

OILFIELD RESEARCH LABORATORIES

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

October 6, 1981

Glenn Caldwell
P. O. Box 42
Garnett, Kansas 66032

Gentlemen:

Enclosed herewith is the report of the analysis of the rotary core taken from the Feuerborn Lease, Well No. 3, located in Linn County, Kansas and submitted to our laboratory on September 15, 1981.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Sanford A. Michel

SAM/kas

5 c to Garnett, Kansas

Oilfield Research Laboratories
GENERAL INFORMATION & SUMMARY

Company Glenn Caldwell Lease Feuerborn Well No. 3
 Location 660' FSL & 50' FEL SE $\frac{1}{4}$
 Section 16 Twp. 20S Rge. 22E County Linn State Kansas

Elevation, Feet
 Name of Sand..... Squirrel
 Top of Core 538.0
 Bottom of Core 568.3
 Top of Sand 538.0
 Bottom of Sand 568.3
 Total Feet of Permeable Sand 28.0
 Total Feet of Floodable Sand 19.1

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
1 - 10	12.0	12.0
10 - 20	9.4	21.4
20 - 33	3.7	25.1
50 - 70	2.9	28.0

Average Permeability Millidarcys 16.9
 Average Percent Porosity 19.5
 Average Percent Oil Saturation 42.0
 Average Percent Water Saturation 44.9
 Average Oil Content, Bbls./A. Ft. 646.
 Total Oil Content, Bbls./Acre 18,922.
 Average Percent Oil Recovery by Laboratory Flooding Tests 10.4
 Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft. 163.
 Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre 3,112.
 Total Calculated Oil Recovery, Bbls./Acre..... See "Calculated Recovery"

Section

OILFIELD RESEARCH LABORATORIES

-2-

The core was sampled and the samples sealed in plastic bags by a representative of the client.

FORMATION CORED

The detailed log of the formation cored is as follows:

<u>Depth Interval, Feet</u>	<u>Description</u>
538.0 - 543.7	Light brown sandstone with fine micaceous partings.
543.7 - 546.5	Grayish light brown shaly sandstone.
546.5 - 548.7	Grayish light brown sandstone with fine shale partings
548.7 - 550.7	Grayish light brown shaly sandstone with fine shale partings.
550.7 - 551.8	Grayish light brown sandstone with fine shale partings
551.8 - 557.7	Grayish light brown shaly sandstone with fine shale and micaceous partings.
557.7 - 559.0	Alternate layers gray shale and light brown sandstone.
559.0 - 560.3	Grayish light brown shaly sandstone.
560.3 - 566.0	Light brown sandstone with fine shale partings.
566.0 - 568.3	Grayish light brown shaly sandstone.

LABORATORY FLOODING TESTS

The sand in this core responded to laboratory flooding tests, as a total recovery of 3,112 barrels of oil per acre was obtained from 19.1 feet of sand. The weighted average percent oil saturation was reduced from 46.1 to 35.7, or represents an average recovery of 10.4 percent. The weighted average effective permeability of the samples is 4.94 millidarcys, while the average initial fluid production pressure is 29.0 pounds per square inch (See Table V).

OILFIELD RESEARCH LABORATORIES

-3-

By observing the data given in Table IV, you will note that of the 30 samples tested, 20 produced water and oil, and 5 produced water only. This indicates that approximately 67 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 4,450 barrels of oil per acre. This is an average recovery of 233 barrels per acre foot from 19.1 feet of floodable sand analyzed in this core.

