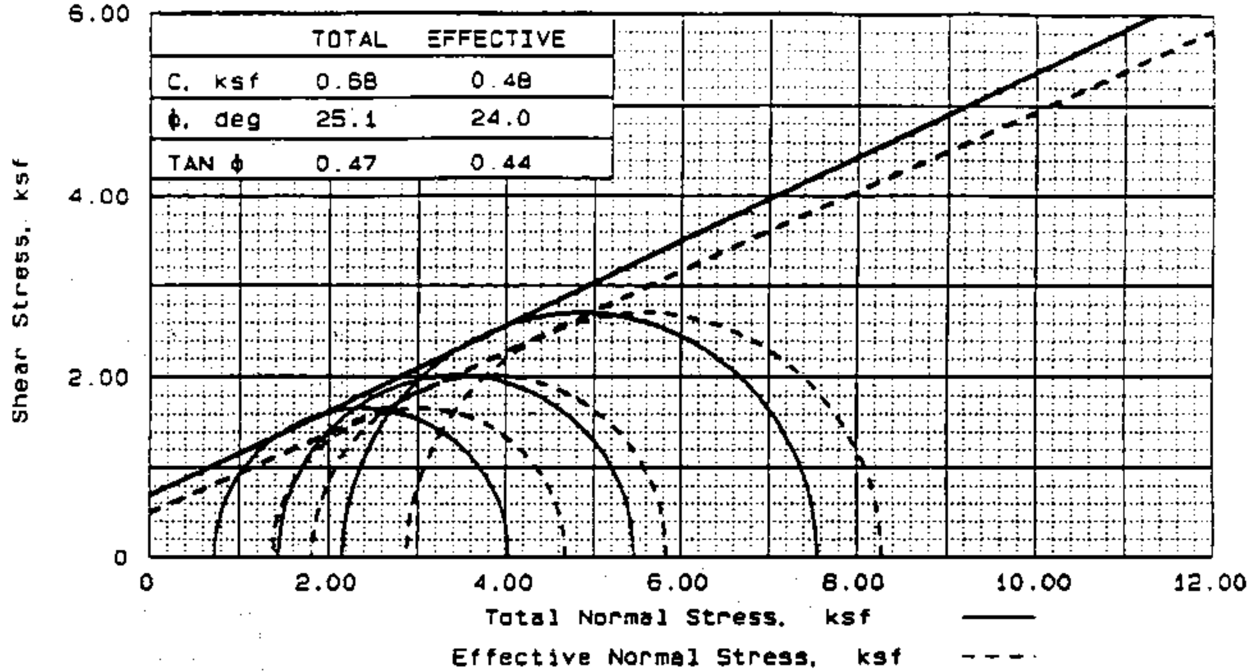
LOCATION: HOLE NO. B-20   6.0'-8.0'

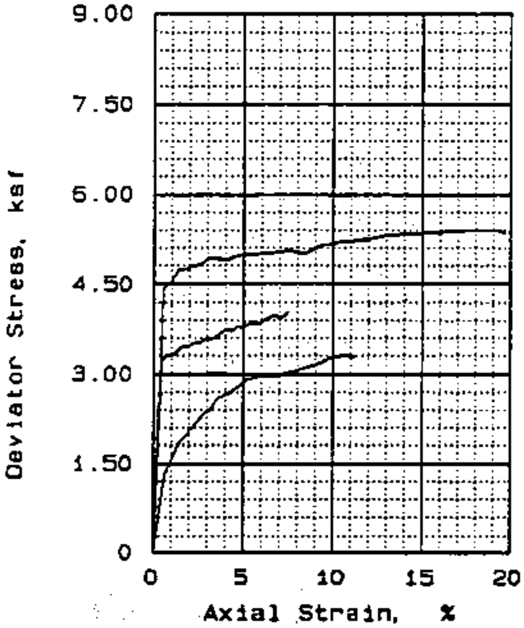
DATE: 01-13-94
File: RUSTB20
REMARKS:
RUN BY J.ALEXANDER

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
	HEIGHT, in	2.84	2.84	2.84
AT TEST	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

FIG. NO.:

CLIENT: RUST E&I

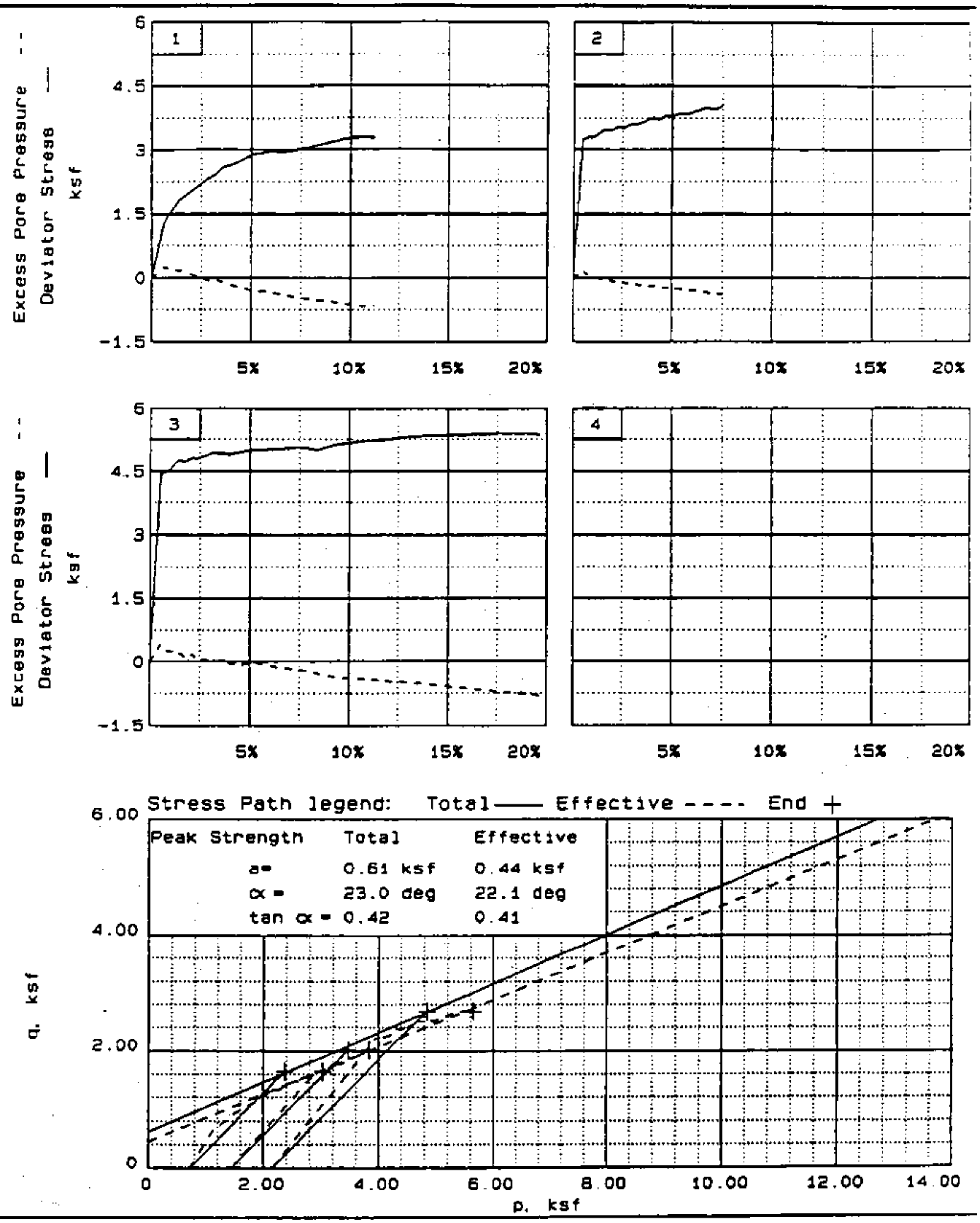
PROJECT: MUSKOGEE COMMUNITY LANDFILL – TRACT A

SAMPLE LOCATION: BH2
DEPTH: 8.0 – 10.0 FEET

PROJ. NO.: 3070576201 DATE: 11/05/93

TRIAXIAL SHEAR TEST REPORT

LAW ENGINEERING, INC.

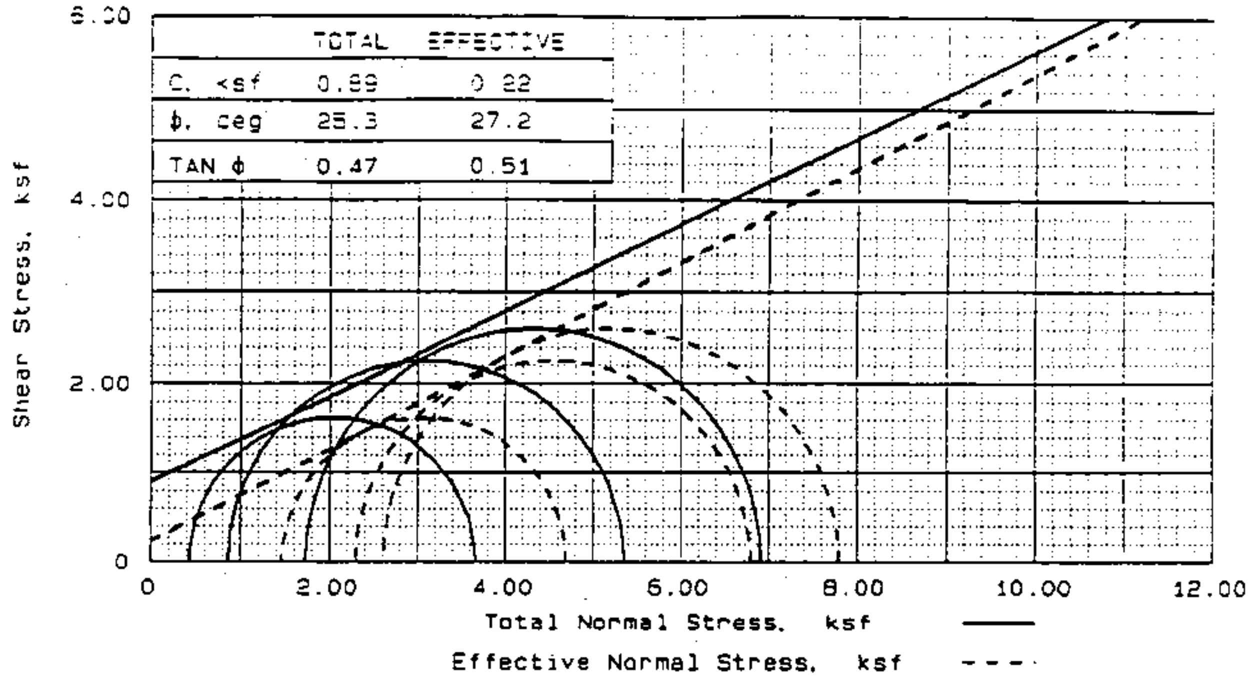


Client: RUST E&I

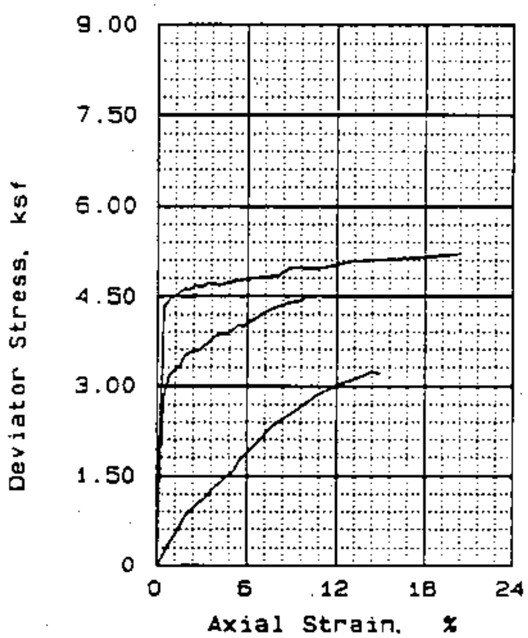
Project: MUSKOGEE COMMUNITY LANDFILL - TRACT A

Location: BH2 DEPTH: 8.0 - 10.0 FEET

File: 5762CUP3 Project No.: 3070576201 Page 2/2 Fig. No. ____



	TOTAL	EFFECTIVE
C, ksf	0.89	0.22
φ, deg	25.3	27.2
TAN φ	0.47	0.51



	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

FIG. NO.

CLIENT: RUST E&I

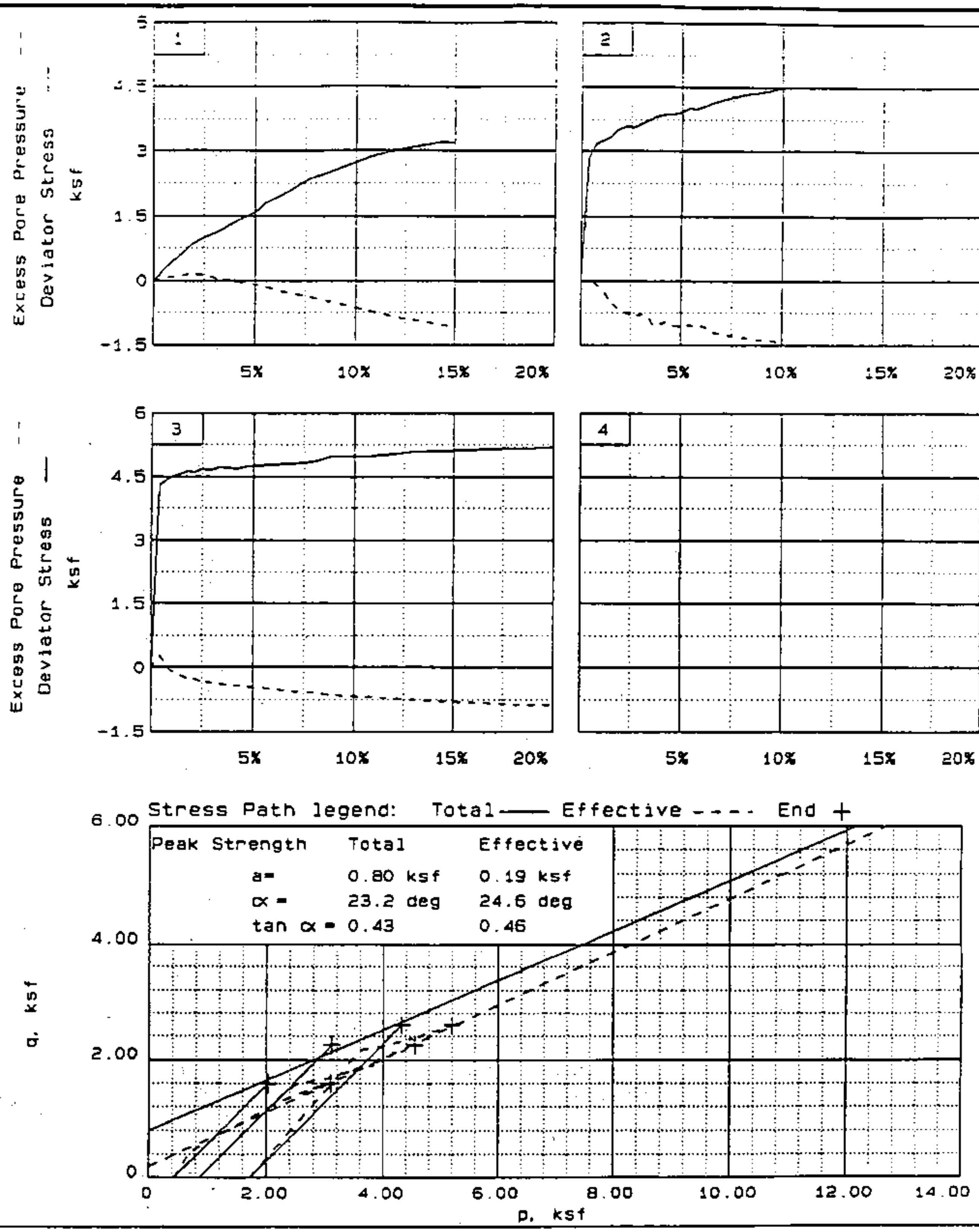
PROJECT: MUSKOGEE COMMUNITY LANDFILL - TRACT A

SAMPLE LOCATION: BH10
DEPTH: 4.0 - 6.0 FEET

PROJ. NO.: 3070576201 DATE: 11/05/93

TRIAXIAL SHEAR TEST REPORT

LAW ENGINEERING, INC.

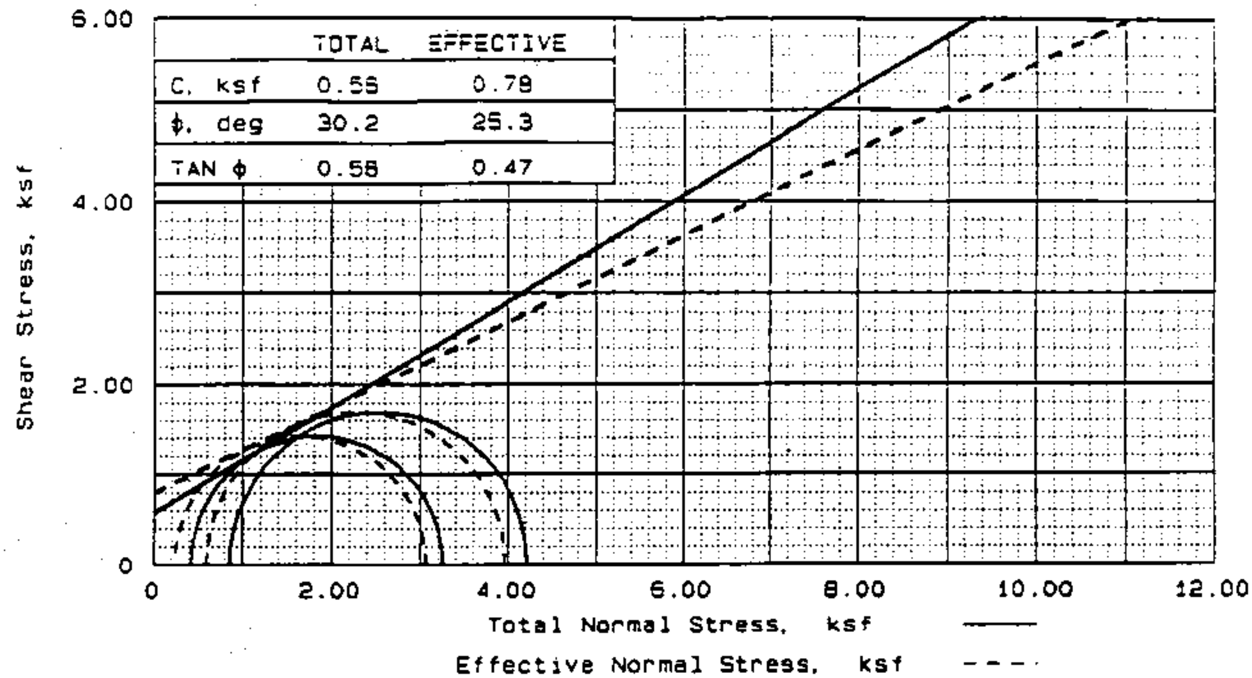


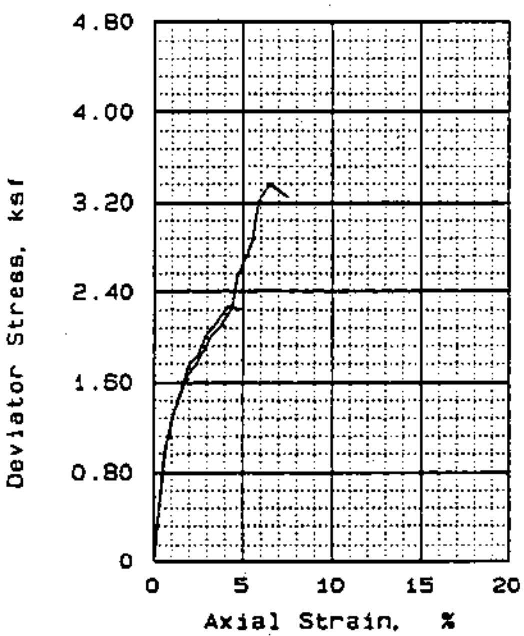
Client: RUST E&I

Project: MUSKOGEE COMMUNITY LANDFILL - TRACT A

Location: BH10 DEPTH: 4.0 - 6.0 FEET

File: 5762CU4 Project No.: 3070576201 Page 2/2 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
	HEIGHT, in	2.81	2.81
AT TEST	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

FIG. NO.

CLIENT: RUST E&I

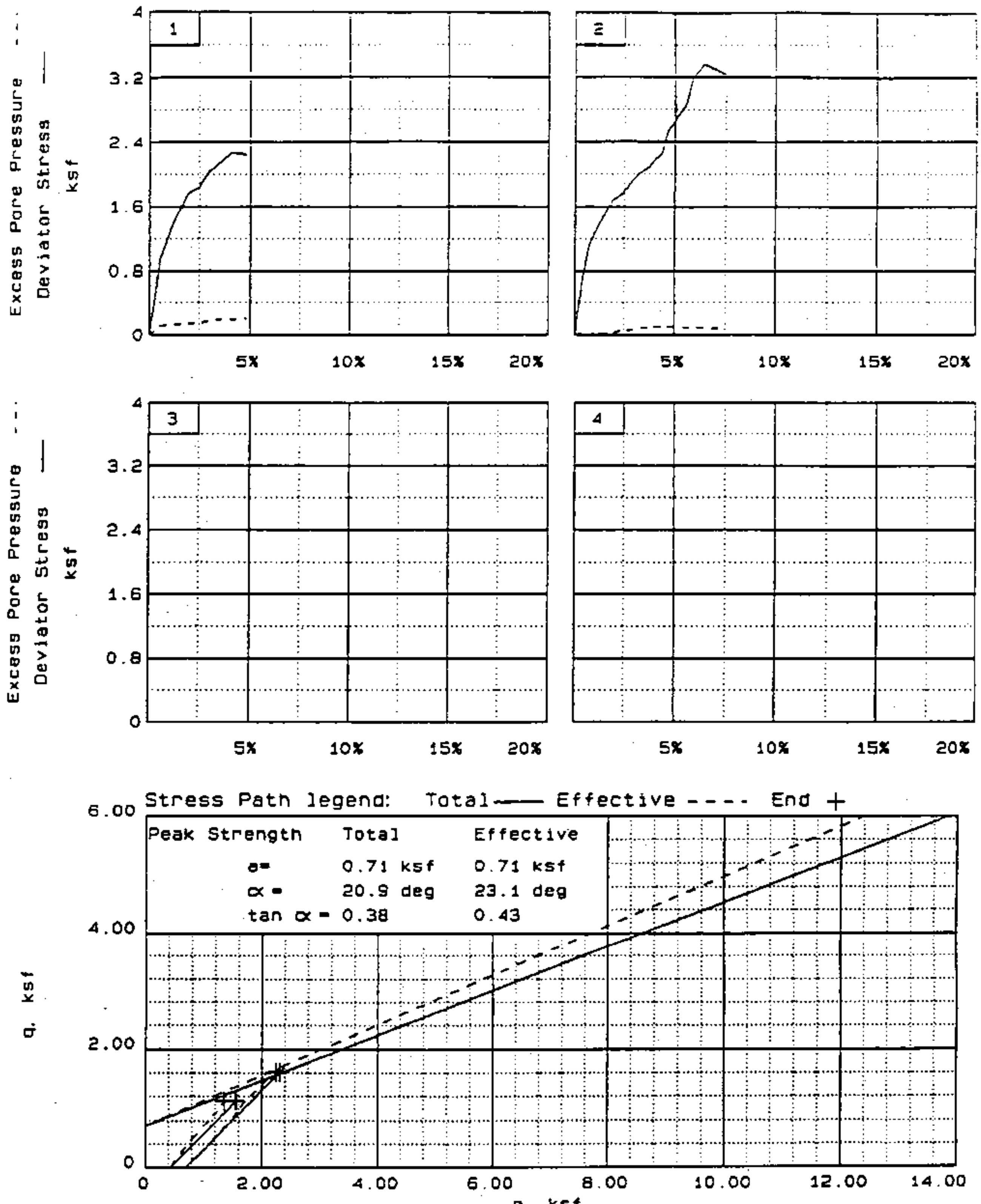
PROJECT: MUSKOGEE COMMUNITY LANDFILL - TRACT A

SAMPLE LOCATION: BH12
DEPTH: 4.0 - 6.0 FEET

PROJ. NO.: 3070576201 DATE: 11/17/93

TRIAXIAL SHEAR TEST REPORT

LAW ENGINEERING, INC.



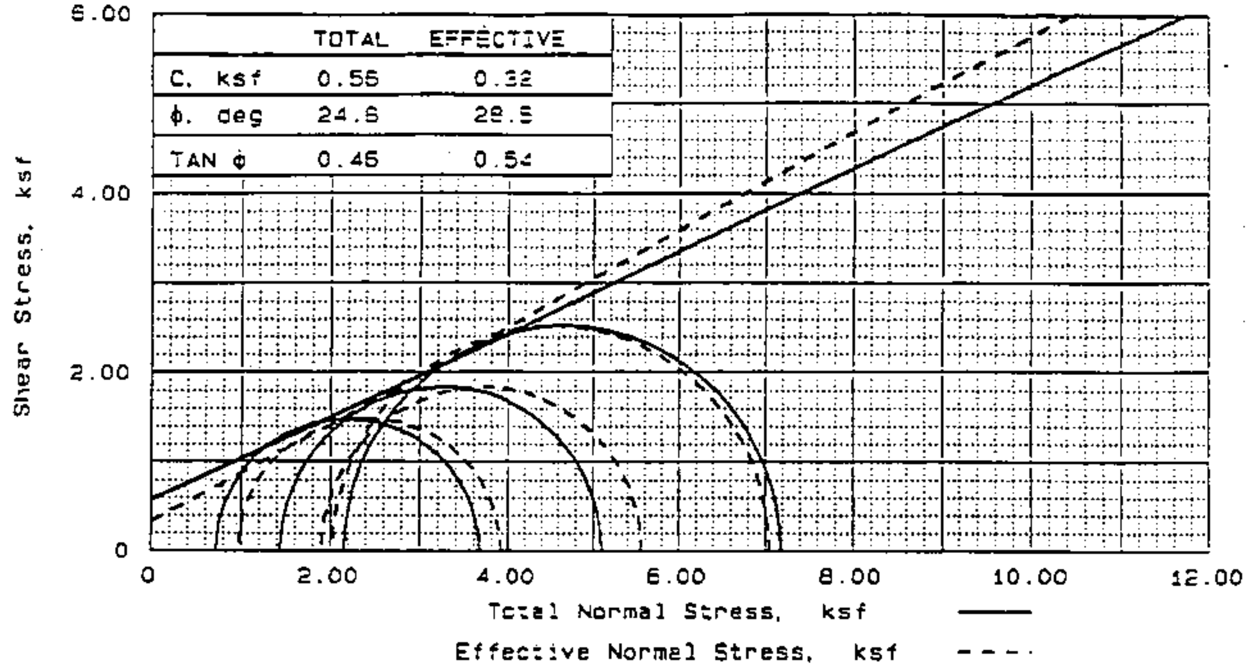
Client: RUST E&I

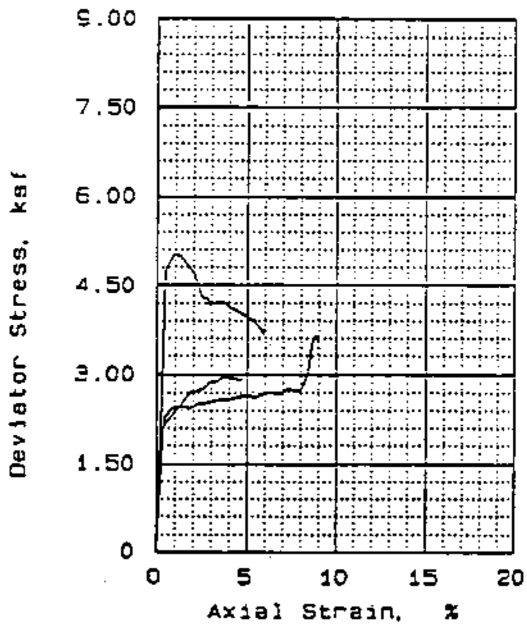
Project: MUSKOGEE COMMUNITY LANDFILL - TRACT A

Location: BH12 DEPTH: 4.0 - 6.0 FEET

File: 5762CU5 Project No.: 3070576201 Page 2/2 Fig. No. ____

	TOTAL	EFFECTIVE
C, ksf	0.56	0.32
ϕ, deg	24.6	28.5
TAN ϕ	0.46	0.54





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
	HEIGHT, in	2.80	2.80	2.80
AT TEST	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
$\bar{\sigma}_1$ FAILURE, ksf		3.92	5.57	7.06
$\bar{\sigma}_3$ 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

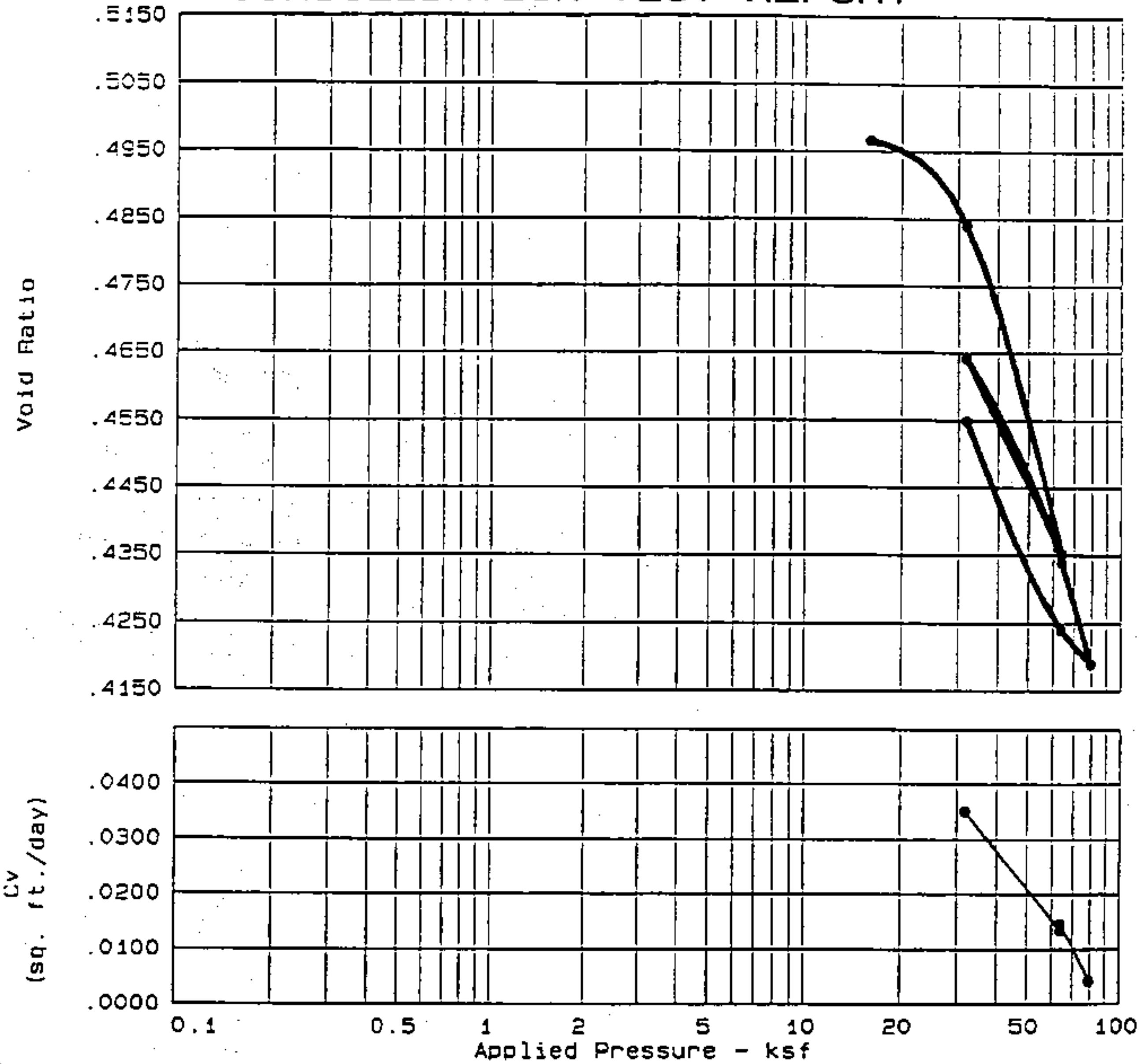
SAMPLE LOCATION: BORING BH-18
DEPTH: 13.0 - 14.0 FEET

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
	67.4 %	15.7	116.3			2.75	32.04	0.17	0.4949

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

CONSOLIDATION TEST REPORT

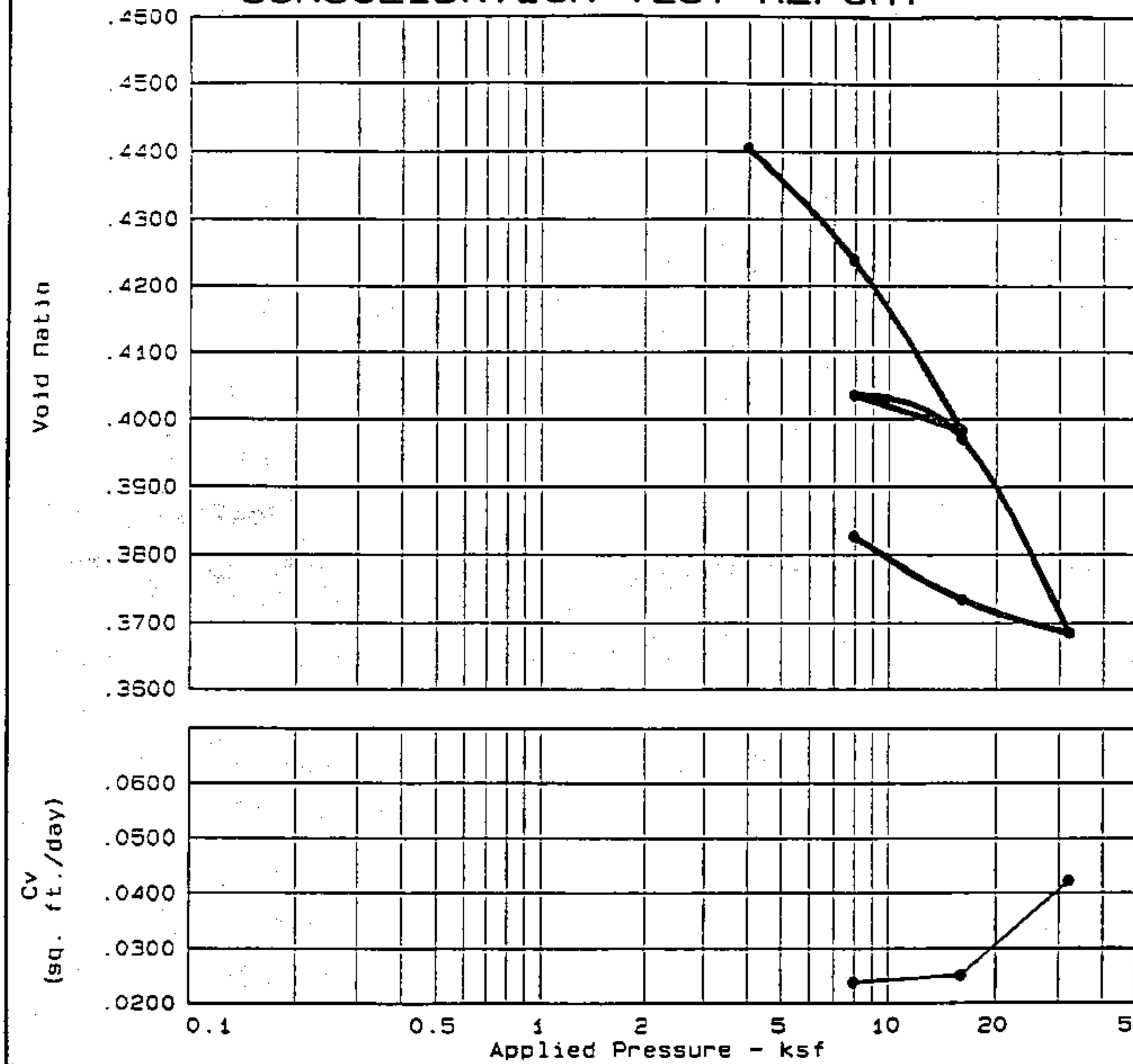
LAW ENGINEERING, INC.

