

26-30s-16E ✓

OILFIELD RESEARCH LABORATORIES

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September 22, 1959

Mr. Nicholas Sage
111 South Meramac
Clayton 5, Missouri

Dear Sir:

Enclosed herewith is the report of the analysis of the 3" Rotary core taken from the Phillips Lease, Well No. WS-1, Wilson County, Kansas, and submitted to our laboratory by you on September 15, 1959.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. McElrea
Carl L. McElrea

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GENERAL INFORMATION & SUMMARY

Company	Nicholas Sage	Lease	Phillips	Well No.	WS-1
Location	SW $\frac{1}{4}$				
Section	26	Twp.	30S	Rge.	16E
		County	Wilson		State Kansas
Name of Sand					Bartlesville
Top of Core					772.0
Bottom of Core					795.5
Pay					
Top of Sand					780.7
Pay					
Bottom of Sand					795.0
Total Feet of Permeable Sand					17.4
Total Feet of Floodable Sand					11.3
Distribution of Permeable Sand:					
Permeability Range Millidarcys	Feet	Cum. Ft.			
0 - 2	5.1	5.1			
2 - 5	1.2	6.3			
5 - 10	4.5	10.8			
10 - 15	2.8	13.6			
15 - 30	1.9	15.5			
30 & above	1.9	17.4			
Average Permeability Millidarcys		12.3			
Average Percent Porosity		15.3			
Average Percent Oil Saturation		35.7			
Average Percent Water Saturation		48.1			
Average Oil Content, Bbls./A. Ft.		427.			
Total Oil Content, Bbls./Acre		9,517.			
Average Percent Oil Recovery by Laboratory Flooding Tests		10.1			
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.		141.			
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre		1,596.			
Total Calculated Oil Recovery, Bbls./Acre		1,650.			
Packer Setting, Feet					
Viscosity, Centipoises @					
A. P. I. Gravity, degrees @ 60 °F					
Elevation, Feet					

A water base mud was used as the circulating fluid during the coring of the sand. Samples were taken from the core and sealed in plastic bags by a representative of the client.

The section of core extending from 772 to 787 feet was in the hole exposed to coring fluid for 24 hours before it was recovered.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
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772.0 - 773.6	- Brownish gray shaley sandstone.
773.6 - 790.1	- Brown laminated shaley micaceous sandstone.
790.1 - 790.6	- Dark carbonaceous shaley micaceous sandstone.
790.6 - 791.4	- Dark and gray shaley carbonaceous micaceous sandstone.
791.4 - 791.6	- Dark carbonaceous sandstone.
791.6 - 792.1	- Gray sandy shale.
792.1 - 792.9	- Dark and gray laminated carbonaceous shaley micaceous sandstone.
792.9 - 795.0	- Brown shaley micaceous sandstone.
795.0 - 795.5	- Gray and dark carbonaceous shaley sandstone.

Coring was started at a depth of 772.0 feet in brownish gray shaley sandstone and completed at 795.5 feet in gray and dark carbonaceous shaley sandstone. This core shows a total of 23.0 feet of sandstone. For the most part, the pay is made up of brown laminated shaley micaceous sandstone.

PERMEABILITY

For the sake of distribution, the core was divided into three sections. The weighted average permeability of the upper, middle and lower sections is 1.5, 8.5 and 19.8 millidarcys respectively; the overall average being 12.3 (See Table III). By observing the data given on the core-graph, it is noticeable that the sand has a very irregular permeability

profile. The permeability of the sand varies from 0.45 to a maximum of 91 millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fairly good weighted average percent oil saturation, namely, 35.7. The weighted average percent oil saturation of the upper, middle and lower sections is 33.2, 32.6 and 40.1 respectively. The weighted average percent water saturation of the upper, middle and lower sections is 49.0, 50.2 and 45.6 respectively; the overall average being 48.1 (See Table III). This gives an overall weighted average total fluid saturation of 83.8 percent.

The weighted average oil content of the upper, middle and lower sections is 341, 399 and 530 barrels per acre foot respectively; the overall average being 427. The total oil content, as shown by this core, is 9,517 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

Part of the sand in this core responded fairly well to laboratory flooding tests, as a total recovery of 1,596 barrels of oil per acre was obtained from 11.3 feet of sand. The weighted average percent oil saturation was reduced from 35.8 to 25.7, or represents an average recovery of 10.1 percent. The weighted average effective permeability of the samples is 4.19 millidarcys, while the average initial fluid production pressure is 23.2 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 23 samples tested, 13 produced water and 11 oil. This indicates that approximately 48 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand has a very wide variation in effective permeability.

