



# OILFIELD RESEARCH LABORATORIES

536 NORTH HIGHLAND - CHANUTE, KANSAS 66720 - PHONE (316) 431-2650

November 10, 1980

Graham Enterprises, Inc.  
Rural Route #1  
Leroy, Kansas 66857

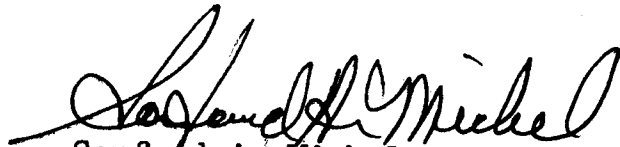
Gentlemen:

Enclosed herewith is the report of the analysis of the rotary core taken from the Graham Lease, Well No. 4, located in Coffey County, Kansas and submitted to our laboratory on August 22, 1980.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES



Sanford A. Michel

SAM/ mkf

4 c to Leroy, Kansas  
1 c to Topeka, Kansas

- REGISTERED ENGINEERS -

FIRE ANALYSIS - WATER ANALYSIS - REPRESSURING ENGINEERING - SURVEYING & MAPPING - PROPERTY EVALUATION & OPERATION

# Oilfield Research Laboratories

## GENERAL INFORMATION & SUMMARY

Company Graham Enterprises, Inc. Lease Graham Well No. 4

Location SE $\frac{1}{4}$  - N2/3 - NW $\frac{1}{4}$

Section 13 Twp 23S Rge 16E County Coffey State Kansas

Elevation, Feet - - - - -

Name of Sand	Lower Squirrel	
Top of Core		952.0
Bottom of Core		972.0
Top of Sand	(Tested)	957.5
Bottom of Sand		972.0
Total Feet of Permeable Sand		12.1
Total Feet of Floodable Sand		6.0

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 20	2.1	2.1
20 - 40	5.4	7.5
40 - 60	3.1	10.6
60 - 80	1.5	12.1

Average Permeability Millidarcys		36.2
Average Percent Porosity		20.3
Average Percent Oil Saturation		53.6
Average Percent Water Saturation		14.3
Average Oil Content, Bbls./A. Ft.		838.
Total Oil Content, Bbls./Acre		10,143.
Average Percent Oil Recovery by Laboratory Flooding Tests		6.0
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.		98.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre		589.
Total Calculated Oil Recovery, Bbls./Acre		See "Calculated Recovery" Section

The core was sampled and the samples sealed in plastic bags by a representative of the client. Fresh water mud was used as a drilling fluid.

FORMATION CORED

The detailed log of the formation cored is as follows:

<u>Depth Interval, Feet</u>	<u>Description</u>
952.0 - 954.0	Grayish brown sandy shale.
954.0 - 957.5	Brown and gray laminated sandstone and shale.
957.5 - 958.1	Brown slightly calcareous sandstone.
958.1 - 959.7	Brown and gray laminated slightly calcareous sandstone and shale.
959.7 - 960.5	Brown slightly calcareous slightly shaly sandstone.
960.5 - 963.1	Dark brown slightly calcareous sandstone.
963.1 - 963.5	Brown and gray slightly calcareous conglomeratic sandstone and shale.
963.5 - 964.0	Brown slightly calcareous sandstone.
964.0 - 965.2	Brown and gray laminated slightly calcareous sandstone and shale.
965.2 - 966.0	Gray sandy shale.
966.0 - 972.0	Dark brown slightly calcareous sandstone.

LABORATORY FLOODING TESTS

The lower portion of the sand in this core responded to laboratory flooding tests, as a total recovery of 589 barrels of oil per acre was obtained from 6.0 feet of sand. The weighted average percent oil saturation was reduced from 57.3 to 51.3, or represents an average recovery of 6.0 percent. The weighted average effective permeability of the samples is 4.29 millidarcys, while the average initial fluid production pressure is 20.0 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 13 samples tested, 7 produced water and oil and 6 samples produced water only. This indicates that approximately 54 percent of the sand represented by these samples is floodable pay sand.

CALCULATED RECOVERY

It would appear from a study of the core data, that efficient primary and waterflood operations in the vicinity of this well should recover approximately 1630 barrels of oil per acre. This is an average recovery of 272 barrels per acre foot from 6.0 feet of floodable sand analyzed in this core.