Remarks:
IN GENERAL ACCORDANCE W/ASTM D2435
ASSUMED SPEC. GRAVITY

Cr = 0.097

Fig. No.______

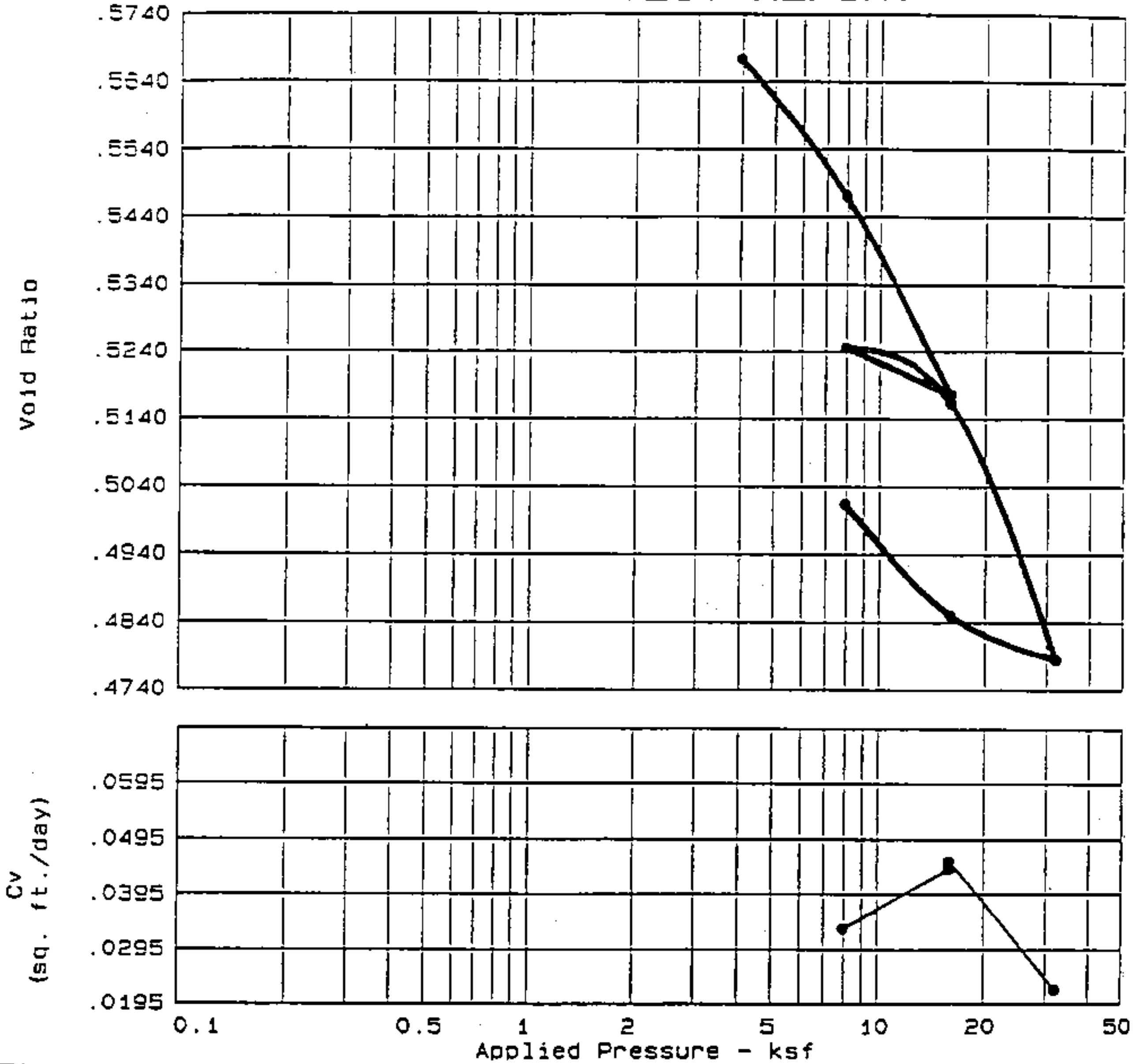
CONSOLIDATION TEST REPORT



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
CONSOLIDATION TEST REPORT **LAW ENGINEERING, INC.**	Cr = 0.018 Fig. No.______

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	MATERIAL DESCRIPTION
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

Remarks:
IN GENERAL ACCORDANCE W/ASTM D2435
ASSUMED SPEC. GRAVITY

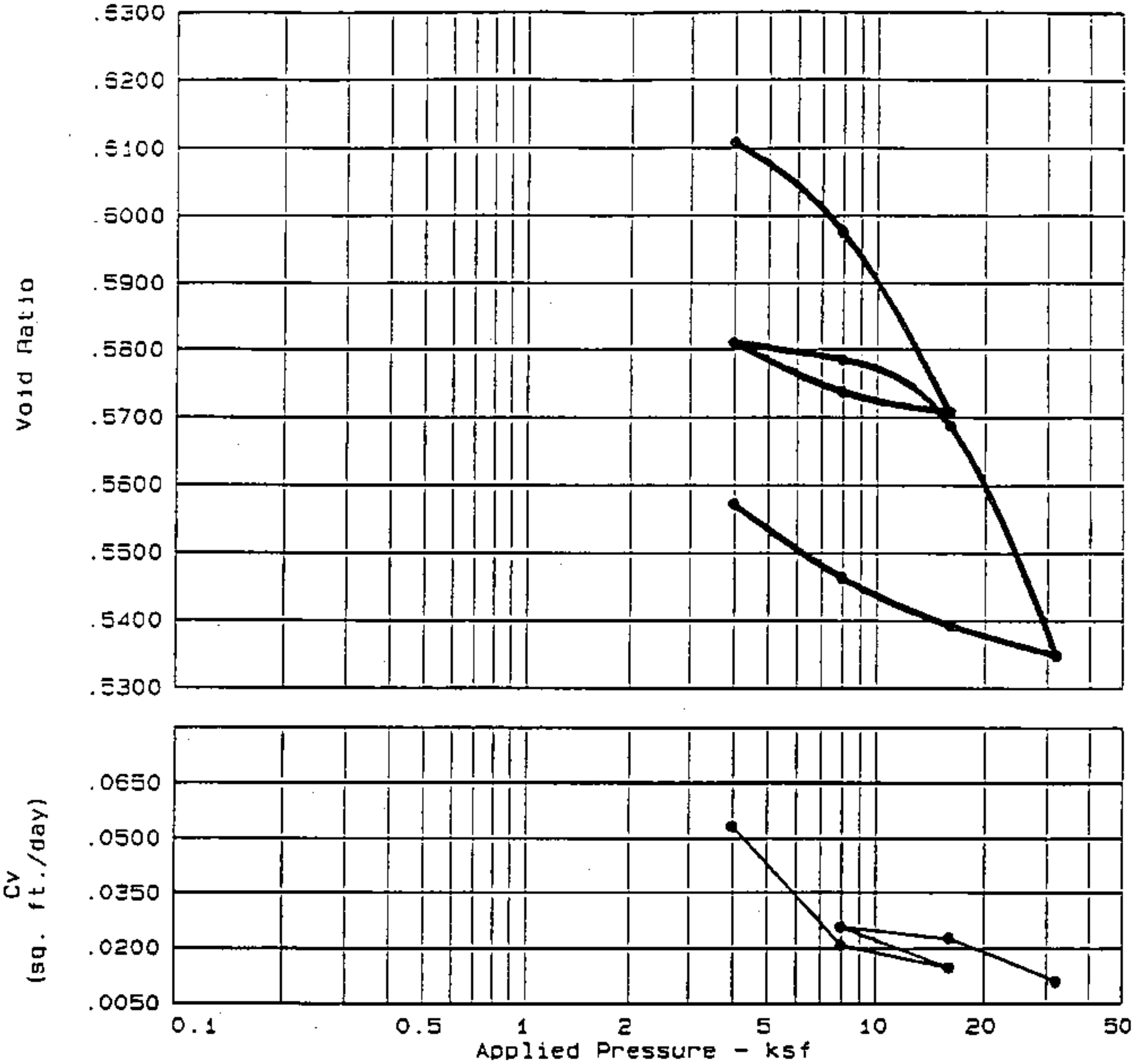
Cr = 0.023

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
	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-8
DEPTH: 8.0 - 10.0 FEET
Date: 01/14/94

Remarks:
IN GENERAL ACCORDANCE W/ASTM D2435
ASSUMED SPEC. GRAVITY

Cr = 0.017

CONSOLIDATION TEST REPORT

LAW ENGINEERING, INC.

Fig. No. ______

LAW ENGINEERING

HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

DATE: 12/29/93

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[X] ASTM D698
PERMEANT:	DE–AIRED TAP WATER

SAMPLE DATA	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	7.20	7.23
AREA OF SAMPLE(cm2),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 k20 readings)

k20 = 2.4 E–09 cm/sec

(or)

k20 = 2.4 E–11 m/sec

k = (aL/2At)*ln(h1/h2)   pipette length = 25.380 cm

k20 = kRt   pipette volume = 25.0 cm^3

Rt = (–0.02452T CELSIUS + 1.495)   a = ain = aout = 0.985 cm^2

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.:	05

BACK PRESSURE SATURATION CONDITIONS

EFFECTIVE STRESS (psi): 2.0

SATURATION METHOD: 1

1) B COEFFICIENT > or = 0.95

2) FINAL SATURATION CALCULATED 100 + or − 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

psi x 70.34 = cm

EFFLUENT PRESSURE(psi): 50.0

HYDRAULIC GRADIENT, i: 17

LAST FIVE HYDRAULIC CONDUCTIVITY READINGS

ELAPSED TIME min	sec	Vin (cm h2o)	Vout (cm h2o)	head loss (cm)	R	k20 cm/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

LAW ENGINEERING

HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

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. NOD		
TYPE OF SPECIMEN:	UNDISTURBED[X] VERTICAL AXIS [x]		
PERMEANT:	DE–AIRED TAP WATER		

SAMPLE DATA	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	6.96	6.99
AREA OF SAMPLE(cm2),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 = 2.1 E–08 cm/sec

(or)

k20 = 2.1 E–10 m/sec

$k = (aL/2At)*\ln(h1/h2)$ pipette length = 28.542 cm

$k20 = kRt$ pipette volume = 25.0 cm^3

$Rt = (-0.02452T \text{ CELSIUS} + 1.495)$ a = ain = aout = 0.876 cm^2

LAW ENGINEERING

HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

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) B COFFICIENT > or = 0.95

SATURATION METHOD: 1

2) FINAL SATURATION CALCULATED 100 + or – 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 min.	sec.	Vin (cm h2o)	Vout (cm h2o)	head loss (cm)	Rt	k20, cm/sec
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

LAW ENGINEERING

HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

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 [X] VERTICAL AXIS [X]		
PERMEANT:	DE–AIRED TAP WATER		

SAMPLE DATA

	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	6.91	6.93
AREA OF SAMPLE(cm2),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 = 1.2 E–08 cm/sec

(or)

k20 = 1.2 E–10 m/sec

$k = (aL/2At) * \ln(h1/h2)$ — pipette length = 25.400 cm

$k20 = kRt$ — pipette volume = 25.0 cm ^ 3

$Rt = (-0.02452T \text{ CELSIUS} + 1.495)$ — a = ain = aout = 0.984 cm ^ 2

LAW ENGINEERING

HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

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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 COFFICIENT > or = 0.95

SATURATION METHOD: 1 — 2) FINAL SATURATION CALCULATED 100 + or – 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 min	sec	Vin (cm h2o)	Vout (cm h2o)	head loss (cm)	Rt	k20, cm/sec
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

LAW ENGINEERING

HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

DATE: 1/31/94

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[X] VERTICAL AXIS [X]		
PERMEANT:	DE–AIRED TAP WATER		

SAMPLE DATA	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	6.86	3.88
AREA OF SAMPLE(cm2),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 = 4.9 E–09 cm/sec

(or)

k20 = 4.9 E–11 m/sec

k = (aL/2At)*ln(h1/h2)

k20 = kRt

Rt = (–0.02452T CELSIUS + 1.495)

pipette length = 25.400 cm

pipette volume = 25.0 cm ^ 3

a = ain = aout = 0.984 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)

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 COFFICIENT > or = 0.95

SATURATION METHOD: 1

2) FINAL SATURATION CALCULATED 100 + or – 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		Vin	Vout	head loss	Rt	K20, cm/sec
min.	sec.	(cm h2o)	(cm h2o)	(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

LAW ENGINEERING

HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

DATE: 12/29/93

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[X] ASTM D698
PERMEANT:	DE-AIRED TAP WATER

SAMPLE DATA

	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	7.23	7.23
AREA OF SAMPLE(cm2),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 = 2.7 E-09 cm/sec

(or)

k20 = 2.7 E-11 m/sec

$k = (aL/2At)*\ln(h1/h2)$ pipette length = 28.600 cm

$k20 = kRt$ pipette volume = 25.0 cm^3

$Rt = (-0.02452T \text{ CELSIUS} + 1.495)$ a = ain = aout = 0.874 cm^2

LAW ENGINEERING

HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

DATE: 12/29/93

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

SATURATION METHOD: 1

1) B COFFICIENT > or = 0.95
2) FINAL SATURATION CALCULATED 100 + or – 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

psi x 70.34 = cm

EFFLUENT PRESSURE(psi): 50.0

HYDRAULIC GRADIENT, i: 17

LAST FIVE HYDRAULIC CONDUCTIVITY READINGS						
ELAPSED TIME		Vin	Vout	head loss	Rt	k20 cm/sec
min	sec	cm H2O	cm H2O	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

LAW ENGINEERING

HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

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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 [X] VERTICAL AXIS [x]		
PERMEANT:	DE–AIRED TAP WATER		

SAMPLE DATA

	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	6.86	6.88
AREA OF SAMPLE(cm2),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 k20 readings)

k20 = 2.6 E–09 cm/sec

(or)

k20 = 2.6 E–11 m/sec

k = (aL/2At)*ln(h1/h2)

pipette length = 28.542 cm

k20 = kRt

pipette volume = 25.0 cm ^ 3

Rt = (–0.02452T CELSIUS + 1.495)

a = ain = aout = 0.876 cm ^ 2

LAW ENGINEERING

HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

DATE: 1/31/94

PROJECT NAME: LAW – TULSA
PROJECT NUMBER: 307–05762–01 LAB NO.: 13

BACK PRESSURE SATURATION CONDITIONS:

EFFECTIVE STRESS (psi): 2.0

SATURATION METHOD: 1

1) B COFFICIENT > or = 0.95

2) FINAL SATURATION CALCULATED 100 + or – 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 min.	sec.	Vin (cm h2o)	Vout (cm h2o)	head loss (cm)	Rt	k20, cm/sec
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

LAW ENGINEERING

HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

DATE: 01/13/94

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

[illegible]

	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	7.52	7.32
AREA OF SAMPLE(cm2),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

[illegible]

k20 = 5.0 E–09 cm/sec

(or)

k20 = 5.0 E–11 m/sec

k = (aL/2At)*ln(h1/h2)   pipette length = 25.40 cm

k20 = kRt   pipette volume = 25.0 cm^3

Rt = (–0.02452T CELSIUS + 1.495)a = ain = aout = 0.095 cm^2

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LAW ENGINEERING

HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

PAGE NO. 2 of 2
DATE: 01/13/94

PROJECT NAME: LAW – TULSA (RUST E & I)
PROJECT NUMBER: 307–05762–01 (396–01402–01) LAB NO.: 16

BACKPRESSURE SATURATION CONDITIONS

EFFECTIVE STRESS (psi): 2.0

SATURATION METHOD: 1

1) B COFFICIENT > or = 0.95

2) FINAL SATURATION CALCULATED 100 + or – 5%

3) VOLUME CHANGE DURING TEST

CONSOLIDATION CONDITIONS

CONFINING PRESSURE(psi): 53.5

CONSOLIDATION PRESSURE(psi): 50.0

EFFECTIVE STRESS(psi): 3.5

PERMEATION CONDITIONS

CONFINING PRESSURE(psi): 54.5

INFLUENT PRESSURE(psi): 52

psi x 70.34 = cm

EFFLUENT PRESSURE(psi): 50

HYDRAULIC GRADIENT, i: 17

[illegible] HYDRAULIC CONDUCTIVITY READINGS

ELAPSED TIME (min)	(sec)	[illegible] (cm H2O)	[illegible] (cm H2O)	[illegible] (cm)	[illegible]	K [illegible]
294	17640	2.40	14.65			
1374	82440	2.80	14.30	0.762	0.86	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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HYDRAULIC CONDUCTIVITY
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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.: 06
SAMPLE LOCATION:	TRACT "A", P–11 0–2 FT.
DESCRIPTION OF SOIL:	TAN AND LIGHT BROWN, SILTY CLAY
TYPE OF SPECIMEN:	UNDISTURBED[ ] REMOLDED[X] ASTM D698
PERMEANT:	DE–AIRED TAP WATER

SAMPLE DATA

	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	7.21	7.21
AREA OF SAMPLE(cm2),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 k20 readings)

k20 = 1.9 E–09 cm/sec

(or)

k20 = 1.9 E–11 m/sec

k = (aL/2At)*ln(h1/h2) pipette length = 25.484 cm

k20 = kRt pipette volume = 25.0 cm^3

Rt = (–0.02452T CELSIUS + 1.495) a = ain = aout = 0.981 cm^2

LAW ENGINEERING

HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

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

SATURATION METHOD: 1

1) B COFFICIENT > or = 0.95

2) FINAL SATURATION CALCULATED 100 + or – 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	sec	Vin (cm H2O)	Vout (cm H2O)	head loss (cm)	Rt	k20 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)

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[X] ASTM D698
PERMEANT:	DE–AIRED TAP WATER

SAMPLE DATA

	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	7.26	7.24
AREA OF SAMPLE(cm2),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 = 2.3 E–09 cm/sec

(or)

k20 = 2.3 E–11 m/sec

$k = (aL/2At)*\ln(h1/h2)$

$k20 = kRt$

$Rt = (-0.02452T \text{ CELSIUS} + 1.495)$ $a = ain = aout = 0.118 \text{ cm}^2$

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.: 02

BACK PRESSURE SATURATION CONDITIONS:

EFFECTIVE STRESS (psi): 2.0 — 1) B COFFICIENT > or = 0.95

SATURATION METHOD: 1 — 2) FINAL SATURATION CALCULATED 100 + or – 5%

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 — psi x 70.34 = cm

EFFLUENT PRESSURE(psi): 60.0

HYDRAULIC GRADIENT, i: 16

LAST FIVE HYDRAULIC CONDUCTIVITY READINGS

ELAPSED TIME min	sec	Vin (cm h2o)	Vout (cm h2o)	head loss (cm)	Rt	k20 cm/sec
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)

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[X] ASTM D698
PERMEANT:	DE–AIRED TAP WATER

SAMPLE DATA

	INITIAL	FINAL
DIAMETER OF SAMPLE(cm)	7.20	7.26
AREA OF SAMPLE(cm2),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 k20 readings)

k20 = 3.3 E–09 cm/sec

(or)

k20 = 3.3 E–11 m/sec

$k = (aL/2At)*\ln(h1/h2)$

$k20 = kRt$

$Rt = (-0.02452T\ \text{CELSIUS} + 1.495)$ $a = ain = aout = 0.118\ cm^2$

LAW ENGINEERING

HYDRAULIC CONDUCTIVITY
ASTM D5084
METHOD C
(FALLING HEAD RISING TAILWATER)

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

SATURATION METHOD: 1

1) B COEFFICIENT > or = 0.95

2) FINAL SATURATION CALCULATED 100 + or – 5%

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

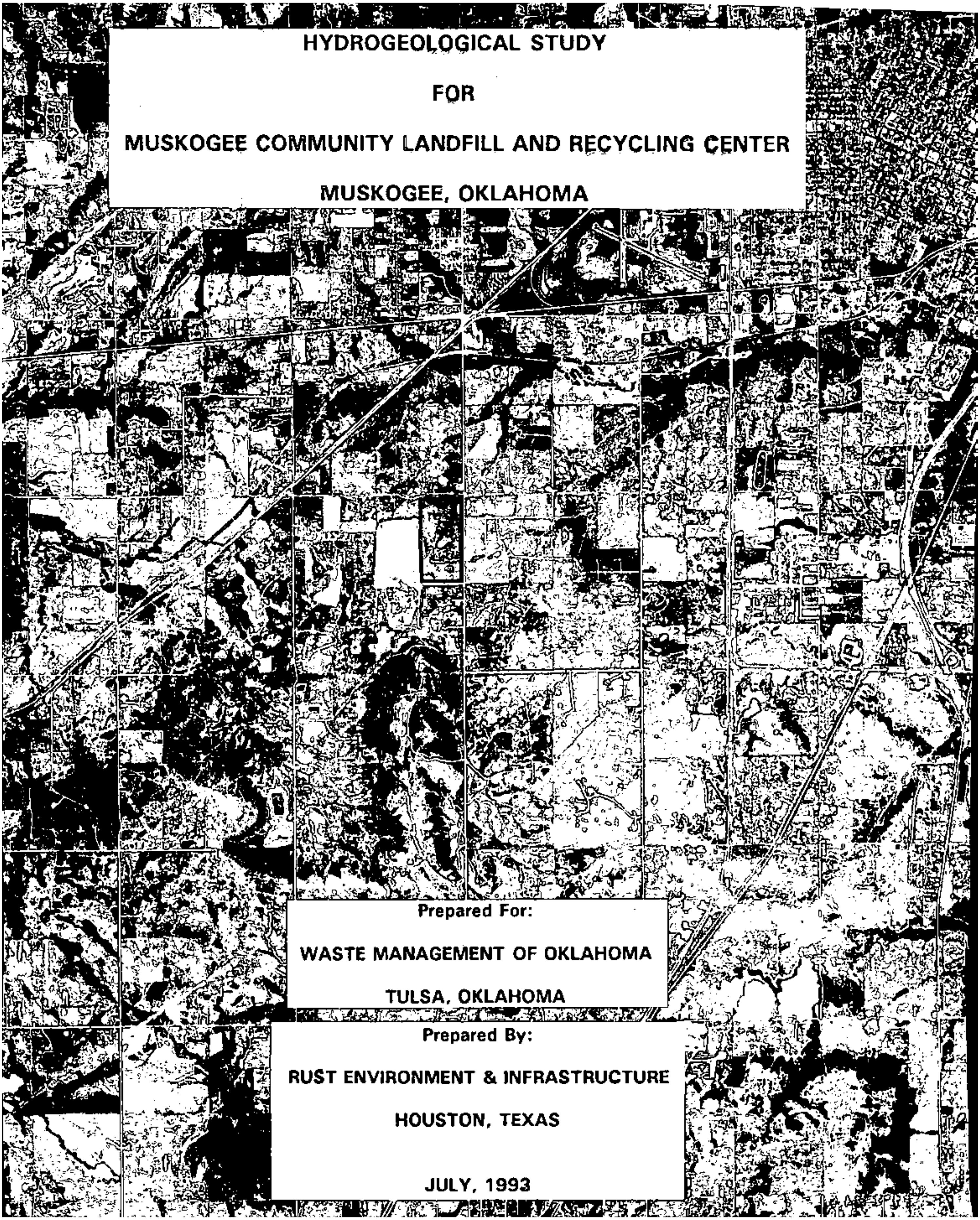
INFLUENT PRESSURE(psi): 52.0 psi x 70.34 = cm

EFFLUENT PRESSURE(psi): 50.0

HYDRAULIC GRADIENT, i: 16

LAST FIVE HYDRAULIC CONDUCTIVITY READINGS						
ELAPSED TIME min	sec	Vin (cm h2o)	Vout (cm h2o)	head loss (cm)	Rt	K20 cm/sec
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)



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

Ltr picked up by M. Daniels

MARK S. COLEMAN
Executive Director

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.

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

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.

RQD %	Description of Rock Quality
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:

	Water Filled Hole, Saturated Zone		Dry Hole, Unsaturated Zone	
Technique/Application	Uncased	Steel	Uncased	Steel
Natural Gamma soil & rock identification, geologic correlation	Yes	Yes	Yes	Yes
Spontaneous Potential soil & rock identification, geologic correlation	Yes	No	No	No
Single-Point Resistance 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. RUST E & 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:

Tract B	Tract C
• 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		$200
Subtotal Task 2B		$20,607

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		$300
Subtotal Task 2C		$13,010
TOTAL TASK 2A - 2C		**$89,750**

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)		$50
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 (without Geotechnical laborabory costs)	**$118,216**
GRAND TOTAL (with Geotechnical laboratory costs)	**$143,390**

COST ESTIMATE FOR GEOTECHNICAL TESTING

Geotechnical Test	Number of Tests: Tract A	Borrow Area	Unit Cost	Total
Particle Size Analysis	60	20	$40	$3,200
Atterburg 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	$200

TOTAL, PLUS 5% MARKUP **$25,174**

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

HOUSTON, TEXAS 77067

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Mark Daniels, WMO

Theresa Talty, WMNA

PROJECT NO. 86251.100

93-140
1 of 3

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FIGURES, Continued

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 acceptances 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

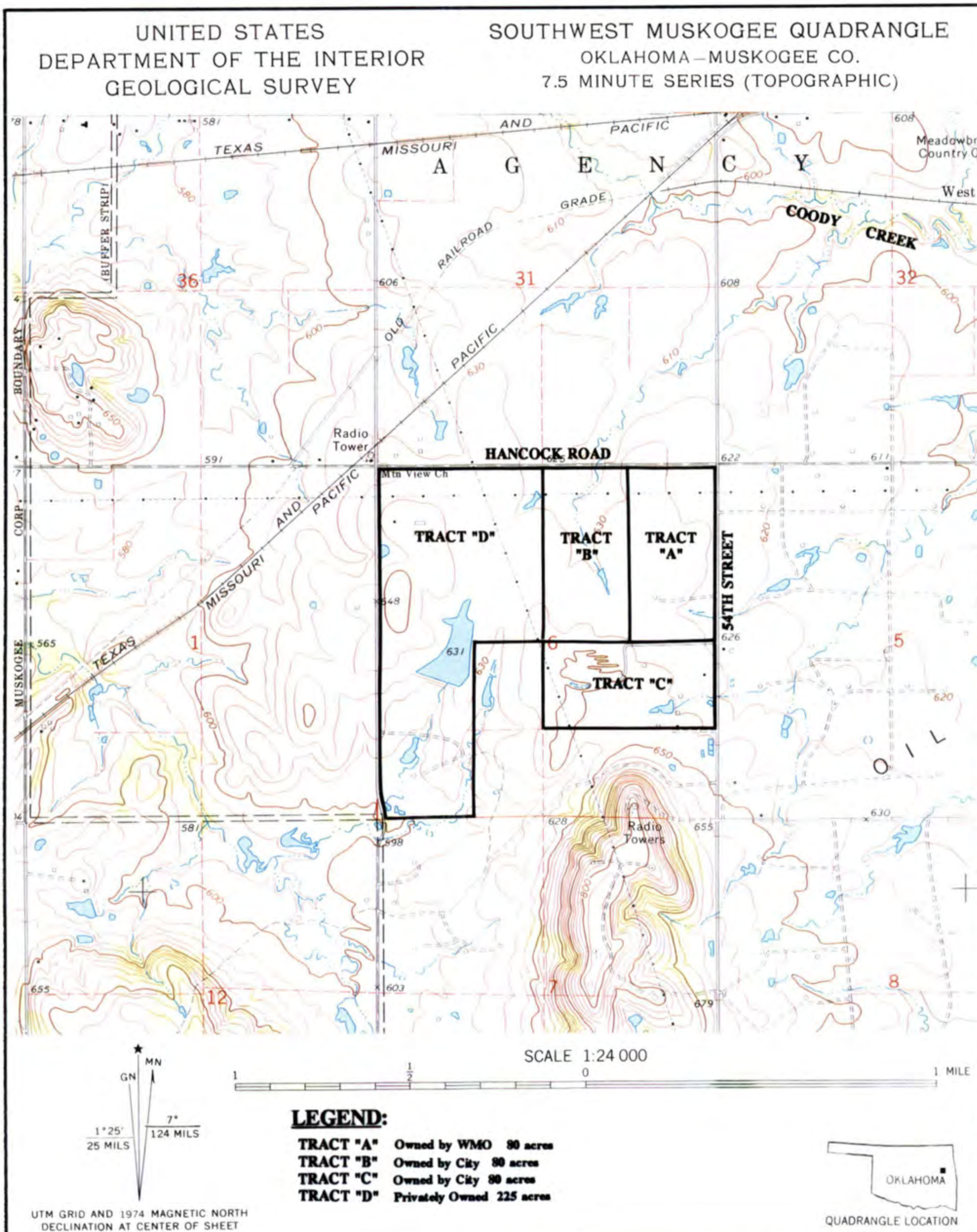
This section describes site-specific conditions including location, history, aerial photography, physiography, topography, climate and previous investigations.