CONCLUSION

It is evident that an efficient water-flood within the vicinity of this well will recover approximately 1,650 barrels of oil per acre, provided the sand will take the required volume of water satisfactorily. This represents an average recovery of 146 barrels of oil per acre foot from the 11.3 feet of floodable pay sand analyzed. The following factors and assumptions were used in calculating this recovery:

Original formation volume factor	1.06
Present formation volume factor	1.02
True water saturation, percent	40.0
Primary oil recovery, percent	8.0
Calculated present oil saturation, percent	49.7
Porosity, percent	17.7
Oil saturation at abandonment, percent	28.0
Performance factor, percent	50.0

The analysis results show 11.3 feet of floodable pay sand extending from 780.7 to 795.0 feet. The sand has fairly good oil and normal water saturations and a wide variation in effective permeability.

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RESULTS OF PERMEABILITY TESTS
TABLE I

Company Nicholas Sage Lease Phillips Well No. WS-1

Sample No.	Depth Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	772.5	Imp.	0.7	0.7	0.00
2	773.0	Imp.	0.6	1.3	0.00
3	773.5	Imp.	0.3	1.6	0.00
4	774.0	Imp.	0.6	2.2	0.00
5	774.5	Imp.	0.5	2.7	0.00
6	775.0	Imp.	0.5	3.2	0.00
7	775.5	Imp.	0.5	3.7	0.00
8	776.0	0.82	0.5	4.2	0.41
9	776.5	1.9	0.5	4.7	0.95
10	777.0	0.53	0.5	5.2	0.26
11	777.5	Imp.	0.5	5.7	0.00
12	778.0	1.3	0.5	6.2	0.65
13	778.5	1.1	0.5	6.7	0.55
14	779.0	1.2	0.5	7.2	0.60
15	779.5	1.0	0.5	7.7	0.50
16	780.0	Imp.	0.5	8.2	0.00
17	780.5	4.3	0.5	8.7	2.15
18	781.0	7.0	0.5	9.2	3.50
19	781.5	5.2	0.5	9.7	2.60
20	782.0	7.2	0.5	10.2	3.60
21	782.5	14.	0.5	10.7	7.00
22	783.0	12.	0.5	11.2	6.00
23	783.5	12.	0.5	11.7	6.00
24	784.0	5.4	0.5	12.2	2.70
25	784.5	6.7	0.5	12.7	3.35
26	785.0	6.2	0.5	13.2	3.10
27	785.5	9.2	0.5	13.7	4.60
28	786.0	6.6	0.5	14.2	3.30
29	786.5	2.6	0.5	14.7	1.30
30	787.0	35.	0.5	15.2	17.50
31	787.5	22.	0.5	15.7	11.00
32	788.0	24.	0.5	16.2	12.00
33	788.5	34.	0.5	16.7	17.00
34	789.0	15.	0.5	17.2	7.50
35	789.5	91.	0.5	17.7	45.50
36	790.0	58.	0.4	18.1	23.20
37	790.5	5.6	0.5	18.6	2.80
38	791.0	0.45	0.8	19.4	0.36
39	791.5	3.6	0.2	19.6	0.72
40	792.0	Imp.	0.5	20.1	0.00

Oilfield Research Laboratories
RESULTS OF PERMEABILITY TESTS
TABLE I

Company Nicholas Sage Lease Phillips Well No. WS-1

Sample No.	Depth Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
41	792.5	1.4	0.8	20.9	1.12
42	793.0	Imp.	0.4	21.3	0.00
43	793.5	21.	0.4	21.7	8.40
44	794.0	11.	0.6	22.3	6.60
45	794.5	11.	0.7	23.0	7.70

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RESULTS OF SATURATION TESTS

TABLE II

Company			Nicholas Sage			Lease			Phillips			Well No.			WS-1		
Sat. No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content Bbls./A. Ft.	Feet of Core		Total Oil Content Bbls./Acre								
			Oil	Water	Total		Ft.	Cum. Ft.									
1	772.2	12.3	28	58	86	267	0.7	0.7	187								
2	773.2	12.0	26	65	91	242	0.9	1.6	218								
3	774.2	12.3	33	54	87	315	1.1	2.7	347								
4	775.2	14.8	32	50	82	367	1.0	3.7	367								
5	776.2	15.0	31	49	80	361	1.0	4.7	361								
6	777.2	13.3	29	38	67	299	1.0	5.7	299								
7	778.2	11.8	43	41	84	394	1.0	6.7	394								
8	779.2	13.3	35	46	81	361	1.0	7.7	361								
9	780.2	13.9	40	44	84	431	1.0	8.7	431								
10	781.2	15.8	29	51	80	365	1.0	9.7	365								
11	782.2	15.8	35	50	85	429	1.0	10.7	429								
12	783.2	15.4	34	52	86	406	1.0	11.7	406								
13	784.2	15.3	33	47	80	392	1.0	12.7	392								
14	785.2	16.2	32	51	83	402	1.0	13.7	402								
15	786.2	12.8	46	43	89	457	1.0	14.7	457								
16	787.2	16.0	39	45	84	484	1.0	15.7	484								
17	788.2	17.7	42	41	83	576	1.0	16.7	576								
18	789.2	22.2	40	47	87	689	1.4	18.1	965								
19	790.2	15.3	44	49	93	522	0.5	18.6	261								
20	791.2	13.4	44	44	88	458	0.8	19.4	367								
21	792.2	16.1	37	48	85	462	0.8	20.2	370								
22	793.2	17.7	41	47	88	564	0.8	21.0	451								
23	794.2	19.4	32	48	80	482	1.3	22.3	627								
Total--									--	--	--	--	--	--	9,517		