OILFIELD RESEARCH LABORATORIES

-4-

These recovery values were calculated using the following data and assumptions:

Original formation volume factor, estimated	1.06
Reservoir water saturation, percent, estimated	10.0
Average porosity, percent	20.9
Oil saturation after flooding, percent	51.3
Performance factor, percent, estimated	50.0
Net floodable sand, feet	6.0

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Sample No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content Bbbs. / A Ft.	Perm., Mill.	Feet of Sand		Total Oil Content	Perm. Capacity Ft. X md.
			Oil	Water	Total			Ft.	Cum. Ft.		
1	957.8	24.0	40	19	59	745	24.	0.6	0.6	447	14.40
2	959.1	21.6	41	18	59	687	43.	1.6	2.2	1099	68.80
3	960.1	16.4	60	15	75	763	8.7	0.8	3.0	610	6.96
4	961.1	17.4	57	18	75	769	19.	1.3	4.3	1000	24.70
5	962.5	19.4	51	18	69	768	26.	1.3	5.6	998	33.80
6	963.7	20.1	55	15	70	858	42.	0.5	6.1	429	21.00
7	966.4	21.6	57	12	69	955	23.	1.0	7.1	955	23.00
8	967.5	21.3	58	9	67	958	54.	1.0	8.1	958	54.00
9	968.4	19.7	54	14	68	825	62.	1.0	9.1	825	62.00
10	969.5	21.4	60	10	70	996	35.	1.0	10.1	996	35.00
11	970.3	20.9	58	9	67	940	37.	1.0	11.1	940	37.00
12	971.1	20.6	57	10	67	911	38.	0.5	11.6	456	19.00
13	971.9	19.8	56	12	68	860	76.	0.5	12.1	430	38.00

Company Graham Enterprises, Inc. Lease Graham Well No. 4

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## SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company	Graham Enterprises, Inc.	Lease	Graham	Well No.				
				4				
Depth Interval, Feet	Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.	Average Percent Porosity	Average Percent Water Saturation	Average Oil Content Bbl./A. Ft.	Total Oil Content Bbls./Acre
957.5 - 964.0	957.5 - 964.0	6.1	27.8	169.66	19.7	50.1	751	4,583
966.0 - 972.0	966.0 - 972.0	6.0	44.7	268.00	20.9	57.3	927	5,560
957.5 - 972.0	957.5 - 972.0	12.1	36.2	437.66	20.3	53.6	838	10,143

# Oilfield Research Laboratories

## RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery		Residual Saturation		Volume of Water Recovered cc*	Effective Permeability Millidarcys**	Initial Fluid Production Pressure Lbs./Sq./In.	
			%	Bbbs./A. Ft.	%	Bbbs./A. Ft.	% Oil	% Water				Bbbs./A. Ft.
1	957.8	24.0	40	745	0	0	40	49	745	336	13.68	10
2	959.1	21.8	41	693	0	0	41	49	693	236	10.92	10
3	960.1	16.5	60	768	0	0	60	34	768	299	6.75	20
4	961.1	17.8	56	773	0	0	56	39	773	165	4.05	25
5	962.5	19.4	51	768	0	0	51	45	768	100	2.25	25
6	963.7	19.7	55	849	0	0	55	43	849	34	5.93	30
7	966.4	21.6	57	955	6	101	51	44	854	130	3.75	20
8	967.5	21.5	58	967	7	117	51	42	850	304	10.65	15
9	968.4	19.8	54	829	3	46	51	45	783	195	4.50	20
10	969.5	21.2	60	987	7	115	53	44	872	134	3.15	20
11	970.3	20.9	58	940	8	130	50	48	810	54	1.05	20
12	971.1	20.8	57	920	5	81	52	44	839	73	1.50	25
13	971.9	20.0	56	869	5	78	51	42	791	173	3.75	20

Well No. 4

Company Graham Enterprises, Inc. Lease Graham

Notes: cc—cubic centimeter.

\*—Volume of water recovered at the time of maximum oil recovery.

\*\*—Determined by passing water through sample which still contains residual oil.

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## SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

