



OILFIELD RESEARCH LABORATORIES

536 NORTH HIGHLAND - CHANUTE, KANSAS - PHONE HE1-2650

April 13, 1968

Mr. E. J. Dunigan, Jr.
P. O. Box 261
Pampa, Texas 79065

Gentlemen:

Enclosed herewith is the report of the analysis of the Rotary core taken from the Earl Davidson Lease, Well No. 1, Woodson County, Kansas, and submitted to our laboratory on April 10, 1968.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

CLP:bjo

3 c. - Pampa, Texas
2 c. - Chanute, Kansas

Earl Davidson

A fresh water mud was used as a circulating fluid in the coring of the sand in this well. This well was drilled in a virgin area. The core was sampled and sealed in tin cans by an employee of Oilfield Research Laboratories.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
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956.0 - 956.3	- Brown slightly laminated shaly sandstone.
956.3 - 959.0	- Laminated sandy shale.
959.0 - 968.0	- Dark brown slightly laminated shaly sandstone.
968.0 - 970.4	- Dark brown laminated shaly sandstone.
970.4 - 971.2	- Hard dark carbonaceous sandstone.
971.2 - 972.0	- Gray to dark shaly sandstone.
972.0 - 973.0	- Sandy shale.
973.0 - 973.4	- Gray to dark shaly sandstone.
973.4 - 977.0	- Sandy shale.

Coring was started at a depth of 956.0 feet in brown slightly laminated shaly sandstone and completed at 977.0 feet in sandy shale. This core shows a total of 13.7 feet of sandstone. For the most part, the pay is made up of dark brown slightly laminated shaly sandstone.

PERMEABILITY

For the sake of distribution, the core was divided into two sections. The weighted average permeability of the upper and lower sections is 70.0 and 61.0 millidarcys respectively; the overall average being 68.8 (See Table III). By observing the data given on

the coregraph, it is noticeable that the sand has a very irregular permeability profile. The permeability of the sand varies from 25. to a maximum of 166. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a very good weighted average percent oil saturation, namely, 60.2. The weighted average percent oil saturation of the upper and lower sections is 60.6 and 58.0 respectively. The weighted average percent water saturation of the upper and lower sections is 18.3 and 17.5 respectively; the overall average being 18.2 (See Table III). This gives an overall weighted average total fluid saturation of 78.4 percent. This fairly low total fluid saturation indicates some fluid was lost during coring which was probably oil.

The weighted average oil content of the upper and lower sections is 980 and 964 barrels per acre foot respectively; the overall average being 978. The total oil content, as shown by this core, is 12,221 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

Most of the sand in this core responded fairly well to laboratory flooding tests, as a total recovery of 2,349 barrels of oil per acre was obtained from 10.9 feet of sand. The weighted average percent oil saturation was reduced from 60.6 to 47.3, or represents an average recovery of 13.3 percent. The weighted average effective permeability of the samples is 2.16 millidarcys, while the average initial fluid production pressure is 22.2 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 14 samples tested, all produced water and 12 oil. This indicates

that approximately 86 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand, after flooding, had a rather high residual oil saturation.

CONCLUSION

On the basis of the above data, we estimate that approximately 1,504 barrels of oil per acre can be recovered from the area, represented by this core, by efficient primary production methods. An additional oil recovery of approximately 2,234 barrels per acre can be expected from efficient waterflooding. The following data was used in calculating the above oil recovery values:

Present formation volume factor	1.06
Irreducible, water saturation, percent	13.0
Primary recovery, percent	None
Present oil saturation, percent	82.1
Average porosity, percent	20.9
Oil saturation after flooding, percent	47.3
Performance factor	0.50
Net floodable pay sand, feet	10.9

The core shows a fairly clean sand section having a very good oil saturation, a low water saturation and a good porosity and permeability. The tests indicate that the formation oil has a rather high viscosity.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company E. J. Dunigan, Jr. Lease Earl Davidson Well No. 1