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.



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

RUST ENVIRONMENT & INFRASTRUCTURE

PROJECT LOCATION MAP, 1993

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 yd^3 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 yd^3.

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

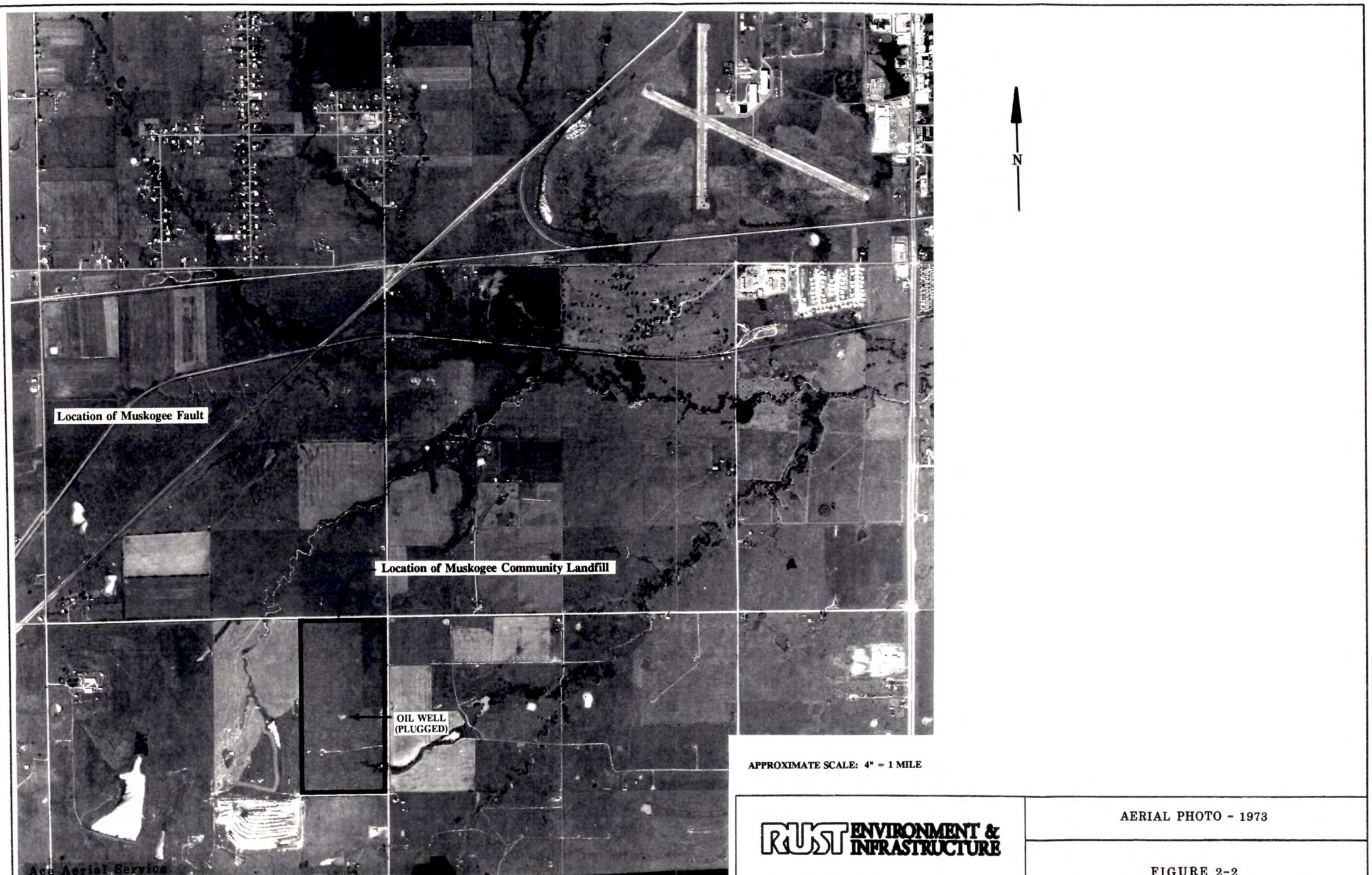
Aerial photographs were reviewed for the years 1973, 1980, 1991, and 1992. There were no aerial photographs available prior to 1973, and the most recent aerial photograph available was from June, 1992.

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.

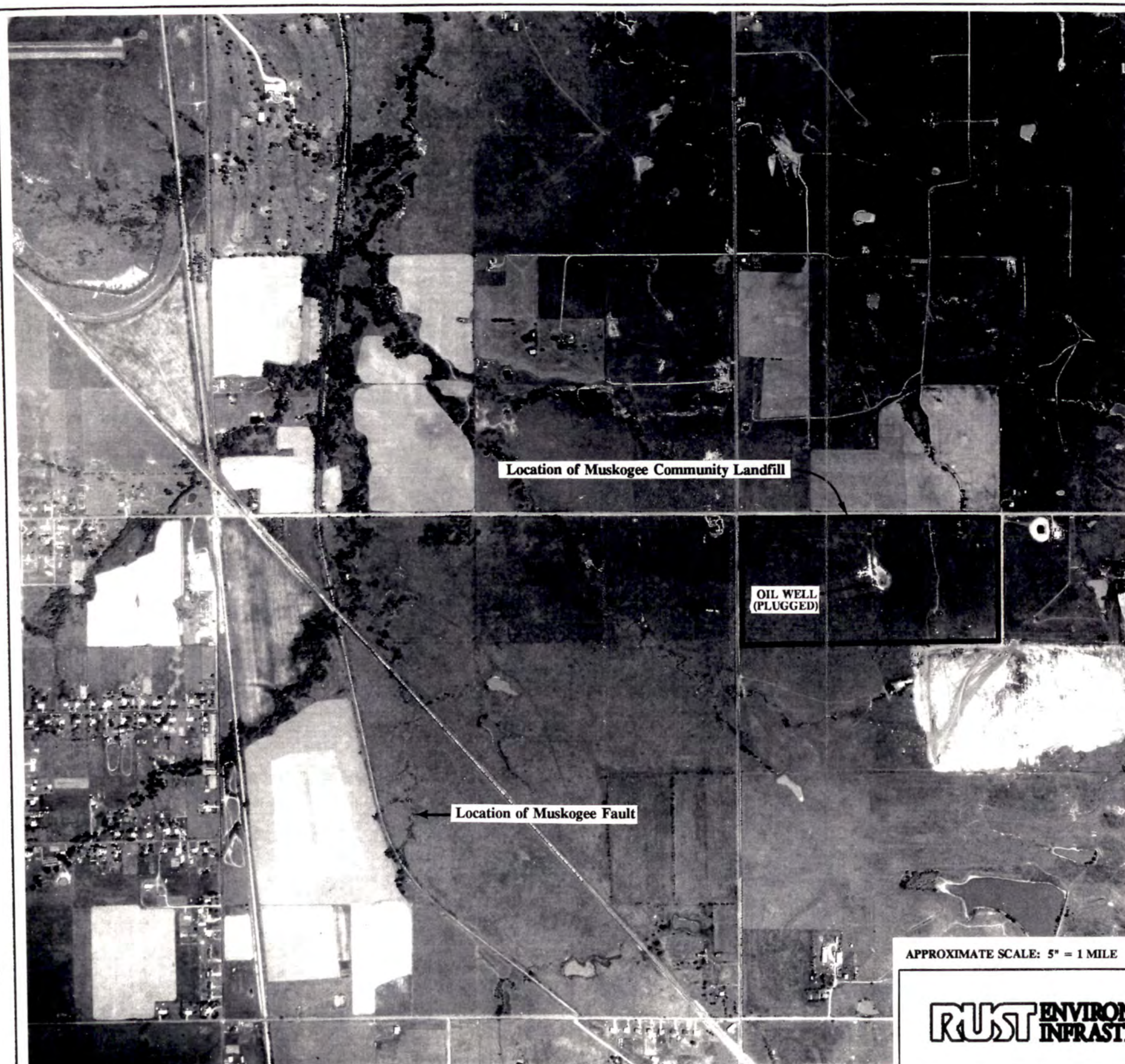
By April, 1991, the southern-most part of Tract A had been excavated. The trench in the southwestern corner had been filled and covered by the City of Muskogee. The area of dead vegetation was still present.



RUST ENVIRONMENT & INFRASTRUCTURE

AERIAL PHOTO - 1973

FIGURE 2-2



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.

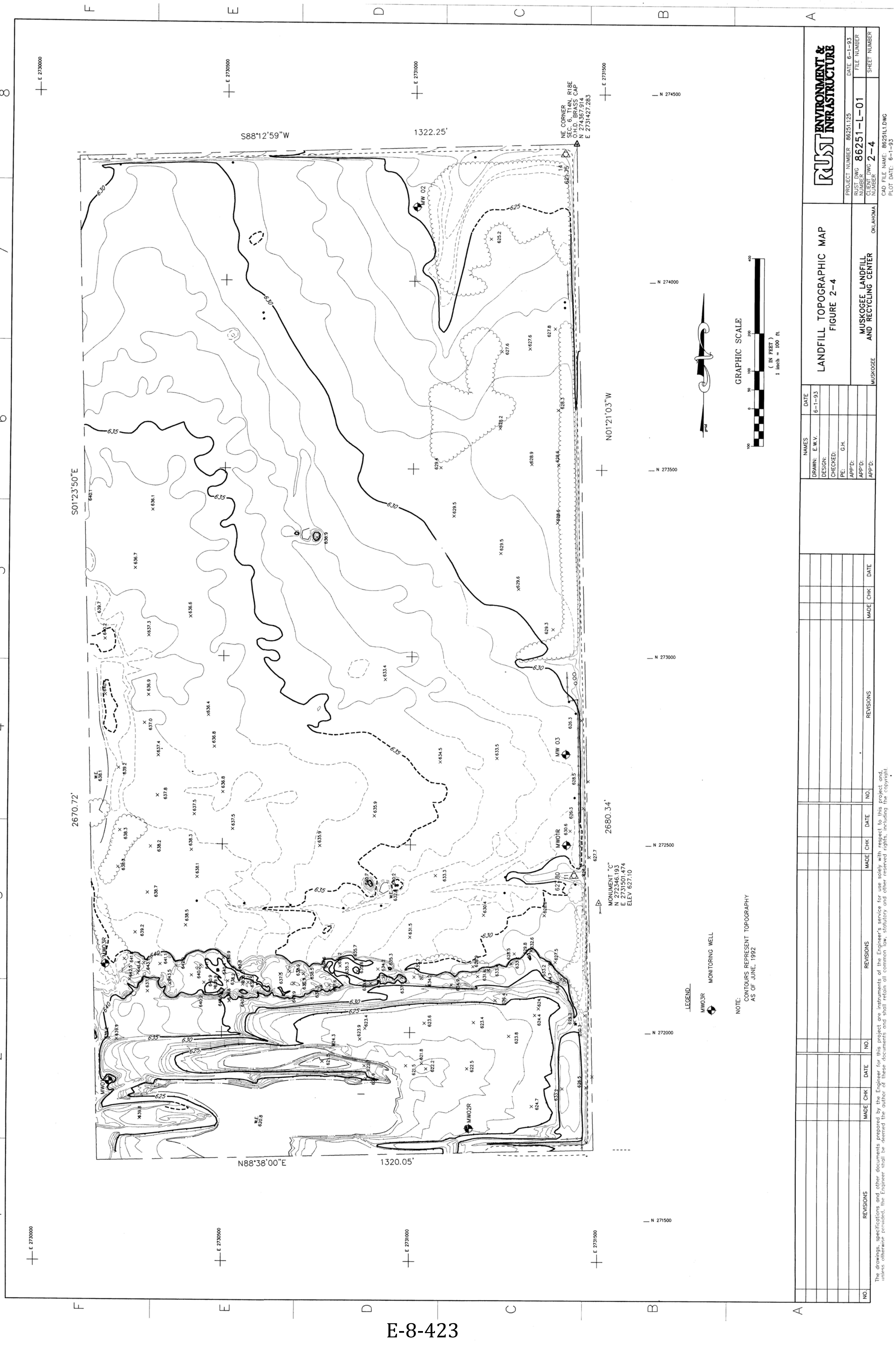
The June, 1992 aerial photograph showed that Tract A remained basically unchanged. The area of dead vegetation was still present. Tract B appeared the same. Landfilling operations for Tract C were active in the southeastern part of the landfill.

2.4 <u>Physiography and Topography</u>

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


LANDFILL TOPOGRAPHIC MAP
FIGURE 2-4
MUSKOGEE LANDFILL AND RECYCLING CENTER
MUSKOGEE
OKLAHOMA
RUST ENVIRONMENT & INFRASTRUCTURE
PROJECT NUMBER 86251.125
RUST DWG NUMBER 86251-L-01
CLIENT DWG NUMBER 2-4
DATE 6-1-93
CAD FILE NAME: 86251L1.DWG
PLOT DATE: 6-1-93
DRAWN: E.W.V.
DATE 6-1-93
PE: G.H.
GRAPHIC SCALE
(IN FEET)
1 inch = 100 ft.
LEGEND
MW03R
MONITORING WELL
NOTE:
CONTOURS REPRESENT TOPOGRAPHY
AS OF JUNE, 1992
NE CORNER
SEC. 6, T14N, R18E
O.H.D. BRASS CAP
N 274387.914
E 2731427.283
MONUMENT "C"
N 272346.193
E 2731501.474
ELEV 627.10
S88°12'59"W
1322.25'
S01°23'50"E
2670.72'
N01°21'03"W
2680.34'
N88°38'00"E
1320.05'
MW 02
MW 03
MW01R
MW02R
MW03R
REVISIONS
MADE
CHK
DATE
NO.
The drawings, specifications and other documents prepared by the Engineer for this project are instruments of the Engineer's service for use solely with respect to this project and, unless otherwise provided, the Engineer shall be deemed the author of these documents and shall retain all common law, statutory and other reserved rights, including the copyright.

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 feel 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

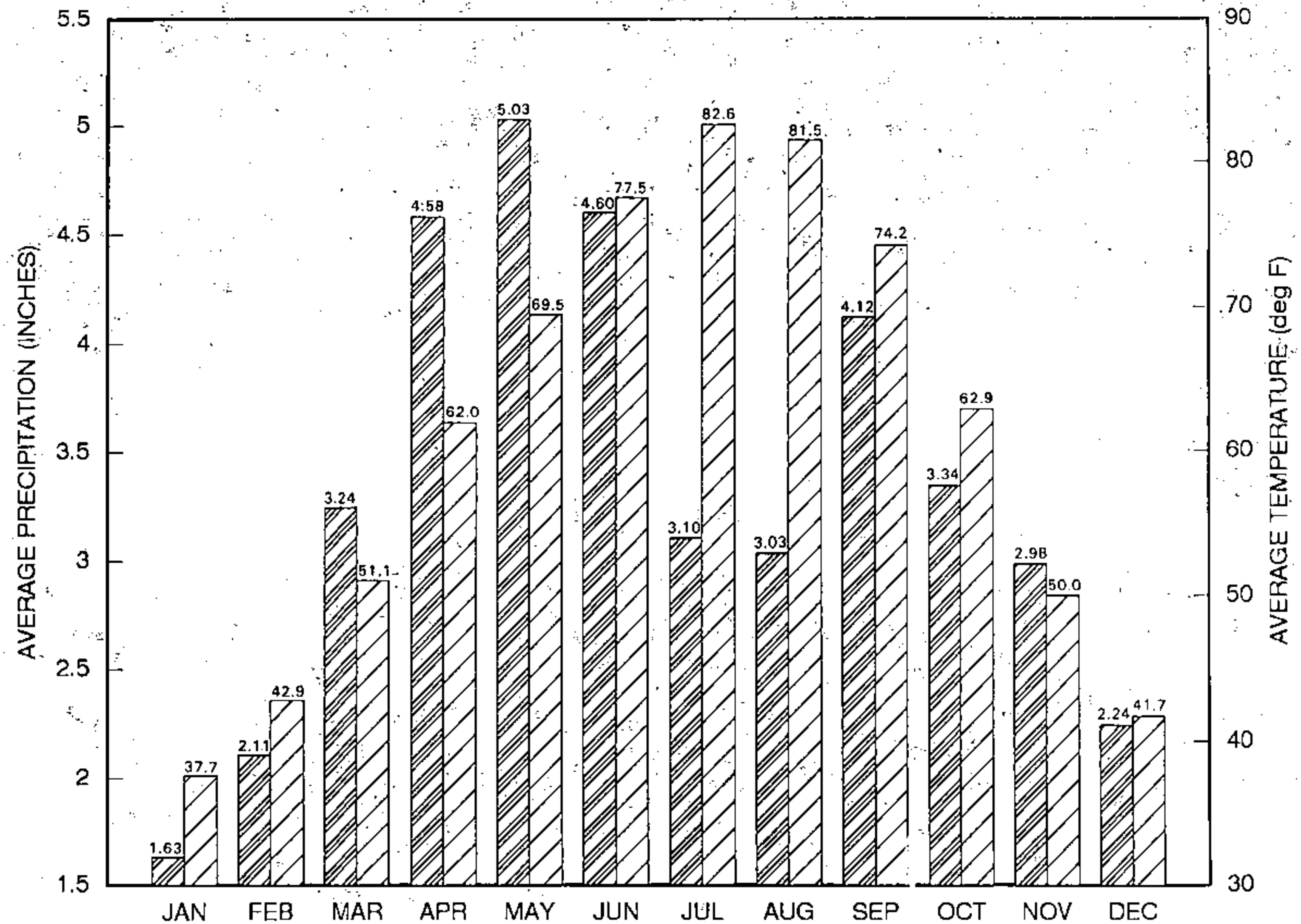
TEMPERATURE AND PRECIPITATION

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

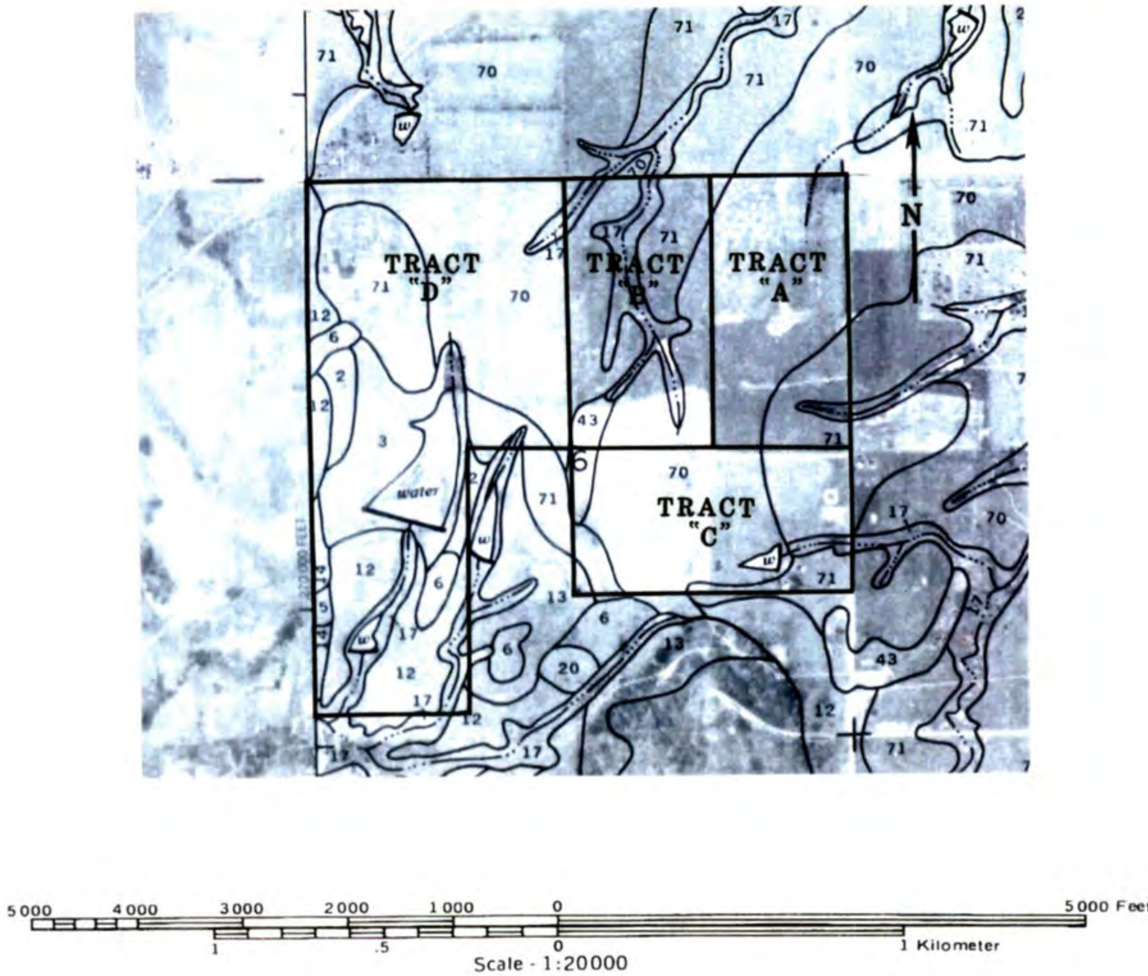
The general soils of the region consist mainly of two types: the Taloka-Parsons-Stigler soils and the Dennis-Bates-Coweta soils (Figure 3-1). Approximately 28 percent of Muskogee County consists of this soil series. It is about 32 percent Taloka soils, 22 percent Parsons soils, 21 percent Stigler soils, 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

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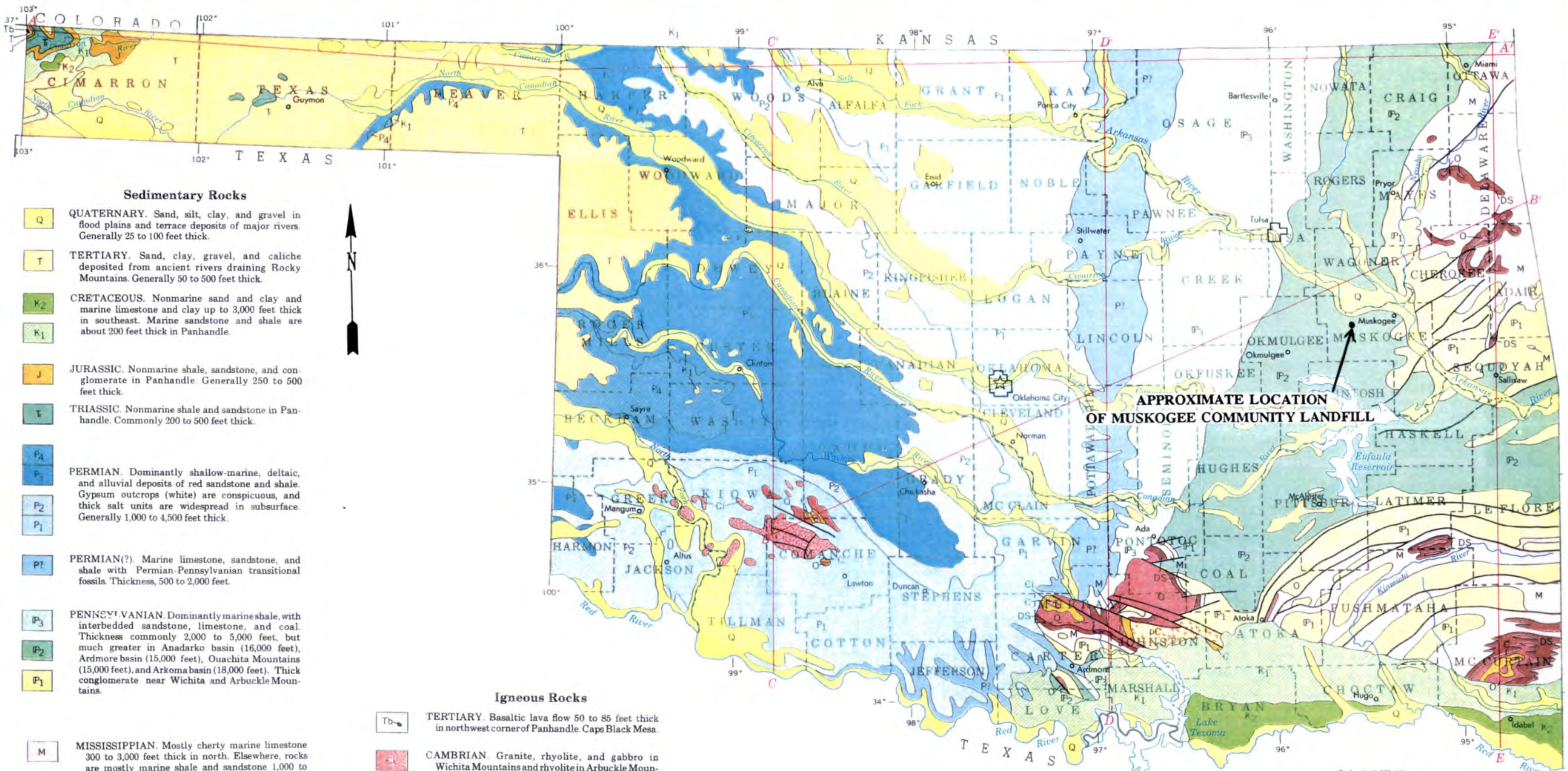

Sedimentary Rocks

Q — QUATERNARY. Sand, silt, clay, and gravel in flood plains and terrace deposits of major rivers. Generally 25 to 100 feet thick.

T — TERTIARY. Sand, clay, gravel, and caliche deposited from ancient rivers draining Rocky Mountains. Generally 50 to 500 feet thick.

K_2, K_1 — CRETACEOUS. Nonmarine sand and clay and marine limestone and clay up to 3,000 feet thick in southeast. Marine sandstone and shale are about 200 feet thick in Panhandle.

J — JURASSIC. Nonmarine shale, sandstone, and conglomerate in Panhandle. Generally 250 to 500 feet thick.

Ꝛ — TRIASSIC. Nonmarine shale and sandstone in Panhandle. Commonly 200 to 500 feet thick.

P_4, P_3, P_2, P_1 — PERMIAN. Dominantly shallow-marine, deltaic, and alluvial deposits of red sandstone and shale. Gypsum outcrops (white) are conspicuous, and thick salt units are widespread in subsurface. Generally 1,000 to 4,500 feet thick.

P? — PERMIAN(?). Marine limestone, sandstone, and shale with Permian-Pennsylvanian transitional fossils. Thickness, 500 to 2,000 feet.

IP_3, IP_2, IP_1 — PENNSYLVANIAN. Dominantly marine shale, with interbedded sandstone, limestone, and coal. Thickness commonly 2,000 to 5,000 feet, but much greater in Anadarko basin (16,000 feet), Ardmore basin (15,000 feet), Ouachita Mountains (15,000 feet), and Arkoma basin (18,000 feet). Thick conglomerate near Wichita and Arbuckle Mountains.

M — MISSISSIPPIAN. Mostly cherty marine limestone 300 to 3,000 feet thick in north. Elsewhere, rocks are mostly marine shale and sandstone 1,000 to 5,000 feet thick, and 10,000 feet thick in Ouachita Mountains.

DS — DEVONIAN-SILURIAN. Marine limestone 100 to 800 feet thick, overlain by black shale 50 to 500 feet thick. In Ouachita Mountains, units are chert, shale, and sandstone 500 to 1,200 feet thick.

O — ORDOVICIAN. Marine limestone and dolomite, with some sandstone and shale. Thickens from 1,000 feet in north to 9,000 feet in south. In Ouachita Mountains, unit is shale, sandstone, and cherty limestone.

C — CAMBRIAN. Marine limestone and dolomite, with a basal sandstone. Generally 500 to 2,000 feet thick.

Igneous Rocks

Tb — TERTIARY. Basaltic lava flow 50 to 85 feet thick in northwest corner of Panhandle. Caps Black Mesa.

Ci — CAMBRIAN. Granite, rhyolite, and gabbro in Wichita Mountains and rhyolite in Arbuckle Mountains. Formed about 525 million years ago; nearly 20,000 feet thick. In subsurface (cross section), includes metamorphic rocks that may be partly Precambrian.

pC — PRECAMBRIAN. Granite, underlying almost all of Oklahoma and cropping out only in the Arbuckle Mountains and Mayes County. Formed 1.05 to 1.35 billion years ago, these are the oldest rocks at the surface in Oklahoma.