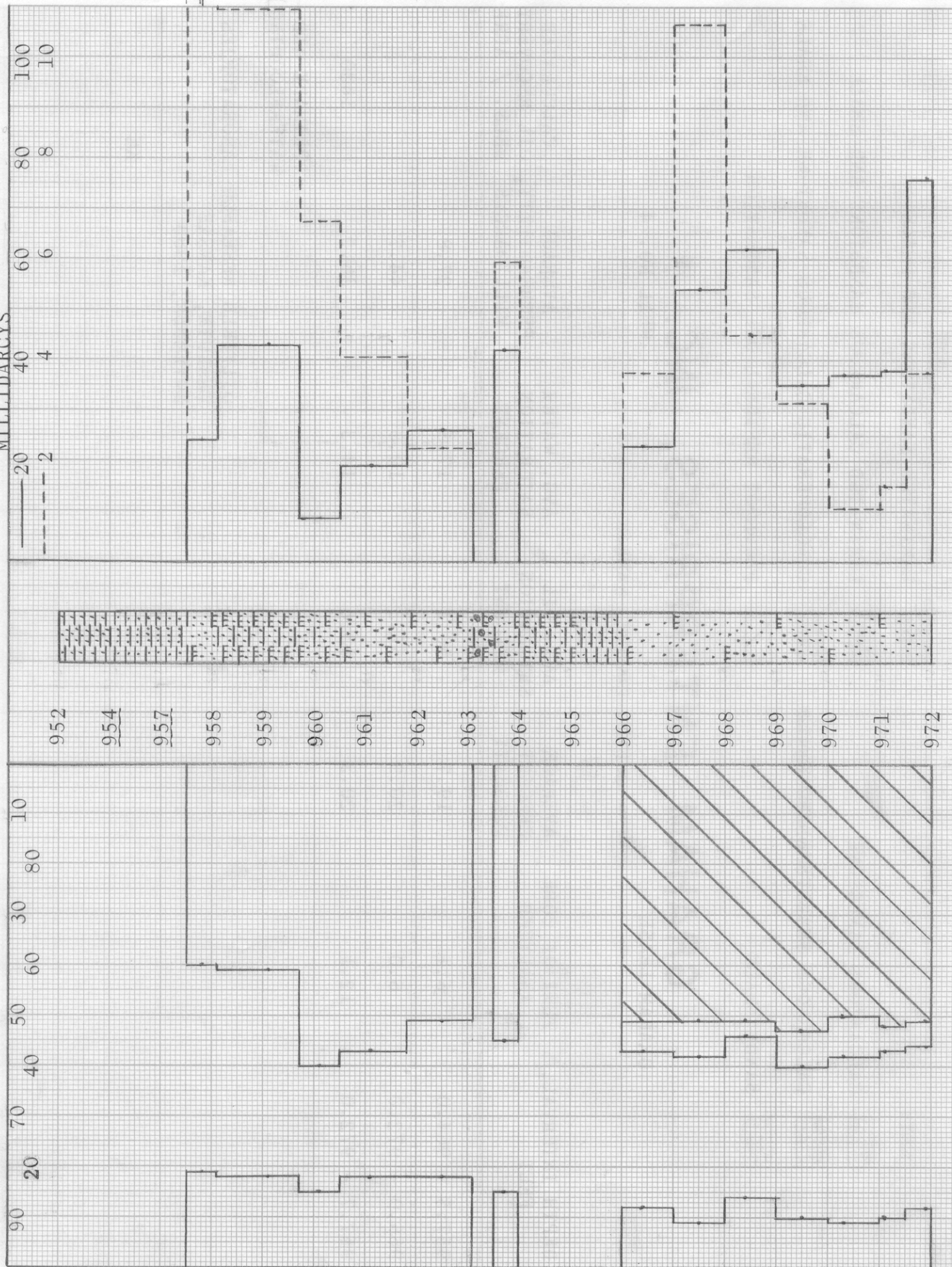
Company	Graham Enterprises, Inc.	Lease	Graham	Well No.	4
Depth Interval, Feet	966.0 - 972.0				
Feet of Core Analyzed	6.0				
Average Percent Porosity	20.9				
Average Percent Original Oil Saturation	57.3				
Average Percent Oil Recovery	6.0				
Average Percent Residual Oil Saturation	51.3				
Average Percent Residual Water Saturation	44.3				
Average Percent Total Residual Fluid Saturation	95.6				
Average Original Oil Content, Bbls./A. Ft.	929.				
Average Oil Recovery, Bbls./A. Ft.	98.				
Average Residual Oil Content, Bbls./A. Ft.	831.				
Total Original Oil Content, Bbls./Acre	5,573.				
Total Oil Recovery, Bbls./Acre	589.				
Total Residual Oil Content, Bbls./Acre	4,984.				
Average Effective Permeability, Millidarcys	4.29				
Average Initial Fluid Production Pressure, p.s.i.	20.0				

NOTE: Only those samples which recovered oil were used in calculating the above averages.

WATER SAT., PERCENT →

← OIL SAT., PERCENT

PERMEABILITY, IN MILLIDARCYS  
EFFECTIVE PERMEABILITY TO WATER, IN MILLIDARCYS



KEY:



CALCAREOUS SANDSTONE



CALCAREOUS SHALY SANDSTONE



SANDY SHALE



LAMINATED SANDSTONE AND SHALE



LAMINATED CALCAREOUS SANDSTONE AND SHALE



CONGLOMERATIC CALCAREOUS SANDSTONE AND SHALE



FLOODPOT RESIDUAL OIL SATURATION

# GRAHAM ENTERPRISES, INC.

GRAHAM LEASE

COFFEY COUNTY, KANSAS

WELL NO. 4

DEPTH INTERVAL, FEET	FEET OF CORE ANALYZED	AVERAGE POROSITY	AVG. OIL SATURATION PERCENT	AVG. WATER SATURATION PERCENT	AVERAGE PERMEABILITY, MILLIDARCS	CALCULATED OIL RECOVERY BBLs. / ACRE

957.5 - 964.0

6.1

19.7

50.1

17.5

27.8

966.0 - 972.0

6.0

20.9

57.3

10.8

44.7

957.7 - 972.0

12.1

20.3

53.6

14.3

36.2

1630

(PRIMARY AND  
WATERFLOODING)

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CHANUTE, KANSAS  
NOVEMBER, 1980

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