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

Original formation volume factor, estimated	1.07
Reservoir water saturation, percent, estimated	30.0
Average porosity, percent	20.2
Oil saturation after flooding, percent	35.7
Performance factor, percent, estimated	50.0
Net floodable sand, feet	19.1

RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Glenn CaldwellLease FeuerbornWell No. 3

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	538.5	19.4	48	44	92	722	15.	1.0	1.0	722	15.00
2	539.5	22.0	39	36	75	666	32.	1.0	2.0	666	32.00
3	540.5	19.8	43	48	91	661	18.	1.0	3.0	661	18.00
4	541.5	21.2	44	39	83	724	16.	1.0	4.0	724	16.00
5	542.5	20.7	50	39	89	803	18.	1.0	5.0	803	18.00
6	543.5	20.3	43	40	83	694	20.	0.7	5.7	486	14.00
7	544.5	16.3	16	65	81	202	6.7	1.3	7.0	263	8.71
8	545.8	16.2	47	47	94	591	3.4	1.5	8.5	887	5.10
9	546.7	20.9	33	43	76	535	52.	0.9	9.4	482	46.80
10	547.5	21.5	52	39	91	867	19.	0.6	10.0	520	11.40
11	548.5	17.4	53	44	97	715	12.	0.7	10.7	501	8.40
12	549.5	18.9	64	33	97	938	6.0	1.0	11.7	938	6.00
13	550.8	21.8	71	27	98	1201	12.	0.6	12.3	721	7.20
14	551.7	20.0	40	45	85	621	11.	0.5	12.8	311	5.50
15	552.5	17.2	45	46	91	601	1.7	1.0	13.8	601	1.70
16	553.5	19.7	44	49	93	672	3.7	1.0	14.8	672	3.70
17	554.5	19.4	52	40	92	783	9.9	1.0	15.8	783	9.90
18	555.5	20.1	51	35	86	795	8.0	1.0	16.8	795	8.00
19	556.8	19.4	41	45	86	617	8.3	1.1	17.9	679	9.13
20	557.5	19.5	41	46	87	620	3.3	0.8	18.7	496	2.64
21	558.1	18.6	47	46	87	678	14.	1.3	20.0	881	18.20
22	559.5	11.6	19	74	93	171	Imp.	1.3	21.3	222	0.00
23	560.5	23.3	37	41	78	669	67.	1.0	22.3	669	67.00
24	561.7	21.7	35	53	88	589	24.	1.0	23.3	589	24.00

RESULTS OF SATURATION & PERMEABILITY TESTS

-2-

TABLE 1-B

Company Glenn Caldwell Lease Feuerborn Well No. 3

Sample No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content Bbls. / A Ft.	Perm., Mill.	Feet of Sand		Total Oil Content	Perm. Capacity Ft. X md.
			Oil	Water	Total			Ft.	Cum. Ft.		
25	562.5	24.0	38	42	80	708	50.	1.0	24.3	708	50.00
26	563.5	22.2	46	40	86	792	25.	1.0	25.3	792	25.00
27	564.5	20.9	55	32	87	892	13.	1.0	26.3	892	13.00
28	565.4	21.1	45	39	84	737	14.	0.7	27.0	516	9.80
29	566.5	18.4	22	50	72	314	8.5	1.0	28.0	314	8.50
30	567.5	19.4	32	50	82	482	7.4	1.3	29.3	627	9.62

Oilfield Research Laboratories

SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company		Lease		Well No.		
Glenn Caldwell		Feuerborn		3		
Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.	Average Percent Oil Saturation	Average Percent Water Saturation	Total Oil Content Bbls./Acre
538.0 - 548.7	10.7	18.1	193.41	41.4	45.0	6,715
549.0 - 568.3	17.3	16.1	278.89	42.4	44.8	12,207
538.0 - 568.3	28.0	16.9	472.30	42.0	44.9	18,922
Depth Interval, Feet	Feet of Core Analyzed	Average Porosity	Average Oil Content Bbl./A. Ft.			
538.0 - 548.7	10.7	19.3	628			
549.0 - 568.3	18.6	19.6	656			
538.0 - 568.3	29.3	19.5	646			

RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Well No. 3

Lease Feuerborn

Company Glenn Caldwell

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.
			%	Bbls./A. Ft.	%	Bbls./A. Ft.	% Oil	% Water			
1	538.5	19.5	48	726	14	212	34	60	112	5.85	25
2	539.5	21.9	39	663	10	170	29	62	190	9.75	25
3	540.5	20.3	42	661	8	126	34	59	62	3.00	35
4	541.5	21.3	44	727	20	330	24	63	198	9.60	10
5	542.5	21.1	49	802	14	229	35	55	46	2.10	25
6	543.5	20.9	43	697	14	227	29	59	78	3.75	35
7	544.5	16.2	16	201	0	0	16	66	0	Imp.	-
8	545.8	16.3	47	594	11	139	36	59	64	3.15	35
9	546.7	20.4	34	538	10	158	24	64	170	8.85	20
10	547.5	21.6	52	871	0	0	52	40	0	Imp.	-
11	548.5	17.3	53	711	0	0	53	44	52	1.80	25
12	549.5	19.0	64	943	15	221	49	48	20	0.90	25
13	550.8	21.9	71	1206	22	374	49	49	130	7.05	25
14	551.7	19.5	41	620	9	136	32	56	8	1.20	25
15	552.5	17.3	45	604	7	94	38	60	7	1.03	50
16	553.5	19.8	44	676	9	138	35	59	40	1.95	30
17	554.5	19.5	52	787	14	212	38	55	70	3.60	25
18	555.5	20.2	51	799	10	157	41	49	16	1.20	30
19	556.8	19.5	41	620	2	30	39	48	9	1.10	50
20	557.5	19.6	41	623	9	137	32	56	28	1.35	25
21	558.1	18.5	47	675	0	0	47	47	0	Imp.	-
22	559.5	11.7	19	172	0	0	19	75	0	Imp.	-
23	560.5	22.8	38	672	6	106	32	64	476	23.69	25
24	561.7	21.8	35	423	0	0	35	54	192	9.90	25

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.

RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Glenn Caldwell Lease Feuerborn Well No. 3

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.
			%	Bbls./A. Ft.	%	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.			
25	562.5	23.9	38	705	4	74	34	57	631	260	8.10	20
26	563.5	22.1	46	789	0	0	46	44	789	12	0.45	45
27	564.5	21.0	55	896	6	98	49	40	798	28	1.20	40
28	565.4	21.0	45	733	0	0	45	46	733	14	0.60	45
29	566.5	18.3	22	312	0	0	22	52	312	0	Imp.	-
30	567.5	19.5	32	484	0	0	32	57	484	10	0.75	50

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.