Geologic contact

Fault

GENERALIZED GEOLOGIC MAP OF OKLAHOMA

(Updated 1979)

Compiled by

CARL C. BRANSON AND KENNETH S. JOHNSON

OKLAHOMA GEOLOGICAL SURVEY Charles J. Mankin, *Director*

RUST ENVIRONMENT & INFRASTRUCTURE

LOCATION OF GEOLOGIC CROSS SECTIONS IN OKLAHOMA

FIGURE 4-1

DUNCAN-PARNELL, INC. CHARLOTTE, NC 800-768-7788

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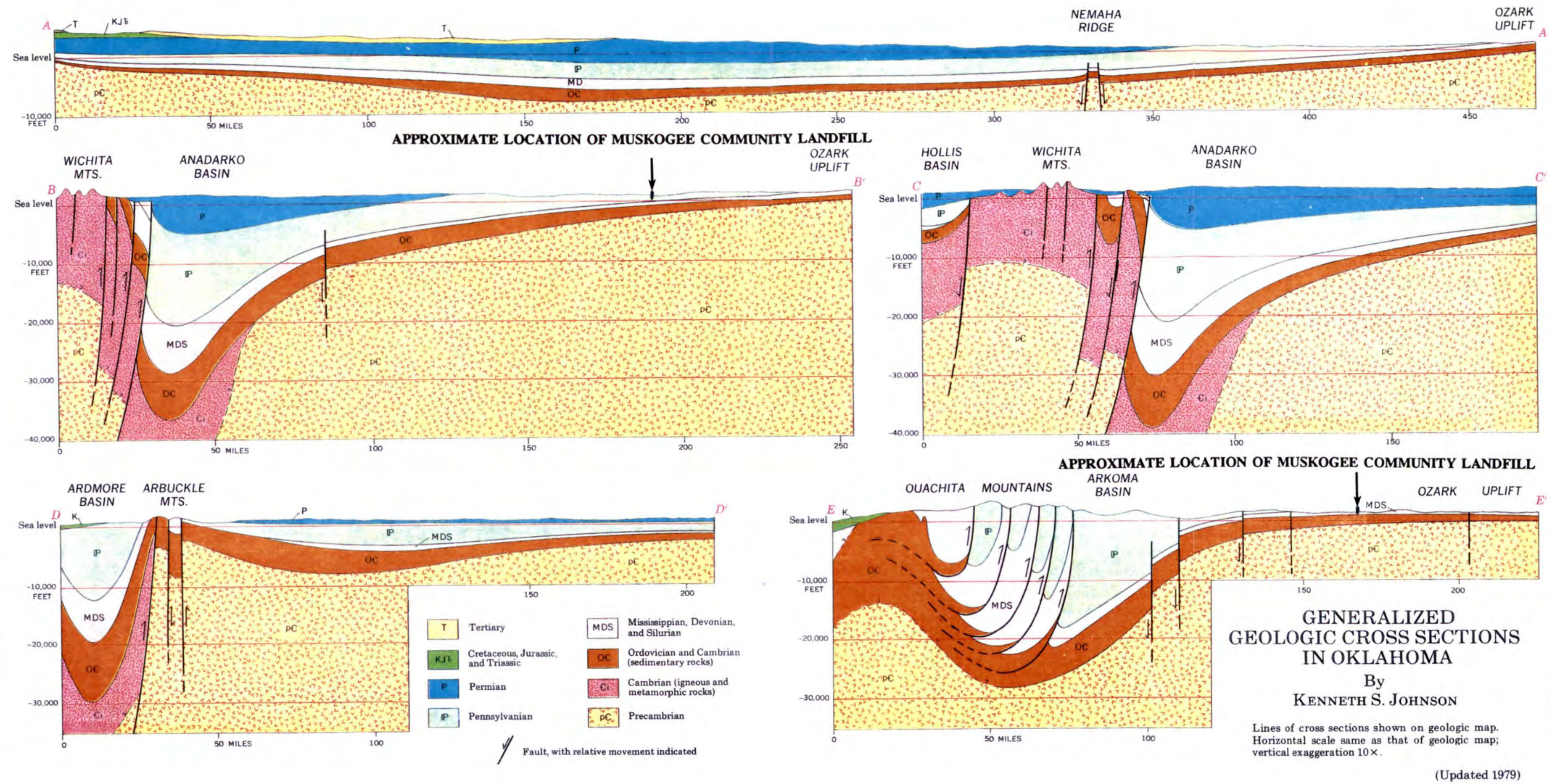
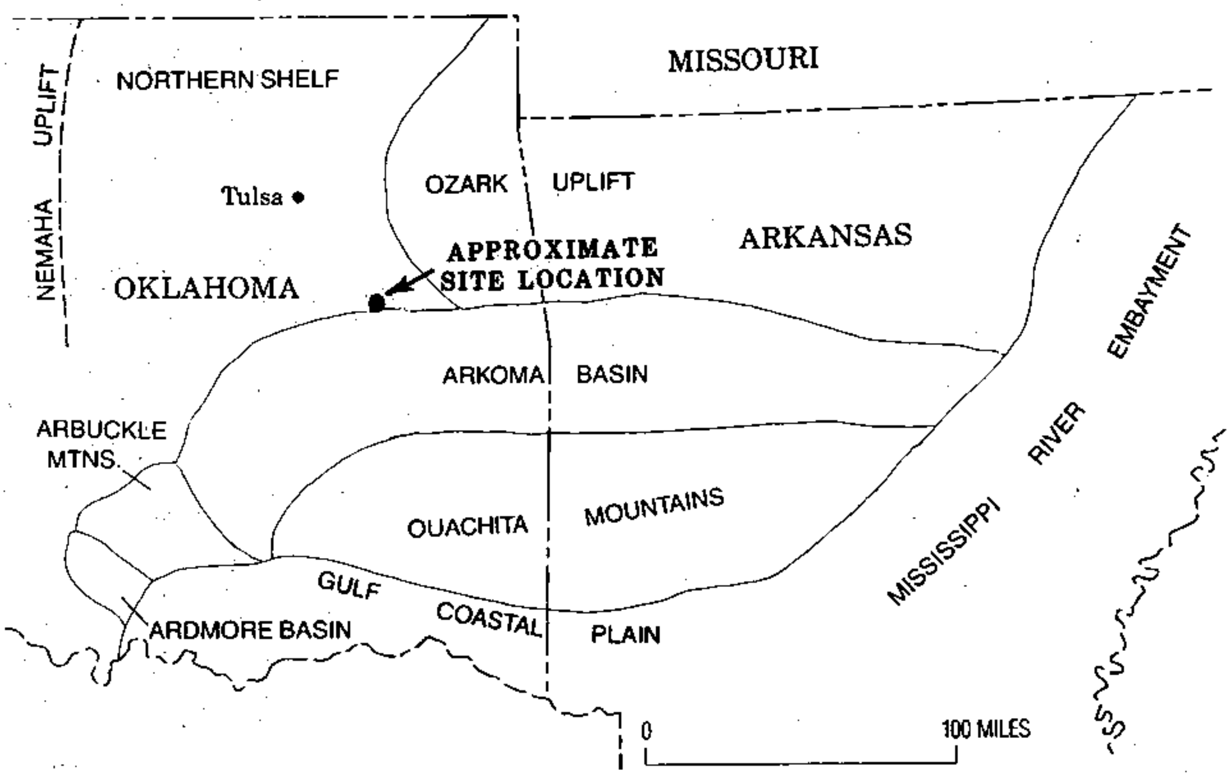


RUST ENVIRONMENT & INFRASTRUCTURE

GENERALIZED GEOLOGIC CROSS SECTIONS IN OKLAHOHMA

FIGURE 4-2



Modified from K.S. Johnson, OGS Guidebook 25, 1988.

RUST ENVIRONMENT & INFRASTRUCTURE

MAJOR GEOLOGIC PROVINCES

FIGURE 4-3

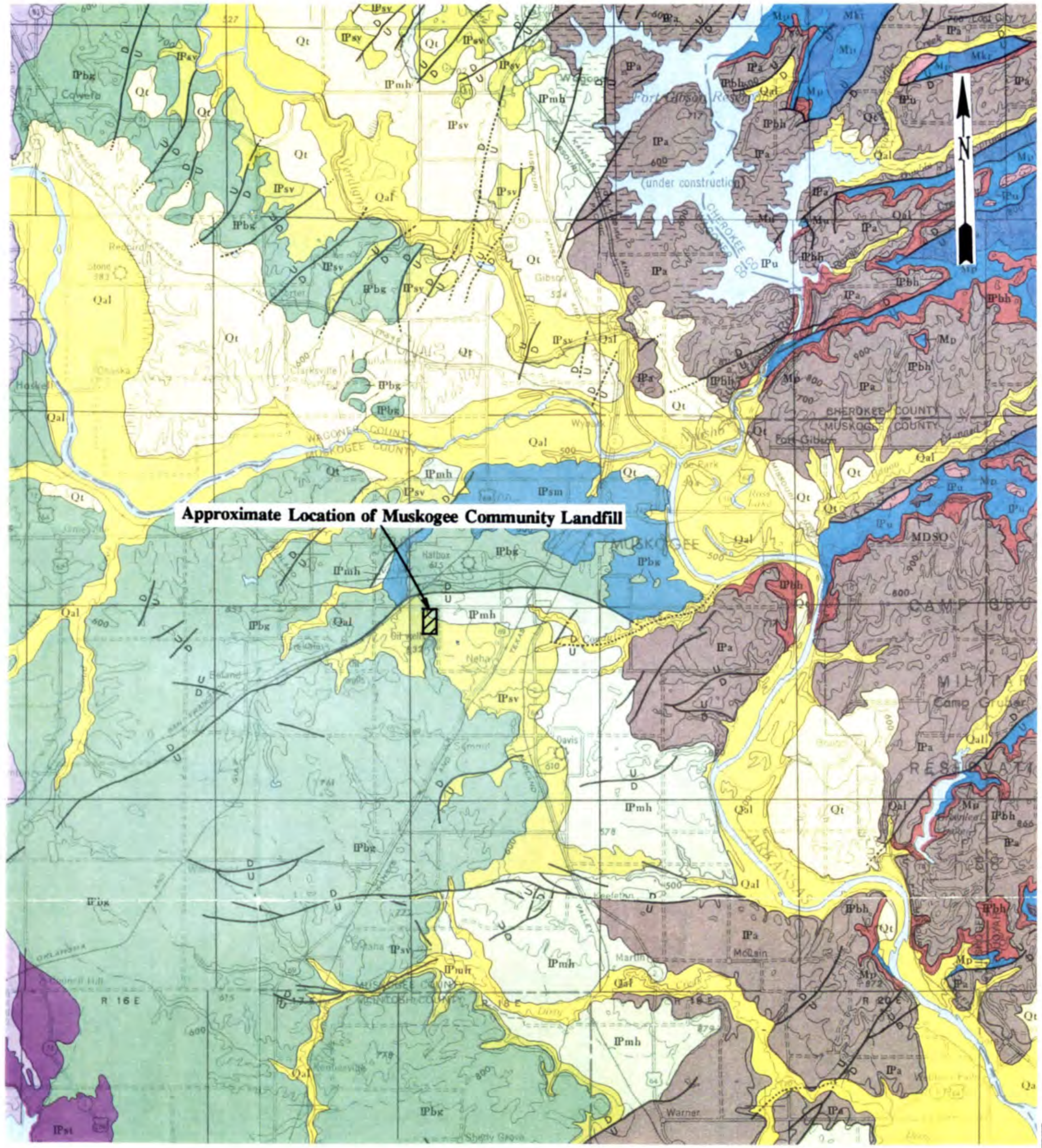
System	Series	Group	Arkoma Basin	Symbol
PENNSYLVANIAN	Desmoinesian	Krebs Gp.	Boggy Fm.	₽bg
PENNSYLVANIAN	Desmoinesian	Krebs Gp.	Savanna Fm.	₽sv
PENNSYLVANIAN	Desmoinesian	Krebs Gp.	McAlester Fm.	₽ma
PENNSYLVANIAN	Desmoinesian	Krebs Gp.	Hartshorne Fm. Upper / Lower	₽hs
PENNSYLVANIAN	Atokan		Atoka Fm.	₽a
PENNSYLVANIAN	Morrowan		Wapanucka Ls. Union Valley Ls. Cromwell ss.	₽m
MISSISSIPPIAN	Chesterian Meramecian Osagean Kinderhookian		"Caney" Sh.	MD
DEVONIAN	Upper		Woodford Sh.	MD
DEVONIAN	Lower	Hunton Gp.	Frisco Ls. Bois d'Arc Ls. Haragan Ls.	DSOhs
SILURIAN	Upper	Hunton Gp.	Henryhouse Fm.	DSOhs
SILURIAN	Lower	Hunton Gp.	Chimneyhill Subgroup	DSOhs
ORDOVICIAN	Upper		Sylvan Sh.	DSOhs
ORDOVICIAN	Upper	Viola Gp.	Welling Fm. Viola Springs Fm.	Ovs
ORDOVICIAN	Middle	Simpson Gp.	Bromide Fm. Tulip Creek Fm. McLish Fm. Oil Creek Fm. Joins Fm.	Ovs
ORDOVICIAN	Lower	Arbuckle Gp.	West Spring Creek Fm. Kindblade Fm. Cool Creek Fm. McKenzie Hill Fm. Butterly Dol.	O€a
CAMBRIAN	Upper	Arbuckle Gp.	Signal Mountain Ls. Royer Dol. Fort Sill Ls.	O€a
CAMBRIAN	Upper	Timbered Hills Gp.	Honey Creek Ls. Reagan Ss.	O€a
PRECAMBRIAN			Granite and rhyolite	p€

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

5 0 5 10 15 20 25 Mi

U.S. Geological Survey, 1967.

Contour interval: 100 feet
Datum: Mean sea level

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.

PENNSYLVANIAN

IPst

STUART SHALE

Shale and minor sandstones. Probably will yield only limited amounts of water of poor quality.

IPt

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.

IPsm IPsv IPmh

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.

IPu IPa IPbh

ATOKA, BLOYD, AND HALE FORMATIONS

- IPu Undifferentiated.
- IPa *Atoka Formation,* shale and sandstone. Yields limited amounts of water of poor quality.
- IPbh *Bloyd 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 Mp Mkr

MISSISSIPPIAN ROCKS ABOVE CHATTANOOGA SHALE

- Mu 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

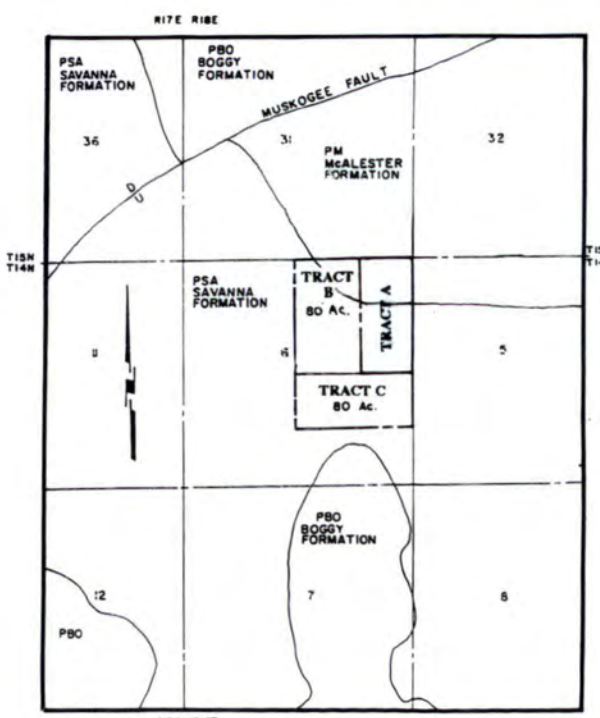
Mississippian and Devonian. *Chattanooga Shale,* shale.

Devonian. *Sallisaw Formation,* limestone, sandstone, and chert; and *Frisco Formation,* limestone.

Silurian. *Quarry Mountain Formation,* limestone; *Tenkiller Formation,* limestone; and *Blackgum 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 *Cotter 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

RUST ENVIRONMENT & INFRASTRUCTURE

REGIONAL GEOLOGIC MAP

FIGURE 4-4

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.

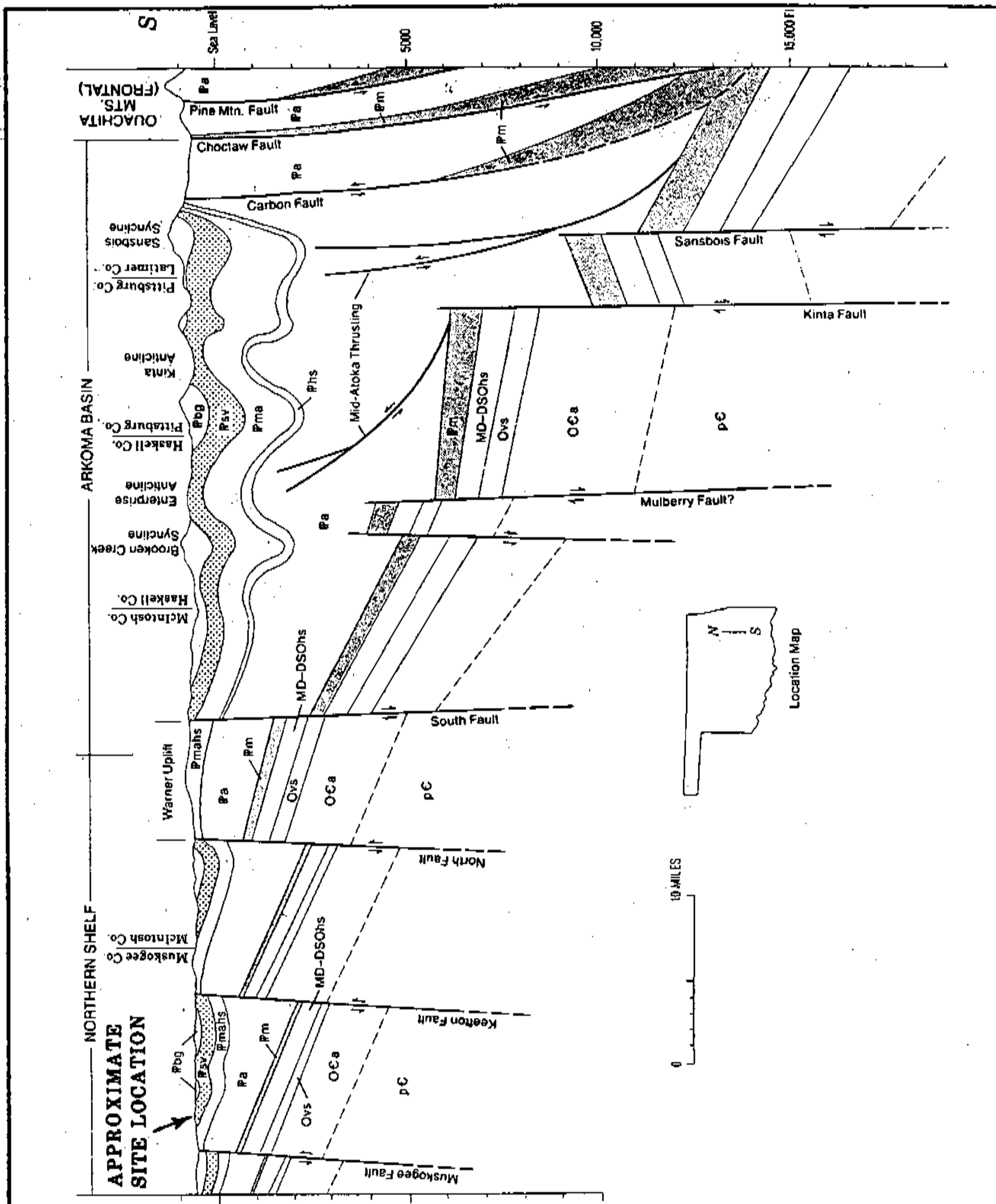
The Oklahoma Geologic Survey indicates two additional faults approximately five miles east of the site (Figure 4-4). One fault trends in a west-southwest to east-northeast direction and the surface expression is concealed in the Quaternary alluvium of Coody Creek. The second fault is in the McAlester 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.



Modified from K.S. Johnson, OGS Guidebook 25, 1988.

RUST ENVIRONMENT & INFRASTRUCTURE

GENERALIZED NORTH-SOUTH STRUCTURAL CROSS SECTION

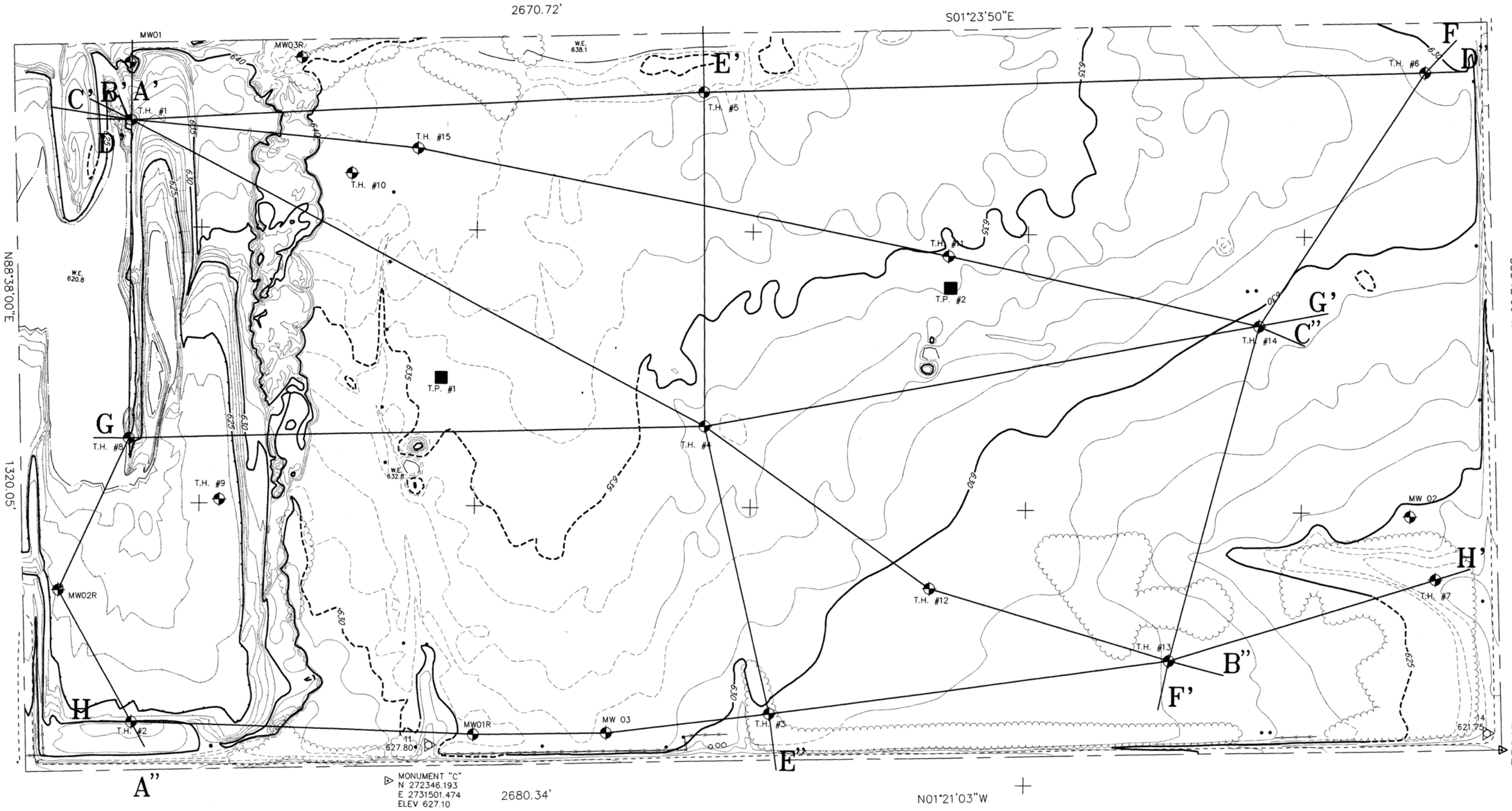
FIGURE 4-5

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.



LEGEND

T.H. #3	PREVIOUS BORING BY POE & ASSOCIATES
E' E"	CROSS SECTION
MW03R	MONITORING WELL BY RUST E & I, POE & ASSOCIATES & STEWART-WHITE & ASSOCIATES
T.P. #2	TEST PIT LOCATION BY POE & ASSOCIATES

NOTE:
CONTOURS REPRESENT TOPOGRAPHY AS OF JUNE, 1992. THE POE & ASSOCIATES. INVESTIGATION WAS PERFORMED IN OCT. 1984

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

NO.	REVISIONS	MADE	CHK	DATE

NAMES		DATE
DRAWN:	E.W.V.	6-1-93
DESIGN:		
CHECKED:		
PE:	G.H.	
APP'D:		
APP'D:		
APP'D:		

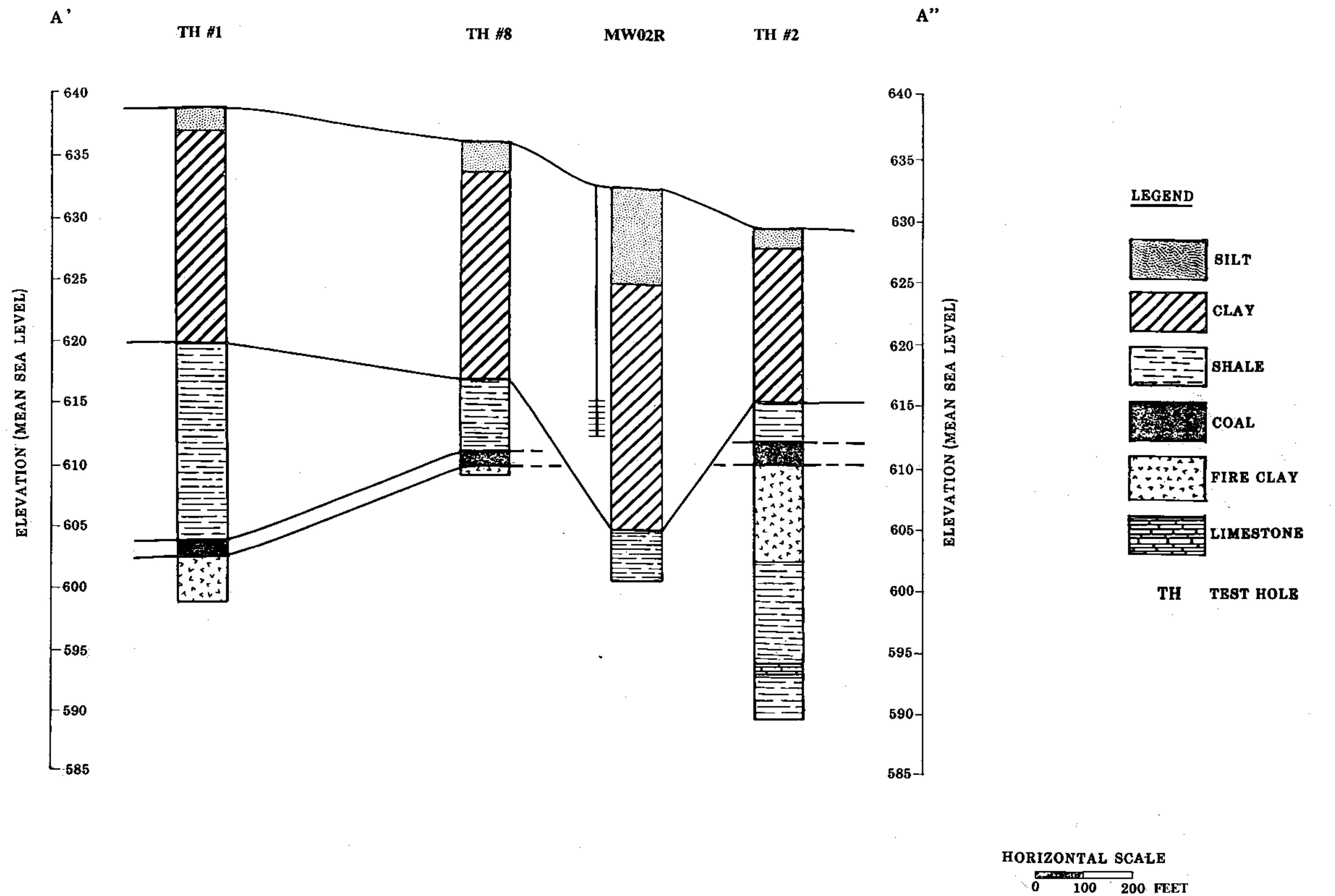
PREVIOUS BORING LOCATION MAP
FIGURE 4-6

MUSKOGEE — MUSKOGEE LANDFILL AND RECYCLING CENTER — OKLAHOMA

RUST ENVIRONMENT & INFRASTRUCTURE

PROJECT NUMBER 86251.125 — DATE 6-1-93
RUST DWG NUMBER 86251-L-02 — FILE NUMBER
CLIENT DWG NUMBER 4-2 — SHEET NUMBER

CAD FILE NAME: 86251L2.DWG
PLOT DATE: 6-1-93

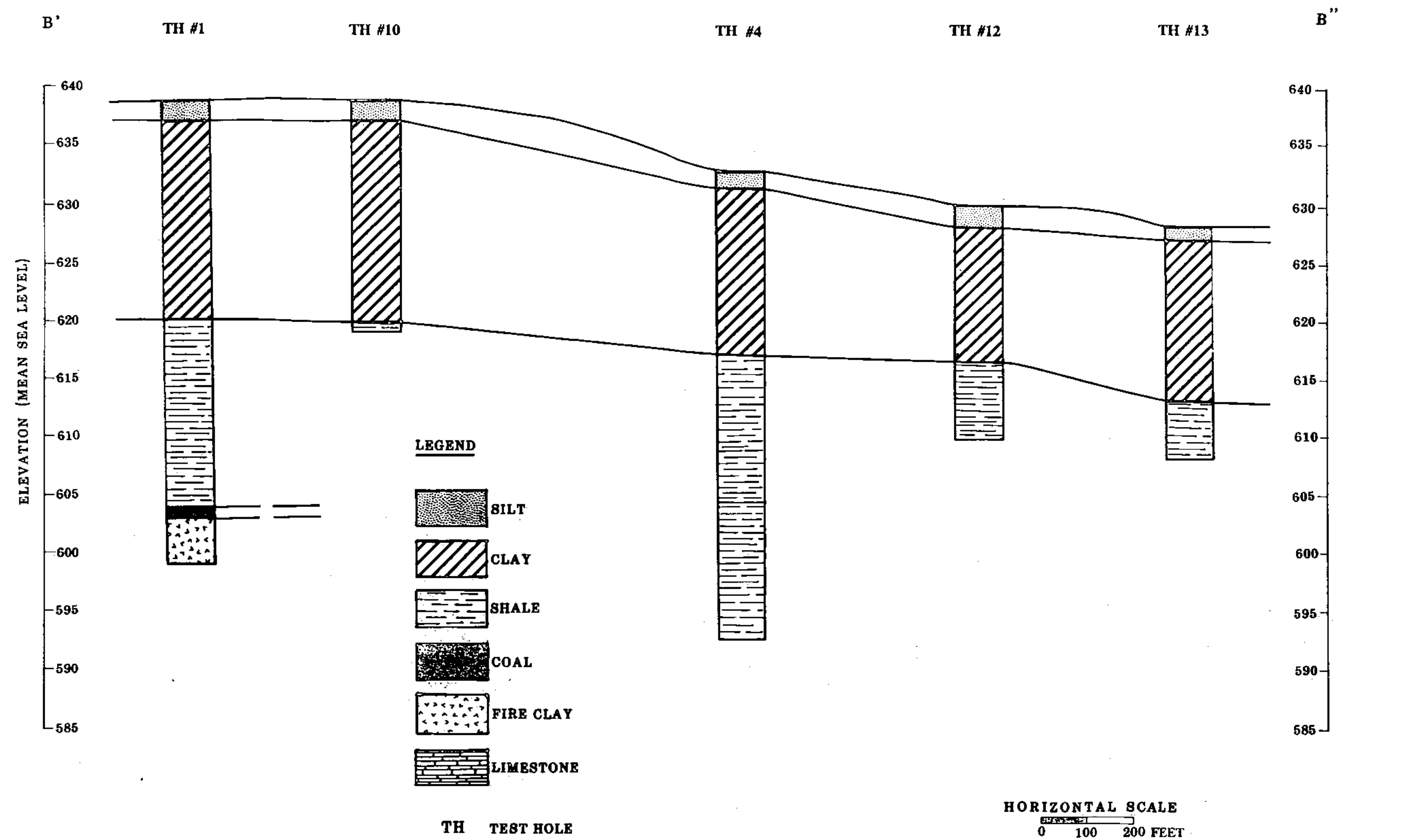


NOTE: THE ELEVATION OF MW02R IS BASED ON CURRENT SURVEYED ELEVATIONS. THE REMAINING TEST HOLE ELEVATIONS ARE BASED ON DATA PROVIDED BY POE AND ASSOCIATES.