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			Ft.	Cum. Ft.		
1	956.1	17.4	57	13	769	41.	0.3	0.3	231	12.30
2	959.1	19.0	55	19	811	43.	0.6	0.9	487	25.80
3	960.1	22.2	62	18	1068	84.	1.0	1.9	1068	84.00
4	961.1	22.1	50	18	858	88.	1.0	2.9	858	88.00
5	962.1	20.9	60	14	973	27.	1.0	3.9	973	27.00
6	963.1	18.2	62	22	875	43.	1.0	4.9	875	43.00
7	964.1	21.0	56	17	912	166.	1.0	5.9	912	166.00
8	965.1	21.4	63	21	1046	25.	1.0	6.9	1046	25.00
9	966.1	20.2	60	17	940	56.	1.0	7.9	940	56.00
10	967.1	22.0	68	16	1161	92.	1.4	9.3	1625	128.80
11	968.2	21.2	70	18	1152	93.	0.6	9.9	691	55.80
12	969.2	20.9	60	24	973	51.	1.0	10.9	973	51.00
13	970.1	22.4	50	18	869	78.	0.8	11.7	696	62.40
14	971.1	18.2	66	17	932	44.	0.8	12.5	846	35.20

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company E. J. Dunigan, Jr. Lease Earl Davidson Well No. 1

Depth Interval, Feet	Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
956.0 - 969.6	956.0 - 969.6	10.9	70.0	762.70
969.6 - 971.2	969.6 - 971.2	1.6	61.0	97.60
956.0 - 971.2	956.0 - 971.2	12.5	68.8	860.30

Depth Interval, Feet	Feet of Core Analyzed	Average Percent Porosity	Average Percent Oil Saturation	Average Percent Water Saturation	Average Oil Content Bbl./A. Ft.	Total Oil Content Bbls./Acre
956.0 - 969.6	10.9	20.8	60.6	18.3	980.	10,679.
969.6 - 971.2	1.6	20.3	58.0	17.5	964.	1,542.
956.0 - 971.2	12.5	20.8	60.2	18.2	978.	12,221.

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company E. J. Dunigan, Jr. Lease Earl Davidson Well No. 1

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	956.1	17.9	57	791	16	222	41	49	152	3.30	20
2	959.1	19.1	55	816	6	89	49	41	14	0.40	35
3	960.1	21.8	62	1048	20	338	42	45	41	1.10	20
4	961.1	22.6	50	877	14	246	36	54	54	1.50	20
5	962.1	21.1	60	982	17	278	43	54	105	3.00	20
6	963.1	18.7	62	900	16	232	46	49	123	3.80	20
7	964.1	21.4	56	930	15	249	41	57	212	6.80	20
8	965.1	21.1	63	1031	12	196	51	39	39	1.00	20
9	966.1	19.9	60	926	5	77	55	42	17	0.40	25
10	967.1	21.6	68	1139	15	251	53	44	23	0.60	25
11	968.2	21.5	70	1170	18	301	52	45	32	0.70	25
12	969.2	21.0	60	977	5	81	55	44	112	3.50	20
13	970.1	21.9	53	900	0	0	53	46	52	1.20	30
14	971.1	17.9	63	875	0	0	63	28	30	0.70	30