Oilfield Research Laboratories

SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

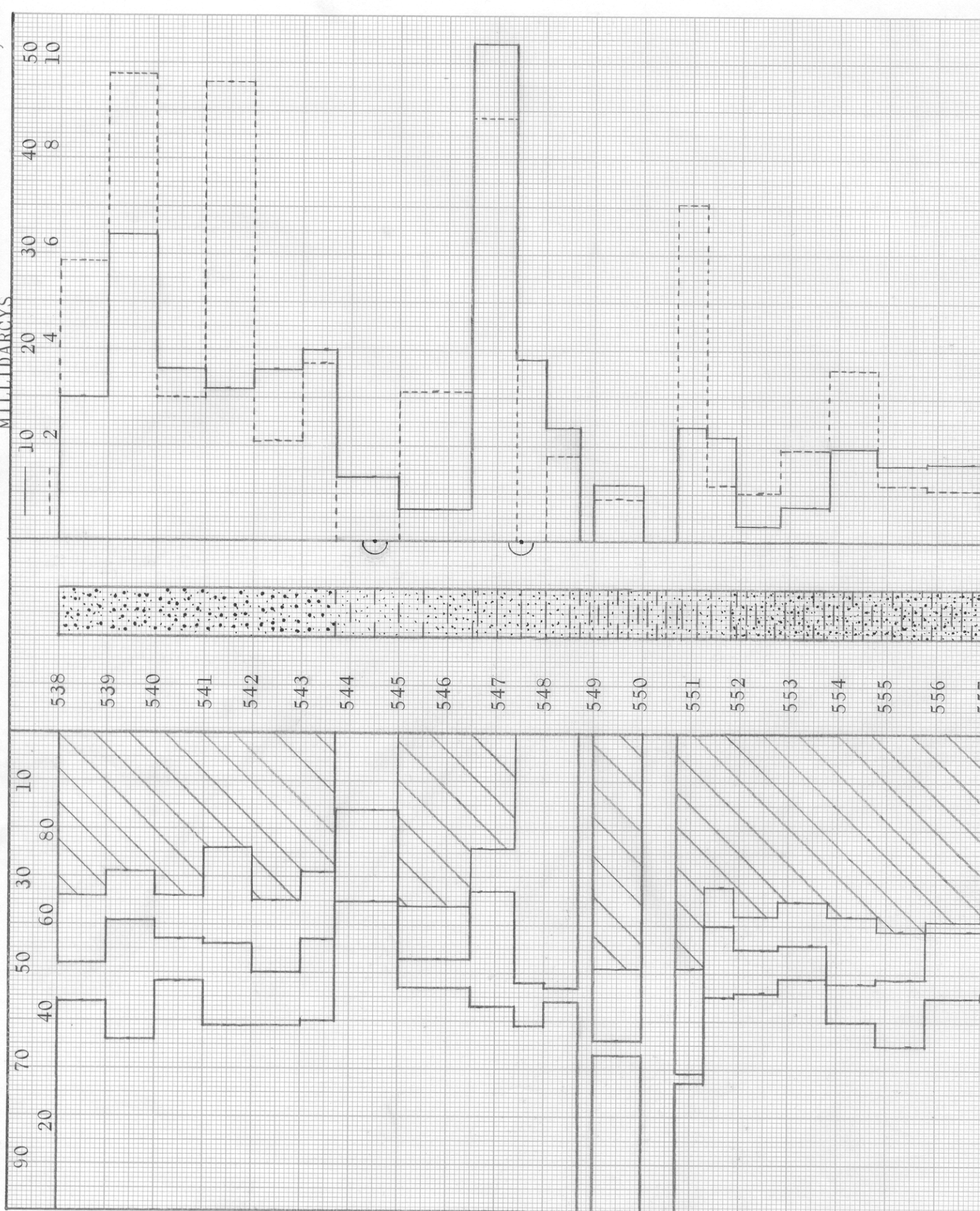
Company	Lease	Feuerborn	Well No.
Glenn Caldwell	538.0 - 548.7	549.0 - 568.3	538.0 - 568.3
Depth Interval, Feet	8.1	11.0	19.1
Feet of Core Analyzed	20.0	20.3	20.2
Average Percent Porosity	43.6	48.0	46.1
Average Percent Original Oil Saturation	12.5	8.9	10.4
Average Percent Oil Recovery	31.1	39.1	35.7
Average Percent Residual Oil Saturation	60.1	53.4	56.2
Average Percent Residual Water Saturation	91.2	92.5	91.9
Average Percent Total Residual Fluid Saturation	672.	755.	719.
Average Original Oil Content, Bbls./A. Ft.	195.	140.	163.
Average Oil Recovery, Bbls./A. Ft.	477.	615.	556.
Average Residual Oil Content, Bbls./A. Ft.	5,443.	8,296.	13,739.
Total Original Oil Content, Bbls./Acre	1,577.	1,535.	3,112.
Total Oil Recovery, Bbls./Acre	3,866.	6,761.	10,627.
Average Effective Permeability, Millidarcys	5.63	4.44	4.94
Average Initial Fluid Production Pressure, p.s.i.	26.3	30.8	29.0