RUST ENVIRONMENT & INFRASTRUCTURE

CROSS SECTION A'-A"

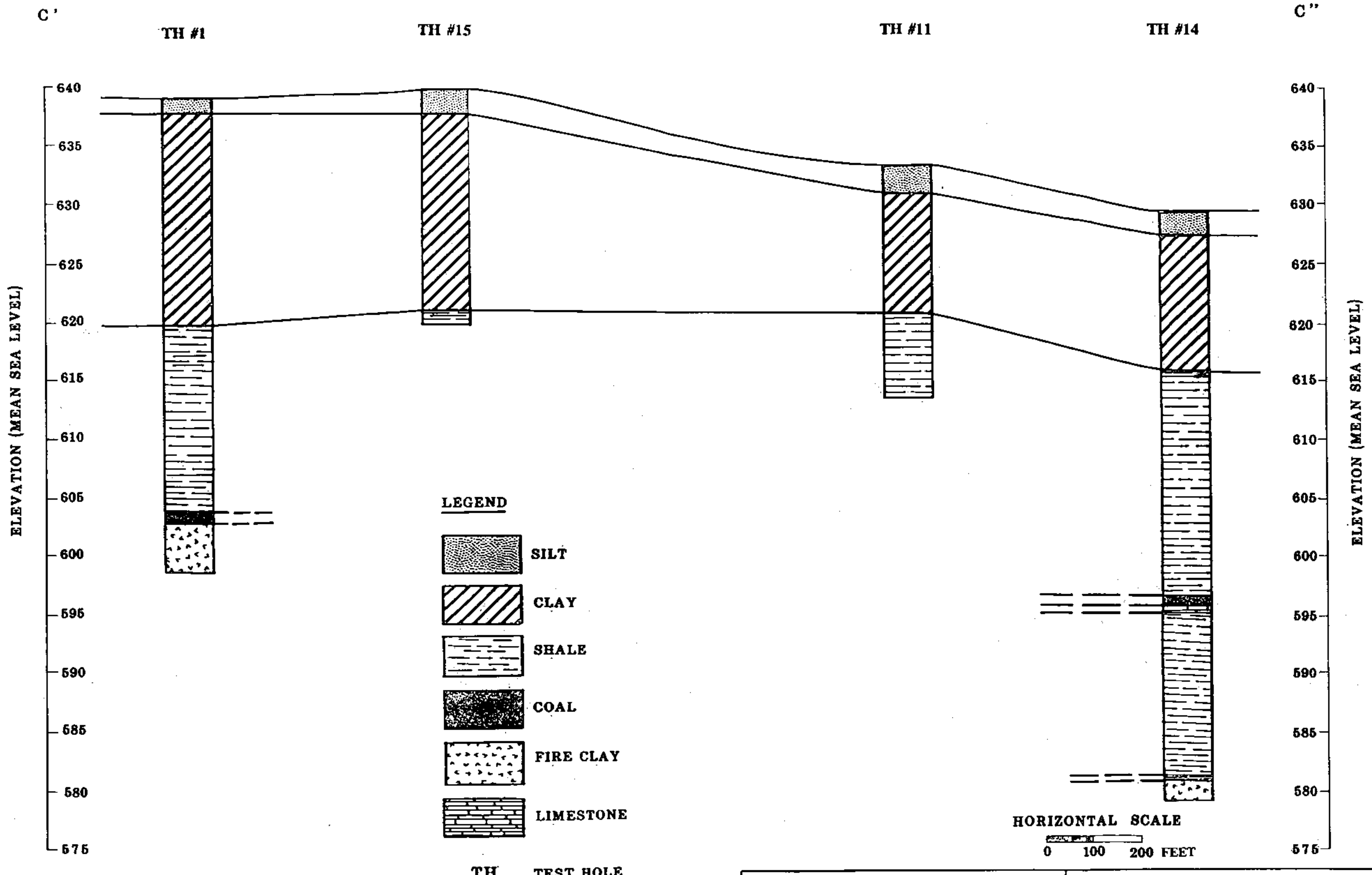
FIGURE 4-7



RUST ENVIRONMENT & INFRASTRUCTURE

CROSS SECTION B'-B"

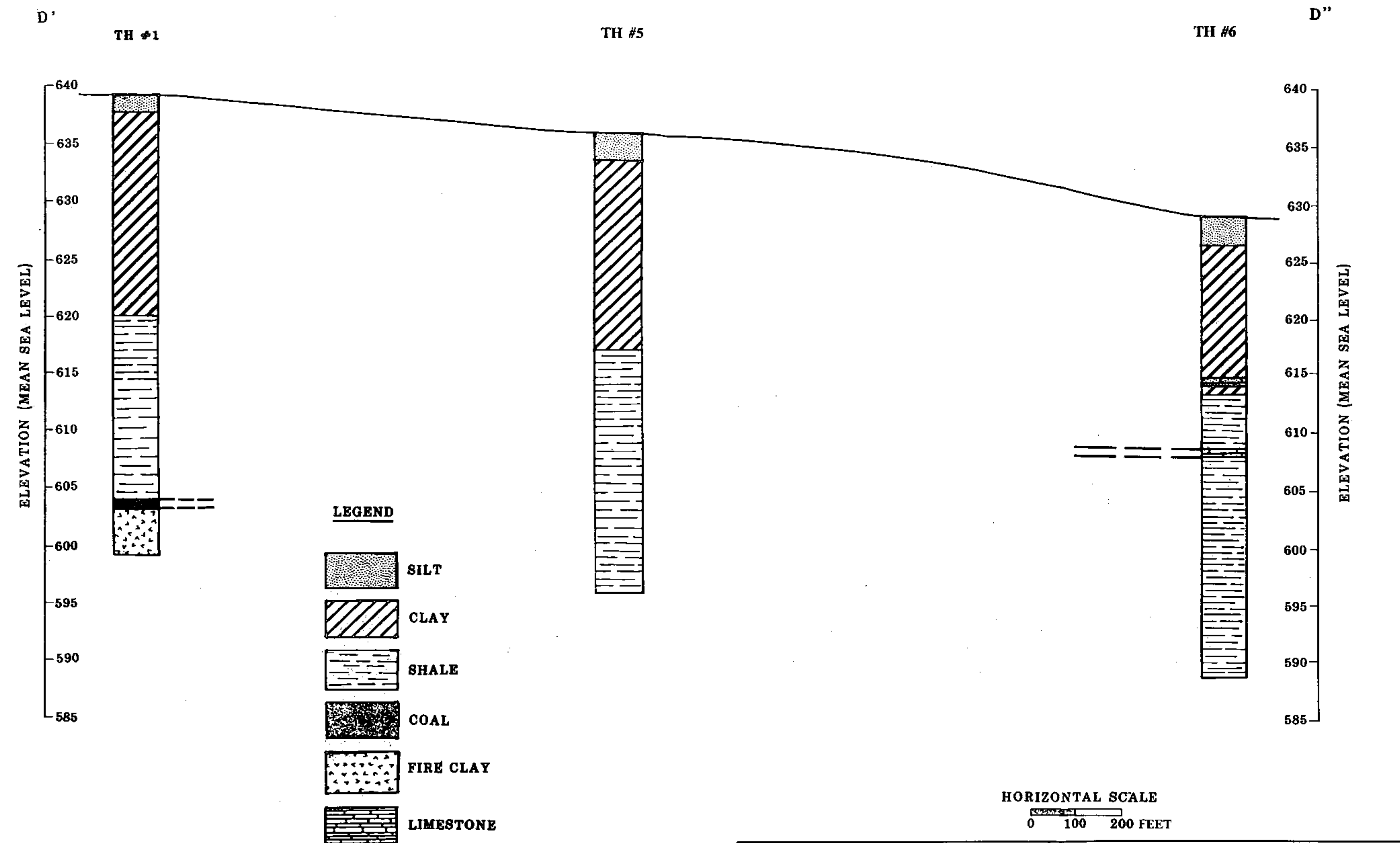
FIGURE 4-8



RUST ENVIRONMENT & INFRASTRUCTURE

CROSS SECTION C'-C"

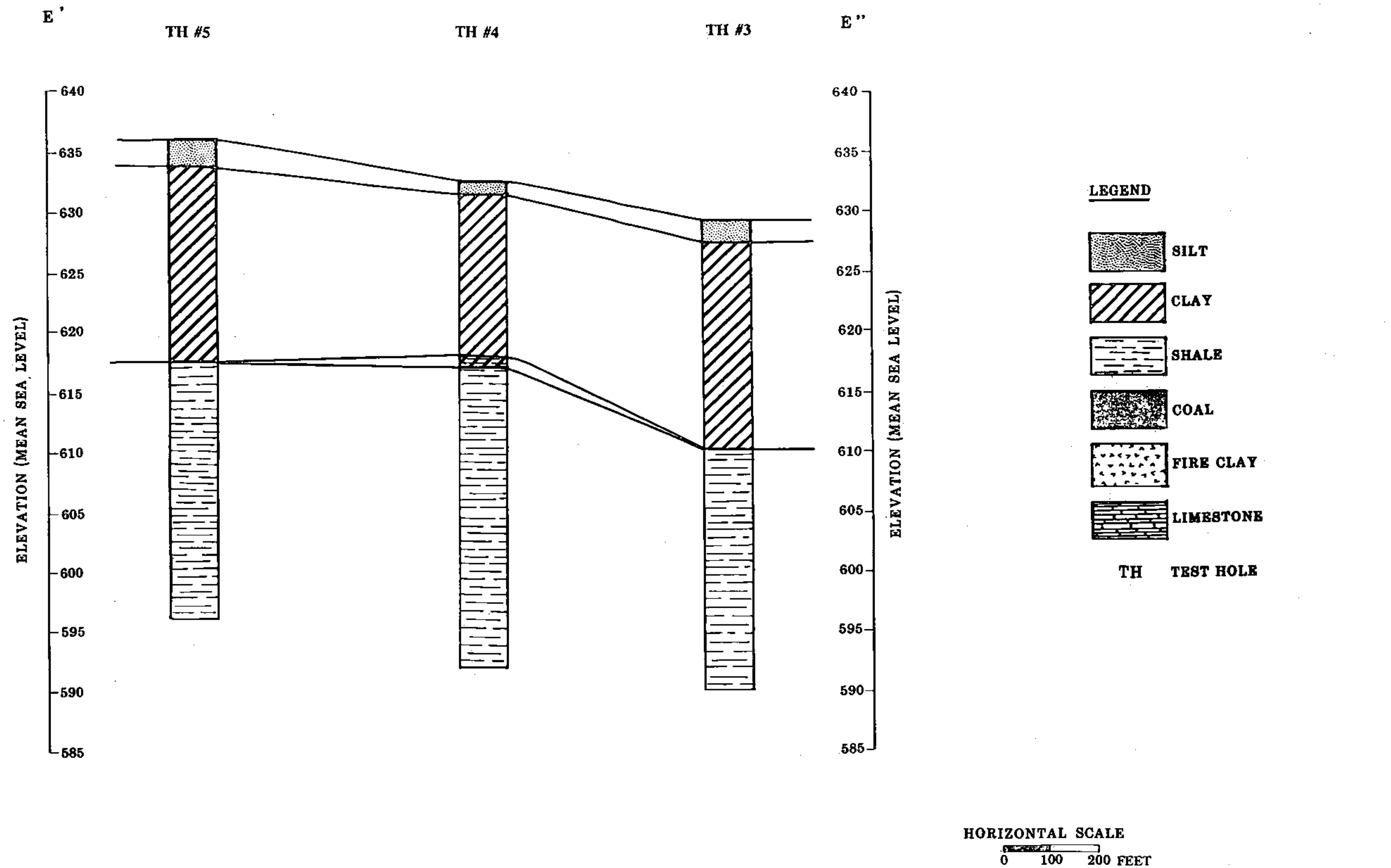
FIGURE 4-9



RUST ENVIRONMENT & INFRASTRUCTURE

CROSS SECTION D'-D"

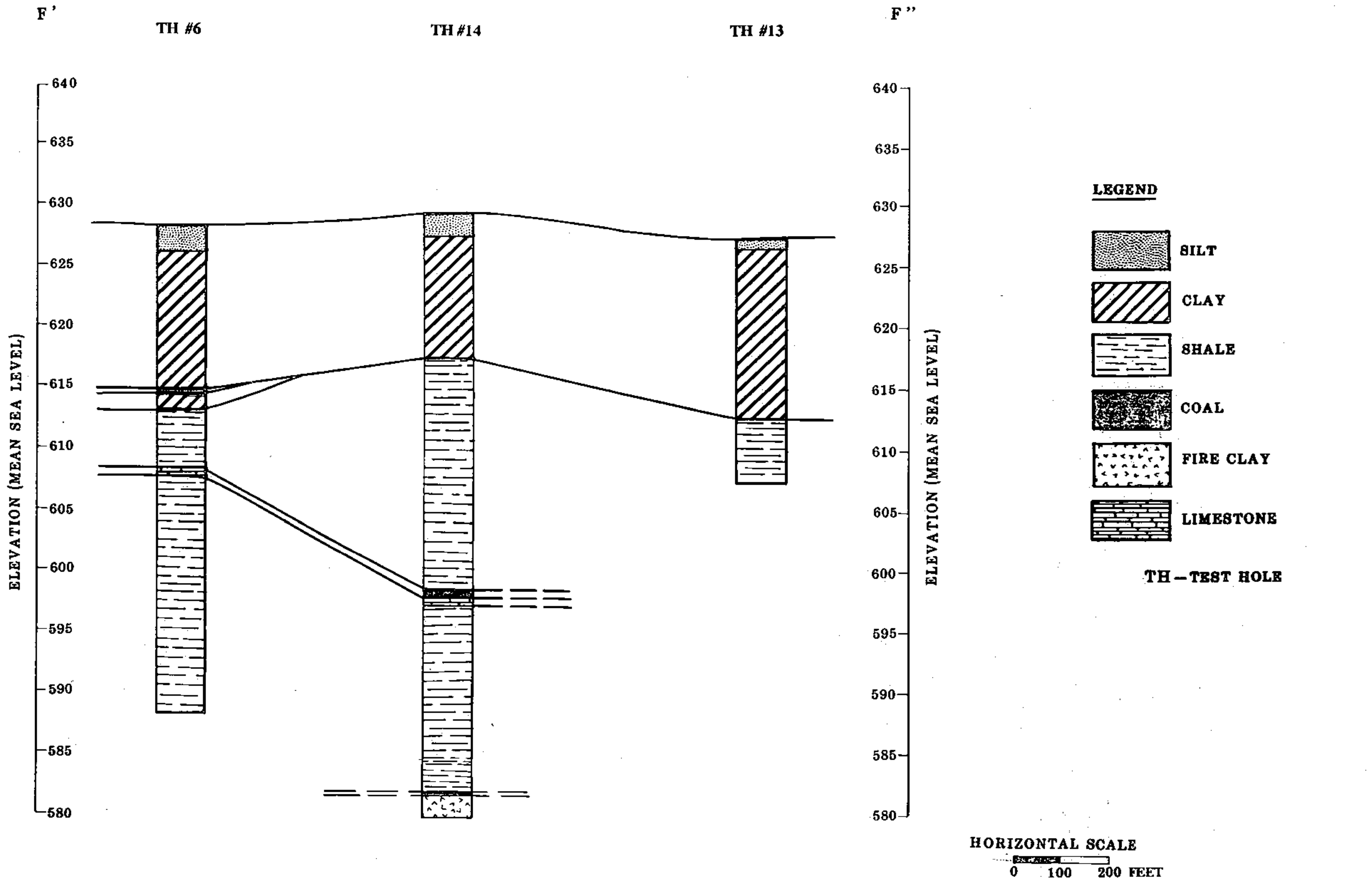
FIGURE 4-10



RUST ENVIRONMENT & INFRASTRUCTURE

CROSS SECTION E'-E"

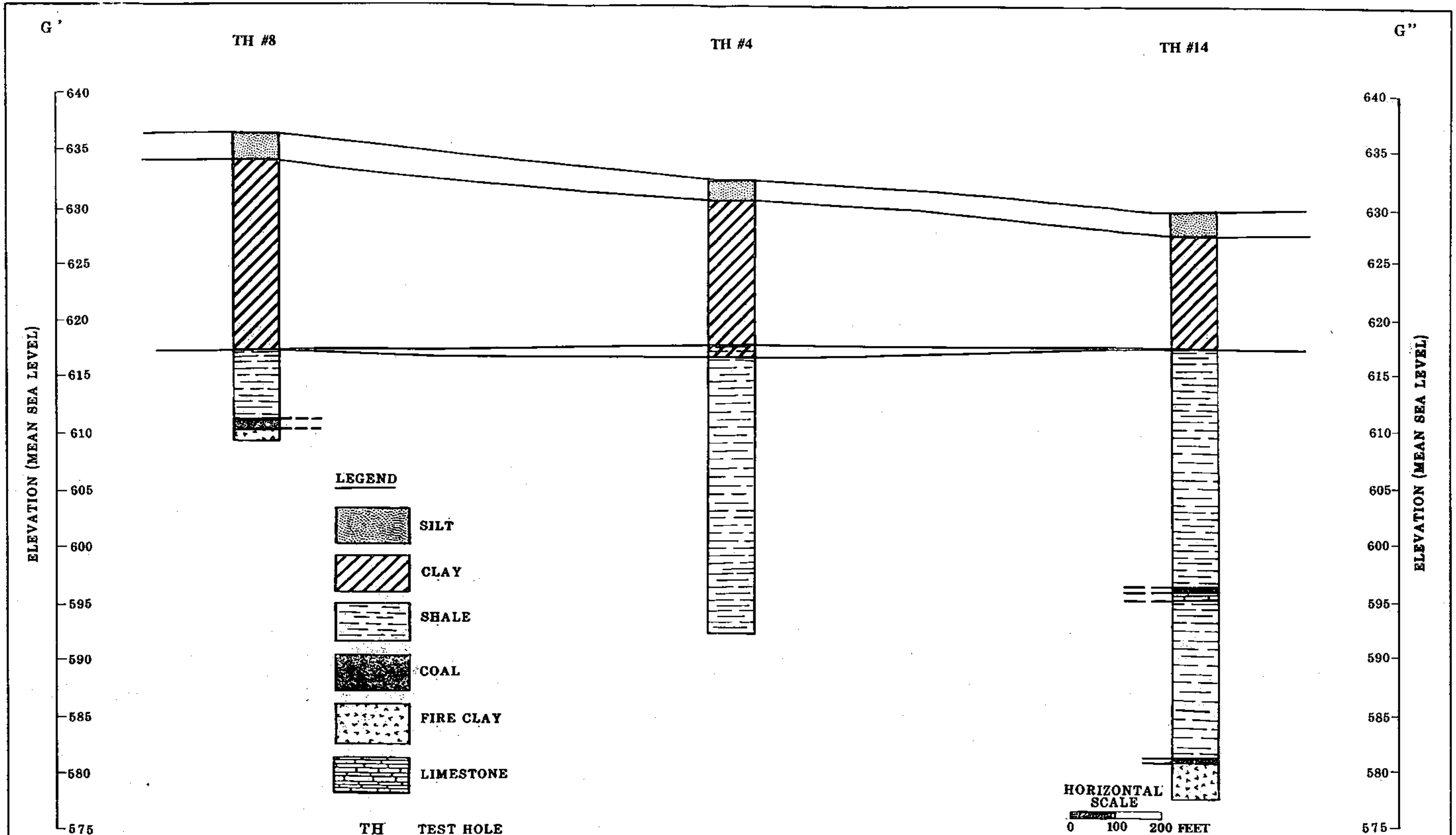
FIGURE 4-11



RUST ENVIRONMENT & INFRASTRUCTURE

CROSS SECTION F'-F"

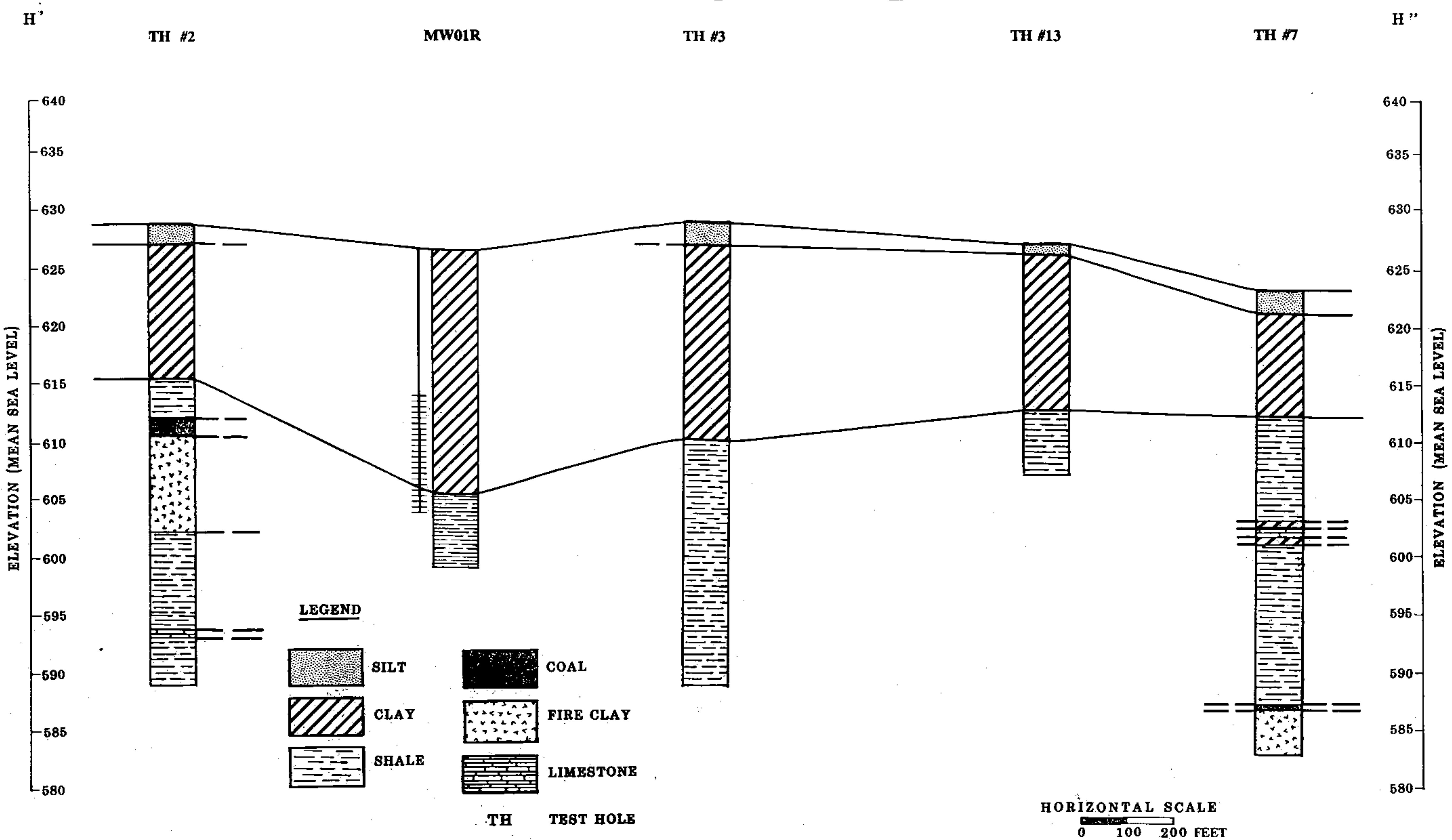
FIGURE 4-12



RUST ENVIRONMENT & INFRASTRUCTURE

CROSS SECTION G'-G"

FIGURE 4-13



NOTE: THE ELEVATIONS OF WELLS MW01R AND MW03 ARE BASED ON CURRENT SURVEYED ELEVATIONS. THE REMAINING TEST HOLE ELEVATIONS ARE BASED ON DATA PROVIDED BY POE AND ASSOCIATES.

RUST ENVIRONMENT & INFRASTRUCTURE

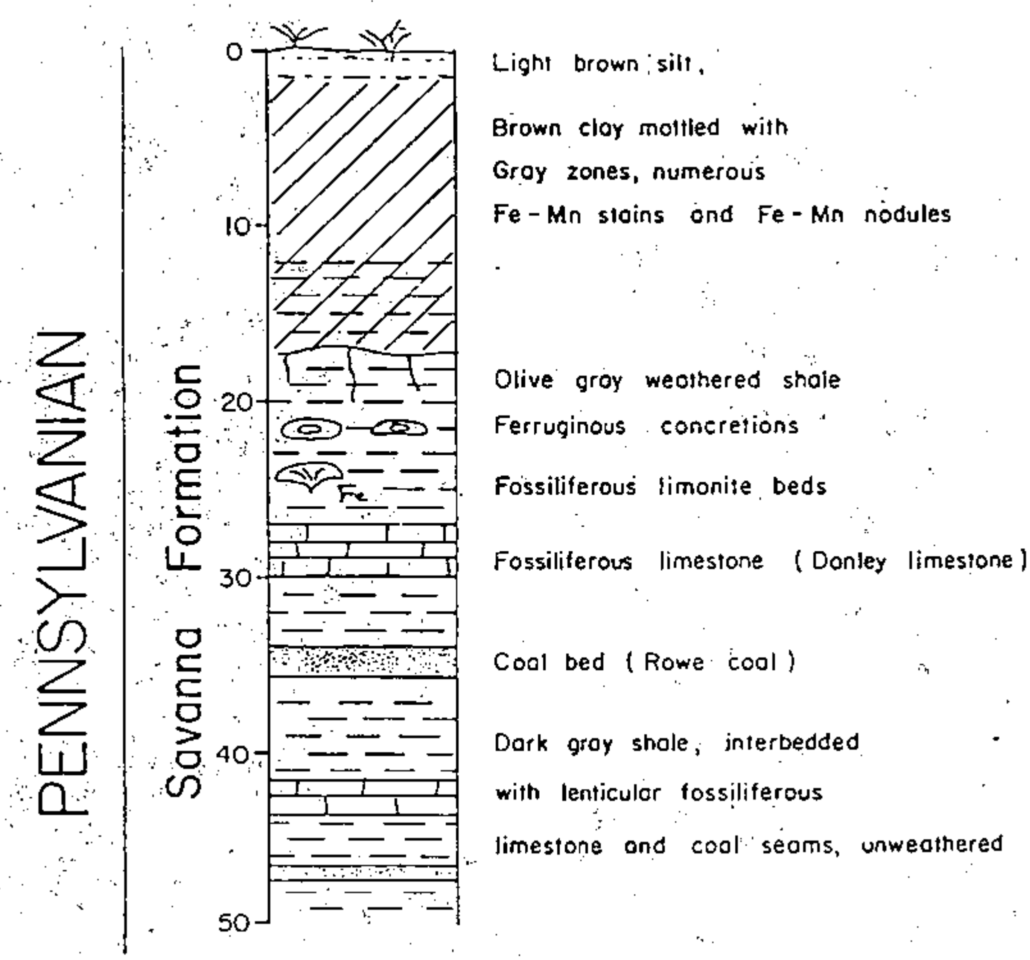
CROSS SECTION H'-H"

FIGURE 4-14

COMPOSITE TYPE SECTION PROPOSED

MUSKOGEE LANDFILL

AGE FORMATION LITHOLOGIC DESCRIPTION



RUST ENVIRONMENT & INFRASTRUCTURE	COMPOSITE STATIGRAPHIC SECTION
POE & ASSOCIATES, INC. 10820 EAST 45TH ST. TULSA, OKLAHOMA 74146 665-8800	DATE 11-8-83 — FIGURE 4-15

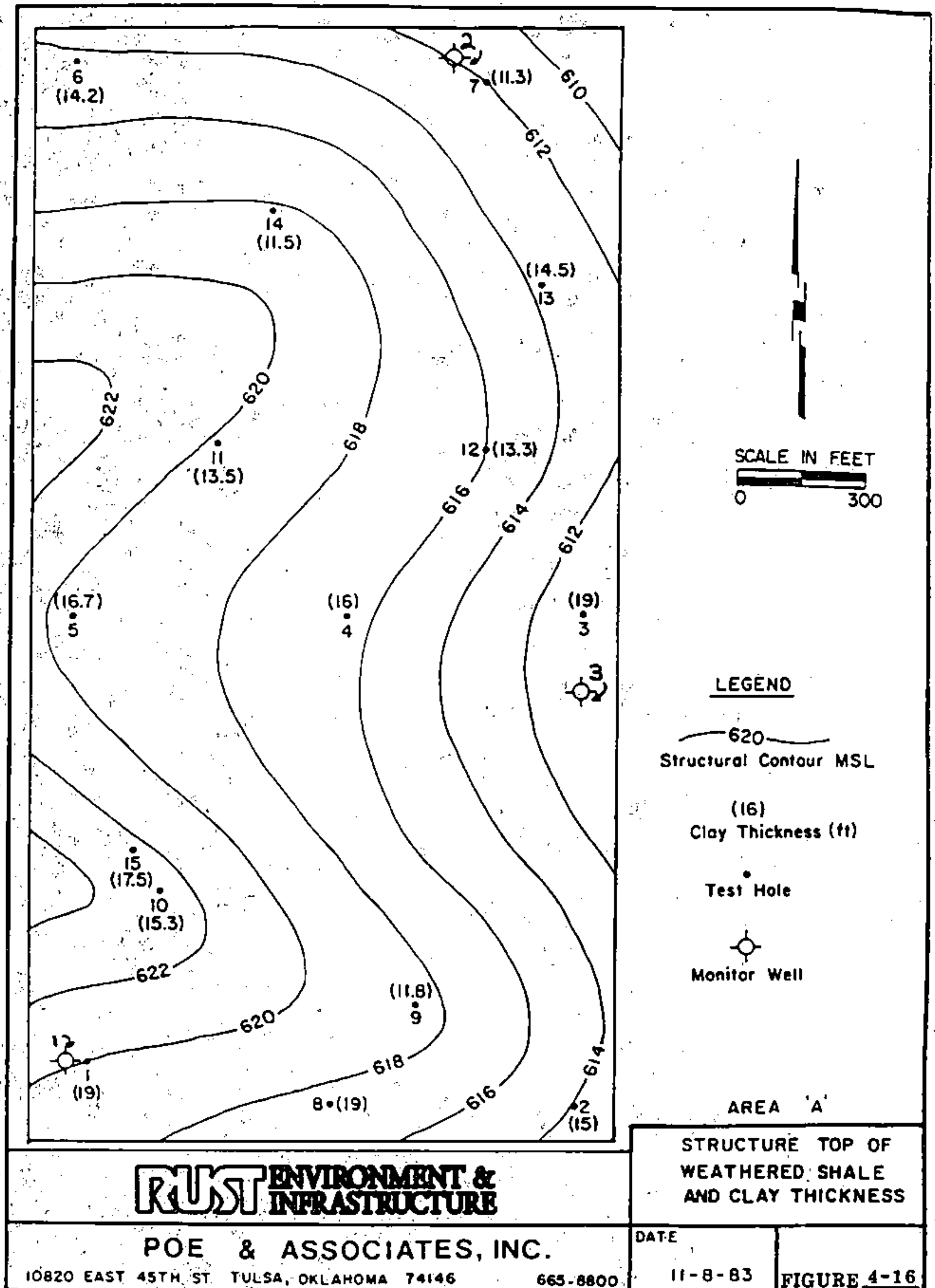
The composite stratigraphic section shows iron-rich concretions and fossiliferous limonite beds which in most cases marks the contact between the clay soil and the weathered shale (Poe and Associates). Figure 4-16, taken from the Poe and Associates report, shows the depth to the top of the weathered 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^{-8} 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).