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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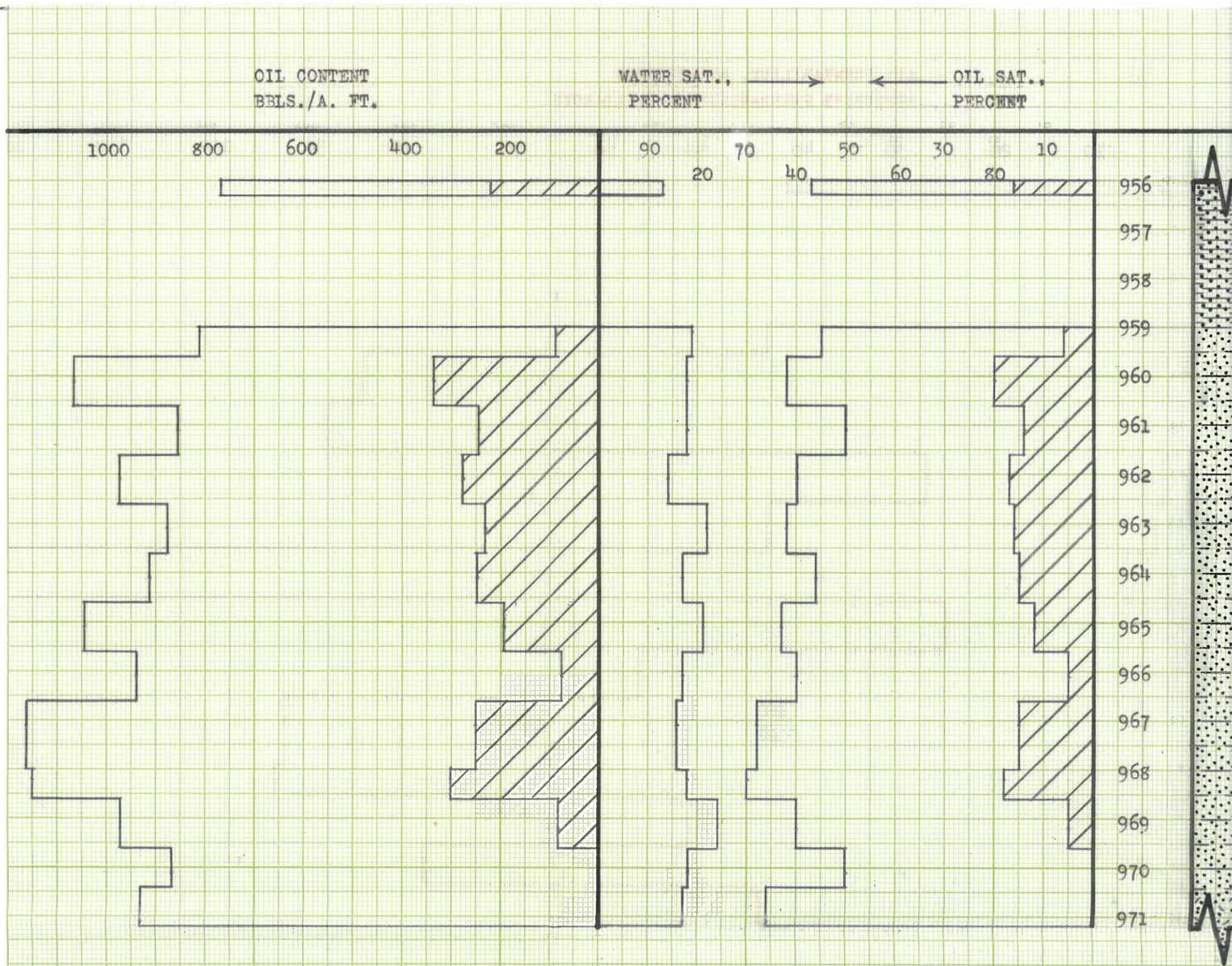
SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company	E. J. Dunigan, Jr.	Lease	Earl Davidson	Well No.	1
Depth Interval, Feet	956.0 - 969.6				
Feet of Core Analyzed	10.9				
Average Percent Porosity	20.9				
Average Percent Original Oil Saturation	60.6				
Average Percent Oil Recovery	13.3				
Average Percent Residual Oil Saturation	47.3				
Average Percent Residual Water Saturation	46.9				
Average Percent Total Residual Fluid Saturation	94.2				
Average Original Oil Content, Bbls./A. Ft.	981.				
Average Oil Recovery, Bbls./A. Ft.	215.				
Average Residual Oil Content, Bbls./A. Ft.	766.				
Total Original Oil Content, Bbls./Acre	10,694.				
Total Oil Recovery, Bbls./Acre	2,349.				
Total Residual Oil Content, Bbls./Acre	8,345.				
Average Effective Permeability, Millidarcys	2.16				
Average Initial Fluid Production Pressure, p.s.i.	22.2				