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company		Lease		Well No.	
Nicholas Sage		Phillips		WS-1	
Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.		
775.7 - 780.7	4.0	1.5	6.07		
780.7 - 785.7	5.0	8.5	42.45		
785.7 - 795.0	8.4	19.8	166.00		
775.7 - 795.0	17.4	12.3	214.52		

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
772.0 - 780.7	8.7	13.2	33.2	49.0	341	2,965
780.7 - 785.7	5.0	15.7	32.6	50.2	399	1,994
785.7 - 795.0	8.6	17.3	40.1	45.6	530	4,558
772.0 - 795.0	22.3	15.3	35.7	48.1	427	9,517

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company			Nicholas Sage			Lease			Phillips			Well No.		WS-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				Bbls./A. Ft.			
1	772.2	12.8	27	268	0	0	27	65	0	Imp.	50+				
2	773.2	12.5	28	272	0	0	28	65	0	Imp.	50+				
3	774.2	12.3	32	305	0	0	32	50	0	Imp.	50+				
4	775.2	15.1	33	386	0	0	33	62	5	0.222	40				
5	776.2	15.4	30	358	0	0	30	61	8	0.222	35				
6	777.2	13.7	26	276	0	0	26	50	0	Imp.	50+				
7	778.2	11.7	42	381	0	0	42	50	0	Imp.	50+				
8	779.2	13.8	34	364	0	0	34	52	0	Imp.	50+				
9	780.2	14.0	42	456	0	0	42	51	0	Imp.	50+				
10	781.2	16.1	29	362	7	87	22	66	17	0.429	25				
11	782.2	16.4	35	446	11	140	24	67	57	1.73	20				
12	783.2	15.7	34	415	5	61	29	59	27	0.700	25				
13	784.2	15.7	33	403	4	49	29	59	14	0.448	30				
14	785.2	16.5	32	410	5	64	27	60	46	1.52	25				
15	786.2	13.0	45	454	0	0	45	50	0	Imp.	50+				
16	787.2	16.6	39	502	13	167	26	64	35	0.893	20				
17	788.2	17.8	42	580	13	180	29	62	155	5.89	15				
18	789.2	22.5	40	699	10	175	30	55	174	23.68	15				
19	790.2	14.9	43	497	0	0	43	46	0	Imp.	50+				
20	791.2	13.9	42	453	0	0	42	50	0	Imp.	50+				
21	792.2	16.4	37	471	13	165	24	67	14	0.380	30				
22	793.2	18.0	41	572	15	209	26	67	13	0.393	25				
23	794.2	20.1	32	499	15	234	17	77	59	1.57	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.

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SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company	Lease	Phillips	Well No.
Nicholas Sage			WS-1
Depth Interval, Feet	780.7 - 785.7	786.7 - 795.0	780.7 - 795.0
Feet of Core Analyzed	5.0	6.3	11.3
Average Percent Porosity	16.1	19.0	17.7
Average Percent Original Oil Saturation	32.6	38.3	35.8
Average Percent Oil Recovery	6.4	13.0	10.1
Average Percent Residual Oil Saturation	26.2	25.3	25.7
Average Percent Residual Water Saturation	62.2	65.1	63.8
Average Percent Total Residual Fluid Saturation	88.4	90.4	89.5
Average Original Oil Content, Bbls./A. Ft.	407.	564.	494.
Average Oil Recovery, Bbls./A. Ft.	80.	190.	141.
Average Residual Oil Content, Bbls./A. Ft.	327.	374.	353.
Total Original Oil Content, Bbls./Acre	2,036.	3,545.	5,581.
Total Oil Recovery, Bbls./Acre	401.	1,195.	1,596.
Total Residual Oil Content, Bbls./Acre	1,635.	2,350.	3,985.
Average Effective Permeability, Millidarcys	0.965	6.76	4.19
Average Initial Fluid Production Pressure, p.s.i.	25.0	21.7	23.2

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