6
(14.2)
7 (11.3)
610
612
14
(11.5)
(14.5)
13
622
620
11
(13.5)
618
12 (13.3)
616
614
612
(16.7)
5
(16)
4
(19)
3
15
(17.5)
10
(15.3)
622
620
(11.8)
9
618
1
(19)
8 (19)
616
614
2
(15)
SCALE IN FEET
0
300
LEGEND
620
Structural Contour MSL
(16)
Clay Thickness (ft)
Test Hole
Monitor Well
AREA 'A'
STRUCTURE TOP OF WEATHERED SHALE AND CLAY THICKNESS
RUST ENVIRONMENT & INFRASTRUCTURE
POE & ASSOCIATES, INC.
10820 EAST 45TH ST TULSA, OKLAHOMA 74146 665-8800
DATE
11-8-83
FIGURE 4-16

TABLE 4-2

GEOTECHNICAL AND HYDROGEOLOGIC PROPERTIES

LOCATION	SOIL SAMPLE	PERMEABILITY	ATTERBERGS			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^{-6} cm/sec	42	20	22	--	--	Field AStM Std 746
Test Pit 2	Subsoil Clay (10.0 ft)	1.4×10^{-6} 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

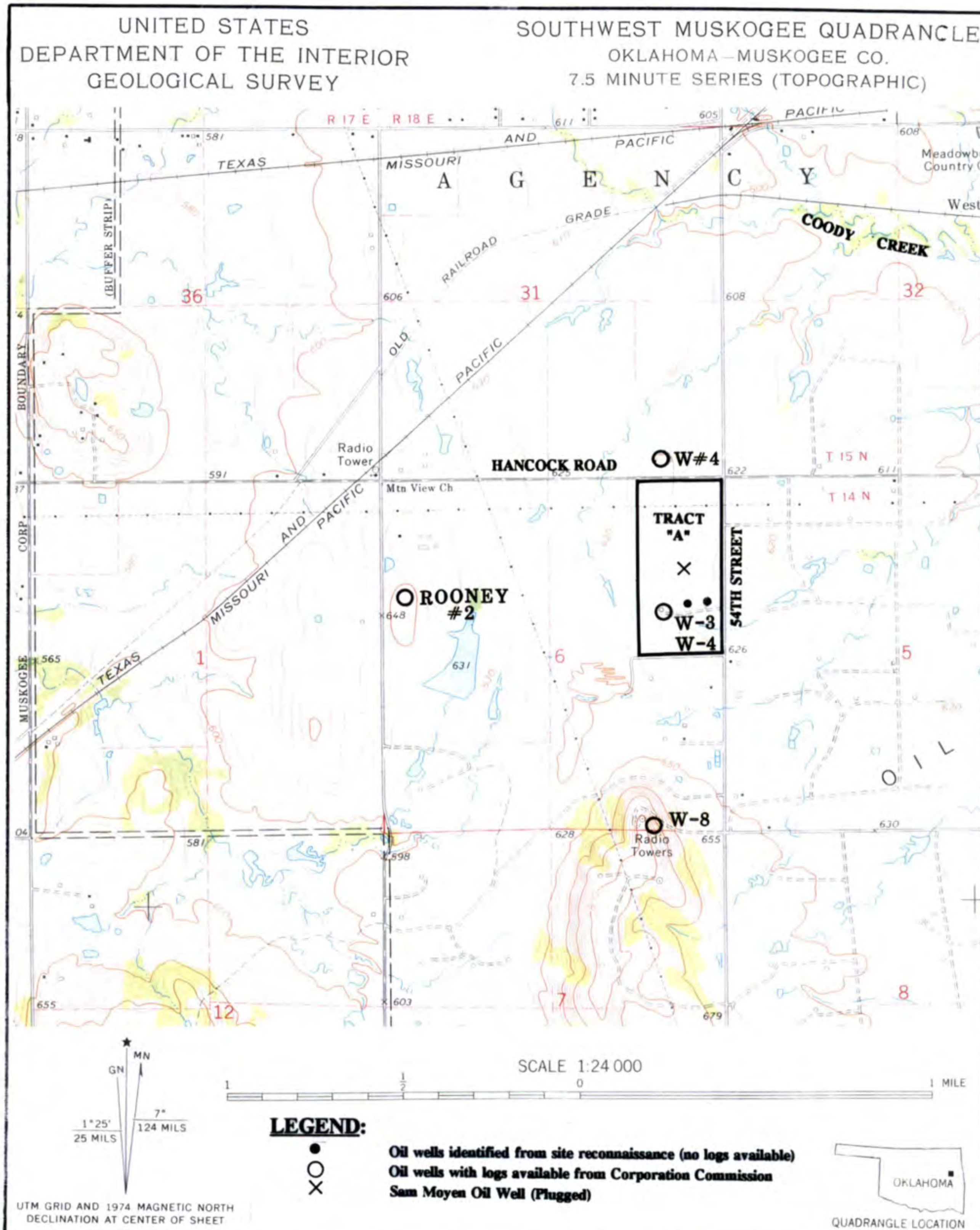
LOCATION	HYDRAULIC CONDUCTIVITY	HYDRAULIC GRADIENT	METHOD
MW02 (Tract A)	8.56×10^{-4} cm/sec	0.007	Rising Head Pump Test
MW03 (Tract A)	1.16×10^{-4} cm/sec	0.005	Rising Head Pump Test
MW04 (Tract C)	6.5×10^{-4} cm/sec	0.01	Rising Head Pump Test

The monitoring wells are screened generally within the weathered shale zone. Rising head pump tests indicate a range of hydraulic conductivities from 1.16 x 10^{-4} cm/sec (MW03) to 8.56 x 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.



RUST ENVIRONMENT & INFRASTRUCTURE

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.

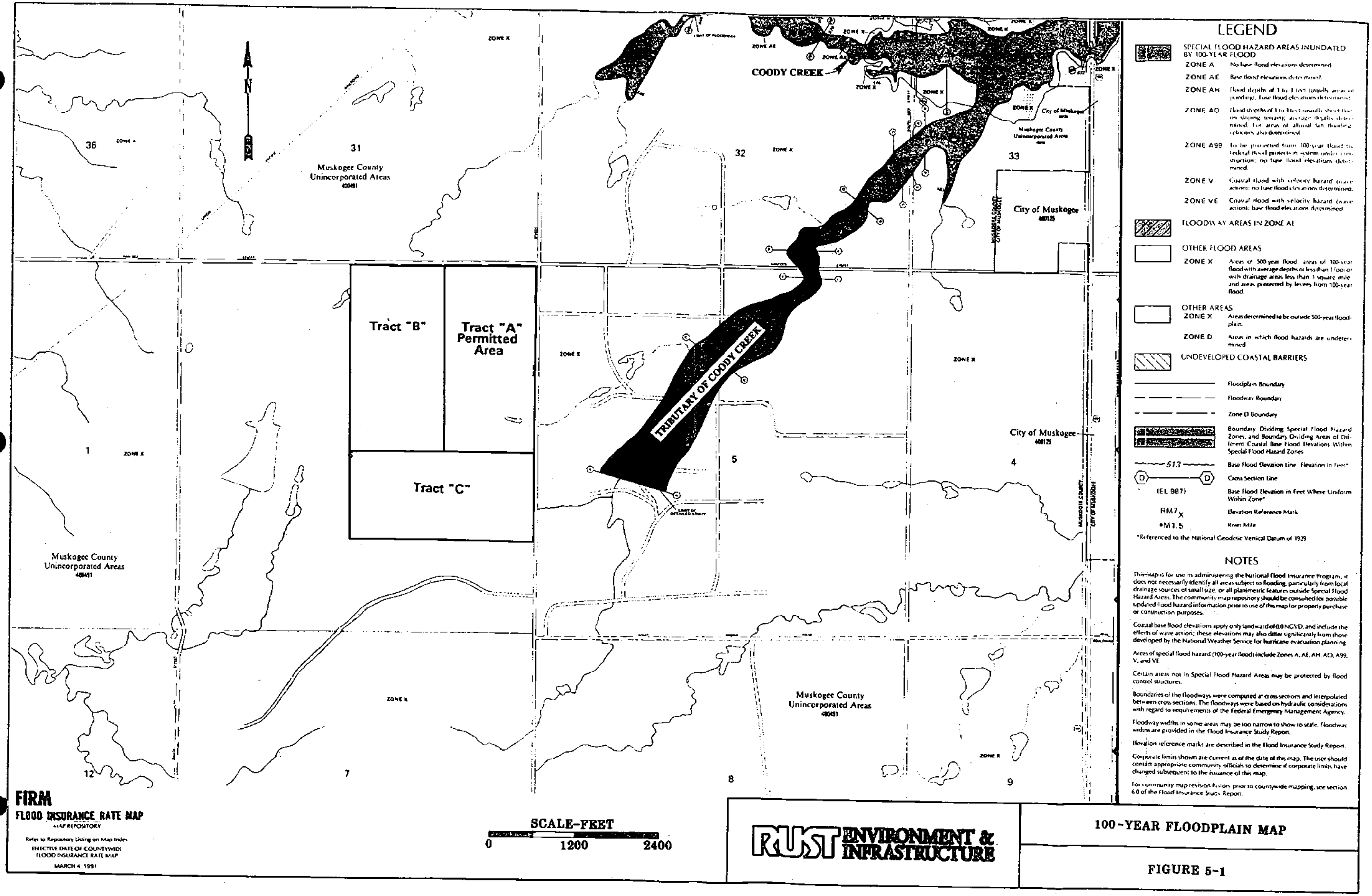
There are no ponds or manmade lakes located within the boundaries of Tract A. The nearest surface water to Tract A is to the west on Tract D with one 10-acre lake and two small ponds. The water from the ponds and lake are used mainly for stock watering. Data compiled by the Oklahoma Water Resources Board 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



LEGEND
SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD
ZONE A
ZONE AE
ZONE AH
ZONE AO
ZONE A99
ZONE V
ZONE VE
FLOODWAY AREAS IN ZONE AE
OTHER FLOOD AREAS
ZONE X
OTHER AREAS
ZONE X
ZONE D
UNDEVELOPED COASTAL BARRIERS
NOTES
COODY CREEK
TRIBUTARY OF COODY CREEK
Tract "B"
Tract "A" Permitted Area
Tract "C"
Muskogee County Unincorporated Areas
City of Muskogee
ZONE X
36
31
32
33
1
5
4
12
7
8
9
FIRM
FLOOD INSURANCE RATE MAP
EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
MARCH 4, 1991
SCALE-FEET
0
1200
2400
RUST ENVIRONMENT & INFRASTRUCTURE
100-YEAR FLOODPLAIN MAP
FIGURE 5-1

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

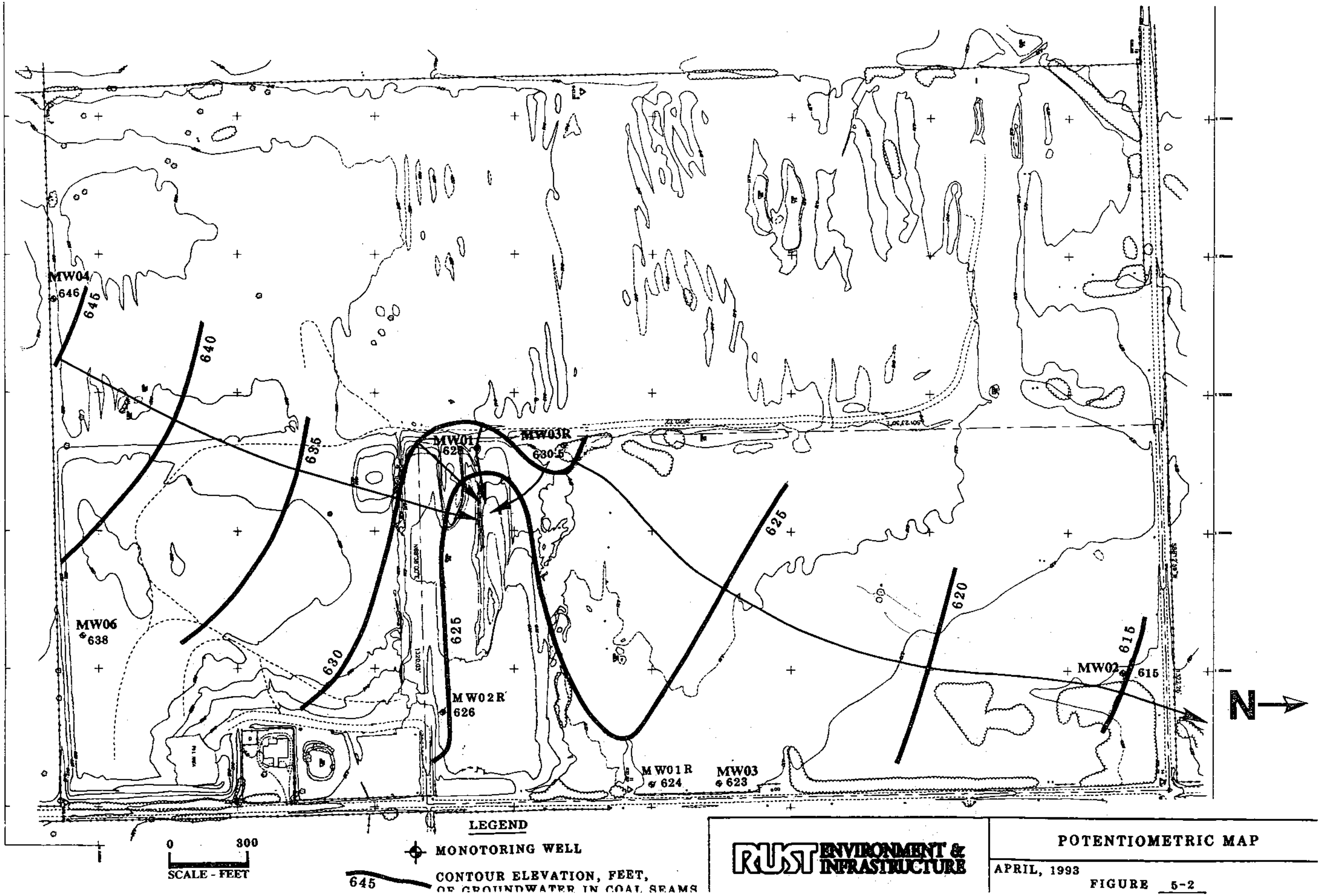
WATER-LEVEL MEASUREMENTS

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

POTENTIOMETRIC MAP

APRIL, 1993

FIGURE 5-2

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 canvasing 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 Celcius

Fevee, 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:

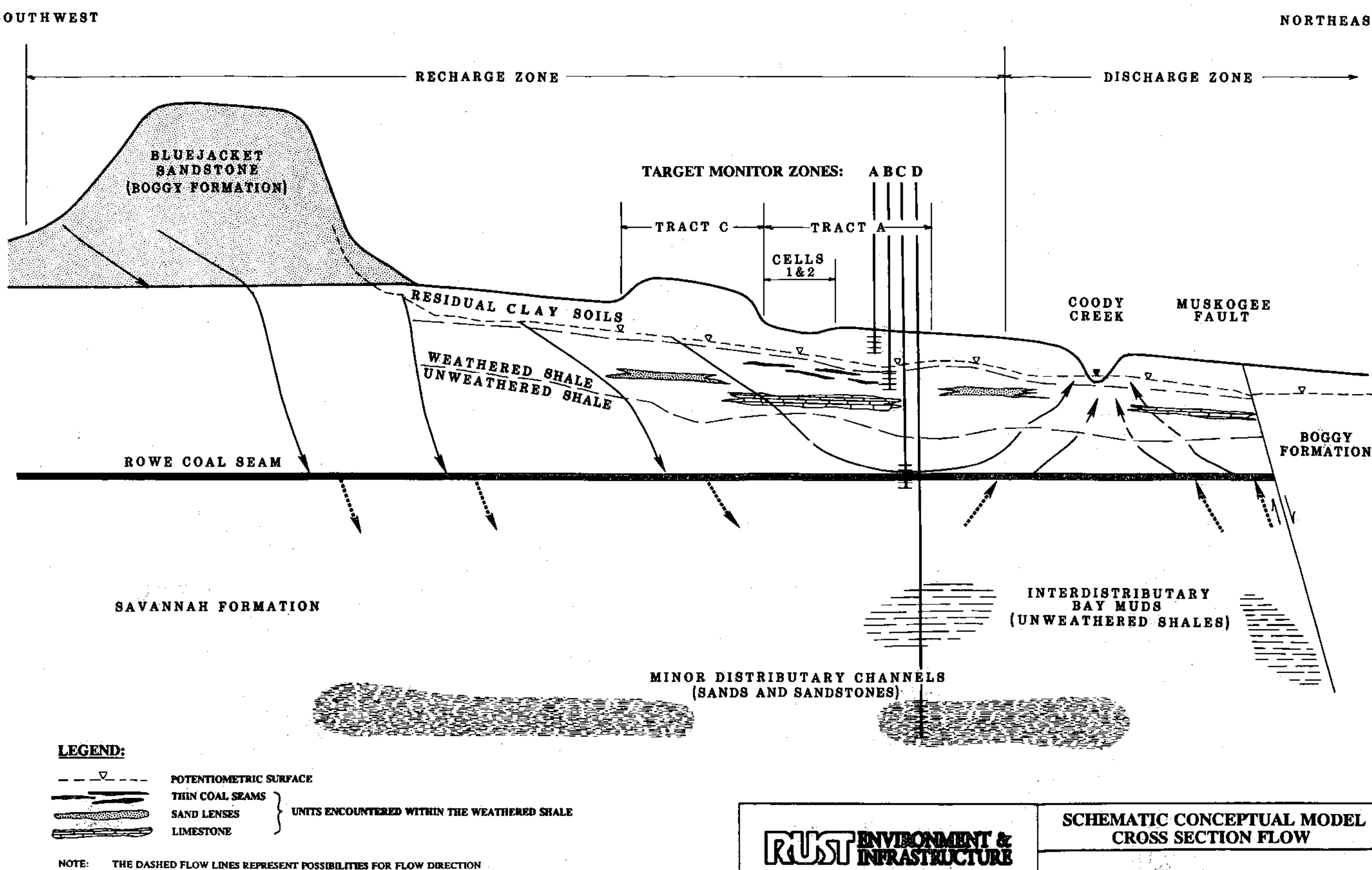
- Hydraulic conductivity,
- Depth to ground water,
- Potentiometric surface,
- Hydraulic gradients, and
- Vertical components of flow.

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.



RUST ENVIRONMENT & INFRASTRUCTURE

SCHEMATIC CONCEPTUAL MODEL CROSS SECTION FLOW

FIGURE 6-1

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^{-6} cm /sec. Laboratory permeabilities were 9.7×10^{-9} 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.

RUST ENVIRONMENT & INFRASTRUCTURE

Formerly SEC Donohue

RUST Environment & Infrastructure Inc.
100 Glenborough, Suite 300
Houston, TX 77067
Tel. (713) 875-0004 • FAX (713) 874-8964

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

Penny P. Carpenter
Project Geologist

cc: Mark Daniels, East Oak
Theresa Talty, WMI-South

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Quality through teamwork

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] $\simeq$ 150
B-6/P-2	586	631	45	Zone C[4] $\simeq$ 50
P-3	586	631	NA[3]	Zone A[4] $\simeq$ 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] $\simeq$ 150
B-14/P-5	587	630	43	Zone C[4] $\simeq$ 50
P-6	587	630	NA[3]	Zone B[4] $\simeq$ 20
P-7	587	630	NA[3]	Zone A[4] $\simeq$ 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] $\simeq$ 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] $\simeq$ 50
P-10	589	641	NA[3]	Zone A[4] $\simeq$ 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.

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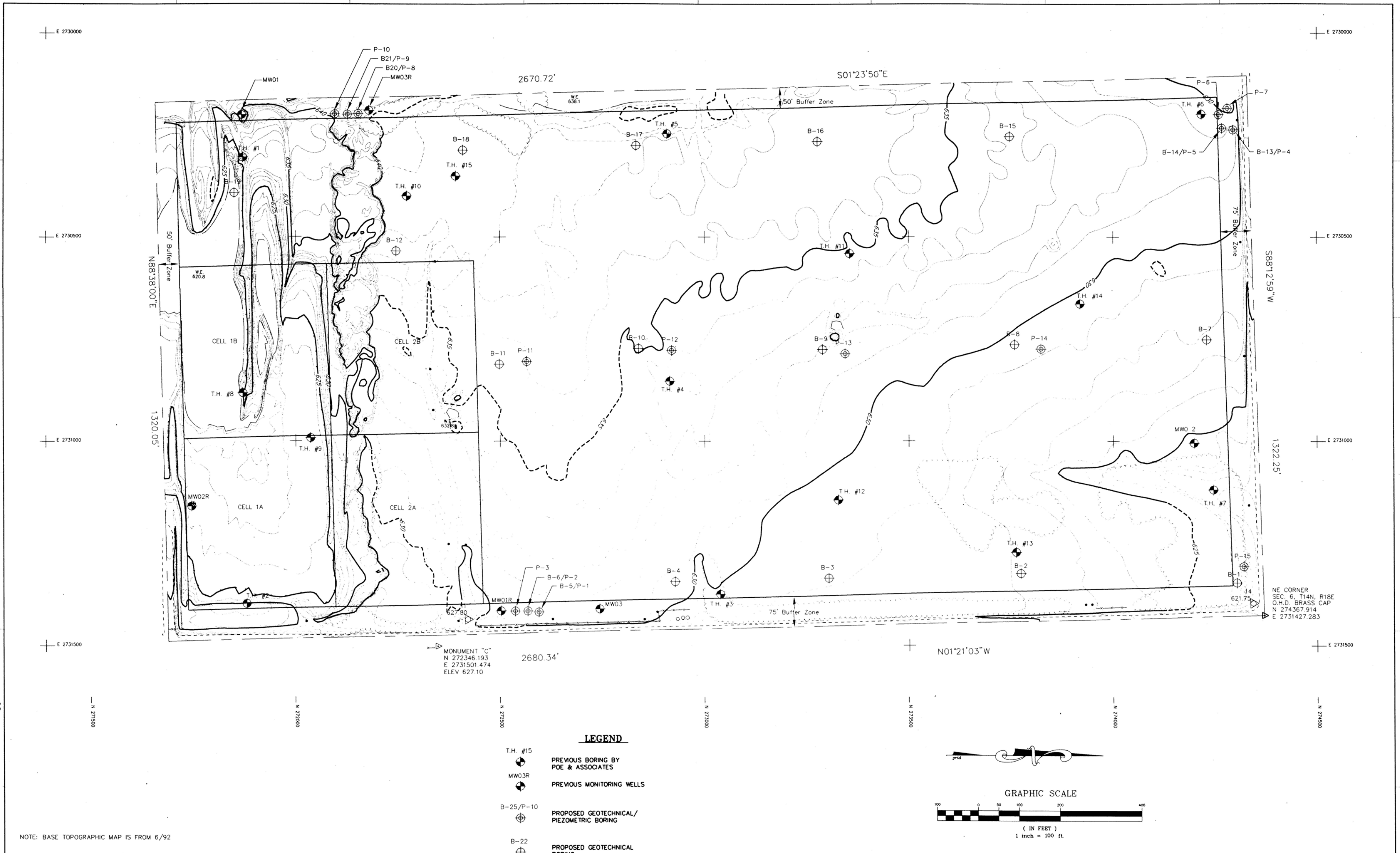

NO.	REVISIONS	MADE	CHK	DATE
1	CHANGE IN PROPOSED PIEZOMETER LOCATIONS, BUFFER ZONE & SEVERAL LOCATIONS OF GEOTECHNICAL BORINGS. ADDITION OF CURRENT LANDFILL CELL LOCATIONS.			
2	CHANGE IN GEOTECHNICAL/PIEZOMETRIC BORING NUMBERS			
3	ADDITION OF (5) PIEZOMETER LOCATIONS (P-11 THRU P-15)			8/12/93

NAMES		DATE
DRAWN:	E.W.V.	6-1-93
DESIGN:		
CHECKED:		
PE:	G.H.	
APP'D:		
APP'D:		
APP'D:		

PROPOSED BORING
LOCATION MAP
FIGURE 7-1

MUSKOGEE LANDFILL AND RECYCLING CENTER
MUSKOGEE OKLAHOMA

RUST ENVIRONMENT & INFRASTRUCTURE

PROJECT NUMBER 86251.125 DATE 6-1-93
RUST DWG NUMBER 86251-L-03 FILE NUMBER
CLIENT DWG NUMBER 7-1 SHEET NUMBER

CAD FILE NAME: 86251L3.DWG
PLOT DATE: 6-1-93

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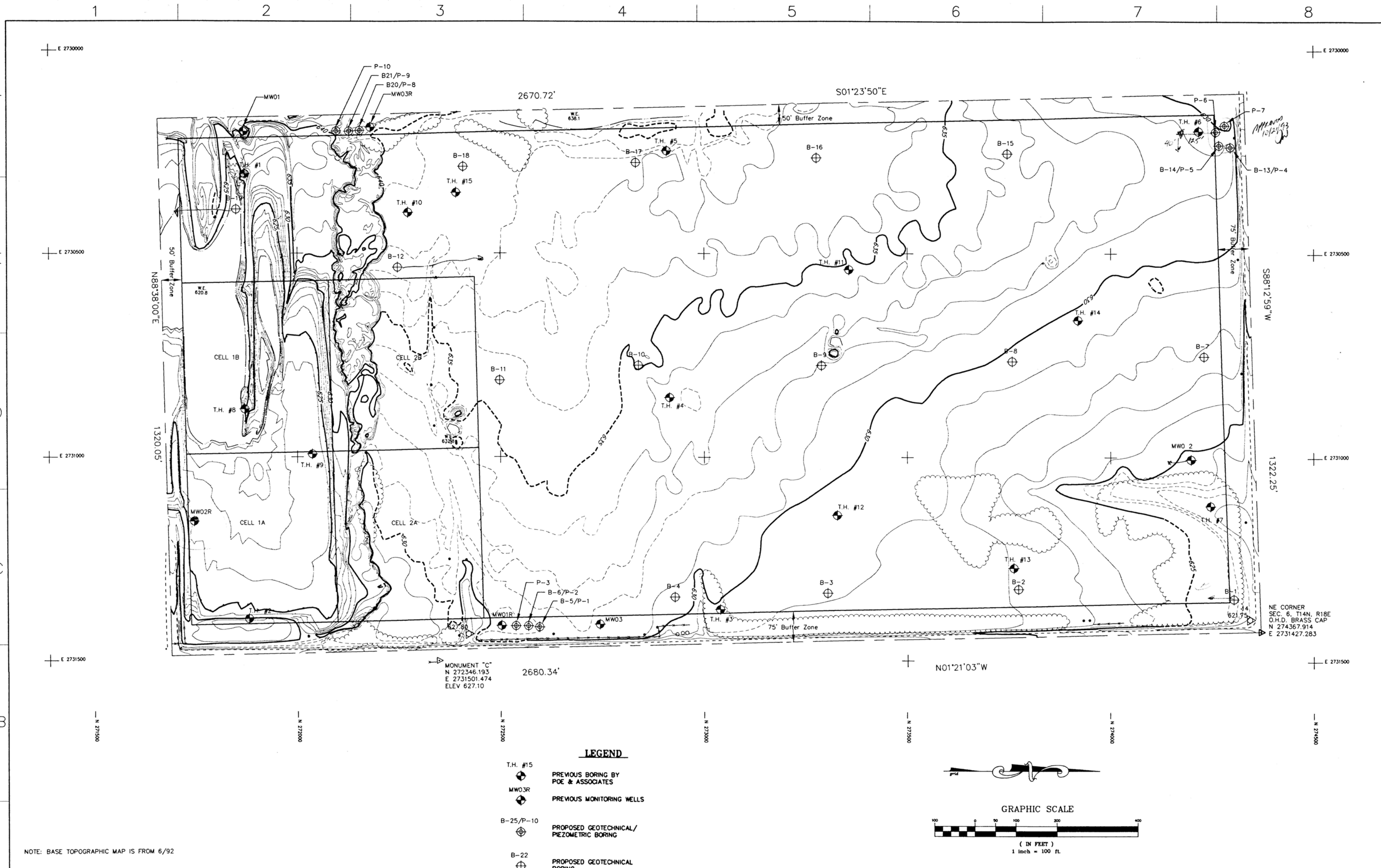

NO.	REVISIONS	MADE	CHK	DATE
1	CHANGE IN PROPOSED PIEZOMETER LOCATIONS, BUFFER ZONE & SEVERAL LOCATIONS OF GEOTECHNICAL BORINGS.			
	ADDITION OF CURRENT LANDFILL CELL LOCATIONS.			
2	CHANGE IN GEOTECHNICAL/PIEZOMETRIC BORING NUMBERS			

	NAMES	DATE
DRAWN:	E.W.V.	6-1-93
DESIGN:		
CHECKED:		
PE:	G.H.	
APP'D:		
APP'D:		
APP'D:		

PROPOSED BORING LOCATION MAP
FIGURE 7-1

MUSKOGEE — MUSKOGEE LANDFILL AND RECYCLING CENTER — OKLAHOMA

RUST ENVIRONMENT & INFRASTRUCTURE

PROJECT NUMBER 86251.125 — DATE 6-1-93
RUST DWG NUMBER 86251-L-03 — FILE NUMBER
CLIENT DWG NUMBER 7-1 — SHEET NUMBER

CAD FILE NAME: 86251L3.DWG
PLOT DATE: 6-1-93

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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.

RQD%	Description of Rock Quality
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] $\simeq$ 150
B-6/P-2	586	631	45	Zone C[4] $\simeq$ 50
P-3	586	631	NA[3]	Zone A[4] $\simeq$ 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] $\simeq$ 150
B-14/P-5	587	630	43	Zone C[4] $\simeq$ 50
P-6	587	630	NA[3]	Zone B[4] $\simeq$ 20
P-7	587	630	NA[3]	Zone A[4] $\simeq$ 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] $\simeq$ 150
B-21/P-9	589	641	52	Zone C[4] $\simeq$ 50
P-10	589	641	NA[3]	Zone A[4] $\simeq$ 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 bls 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.

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Appendix A

SOIL BOREHOLE LOG

SITE NAME AND LOCATION: Muskogee Landfill, Muskogee, Oklahoma	DRILLING METHOD: Hollow-stem augers, 3-¼-inch x 7-inch O.D.	BORING NO. B-1
	SAMPLING METHOD: 24-inch split spoon on 5-foot centers	SHEET 1 OF 1
DATUM N272500.8 E2731415.1 ELEVATION 627.7 ft	WATER LEVEL / TIME / DATE / CASING DEPTH	DRILLING START TIME 14:30 DATE 11/18/92; FINISH TIME 15:30 DATE 11/18/92
DRILL RIG CME 75	SURFACE CONDITIONS: Dozer removed 3 to 4 feet of wet, loose soils so drilling rig could set up over boring location	
ANGLE Vertical BEARING		
SAMPLE HAMMER TORQUE FT.-LBS		

DEPTH IN FEET (ELEVATION)	BLOWS/6 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
0–5			CLAY (CH), tan, homogeneous structure, ferrous nodules, ferrous staining								
5.5	2,4,7										
10.5	5,7,10										
14.5			- interbedded silty clay @ 14.5 feet								
15.5	21,26, 26		- H_2O within interbedded silty clay @ 16 feet, ferrous staining, fossilized plant and animal detritus								
20	33,34 50		- interbedded shale with ferrous staining and weak cementation @ 20 feet, fossilized plant and animal detritus								
21			SHALE, black and gray, weathered, fissile, silt partings, dry								
25.5	24,50		- gray @ 25 feet								
27.5			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.

DRILLING CONTR. Terracon Environmental, Inc.