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

KEUFEL STANDARD MILLIMETER CROSS SECTION

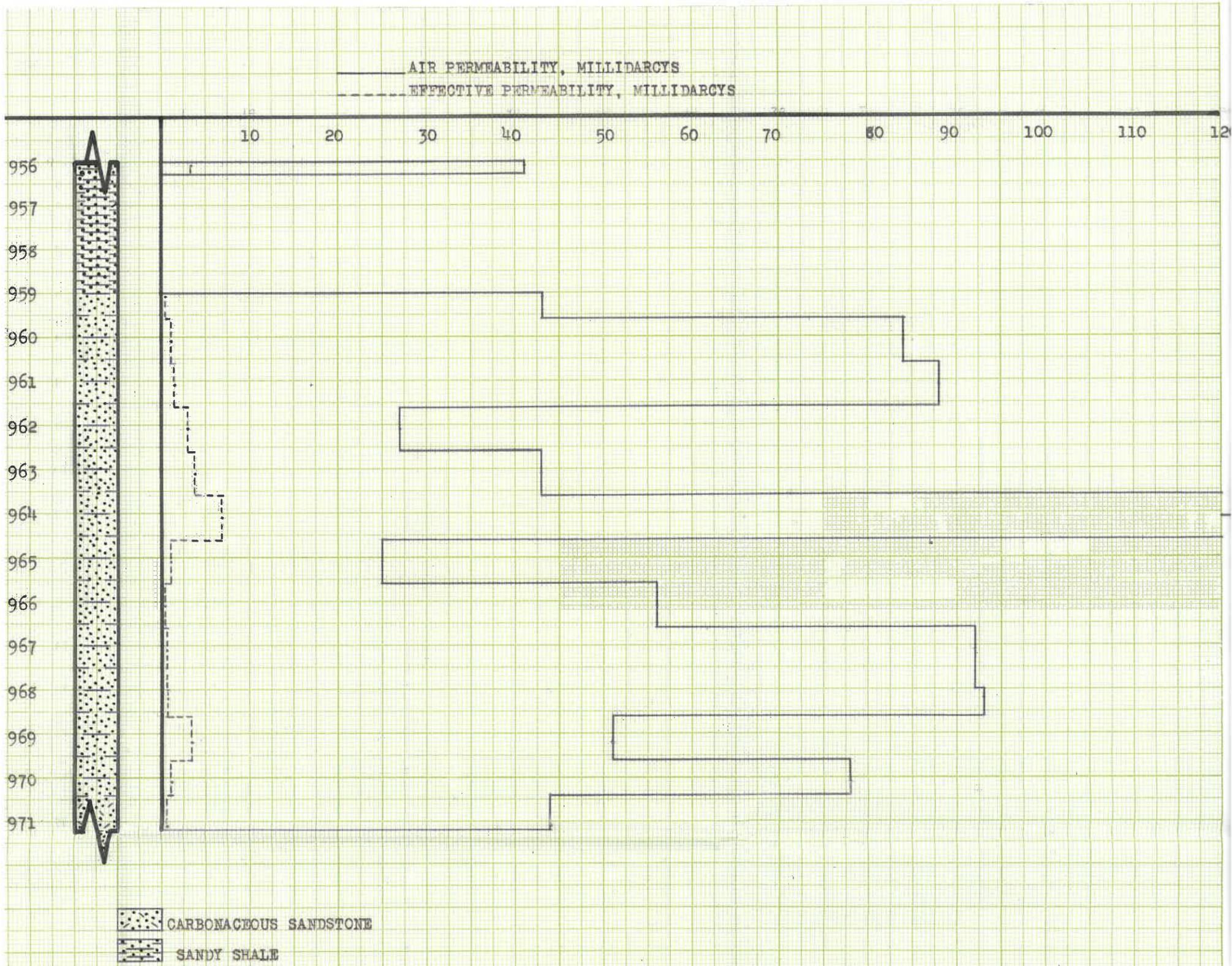


KEY:
 FLOOD POT RECOVERY
 SHALY SANDSTONE

E. J. DUN
 E. DAVIDSON LEASE
 WOODSON COUNTY

DEPTH INTERVAL FEET	FEET OF CORE ANALYZED	AVERAGE POROSITY PERCENT	AVG. OIL SATURATION PERCENT	AVG. WATER SATURATION PERCENT
956.0 - 969.6	10.9	20.8	60.6	18.3
969.6 - 971.2	1.6	20.3	58.0	17.5
956.0 - 971.2	12.5	20.8	60.2	18.2

KEUFEL MADE IN



DUNIGAN, JR.

JOHNSON LEASE WELL NO. 1
 JOHNSON COUNTY, KANSAS

AVG. WATER SATURATION PERCENT	AVG. OIL CONTENT BBLs./A. FT.	TOTAL OIL CONTENT BBLs./ACRE	AVG. AIR PERMEABILITY MILLIDARCYS	CALCULATED OIL RECOVERY BBLs/ACRE
18.3	980.	10,679.	70.0	
17.5	964.	1,542.	61.0	
18.2	978.	12,221	68.8	3,738 (Primary & Secondary)

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 CHANUTE, KANSAS
 APRIL, 1968