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

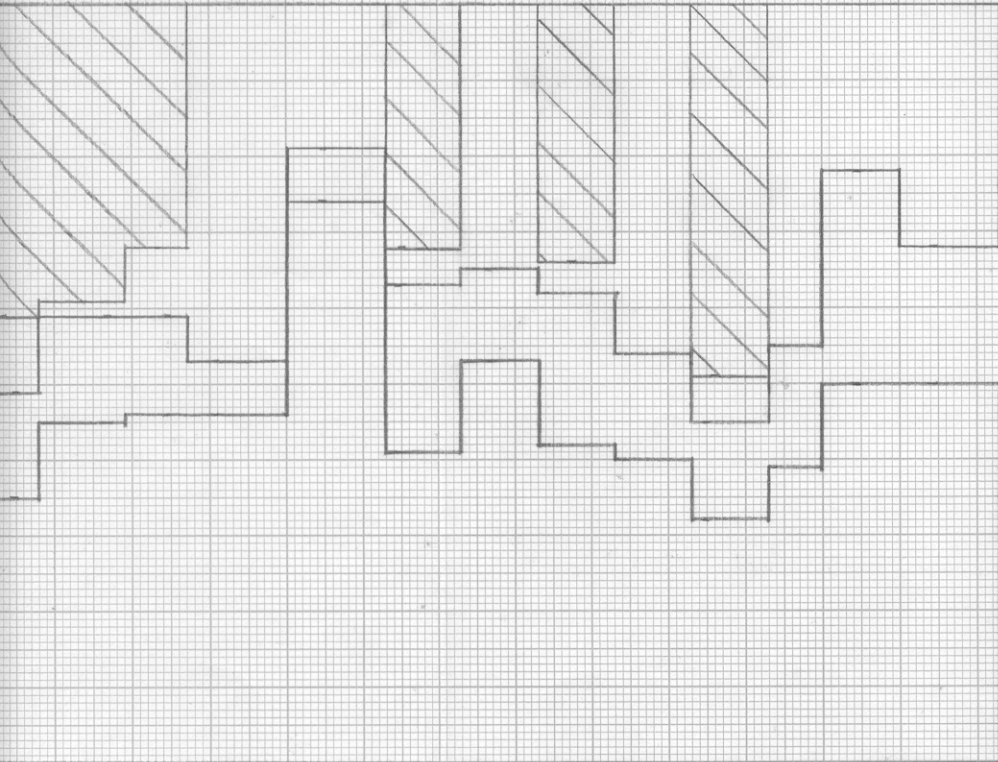
WATER SAT., PERCENT

OIL SAT., PERCENT

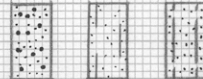
PERMEABILITY, IN MILLIDARCYS
EFFECTIVE PERMEABILITY TO WATER, IN MILLIDARCYS



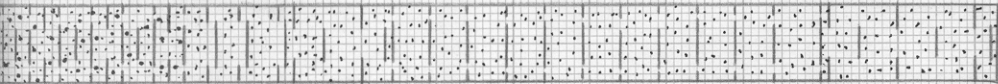
556
557
558
559
560
561
562
563
564
565
566
567
568



KEY:



MICACEOUS SANDSTONE
SHALY SANDSTONE
SANDSTONE WITH SHALE PARTINGS



SHALY SANDSTONE WITH SHALE PARTINGS
MICACEOUS SHALY SANDSTONE WITH SHALE PARTINGS
ALTERNATE LAYERS OF SANDSTONE AND SHALE
FLOODPOT RESIDUAL OIL SATURATION
IMPERMEABLE TO WATER



23.69
67

GLENN CALDWELL

PROPERTY LEASE
WELL NO. 2

○ IMPERMEABLE TO WATER

GLENN CALDWELL

FEUERBORN LEASE

WELL NO. 3

LINN COUNTY, KANSAS

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

538.0 - 548.7 10.7 19.3 41.4 45.0 18.1

549.0 - 568.3 18.6 19.6 42.4 44.8 16.1

538.0 - 568.3 29.3 19.5 42.0 44.9 16.9

(PRIMARY AND
WATERFLOODING)

OILFIELD RESEARCH LABORATORIES
CHANUTE, KANSAS
OCTOBER, 1981

PDC