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DATE 11/18/92

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SOIL BOREHOLE LOG

SITE NAME AND LOCATION	Muskogee Landfill Muskogee, Oklahoma
DATUM	N271744.8 E2731158.9
ELEVATION	632.2 ft
DRILLING METHOD	Hollow-stem Augers, 3½-inch I.D. x 7-inch O.D.
SAMPLING METHOD	24-inch split spoons on five-foot centers
BORING NO.	B-2
SHEET	1 OF 2
DRILL RIG	CME 75
ANGLE	Vertical
BEARING	
SAMPLE HAMMER TORQUE	FT.-LBS
SURFACE CONDITIONS	Level and flat on fill pad

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
CASING DEPTH	NA	NA	NA	NA

DRILLING	START	FINISH
TIME	09:00	10:00
DATE	11/18/92	11/18/92

DEPTH IN FEET (ELEVATION)	BLOWS/6 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
			FILL, silty clay, tan								
2			- dark brown @ 2 ft								
4	push		- silty sand intermixed with clay @ 3 ft								
6			- silty clay @ 6 ft								
8											
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_2O within 1-inch claystone layer @ 20 ft, silt partings, ferrous staining								
22											
24											
26	7,12,15										
28			SHALE, blue gray, weathered, fissile, dry								

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SOIL BOREHOLE LOG

SITE NAME AND LOCATION Muskogee Landfill Muskogee, Oklahoma	DRILLING METHOD: Hollow-stem augers, 3¼-inch I.D. x 7-inch O.D. SAMPLING METHOD: 24-inch split spoons on 5-foot centers	BORING NO. B-2 SHEET 2 OF 2
DATUM ELEVATION	WATER LEVEL / TIME / DATE / CASING DEPTH	DRILLING START TIME 09:00 DATE 11/18/92; FINISH TIME 10:00 DATE 11/18/92
DRILL RIG	SURFACE CONDITIONS	
ANGLE BEARING		
SAMPLE HAMMER TORQUE FT.-LBS		

DEPTH IN FEET (ELEVATION)	BLOWS/6 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
	21,50		SHALE, blue gray, silty, weathered, fissile, dry								
32			TOTAL DEPTH @ 31 feet								
34			BOTTOM ELEVATION @ 601.2 feet								

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SOIL BOREHOLE LOG

SITE NAME AND LOCATION	Muskogee Landfill Muskogee, Oklahoma
DRILLING METHOD:	Hollowstem Augers, 3¼-inch I.D. x 7-in O.D.
SAMPLING METHOD:	24-inch split spoons on 5-foot centers
BORING NO.	B-3
SHEET	1 OF 2
DATUM	N272179.4 E2730189.7
ELEVATION	641.5 ft
DRILL RIG	CME 75
ANGLE	Vertical
BEARING	
SAMPLE HAMMER TORQUE	FT.-LBS
SURFACE CONDITIONS	Wet and muddy

WATER LEVEL	14.5			
TIME	10:04			
DATE	11/19			
CASING DEPTH	n/a			

DRILLING	START	FINISH
TIME	0900	1035
DATE	11/19/92	11/19/92

DEPTH IN FEET (ELEVATION)	BLOWS/6 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, 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											

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SOIL BOREHOLE LOG

SITE NAME AND LOCATION	Muskogee Landfill Muskogee, Oklahoma
DRILLING METHOD:	Hollowstem Augers, 3½-inch I.D. x 7-inch O.D.
SAMPLING METHOD:	24-inch split spoons on 5-foot centers
BORING NO.	B-3
SHEET	2 OF 2
DRILLING START TIME	09:00
DRILLING FINISH TIME	10:35
DRILLING START DATE	11/19/92
DRILLING FINISH DATE	11/19/92
WATER LEVEL	14.5
TIME	10:04
DATE	11/19
CASING DEPTH	N/A
DATUM	
ELEVATION	
DRILL RIG	
ANGLE	
BEARING	
SAMPLE HAMMER TORQUE (FT.-LBS)	
SURFACE CONDITIONS	Wet and Muddy

DEPTH IN FEET (ELEVATION)	BLOWS/ 6 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
	7,9, 16		CLAY (CH)								
32			- H_2O within 1-inch coal seam @ 30 feet								
34			- Coal seams, 32 to 35 feet								
36	21,50		SHALE, blue gray, weathered, fissile, dry								
38											
	50										
40											
42			TOTAL DEPTH @ 39.5 feet BOTTOM ELEVATION @ 602.00 feet								

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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 <u>BASE</u> 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

Test Hole	Surface Elev.MSL	Depth of Hole (ft.)	Clay Thickness (ft.)	Top Weathered Shale MSL	Top Coal MSL	Top Unweathere Shale M
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	--	--	--

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PE #7966
TULSA, OKLAHOMA
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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'

ELEV	DEPTH	DESCRIPTION OF MATERIAL TYPE, TEXTURE, COLOR, CONSISTENCY
	1.2	Silt, sandy, brown
	1.8	Silt, sandy, clayey, brown
	4.7	Clay, sandy, silty, brown to tan w/traces of red
	8.6	Clay, sandy, brown to tan w/yellow & traces of grey
	11.0	Clay, tan to yello w/grey
	19.2	Clay, slightly sandy, yellow w/grey
	24.0	Shale, weathered, tan to grey
	25.7	Shale, black
	27.2	Shale, tan to grey, soft
	33.5	Shale, black, moist
	34.7	Shale, blue, grey
	35.7	Coal 12"
	40.0	Fireclay

PENETRATION TEST		
FROM	TO	BLOWS

SHELBY TUBES		
NO.	FROM	TO

CORING		
FROM	TO	LOSS

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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'

ELEV	DEPTH	DESCRIPTION OF MATERIAL TYPE, TEXTURE, COLOR, CONSISTENCY
	2.0	Silt, sandy, brown.
	3.4	Clay, sandy, brown to tan w/traces of grey
	9.4	Clay, sandy, tan to yellow w/grey
	13.5	Clay, yellow w/grey
	17.0	Shale, weathered, tan to grey w/clayey layers
	18.5	Coal, smutty (cropline), wet
	27.0	Fireclay
	34.5	Shale, grey w/occas. sandstone layers
	36.0	Limestone w/occas. Shale lenses
	40.0	Shale, grey

PENETRATION TES[T]		
FROM	TO	BL[OWS]

SHELBY TUBES		
NO.	FROM	T[O]

CORING		
FROM	TO	L[OG]

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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'

ELEV	DEPTH	DESCRIPTION OF MATERIAL TYPE, TEXTURE, COLOR, CONSISTENCY
	2.2	Silt, sandy, brown
	4.0	Clay, brown to tan w/yellow & grey sandy
	7.4	Clay, sandy, tan to yellow w/traces of grey
	16.2	Clay, yellow w/grey
	19.0	Clay, shaley, tan to yellow w/grey
	31.0	Shale, weathered, tan to grey
	33.2	Shale, tan to grey, moist (water 31')
	40.0	Shale, blue, grey

PENETRATION TES		
FROM	TO	BLO

SHELBY TUBES		
NO.	FROM	TO

CORING		
FROM	TO	LOS

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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'

ELEV	DEPTH	DESCRIPTION OF MATERIAL TYPE, TEXTURE, COLOR, CONSISTENCY
	1.7	Silt, sandy, brown
	2.5	Clay, sandy, silty, brown
	3.3	Clay, redish brown
	7.0	Clay, tan to yellow w/grey
	14.3	Clay, sandy, yellow w/grey
	15.8	Shaley clay
	28.0	Shale, tan to grey, weathered, water at 26.5'
	34.0	Shale, grey w/tan
	40.0	Shale, blue, grey

PENETRATION TES[T]		
FROM	TO	BL[OWS]

SHELBY TUBES		
NO.	FROM	T[O]

CORING		
FROM	TO	L[OG]

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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'

ELEV	DEPTH	DESCRIPTION OF MATERIAL TYPE, TEXTURE, COLOR, CONSISTENCY
	2.2	Silt, sandy, brown
	3.4	Clay, brown to tan w/red
	15.5	Clay, tan to yellow w/grey
	16.7	Clay, shaley, yellow & grey
	34.5	Shale, tan to grey, weathered, moist, w/siltstone layers (calcareous)
	40.0	Shale, blue, grey w/occas. siltstone layers

PENETRATION TES[T]		
FROM	TO	BLO[WS]

SHELBY TUBES		
NO.	FROM	T[O]

CORING		
FROM	TO	LO[G]

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(918) 745-0268

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 Gabby METHOD OF DRILLING Air

SURFACE ELEVATION WATER TABLE DEPTH OF HOLE 40'

ELEV	DEPTH	DESCRIPTION OF MATERIAL TYPE, TEXTURE, COLOR, CONSISTENCY
	2.0	Silt, sandy, brown
	3.2	Clay, brown to tan w/red
	13.4	Clay, tan to yellow w/grey
	13.7	Clay, sandy, yellow w/grey
	14.0	Siltstone, broken
	14.7	Clay, moist, yellow w/grey
	16.0	Shale, clayey
	20.0	Shale, sandy, tan w/occas. siltstone layers
	20.2	Limestone
	35.0	Shale, tan to grey, wet at 20' w/occas. siltstone layers
	40'	Shale, blue, grey

PENETRATION TEST		
FROM	TO	BLOWS

SHELBY TUBES		
NO.	FROM	TO

CORING		
FROM	TO	LOG

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(918) 745-0256

REPORT NO. ______
DATE: ______

REPORT OF TEST HOLE NO. 7

REPORTED TO: W. 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'

ELEV	DEPTH	DESCRIPTION OF MATERIAL TYPE, TEXTURE, COLOR, CONSISTENCY
	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
	36.2	Coal, wet
	40.0	Fireclay

PENETRATION TE[ST]		
FROM	TO	BL[OWS]

SHELBY TUBES		
NO.	FROM	

CORING		
FROM	TO	L

WITHAM DRILLING

★ FOUNDATION · CORE · SOIL TESTING ★

★ COMPLETE WATER WELL INSTALLATION ★

STAN WITHAM
INOLA, OKLAHOMA
(918) 543-8837

NELSON HOSS
PE #7968
TULSA, OKLAHOMA
(918) 746-0256

REPORT NO. ________
DATE: ________

REPORT OF TEST HOLE NO. 8

REPORTED TO H. H. 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 27'

ELEV	DEPTH	DESCRIPTION OF MATERIAL TYPE, TEXTURE, COLOR, CONSISTENCY	PENETRATION TEST FROM	TO	BLO
	2.1	Silt, sandy, brown			
	3.3	Clay, brown to tan w/red			
	8.5	Clay, tan to yellow w/grey			
	15.5	Clay, yellow w/grey			
	19.0	Clay, shaley			
	21.0	Shale, tan, clayey			
	23.5	Shale, dark grey, clayey			
	25.0	Shale, black, moist w/clayey layers			
	26.0	Coal 12"			
	27.0	Fireclay			

SHELBY TUBES NO.	FROM	TO

CORING FROM	TO	LO

WITHAM DRILLING

★ FOUNDATION · CORE · SOIL TESTING ★

★ COMPLETE WATER WELL INSTALLATION ★

STAN WITHAM
INOLA OKLAHOMA
(918) 543-8437

NELSON HOSS
PE #7966
TULSA OKLAHOMA
(918) 745-0256

REPORT NO. ______
DATE: ______

REPORT OF TEST HOLE NO. 9

REPORTED TO Y. 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'

ELEV	DEPTH	DESCRIPTION OF MATERIAL TYPE, TEXTURE, COLOR, CONSISTENCY
	1.8	Silt, sandy, brown
	2.3	Clay, brown to tan w/red
	12.0	Clay, tan to yellow w/grey
	12.3	Clay, tan w/black (coal smut) (cropline)
	15.0	Clay, tan to yellow w/grey & red
	17.2	Clay, shaley, tan w/grey
	20.0	Shale, tan w/clayey layers

PENETRATION TE		
FROM	TO	BLC

SHELBY TUBE		
NO.	FROM	T

CORING		
FROM	TO	LO

WITHAM DRILLING

★ FOUNDATION · CORE · SOIL TESTING ★

★ COMPLETE WATER WELL INSTALLATION ★

STAN WITHAM
INOLA OKLAHOMA
(918) 543-6537

NELSON HOSS
PE #7956
TULSA OKLAHOMA
(918) 746-0258

REPORT NO. ______
DATE: ______

REPORT OF TEST HOLE NO. 10

REPORTED TO E. 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'

ELEV	DEPTH	DESCRIPTION OF MATERIAL TYPE, TEXTURE, COLOR, CONSISTENCY
	2.0	Silt, sandy, brown
	2.7	Clay, brown to tan
	5.4	Clay, tan to yellow w/grey
	19.0	Clay, yellow w/grey
	19.5	Clay, shaley w/siltstone fragments
	20.0	Shale, tan

PENETRATION TEST		
FROM	TO	BLO

SHELBY TUBES		
NO.	FROM	TO

CORING		
FROM	TO	LOS

WITHAM DRILLING

★ FOUNDATION · CORE · SOIL TESTING ★

★ COMPLETE WATER WELL INSTALLATION ★

STAN WITHAM
INOLA, OKLAHOMA
(918) 543-8637

NELSON HOBB
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'

ELEV	DEPTH	DESCRIPTION OF MATERIAL TYPE, TEXTURE, COLOR, CONSISTENCY
	2.3	Silt, sandy, brown
	10.8	Clay, tan to yellow w/grey
	13.0	Clay, tan to yellow w/grey, shaley w/siltstone layers
	20.0	Shale, tan w/occas. siltstone layers

PENETRATION TES		
FROM	TO	BLO

SHELBY TUBES		
NO.	FROM	T

CORING		
FROM	TO	LO

WITHAM DRILLING

★ FOUNDATION · CORE · SOIL TESTING ★

★ COMPLETE WATER WELL INSTALLATION ★

STAN WITHAM
INOLA, OKLAHOMA
(918) 543-8537

NELSON HOBB
PE #7958
TULSA, OKLAHOMA
(918) 745-0258

REPORT NO. ________
DATE: ________

REPORT OF TEST HOLE NO. 12

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'

ELEV	DEPTH	DESCRIPTION OF MATERIAL TYPE, TEXTURE, COLOR, CONSISTENCY
	2.0	Silt, sandy, brown
	2.7	Clay, brown to tan w/traces of red
	13.0	Clay, tan to yellow w/grey
	20.0	Shale, tan, weathered w/occas. siltstone layers

PENETRATION TEST		
FROM	TO	BLO

SHELBY TUBES		
NO.	FROM	TC

CORING		
FROM	TO	LOS

WITHAM DRILLING
★ FOUNDATION · CORE · SOIL TESTING ★
★ COMPLETE WATER WELL INSTALLATION ★

STAN WITHAM
INOLA, OKLAHOMA
(918) 543-8837

NELSON HOSS
PE #7968
TULSA, OKLAHOMA
(918) 746-0258

REPORT NO. ______
DATE: ______

REPORT OF TEST HOLE NO. 13

REPORTED TO M. H. 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'

ELEV	DEPTH	DESCRIPTION OF MATERIAL TYPE, TEXTURE, COLOR, CONSISTENCY
	1.0	Silt, sandy, brown
	3.4	Clay, brown to tan
	1[illegible].5	Clay, tan to yellow w/grey
	20.0	Shale, tan, weathered w/occas. silt-stone layers

PENETRATION TES[T]		
FROM	TO	BLO[WS]

SHELBY TUBES		
NO.	FROM	T[O]

CORING		
FROM	TO	LO[G]

WITHAM DRILLING

★ FOUNDATION · CORE · SOIL TESTING ★

★ COMPLETE WATER WELL INSTALLATION ★

STAN WITHAM
INOLA, OKLAHOMA
(918) 543-5537

NELSON HOSS
PE #7868
TULSA, OKLAHOMA
(918) 746-0258

REPORT NO. ______
DATE: ______

REPORT OF TEST HOLE NO. 14

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 50'

ELEV	DEPTH	DESCRIPTION OF MATERIAL TYPE, TEXTURE, COLOR, CONSISTENCY
	2.0	Silt, sandy, brown
	3.3	Clay, brown to tan w/red
	12.0	Clay, tan to yellow w/grey
	20.0	Shale, tan w/occas. siltstone layers
	33.0	Shale, tan to grey
	33.3	Shale, blue grey
	33.5	Coal, water 33.5'
	34.3	Limestone
	39.0	Shale, blue grey, soft, water 39'
	48.0	Shale, sandy, grey w/sandstone lenses
	48.1	Coal
	50.0	Fireclay

PENETRATION TES

FROM	TO	BL

SHELBY TUBES

NO.	FROM	T

CORING

FROM	TO	LO

WITHAM DRILLING

★ FOUNDATION · CORE · SOIL TESTING ★

★ COMPLETE WATER WELL INSTALLATION ★

STAN WITHAM
INOLA OKLAHOMA
(918) 543-8537

NELSON HOSS
PE #7868
TULSA OKLAHOMA
(918) 746-0256

REPORT NO. ______
DATE: ______

REPORT OF TEST HOLE NO. 15

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'

ELEV	DEPTH	DESCRIPTION OF MATERIAL TYPE, TEXTURE, COLOR, CONSISTENCY
	2.0	Silt, sandy, brown
	3.0	Clay, brown to tan w/red
	17.2	Clay, tan to yellow w/grey
	19.5	Clay, sandy, tan & grey w/siltstone fragments
	20.0	Shale, clayey, tan

PENETRATION TEST

FROM	TO	BL

SHELBY TUBES

NO.	FROM	T
1	10	1

CORING

FROM	TO	LO

WITHAM DRILLING

* FOUNDATION · CORE · SOIL TESTING *
☆ COMPLETE WATER WELL INSTALLATION ☆

STAN WITHAM
INOLA OKLAHOMA
(918) 543-8837

NELSON HOSS
PE #7868
TULSA OKLAHOMA
(918) 746-0256

REPORT NO. ______
DATE: ______

REPORT OF TEST HOLE NO. 16 MW

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 27'

ELEV	DEPTH	DESCRIPTION OF MATERIAL TYPE, TEXTURE, COLOR, CONSISTENCY
	2.4	Silt, sandy, brown
	3.0	Clay, brown to tan w/red
	7.7	Clay, tan to yellow w/traces of grey
	16.0	Clay, yellow w/grey & tan
	16.8	Shaley clay w/siltstone fragments
	17.1	Siltstone
	18.0	Clay, shaley, tan & grey
	23.5	Shale, tan w/siltstone layers
	27.0	Shale, tan to grey

PENETRATION TEST		
FROM	TO	BLOWS

SHELBY TUBES		
NO.	FROM	TO

CORING		
FROM	TO	LOST

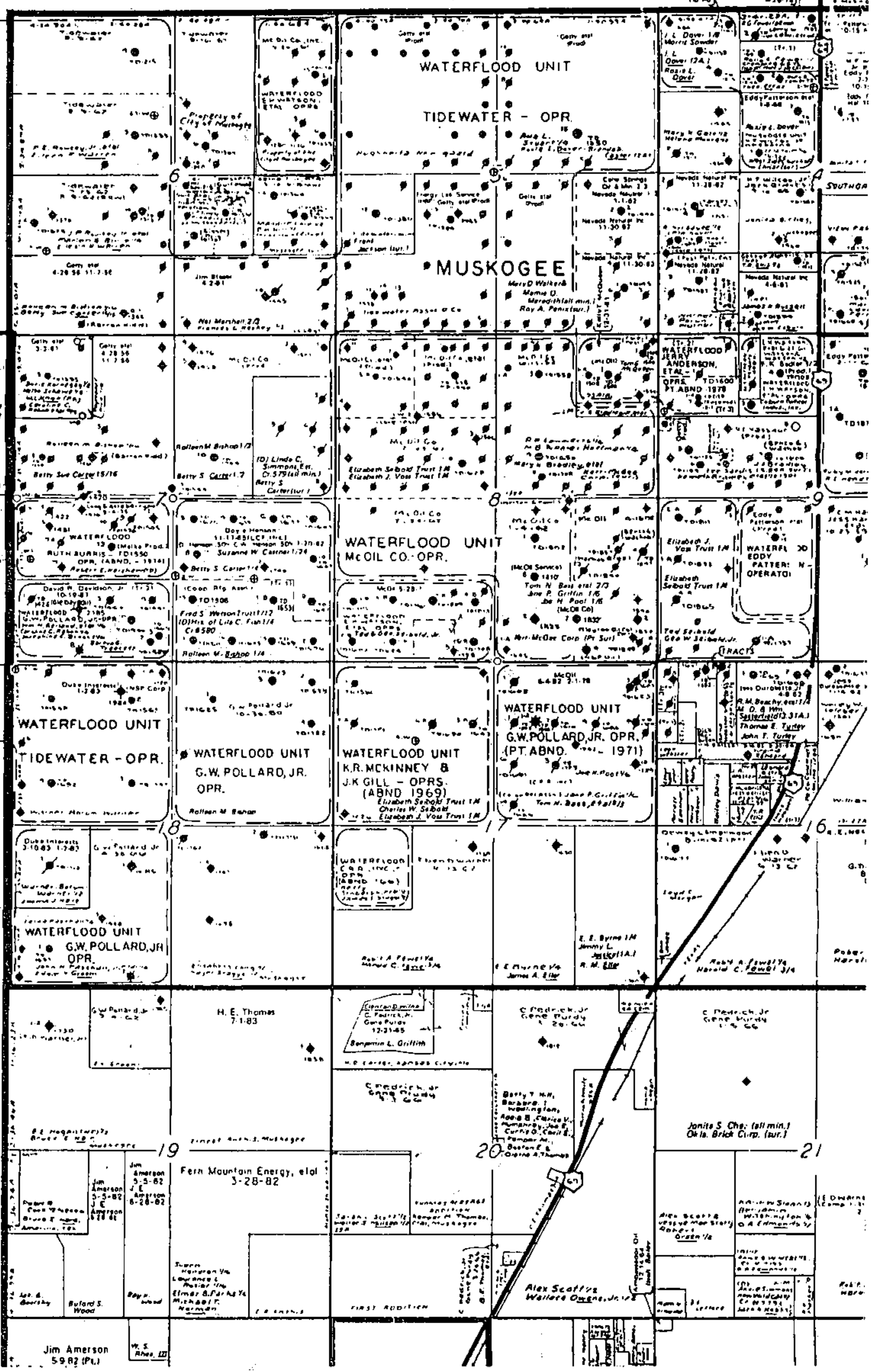
Appendix B

Petroleum Information

a company of The Dun & Bradstreet Corporation

Midcontinent Map
P.O. Box 7612
Denver, Colorado 8020

5 wells 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*

Form 1002A OKLAHOMA CORPORATION COMMISSION
OIL AND GAS CONSERVATION DEPARTMENT

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

271943

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 19 DRILLING FINISHED 7-8-62 19
DATE OF FIRST PRODUCTION — COMPLETED 7-19-62
WELL LOCATED SE ¼ SW ¼ SE ¼ 10' North of South Line and 3960' ft. East of West Line of Section Line
Elevation (Relative to sea level) DERRICK FLOOR GROUND 799.5
CHARACTER OF WELL (Oil, gas or dryhole) water injection

Locate well correctly

OIL OR GAS SANDS OR ZONES

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

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	1536-38-42-44		Sand perf. w/ Howco 3-way tool.				

CASING RECORD

Size	Wt.	Thds.	Make	Ft.	In.	Ft.	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 Ft. @ In.	Sacks Cement	Chemical Gal.	Chemical Make	Method of Cementing	Amount	Mudding Method	Results (See Note)
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 if pump is used, describe

OCC-3, Boone, Shackelford, File

Give detailed description and thickness of all formations, noting particularly water, oil or gas.

SEP 8 1962

REF. NO. 7307

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 - Bkn	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	1441			
Sand	1441	1465			
Shale	1465	1529			
Sand	1529	1562			
Sand - Bkn	1562	1571			
Sand	1571	1601			
Shale	1601	1611			
Sandy - Lime	1611	1613			
Shale - Lime	1613	1625			
TD	1625				
PBTD	1601				

RECEIVED
CONSERVATION DEPARTMENT
AUG 31 1962
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.

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

Subscribed and sworn to before me this 6th day of August 19

My Commission expires 9-30-62 Marguerite Shelley Notary Public.

FARM NAME Seibold B WELL NO. 4 COUNTY Muskogee SEC. 31 TWP. 15 N. RGE. 18 E

10477

Form 1002A

OKLAHOMA CORPORATION COMMISSION

OIL AND GAS CONSERVATION DEPARTMENT

WELL RECORD

640 Acres
N

Locate well correctly

COUNTY Muskogee SEC. 31 TWP. 15N RGE. 18East

COMPANY OPERATING John K. Gill & K.R. McKinney

OFFICE ADDRESS 108½ S. Morton; Okmulgee, Okla.

FARM NAME Seibold B WELL NO. 4

DRILLING STARTED 3/13 19 64 DRILLING FINISHED 3/22 19 64

DATE OF FIRST PRODUCTION ______ COMPLETED ______

WELL LOCATED ¼ SW ¼ SE ¼ SE ¼, North of South Line and ______ ft. 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	Ft.	In.	Ft.	In.	Size	Length	Depth Set	Make
8	20	10	LW	280	05			8	275		
4½	9.5	8rd	SL	1162							

Liner Record: Amount ______ Kind ______ Top ______ Bottom ______

CEMENTING AND MUDDING

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

Type Rig 28 - L Bucyrus Erie

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 all formations drilled through, contents of sand, whether dry, 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 qtr.

RECEIVED
JUL 21 1964
CONSERVATION DEPARTMENT
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.

John K. Gill
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. Laddicum
Notary Public.

(Mail to Corporation Commission, Oklahoma City, Oklahoma)

OKLAHOMA CORPORATION COMMISSION

OIL AND GAS CONSERVATION DEPARTMENT

Form 1002A

Capped

OCT 23 1965

NAT. OIL INDE
OKLAHOMA CITY
REF. NO. 65-4279

WELL RECORD

640 Acres
N

Locate well correctly

COUNTY MUSKOGEE, SEC 6, TWP. 14-N. RGE. 18 East

COMPANY OPERATING Watson & Watson

OFFICE ADDRESS Morris, Oklahoma

FARM NAME Wrigley WELL NO. 3

DRILLING STARTED 7-23, 1965 DRILLING FINISHED 8-27, 1965

DATE OF FIRST PRODUCTION 8-27-65 COMPLETED 8-27-65

WELL LOCATED CL ¼ SE ¼ NE ¼ 660'. North of South Line and 660 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 Stray	1175	1190	4		
2 Muskogee	1206	1218	5		
3 Timberridge	1246	1250	6		

Perforating Record If Any

Formation	From	To	No. of Shots

Shot Record

Formation	From	To	Size of Shot
Muskogee	1206	1226	40 qts

CASING RECORD

Size	Wt.	Thds.	Make	Amount Set Ft.	In.	Amount Pulled Ft.	In.	Packer Record Size	Length	Depth Set	Make
8 5/8	28	8	LW	XX 503							
10	60	8	SS	60							
5½	17	10	LW	1200							

Liner Record: Amount Kind Top Bottom

CEMENTING AND MUDDING

Size	Amount Set Ft.	In.	Sacks Cement	Chemical Gal.	Make	Method of Cementing	Amount	Mudding Method	Results (See Note)
5½	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 feet to Cable tools were used from 0 feet to 1272 feet, and from feet to feet, and from feet to

Type Rig Spudder

INITIAL PRODUCTION TEST

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

Give detailed description and thickness of all formations drilled through, contents of sand, whether dry, water, oil or gas.

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		
Limey Shale	60	76	Shale	1250	1268
Shale	76	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	505			
Shale	505	578			
Sandy Shale	578	596			
Shale	596	665			
Lime	665	675			
Shale	675	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	1095			
Sand	1095	1118			
Shale	1118	1140			
Shale	1140	1175			
Stray Sand	1175	1182			
Sand	1182	1190			
Limey Sand	1190	1192			
Shale	1192	1200			
Sand	1200	1218			

RECEIVED
OKLAHOMA CORPORATION COMMISSION
CONSERVATION DEPARTMENT
OCT 18 1965

RECEIVED
CONSERVATION DEPARTMENT
SEP 29 1965
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.

L. M. Watson Partner

Name and title of representative of company

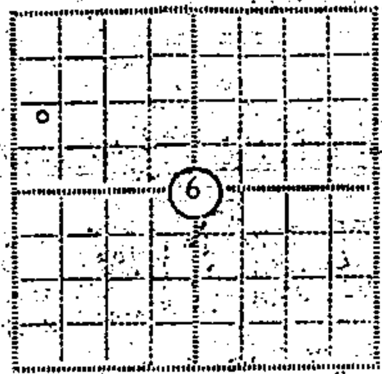
WRIGLEY WELL NO. #3 COUNTY MUSKOGEE

271931

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— 112-27-49

SEC. 6
TWP. 14N
RGE. 18E

William H.Pine
Okmulgee, Oklahoma.

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

NOTE: All above measurements are taken from Lane Wells Logs which are off from plus 3½' at 750 to minus 7' at 2082.

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 11-20-49. OIL

The shows in the Burgen below 2018 prob. justify drilling out to 2082 T.D. running string 5½" & 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.

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

PERFORATING RECORD:

			No.Shots
Burgen	2042	2047	10 holes
Burgen	2031	2038	14 holes
Burgen	2011	2018	14 holes
Burgen	1976	1989	26 holes
Burgen	1976	1989	500 Gals.

SHOT RECORD:

			Size shot
Simpson Dolo	1785'	1794	17 holes
Simpson Dolo.	1785	1794	500 Gall
Wapanucka	1244	1254	34 holes
Wapanucka	1239	1244	17 holes
Wapanuka	1239	1254	1000 Gal
Simpson Dolo	1785	1794	17 holes
Simpson Dolo.	1786	1794	500 gal.
Wapanucka	1244	1254	34 holes
Wapanucka	1239	1244	17 holes
Wapanucka	1239	1254	1000 gal
Wapanucka	1239	1254	4000 gal
	777		1 hole
Booch	753½	758½	10 holes
Booch	753½	754½	Hydrafrac

FORMATION	TOP	BOTTOM
Clay, yellow		5
Shale	5	45
Sand	45	65
Shale	65	237
Sand	237	250
Shale	250	298
Lime, broken	298	301
Shale	301	425
Lime	425	437
Shale	437	498
Sand, sho, Gas	498	506
Shale	506	510
Sand, wtr. 3 blr./hr.	510	524
Shale	524	635
Lime	635	645
Shale	645	752
Sand, so	752	756
Shale	756	796
Lime	796	811
Shale	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 , SD	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 Limr	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 2033½ 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
Burgan	2011	2018	14 "	Nothing shwn

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

Burgan	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 Plud 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:

			At.Set	
10-3/4"	40#	8 Used	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' Sax- 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.

Botton hole Plugs used.

CABLE TOOLS FROM o to 2082'

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 2082'

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

Eloy Del Bosque

Enclosures

2201 N. LAMAR, SUITE 200 · AUSTIN, TEXAS 78705
512-474-6721 · FAX: 512-474-5428

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

White — Water Resources Board
Canary — Drillers Copy
Pink — Drillers Copy

#23573

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
PHONE ____

2. LEGAL DESCRIPTION OF WELL
SW ¼ of SE ¼ of SE ¼ of sec. 11 ; TWP. 14N N/S; RGE 17E EIM (Circle One) WIM ECM; COUNTY Muskogee

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. LOG

Material	From	To	Saturated
Overburden	0	3	
Sandstone	3	42	
Shale	42	102	

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Oklahoma Water Resources Board

7. LOCATION PERMIT
If this well is Non-Domestic, has this location been permitted?
☐ Yes ☐ No Permit No. ____

8. NEW WELL CONSTRUCTION DATA
DATES: Started 7/23/86 Completed 7/23/86
Contractor Venture Drilling, Inc.
Driller Steve Ludwig
Diameter Hole 6" in. Total Depth 102 ft.

CASING RECORD

	Diameter	From	To
Inside	6" in.	0 ft.	18½ ft.
Outside	in.	ft.	ft.

Cement Grout Surface Seal ☒ Yes ☐ No
Type of Surface Seal: ____ Depth of Seal: 18 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.

9. WELL TEST DATA
Static Water Level Below Land Surface ____ ft.
If Artesian: Flows ____ gpm.
Approximate Yield 1 gpm.

10. 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.

11. PLAT
10 AC

SW ¼ of SE ¼ of SE ¼ of SEC 11 ;
TWP 14N N/S; RGE 17E (Circle One) EIM,WIM,ECM

12. PUMP INFORMATION
Pump Type ____
Power Source ____
Rated Capacity ____ gpm.
Depth of Bowls or Cylinder ____ ft.

13. 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 ____

14. 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 # 918/456-8119
Signed Steve Ludwig Date 8/19/86

Form 424-0884
USE ADDITIONAL SHEETS IF NECESSARY

2

MULTIPURPOSE COMPLETION REPORT

OKLAHOMA WATER RESOURCES BOARD
600 N. HARVEY AVE.
P.O. BOX 150
OKLAHOMA CITY, OK 73101-0150

Please plot well location
1 mile

N

Legal Description

SW 1/4 SE 1/4 NE 1/4 of Sec. 6 Twp. 14N Rge. 18E

County Muskogee Well No: MW03R

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:

- ☐ Geotechnical Boring
- ☐ Water Supply Pump Well
- ☒ Monitor Well
- ☐ Observation Well
- ☐ Piezometer
- ☐ Plugging
- ☐ Pump Inst. *
- ☐ Reconditioning
- ☐ W.W. Test Hole
- ☐ De-watering
- ☐ Other
- ☐

G.W. Use

- ☐ Domestic
- ☒ Non-Domestic

Specify Purpose Monitoring Well

Drilling Method

- ☐ Hand Auger
- ☐ Cable Tool
- ☐ Air Rotary
- ☐ Fluid Rotary
- ☒ H.S. Auger
- ☐ S.S. Auger
- ☐ Rev. Rotary
- ☐ D.W. Rev. Rotary
- ☐ Other

Lithologic Log

Material	From	To	Below Water
Fill: silty clay, tan	0	2	
clay, tan and gray	2	35	
Weathered shale, gray	35	39.5	

* two additional monitor wells installed

Non-Domestic Permitting

If this well is for other than domestic use (use of water for household purposes, for farm and domestic animals up to the normal grazing capacity of the land & for the irrigation of land not to exceed 3 acres)

Permit No:

New Boring or Well Construction Data

Date: Started 11-18-92 Completed 11-20-92

Firm Terracon Consultants, Inc.

Operator Allan Brantley

Type of Construction ☒ Open Hole ☐ Cased Hole

Hole Diameter 8" inches total depth 39.5 feet

Hole Diameter ______ inches total depth ______ feet

CASING RECORD

	diameter		from		to	
Surface pipe		inches		feet		feet
Well casing	2"	inches	+0.5	feet	39.5	feet
Well casing		inches		feet		feet
Well casing		inches		feet		feet

SCREEN or PERFORATION RECORD

Type and Slot Size	from		to	
0.010 Slot Screen PVC	29.5	feet	39.5	feet
		feet		feet
		feet		feet

GRAVEL PACK

Type and Size	from		to	
Colorado Silica 10/20	27.5	feet	39.5	feet
		feet		feet
		feet		feet

SEAL

Cement Grout Surface Seal Installed ☒ Yes ☐ No

	from		to	
Type of Surface Seal Enviroqrout	0	feet	24.5	feet
Aquifer Seal Type 1/4" bentonite pellets	24.5	feet	27.5	feet
		feet		feet

HYDROLOGIC DATA

First Water Zone Encountered 28.0 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 Terracon Consultants, Inc. Lic. No. OP-0315

Address 5865 S. Garnett Phone 918 250 0461

Signed Lee Allen Brantley Date 12-17-92

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Oklahoma Water Resources Board

* See Pump Installers Form On Back

04928521

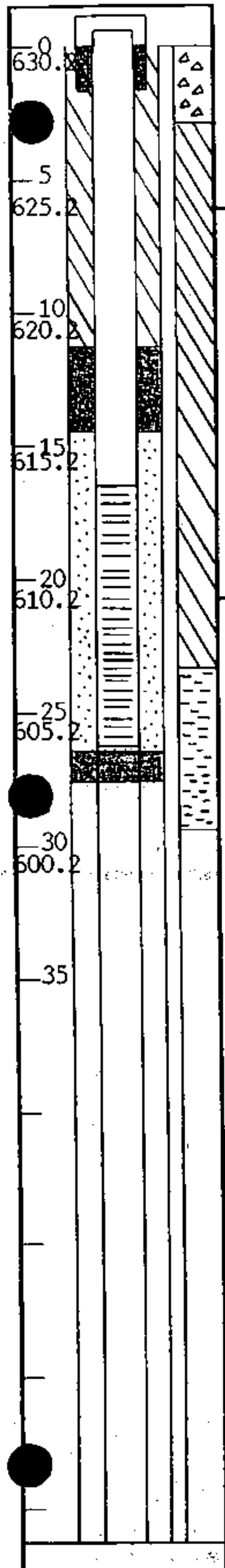
KW

Appendix C

Well No. MW-01R

Boring No. X-Ref: B-1

MONITOR WELL CONSTRUCTION SUMMARY



Survey Coords: N272500.8 E2731415.1

Elevation Ground Level 630.2 ft

Top of Casing 633.01 ft

Drilling Summary:

Total Depth 29.25 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) 3½-inch I.D. x 7-inch O.D. hollow-stem augers

Drilling Fluid None

Protective Casing 6-inch anodized aluminum

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish 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 Design & Specifications

Basis: Geologic Log X 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: ½-inch bentonite pellets 11.5 to 14.5 ft

Well Development: B-K Hand Pump

Initial H_2O level = 15.10 feet

TOC/Well volume = 1.7 gallons

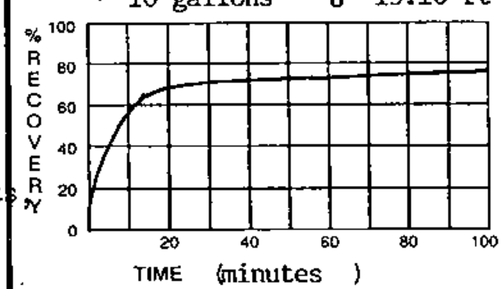
Amount developed = 10 gallons or 5.8 well volumes

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 S_o= 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

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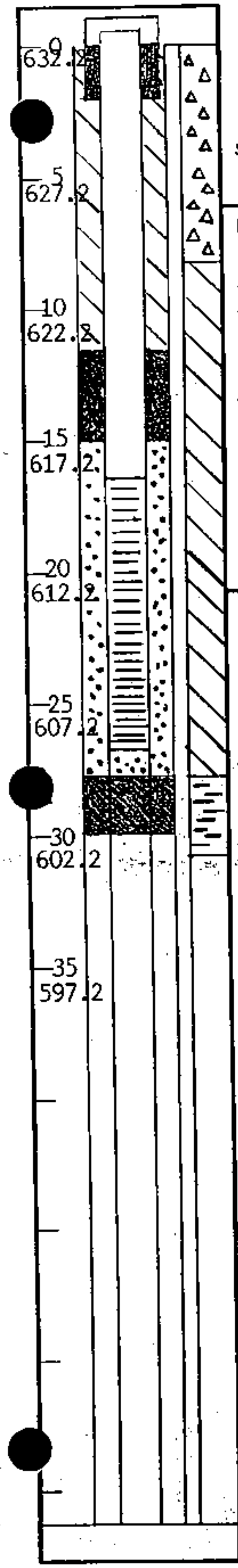
Well No. MW02R

Boring No. X-Ref: B-2

MONITOR WELL CONSTRUCTION SUMMARY



Survey Coords: N271744.8 E2731158.9

Elevation 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) 3¼-inch I.D. x 7 inch O.D. hollow-stem augers

Drilling Fluid None

Protective Casing 6-inch anodized aluminum

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish 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 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 grout 2 to 12 feet

Bentonite Seal: ¼-inch bentonite pellets, 12 to 15 feet

Well Development:

B-K Hand Pump Initial H_2O level (estimated) = 9.50 ft, TOC/well volume = 3.5 gallons

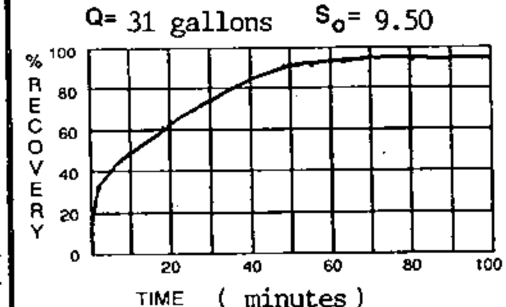
Amount developed = 31 gallons or 8.8 well volumes

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 S_o= 9.50



Comments: Borehole collapse and settlement of fines 28 to 30 feet, auger 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

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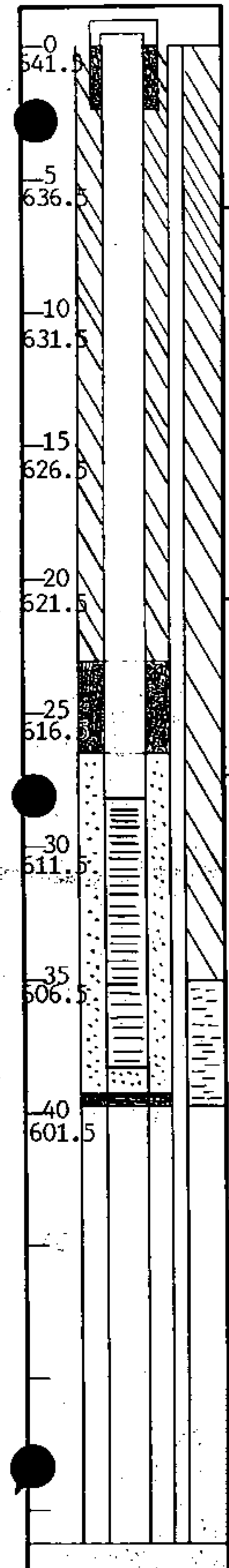


Well No. MW-03R

Boring No. X-Ref: B-3

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: N272179.4 E2730189.7

Elevation 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) 3½-inch I.D. x 7-inch O.D. hollow-stem augers
Drilling Fluid None
Protective Casing 6-inch anodized aluminum

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish 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 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: ½-inch bentonite pellets 23.1 to 26.1 ft

Well Development: B-K Hand Pump

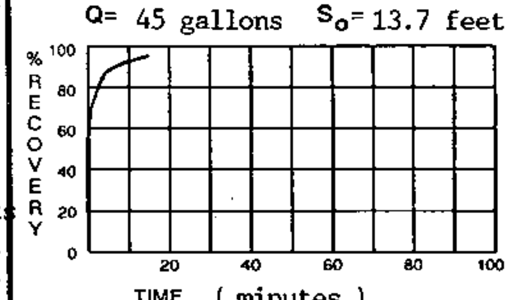
Initial H_2O level = 13.7
TOC/Well volume = 4.5 gallons
Amount developed = 45 gallons or 10 well volumes

Stabilization Test Data: Inoperable Meter

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= 45 gallons S_o= 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 Landfill

LOCATION Muskogee, Oklahoma

WC 03248

SUPERVISED BY Greg Hassett

DATE 11/19/92

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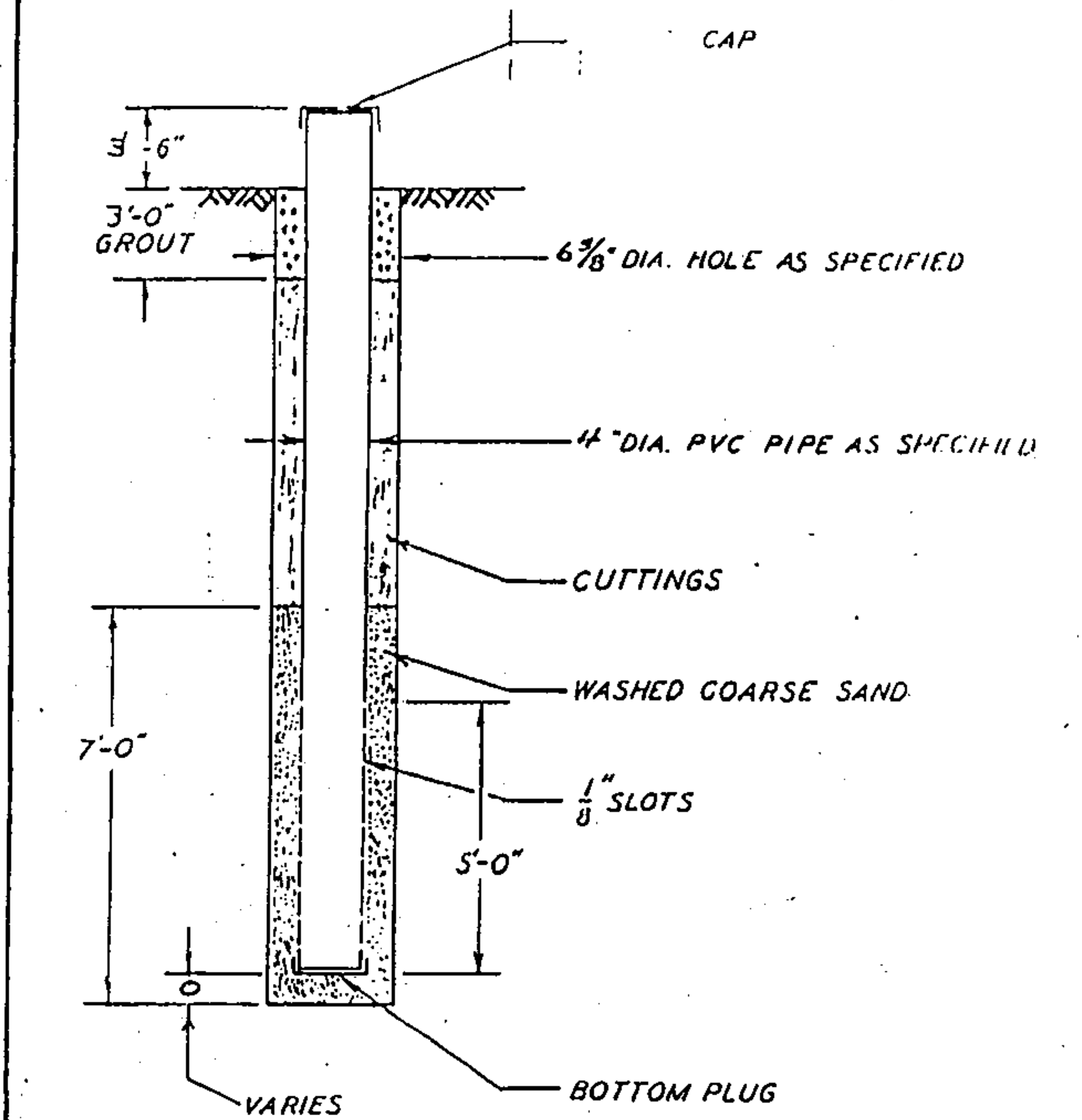


CITY OF MUSKOGEE, OKLAHOMA
Land Fill Southwest of City

Well located near entrance
Depth 25.0 feet

CK.	ENG.
DR.	TR.
APPL.	

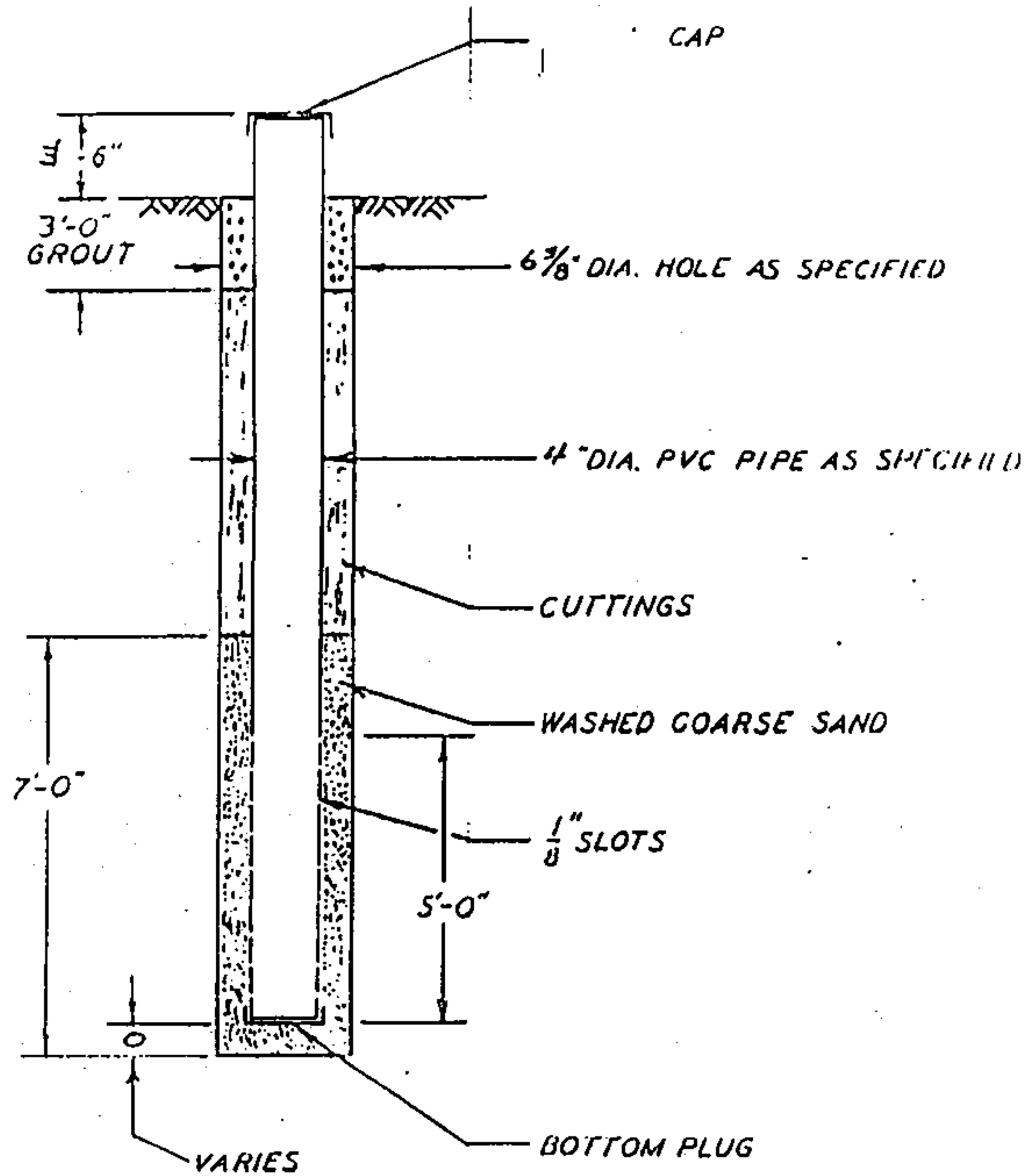
ISSUE

MONITORING WELL NO. 1

SCALE: NONE

STEWART, WHITE & ASSOCIATES, I

Tulsa, Oklahoma

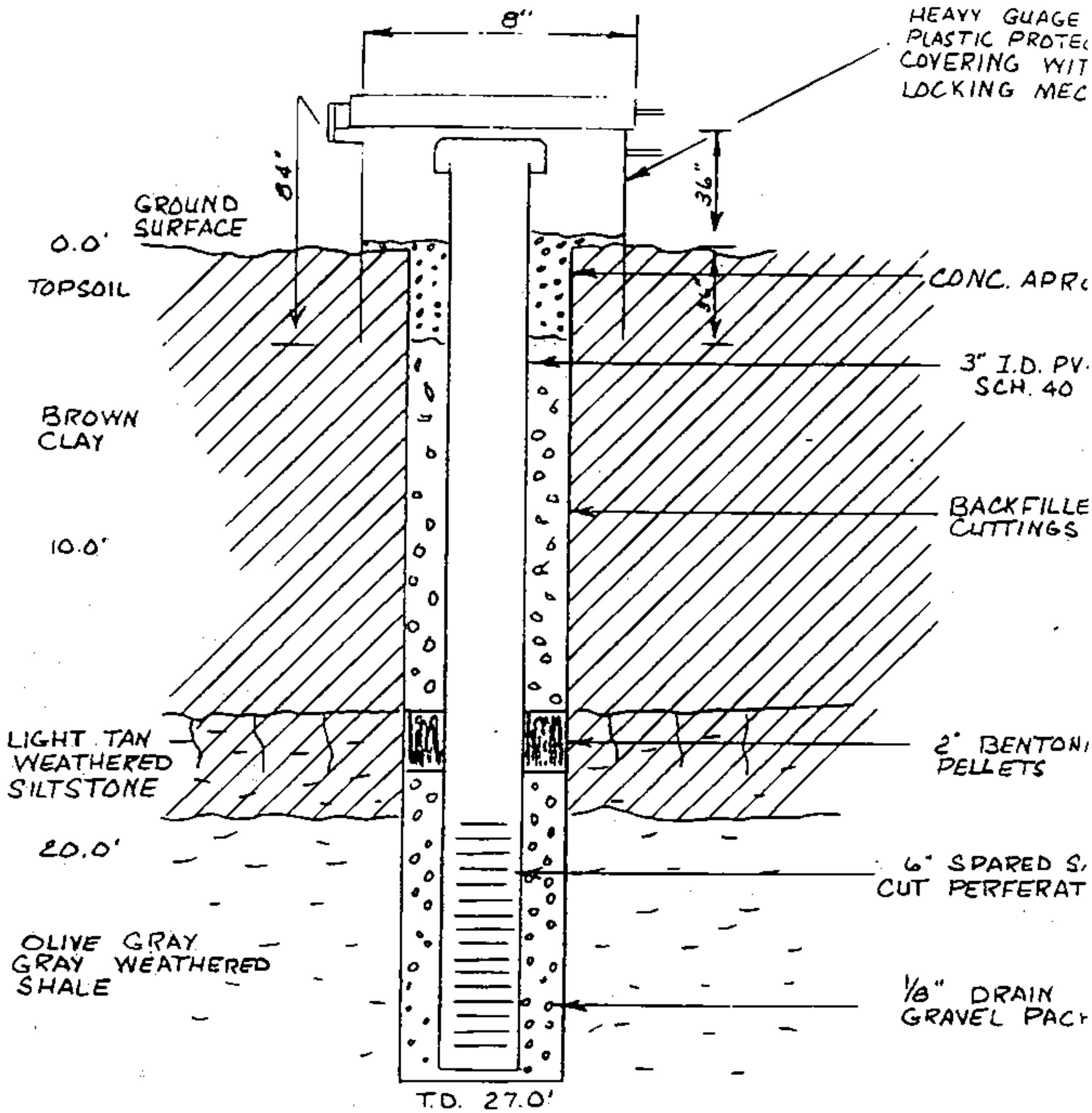


City of Muskogee, Oklahoma

Land Fill Southwest of City

Well located Northeast area
Depth 30.0 feet.

ISSUE	CH.	ENG.	MONITORING WELL NO. 2
	DR.	TR.	SCALE: NONE
	APPL.		STEWART, WHITE & ASSOCIATES, Tulsa, Oklahoma

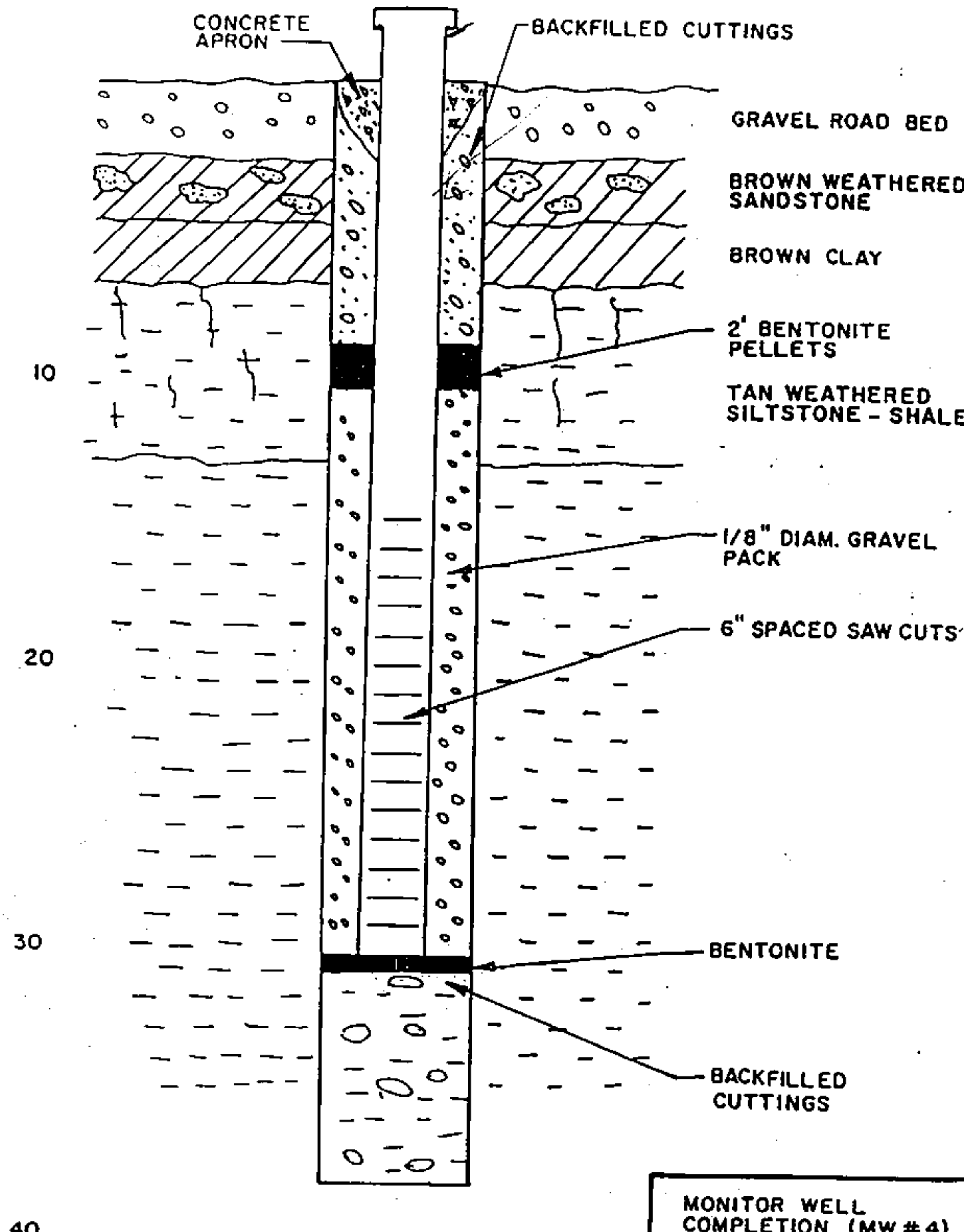


M.R. McComas & Associates, Inc.

HYDROGEOLOGY

MONITOR WELL COMPLETION DIAGRAM (MW3)

SCALE	DATE	
NONE		



MONITOR WELL COMPLETION (MW #4)

POE & ASSOCIATES, INC.
10820 EAST 45TH ST. TULSA, OKLAHOMA 74146 665-8800

DATE	DRAWING NO.
1-31-84	

Appendix D

WMI ENVIRONMENTAL MONITO[illegible]G LABORATORIES, INC.

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

Field Blank?

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
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 ND = Not Detected TBK = Trip Blank s = EML Subcontract Data

Page:

WMI ENVIRONMENTAL MONITO[illegible]G LABORATORIES, INC.

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	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

NA = Not Analyzed   ND = Not Detected   TBK = Trip Blank   s = EML Subcontract Data

WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

E V E N T   S U M M A R Y   R E P O R T

Page:

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   s = 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: 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~~	626.74 H. Daniel	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 CONDUCTANCE 8	4930	1.0	4010	1.0	1920	1.0	UMHOS/CM
TOTAL ORGANIC CARBON 9	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 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

NA = Not Analyzed   ND = Not Detected   TBK = Trip Blank   s = EML Subcontract Data

WMI ENVIRONMENTAL MONITO[illegible]G LABORATORIES, INC.

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-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 37	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

NA = Not Analyzed   ND = Not Detected   TBK = Trip Blank   s = EML Subcontract Data

WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

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-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

WMI ENVIRONMENTAL MONITO[ ]G LABORATORIES, INC.

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 Background	EML RL	852-MW06 AH0584 27-APR-1993 Background	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

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 73111-0000

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
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

NA = Not Analyzed ND = Not Detected TBK = Trip Blank s = EML Subcontract Data

WMI ENVIRONMENTAL MONITORING LABORATORIES, INC.

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
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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

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~~ Schmidt

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

METLAB

MLTS 83-3576

Table I

Summary of Chemical Analysis of Five (5) Muskogee Water Samples
Tested for M.R. McComas and Associates, Inc.

Constituents	Units	MW-1	MW-2	MW-3	Abd. Well	Cody Creek
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,

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

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

SCOTT A. THOMPSON
Executive Director

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

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

1-7-2016

Prepared by

BIGGS & MATHEWS ENVIRONMENTAL
1700 Robert Road, Suite 100 • Mansfield, Texas 76063 • 817-563-1144

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 of 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 he 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 "<u>Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance</u>" (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

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TABLES

Table 5-1
Muskogee Recycling and Disposal Facility
Sample Collection, Preservation, and Holding Times

PARAMETER	SAMPLE COLLECTION[1] AND CONTAINER	SAMPLE [2,3] PRESERVATION	RECOMMENDED[4] HOLDING TIMES
Acid Extractables	1000 ml Glass only (amber) with Teflon liner	Cool, 4ºC	Extract within 7 days; analyze within 40 days
Alkalinity	100 ml P, G	Cool, 4ºC	14 days
Ammonia	125 ml P, G	Cool, 4ºC H_2SO_4 to pH < 2	28 days
Base/Neutral Extractables (priority pollutants)	1000 ml Glass only (amber) with Teflon liner	Cool, 4ºC	Extract within 7 days; analyze within 40 days
Biochemical Oxygen Demand, 5 day (BOD 5)	1000 ml P, G	Cool, 4ºC	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, 4ºC H_2SO_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, 4ºC	24 hours
Cyanide	1000 ml P, G	Cool, 4ºC 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, 4ºC	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 COLLECTION[1] AND CONTAINER	SAMPLE [2,3] PRESERVATION	RECOMMENDED[4] 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, 4ºC	48 hours
Nitrite	125 ml P, G	Cool, 4ºC	48 hours
Oil and grease	1000 ml G only	Cool, 4ºC H_2SO_4 to pH < 2	28 days
PCB (Priority Pollutant)	1000 ml Glass only (amber) with Teflon liner	Cool, 4ºC	Extract within 7 days; analyze within 40 days
Pesticides Endrin Lindane Toxaphene Methoxychlor	1000 ml Glass only (amber) with Teflon liner	Cool, 4ºC	Extract within 7 days; analyze within 40 days
pH (field)	25 ml P, G	None required	Analyze immediately
Phenols	500 ml G only	Cool, 4ºC H_2SO_4 to pH < 2	28 days
Phosphorus (total)	125 ml P, G	Cool, 4ºC H_2SO_4 to pH < 2	28 days

Table 5-1 (Cont'd)

Muskogee Recycling and Disposal Facility
Sample Collection, Preservation, and Holding Times

PARAMETER	SAMPLE COLLECTION[1] AND CONTAINER	SAMPLE [2,3] PRESERVATION	RECOMMENDED[4] HOLDING TIMES
Specific Conductance (field)	100 ml P, G	None required	Analyze immediately
Sulfate	50 ml P, G	Cool, 4ºC	28 days
Temperature (field)	1000 ml P, G	None required	Analyze immediately
Total Dissolved Solids Residue on evaporation (TDS/ROE) 180ºC	1000 ml P	Cool, 4ºC	7 days
Total Organic Carbon (TOC)	2-40 ml P	Cool, 4ºC H_2SO_4 to pH < 2	28 days
Total Suspended Solids (TSS)	1000 ml P	Cool, 4ºC	7 days
Volatile Organic Acids, Priority pollutants	4-40 ml glass vial with septum caps	Cool, 4ºC	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 4ºC 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 (HNO_3) in water solutions and concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) 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
Metals. dissolved		
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)
Metals, total		
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^{o}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 ***Organic Constituents:***	CAS RN
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 Parameters[1]:***	***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:

[1]Inorganic 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

WASTE MANAGEMENT

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

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.

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 ____

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.

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)
		1st		1st						
		2nd		2nd						
		3rd		3rd						
		4th		4th						
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 (umhos/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.*

FIELD COMMENTS

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):

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.)

Chain of Custody Record

TAL-4124-280 (0508)

Sampler ID ______________

Temperature on Receipt ______

Drinking Water? Yes ☐ No ☐

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

Client	Project Manager	Date	Chain of Custody Number 172947
Address	Telephone Number (Area Code)/Fax Number	Lab Number	Page ______ of ______
City / State / Zip Code	Site Contact / Lab Contact	Analysis (Attach list if more space is needed)	
Project Name and Location (State)	Carrier/Waybill Number		Special Instructions/ Conditions of Receipt
Contract/Purchase Order/Quote No.	Matrix / Containers & Preservatives		

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil		Containers & Preservatives: Unpres.	H_2SO_4	HNO_3	HCl	NaOH	ZnAc/ NaOH		Analysis	Special Instructions/ Conditions of Receipt

Possible Hazard Identification

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal

☐ Return To Client ☐ Disposal By Lab ☐ Archive For ______ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required

☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other______

QC Requirements (Specify)

1. Relinquished By	Date	Time	1. Received By	Date	Time
2. Relinquished By	Date	Time	2. Received By	Date	Time
3. Relinquished By	Date	Time	3. Received By	Date	Time

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy