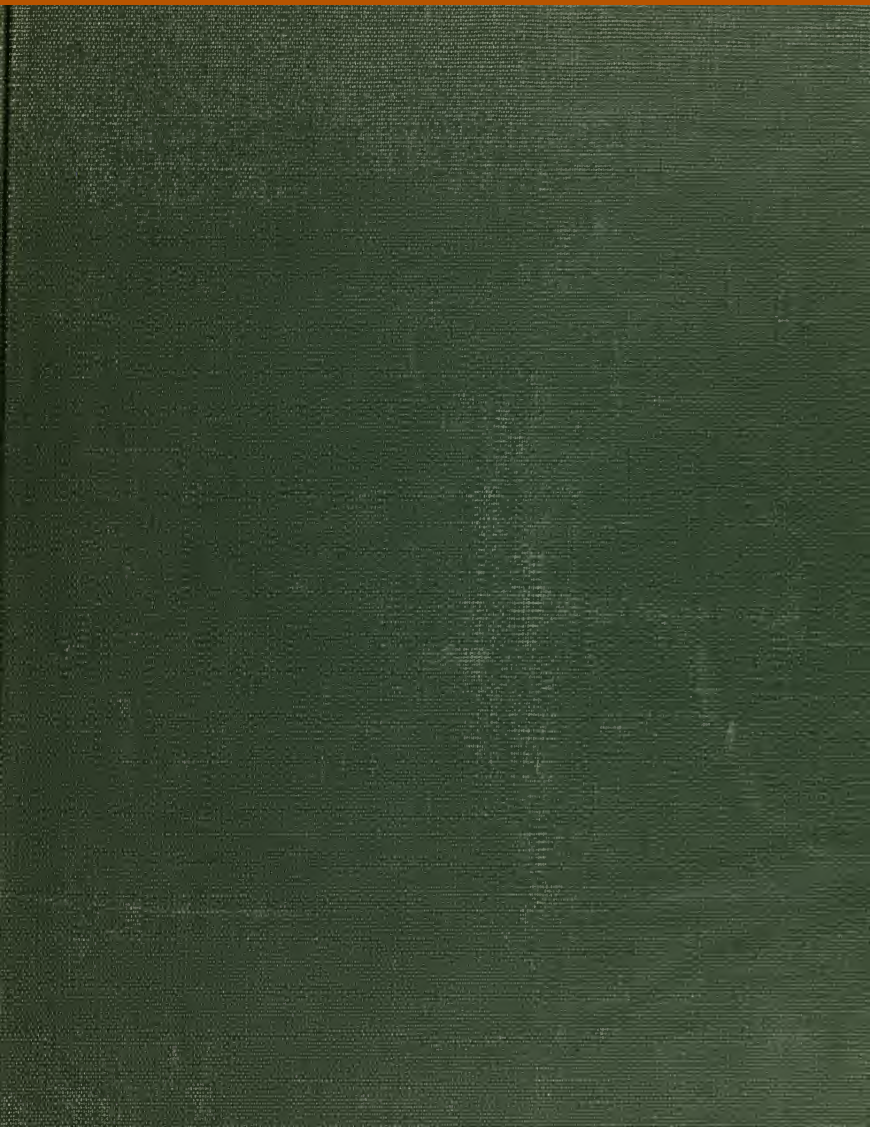

State of Illinois
William G. Stratton, Governor
DEPARTMENT OF REGISTRATION AND EDUCATION
Vera M. Binks, Director

Division of the

STATE GEOLOGICAL SURVEY

M. M. Leighton, Chief

Urbana

CIRCULAR NO. 182

SUMMARY OF WATER FLOOD OPERATIONS IN ILLINOIS OIL POOLS DURING 1951

By

Paul A. Witherspoon and Paul J. Shanor
and
Members of the Illinois Secondary Recovery and Pressure Maintenance
Study Committee

Printed by Authority of the State of Illinois

Urbana, Illinois
1953

Errata for Circular 182

Page 3 - 4th paragraph, line 1, for "6,672,008" read 6,395,944.
Line 4, for "21,889,880" read 19,845,680.

5th paragraph, line 1, for "6,672,008" read 6,395,944.

Page 11 - Map location no. 61, for "2,114,808" read 457,898.

Map location no. 65, for "450,522" read 174,458;
for "6,109,748" read 5,722,458.

Page 15 - in totals at end of Table I, for "6,672,008" read 6,395,944;
for "21,889,880" read 19,845,680.

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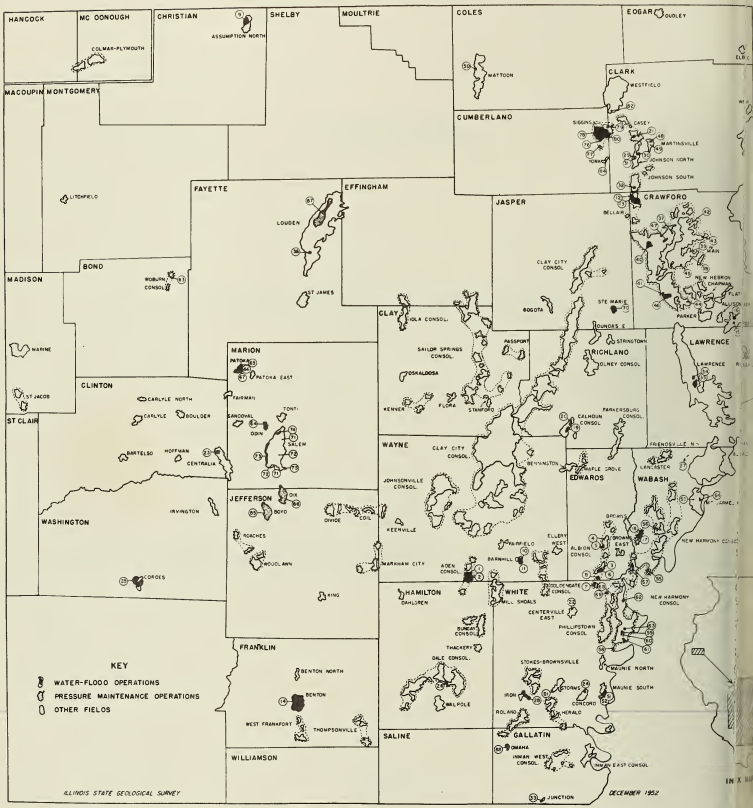
1953

Figure 1

MAP SHOWING

WATER FLOOD AND PRESSURE MAINTENANCE

OPERATIONS IN ILLINOIS DURING 1951



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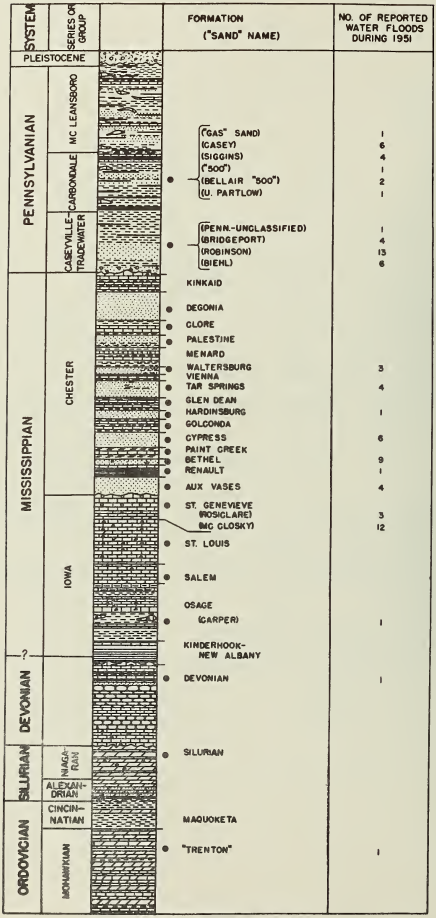
Illustrations

Figure 2

GENERALIZED GEOLOGIC COLUMN SHOWING FORMATIONS SUBJECTED TO WATER FLOODING IN THE ILLINOIS BASIN



(● OIL PRODUCING FORMATIONS)

"SUMMARY OF WATER FLOOD OPERATIONS IN ILLINOIS OIL POOLS DURING 1951"

INTRODUCTION

This report is the result of a joint effort by the Illinois Secondary Recovery and Pressure Maintenance Study Committee and the Illinois State Geological Survey. The following persons were appointed to the Study Committee by Governor Adlai E. Stevenson, early in 1952, to assist in the compilation of data on water flooding operations in Illinois oil pools during 1951:

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Mattoon, Illinois

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Kewanee Oil Company
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Salem, Illinois

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Sohio Petroleum Company
Centralia, Illinois

E. C. Wells
Carter Oil Company
Mattoon, Illinois

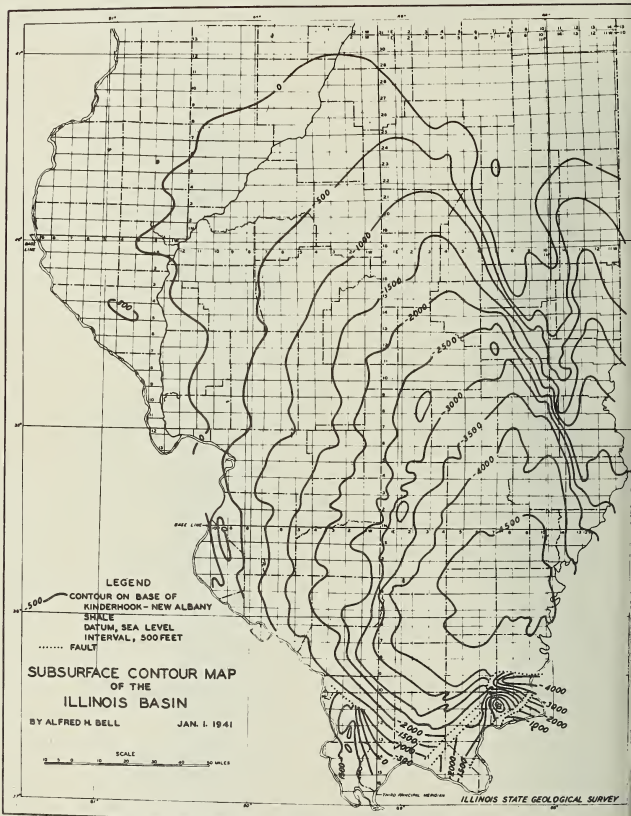
M. R. Wilson
The Texas Company
Salem, Illinois

R. A. Wilson
Tidewater Associated Oil Company
Robinson, Illinois

As a means to collect information on the water injection projects in operation during

Figure 3

SUBSURFACE CONTOUR MAP OF THE ILLINOIS BASIN



1951, the Study Committee set up a questionnaire on July 1, 1952. The Geological Survey sent the questionnaire to all water flood operators in Illinois and compiled the data returned. This questionnaire did not request data on gas injection operations other than whether or not gas injection had previously been used.

This report supplements two previous summaries of water flooding operations in Illinois which were published by the Interstate Oil Compact Commission, "Summary of Water Flooding Operations in Illinois, 1950," which reported operations during 1949, and "Summary of Water Flooding Operations in Illinois to 1951," which reported operations during 1950. These reports were reprinted by the Illinois State Geological Survey as Circulars 165 and 176 respectively.

SUMMARY OF RESULTS

Table I presents a summary of the information collected concerning water flood projects in operation during 1951. The data are arranged alphabetically by fields and include 84 water flood projects. Excluding the McClosky "dump" floods in the Clay City Consolidated field, there were approximately 90 water floods in operation in Illinois during 1951. Table I provides data on 93 percent of these projects. In terms of cumulative figures, however, this summary approaches 100 percent coverage because the unreported projects are small pilot floods.

A total of 57,146,845 barrels of water was injected during 1951, and 6,672,008 barrels of water flood oil was produced (exclusive of the McClosky "dump" floods), or a ratio of 8.5 barrels of water for each barrel of oil produced. A cumulative total of 148,279,296 barrels of water had been injected by the end of 1951 in recovering 21,889,880 barrels of oil, or an input water-oil ratio of 6.8. The cumulative input water-oil ratio is lower than the 1951 ratio because a considerable number of new projects were started in 1951 (and a few in 1950) from which appreciable increases in oil production had not been realized by the end of the year.

The 6,672,008 barrels of water flood oil recovered in 1951 is 11 percent of the state's otal oil production of 60,244,000 barrels. Comparable figures for 1950 were 3,107,154 barrels of water flood oil out of a total of 62,028,000 barrels. It is interesting to note that the 17,643 roductive acres that were subjected to injection during 1951 represent only 4 percent of the tate's total oil-productive area. This is an impressive indication of the contribution water looding is making to the recovery of one of the state's most valuable mineral resources.

It is estimated that the McClosky "dump" floods recovered 1 and 1-2 million barrels f water flood oil during 1951 and have an accumulated secondary recovery of 8 million barrels. hus, the total accumulated water flood oil recovery in Illinois was approximately 30 million arrels by the end of 1951.

Table II presents data on the four pressure maintenance projects that used water in- ction during 1951. The oil-production statistics include both primary recovery and any addi- onal oil obtained by pressure maintenance operations. These water injection operations augment atural water drives.

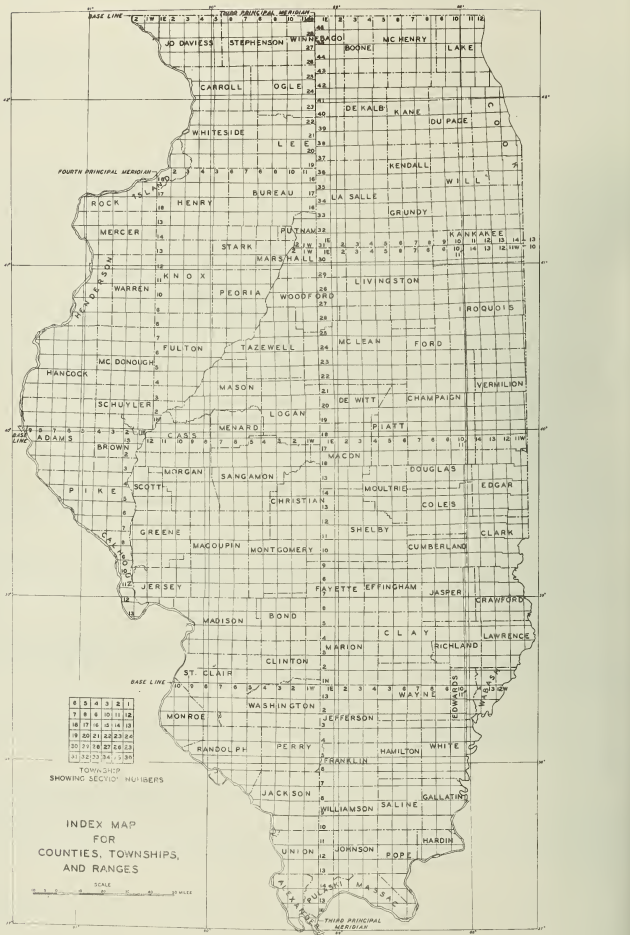
Each project listed in Tables I and II has been numbered, and corresponding numbers n Figure 1 show the location of water flood and pressure maintenance operations in Illinois uring 1951.

A generalized geologic column (Fig. 2) indicates the oil-producing formations in the linois Basin. Listed opposite these oil-producing formations are the number of reported water oods as taken from Table I. It will be seen that the water floods are divided almost equally tween Pennsylvanian and Mississippian formations and that three limestone formations are ing flooded among a predominant number of sandstones.

A subsurface contour map of the Illinois Basin is shown in Fig. 3, which is based on the bsea elevation of the base of the Kinderhook-New Albany shale (see Fig. 2). This contour map reproduced from "Developments in Eastern Interior Basin in 1940" by A. H. Bell (Bull. merican Assoc. Petrol. Geol., Vol. 25 No. 6, 1941, also Illinois Geol. Survey Ill. Pet. 38). n index map of counties, townships, and ranges in Illinois is shown in Figure 4.

Figure 4

INDEX MAP FOR COUNTIES, TOWNSHIPS, AND RANGES



WATER SUPPLY

by
Frank C. Foley*

Increased water flooding operations in Illinois are accompanied by an increased demand for water. In many parts of the oil fields of southern Illinois, water, especially groundwater, is in limited supply. Brine is available at most places in the oil fields but not usually in quantities adequate for large-scale water flooding projects such as the Salem Unit or the Benton Unit. It is necessary, therefore, in most flooding projects to supplement available brine with fresh water from streams and wells.

The availability of water from streams is usually readily determined, and data on stream flows can be obtained from the District Engineer, U. S. Geological Survey, 605 South Neil Street, Champaign, Illinois, and the Illinois State Water Survey, Urbana, Illinois.

Groundwater, other than brines, in the oil fields of southern Illinois must be obtained largely from the surficial glacial drift deposits and recent valley alluvium or in some places from Pennsylvanian sandstones or Mississippian limestones. There are many good aquifers in the glacial drift and alluvial deposits, but careful search of well records and field study is necessary to locate them. Recent alluvial deposits are found in present stream valleys. The largest deposits of water-yielding sand and gravel in the glacial drift are usually found in buried preglacial valleys or in valleys that drained from melting ice sheets. The first problem is the discovery and mapping of the buried valleys, after which the location of water-yielding sand or gravel in them requires additional detailed investigation. The Illinois State Geological Survey has located many buried valleys but many more years of study will be necessary before all potential water-yielding deposits are known (Horberg, Leland, Bedrock Topography of Illinois: Illinois Geol. Survey Bull. 73, 1950).

Before beginning field exploration for groundwater sources, review of the data on file in the State Geological Survey and the State Water Survey is essential and frequently indicates favorable avenues for further investigation. These studies commonly point to the need for surface electrical earth resistivity exploration and a field canvass of existing water sources.

The electrical earth resistivity method has been used with much success for more than 20 years by the Illinois Geological Survey to locate test drilling sites for probable deposits of sand and gravel in the unconsolidated glacial and fluvial overburden. This method is not infallible but is a very useful geophysical tool when combined with geological data by experienced personnel.

After geophysical, geologic, and test drilling data are assembled and analyzed, determination of the capacity and characteristics of the water-yielding formation by pumping test procedures is the final step before proceeding to construction of the water supply development. The Illinois Water Survey is prepared to furnish measuring equipment and skilled observational personnel for work of this type.

The 130,000 well logs on file in the Illinois Geological Survey are an abundant source of data for work in groundwater geology. Unfortunately, logs of many oil wells give no information or only sketchy information on the unconsolidated material above bedrock. Thousands of logs merely report "surface material." It is urged that oil operators make a specific effort to obtain detailed logs of the surficial material, for that material might be an important source of groundwater. Complete logs will greatly improve the assistance which the Geological Survey will be able to give in locating groundwater.

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*Geologist and Head, Division of Groundwater Geology and Geophysical Exploration, Illinois State Geological Survey. This statement has been prepared in collaboration with H. E. Hudson, Jr., Engineer and Head, Engineering Subdivision, Illinois State Water Survey.

TABLE I

ILLINOIS WATER FLOOD PROJECTS DURING 1951

GENERAL INFORMATION

Map No.	Field	Operator	Project	Formation "Sand"	County
1	Aden Consolidated	Texas	Aden	Aux Vases	Wayne
2	Aden Consolidated	Texas	Aden	McClosky	Wayne
3	Albion Consolidated	Carter	Albion	Lower Bridgeport	Edwards
4	Albion Consolidated	Continental	Stafford	McClosky	Edwards
5	Albion Consolidated	Jarvis Brothers and Marcell	-	McClosky	Edwards
6	Albion Consolidated	Superior	South Albion	Bridgeport	Edwards
7	Albion Consolidated	Yingling	Biehl Unit #1	Biehl	White
8	Albion Consolidated	Yingling	Biehl Unit #2	Biehl	Edwards
9	Assumption North	Continental	Benoist	Benoist	Christian
10	Barnhill	Ashland	Barnhill	McClosky	Wayne
11	Barnhill	Wayne Development	Walter	McClosky	Wayne
12	Bellair	Forest	Bellair	Bellair "500"	Crawford
13	Bellair	Pure	Fulton	Bellair "500"	Crawford
14	Benton	Shell	Benton Unit	Tar Springs	Franklin
15	Birds	Franchot	Highsmith	Robinson	Crawford
16	Birds	Yingling	J. W. Lindsay	Robinson	Crawford
17	Brown's East	Magnolia	Bellmont	Cypress	Wabash
18	Brown's East	Magnolia	Bellmont Water Flood Association	Cypress	Wabash
19	Calhoun Consolidated	Ashland	Calhoun	McClosky	Richland
20	Calhoun Consolidated	Phillips	Bohlander	McClosky	Richland
21	Casey	Forest	Casey	Casey	Clark
22	Centerville East	Sun	East Centerville	Tar Springs	White
23	Centralia	Sohio	Copple-Trenton	Trenton	Clinton
24	Concord	Phillips	Tuley	McClosky	White
25	Cordes	Shell, et al.	Cordes	Benoist	Washington
26	Dale Consolidated	Texas	West Dale Unit	Aux Vases	Hamilton
27	Friendsville North	Magnolia	J. L. Litherland	Biehl	Wabash
28	Iron	Shell	Iron Unit	Hardinsburg	White
29	Johnson North	McMahon	Block "A"	Casey	Clark
30	Johnson North	McMahon	Block "B"	500 ft.	Clark
31	Johnson North	Tidewater	Clark County No. 1	Casey	Clark
32	Johnson South	Forest	South Johnson	Upper Partlow	Clark
33	Junction	J. A. Lewis	-	Waltersburg	Gallatin
34,35	Lawrence	Ohio	Two Projects	Bridgeport	Lawrence

Location			Date First Injection	PRODUCTION AND INJECTION STATISTICS (Barrels)						Map No.
				Water Injection		Secondary Recovery Oil Production		Water Production		
Section	Township	Range		Total 1951	Cumulative 12-31-51	Total 1951	Cumulative 12-31-51	Total 1951	Cumulative 12-31-51	
),9,16,17	-3S	-7E	August, 1946	370,774	888,874	58,915	77,581	) 58,035)	) 110,334)	1
3,9,16,17	-3S	-7E	August, 1946	355,112	752,755	40,847	105,790	)	)	2
1,12	-3S	-10E	December, 1947	47,360	182,446	5,922	29,546	36,473	-	3
3	-2S	-10E	May, 1943	-	-	-	22,451*	-	-	4
4	-2S	-10E	July, 1951	6,120	6,120	-	-	None	None	5
,11,12	-3S	-10E	August, 1946	-	854,511*	-	173,502*	-	789,679*	6
3	-3S	-10E	August, 1949	403,920	884,639	127,474	243,291	-	-	7
4	-3S	-10E	December, 1950	184,410	186,138	46,415	46,415	-	-	8
),4,9,10	-13N	-1E	July, 1950	627,366	865,373	146,866	160,409	110,127	132,826	9
6,34,35	-2S	-8E	January, 1951	543,300	543,300	18,725	18,725	18,520	18,520	10
6	-2S	-8E	December, 1950	83,185	83,185	-	-	-	-	11
,11,12	-8N	-14W	July, 1948	1,969,900	6,977,000	91,200	216,650	-	-	12
,11,12	-8N	-14W	July, 1948	4,637,798	12,852,050	163,255	366,875	1,965,288	3,114,433	13
	-6S	-2,3E	November, 1949	9,518,589	19,997,583	1,803,751	1,751,527*	1,380,445	1,620,046	14
1	-5N	-11W	June, 1951	247,374	247,374	-	-	-	-	15
6	-5N	-11W	August, 1950	520,312	618,186	21,454	21,454	-	-	16
,11	-2S	-14W	November, 1947	103,542	456,061	82,505*	335,118*	29,760	38,778	17
,2,11,12	-2S	-14W	January, 1951	611,257	611,257	93,299*	93,299*	-	-	18
,18	-2N	-10E	September, 1951	72,050	72,050	245	245	-	-	19
3	-2N	-9E								
	-2N	-10E	June, 1950	152,780	199,056	3,798	3,798	4,558	4,558	20
4,15,23	-10N	-14W	March, 1950	671,500	1,124,000	54,270	71,676	-	-	21
	-4S	-10E	October, 1950	23,701	26,073	1,374	1,374	None	None	22
5	-2N	-1W	November, 1951	33,138	33,138	3,066*	3,066*	246	246	23
1	-6S	-10E	July, 1951	105,939	105,939	18,301	18,301	9,114	9,114	24
4,15,22, 3	-3S	-3W	August, 1950	1,305,582	1,892,548	519,371	529,308	555,804	656,815	25
1	-6S	-6E	July, 1951	181,853	181,853	None	None	1,998	1,998	26
12	-1N	-13W	July, 1947	63,192	223,143	17,577*	109,366*	28,760	66,475	27
3,24,25	-6S	-8E	December, 1950	1,149,485	1,255,092	None	None	13,575	13,663	28
	-9N	-14W	April, 1949	868,305	2,562,986	53,164	133,649	536,320	848,867	29
5,36	-10N	-14W	May, 1951	46,175	46,175	None	None	None	None	30
	-9N	-14W	February, 1950	524,369	915,126	16,000	21,000	121,914	129,955	31
7,34	-9N	-14W	March, 1949	2,305,700	5,585,000	105,200	256,000	-	-	32
6,17,20, 1	-9S	-9E	May, 1951	81,347	81,347	None	None	None	None	33
-	-	-	-	3,294,973	5,316,541	337,821	520,795	425,371	557,916	34,35

TABLE I (Continued)

Map No.	DEVELOPMENT AS OF 12-31-51						INJECTION WATER			
	Number of Wells		Injection Pattern	Spacing Acres Per Input Well	Productive Acreage Subjected To Injection	Productive Acreage Total	Source	Type	Avg. Bbls. Per Day Per Well Per Foot	Average Wellhead Pressure PSI
	Injection	Producers								
1	6	16	Perimeter	-	1,050	1,050	Pennsylvanian sand	Brine	16.9	1,250
2	5	17	Perimeter	-	920	920	Pennsylvanian sand	Brine	54.1	850
3	1	5	Flank	-	106	106	Produced	Brine	10.0	200
4	1	1	-	-	20	20	Produced	Brine	-	-
5	1	6	-	-	140	140	-	Brine	1.3	Vacuum
6	2	12	Perimeter	-	203	-	Produced	Brine	-	-
7	3	13	Flank	-	220	220	Pennsylvanian sand	Brine	21.6	725
8	1	6	Flank	-	90	90	Pennsylvanian sand	Brine	22.9	175
9	13	27	Perimeter	-	400	400	Shallow sand and produced	Brine	10.4	800
10	7	22	-	40	320	-	Cypress	Brine	23.6	0
11	1	2	-	-	40	40	Cypress	Brine	12.7	-
12	56	51	5-spot	4.4	200	-	Gravel bed	Fresh	2.5	285
13	131	125	5-spot	4.4	443	443	Gravel bed	Fresh	4.6	265
14	107	123	5-spot	20	2,200	2,200	Lake	Fresh	6.6	380
15	9	6	5-spot	10	40	60	Tar Springs	Brine	4.9	100
16	11	41	5-spot	4.4	160	360	1,300 ft. sand	Brine	4.2	185
17	3	11	-	-	184	184	-	-	-	1,700
18	-	-	5-spot	20	-	-	Tar Springs	Brine	-	900
19	3	7	Flank	-	195	-	Cypress	Brine	41.7	-
20	3	10	Irregular	20	110	160	Upper sand and produced	Brine	13.9	0
21	62	27	5-spot	4.4	175	-	Gravel bed	Fresh	3.0	200
22	1	5	Spot	-	80	-	Gravel bed	Fresh	10.8	900
23	2	12	-	20	160	200	Devonian	Brine	12.3	Vacuum
24	1	5	-	Irregular	65	85	Upper sand and produced	Brine	21.8	0
25	36	68	5-spot	10	640	640	Pottsville	Brine	7.1	225
26	3	16	-	-	295	295	Shallow sand and produced	Fresh and brine	24.2	200
27	2	3	-	-	40	40	-	-	-	950
28	19	22	5-spot	20	390	430	Tar Springs	Brine	-	264
29	26	24	5-spot	4.4	125	-	20 ft. well	Fresh	4.6	222
30	27	6	5-spot	4.4	80	-	20 ft. well	Fresh	0.3	180
31	14	18	5-spot	4.4	64	80	Gravel bed and produced	Fresh and brine	6.0	200
32	47	47	5-spot	4.4	200	-	Produced	Brine	2.8	250
33	5	9	Modified 5-spot	Irregular	50	-	Gravel bed	Fresh	4.8	650
34,35	61	142	-	-	581	-	-	Fresh	-	-

RESERVOIR STATISTICS (Average Values)						REMARKS	Map No.
Depth Feet	Net Pay Thickness Feet	Porosity Per Cent	Permeability Millidarcys	Oil Gravity API	Oil Viscosity Centipoises		
3,200	10	22	150	)	-		1
3,350	3.6	-	-	35.4)	6.5 @ 100° F.		2
1,900	13	20	305	35	6.0 @ 100° F.	Viscosity at original reservoir conditions 7.9 cp.	3
3,222	4	16.3	898	39	-	Dump flood; *As of 6-1-52.	4
3,150	30	-	-	37	-		5
1,900	20	19.7	304	32.5	6.3 @ 95° F.	*As of 6-1-52.	6
2,000	17.1	20.2	265	38.0	5.3 @ 88° F.		7
1,950	22.0	19.3	303	35.8	6.0 @ 84° F.		8
1,050	12.7	19.4	102.5	39.7	-	Original viscosity approximately 3 cp.	9
3,350	9	-	-	39	-		10
3,450	18	-	-	-	-		11
550	38	17.1	148	32.4	16 @ 77° F.	Previously subjected to gas injection.	12
560	21	18.6	149	32	18.7 @ 77° F.	Original BHP 200 psi.	13
2,100	35	19	65	38	3.5 @ 86° F.	*1950 production 52,224 bbls. below normal.	14
950	26	18.9	162	31.7	21		15
960	31	19.1	135	31.6	17 @ 80° F.		16
-	-	-	-	-	-	*Includes primary production.	17
2,570	-	-	-	-	-	*Includes primary production.	18
3,150	6	-	-	37	-		19
3,130	10	11.2	67.5	36	-		20
450	10	17.4	173	31.9	16.6 @ 70° F.	Previously subjected to gas injection.	21
2,530	6	-	-	38.0	-		22
3,950	22	10	-	39.8	2.7	Pilot flood; *Includes primary and water flood.	23
2,960	30	-	-	-	-		24
1,230	14	20	250	37	-	Cooperative: Shell, Magnolia, McBride, Horton.	25
3,050	14	17	125	-	-	Previously subjected to gas injection.	26
-	-	-	-	-	-	*Includes primary production.	27
2,500	-	-	-	36.0	-		28
450	10-30	20.8	399	33.9	10.7 @ 70° F.	Previously subjected to gas injection.	29
480	22	18.3	66	33	10 @ 70° F.		30
425	17	20.6	415	33.9	10.7 @ 70° F.	Subjected to gas injection 1946-47.	31
490	48	16.6	319	29.2	14.7 @ 77° F.	Previously subjected to gas injection.	32
1,750	14	-	-	34.7	6.7 @ 81° F.	Pilot flood.	33
-	-	-	-	-	-		34,35

TABLE I (Continued)

GENERAL INFORMATION

Map No.	Field	Operator	Project	Formation "Sand"	County
36	Louden	Carter	Pilot No. 1	Cypress	Fayette
37	Main	Arkansas Fuel	North Morris	Robinson	Crawford
38	Main	Buckeye	J. S. Kirk	Robinson	Crawford
39	Main	Logan	Alexander-Reynolds	Robinson	Crawford
40,41	Main	Ohio	Two Projects	Robinson	Crawford
42	Main	Petroleum Producing	-	Robinson	Crawford
43	Main	Skiles	Dennis-Lloyd	Robinson "4"	Crawford
44	Main	Skiles	Highsmith	Robinson "1" and "2"	Crawford
45	Main	Skiles	Walter Community	Robinson "1" and "3"	Crawford
46	Main	Tidewater	Dennis-Hardin	Robinson	Crawford
47	Main	Tidewater	Henry-Ikemire	Robinson	Crawford
48	Martinsville	Magnolia	Casey	Casey	Clark
49	Martinsville	Magnolia	Carper	Carper	Clark
50	Mattoon	Phillips	Mattoon	Rosiclare	Coles
51	Maunie South	Magnolia	Tar Springs Unit	Tar Springs	White
52	Maunie South	Magnolia	Tar Springs Unit #2	Tar Springs	White
53	Mt. Carmel	First National Petroleum Trust	Shaw Courter	Biehl	Wabash
54	Mt. Carmel	Superior	North Mt. Carmel	Biehl	Wabash
55	New Harmony Consolidated	Phillips	Schultz	Cypress	Wabash
56	New Harmony Consolidated	Skiles	West Maud	Benoist	Wabash
57	New Harmony Consolidated	Skiles	Siegert Bottoms	Benoist	Wabash Edwards
58	New Harmony Consolidated	Sun	Fort "A"	McClosky	White
59	New Harmony Consolidated	Sun	Greathouse	Bethel	White
60	New Harmony Consolidated	Sun	Greathouse	McClosky	White
61	New Harmony Consolidated	Superior	Waltersburg	Waltersburg	White, Ill. Posey, Ind.
62	New Harmony Consolidated	Tidewater	O. R. Evans	Aux Vases	White
63	New Harmony Consolidated	Tidewater	E. S. Dennis "A"	Bethel	White
64	Odin	Ashland	Odin	Cypress	Marion
65	Patoka	Sohio	Patoka Benoist	Benoist	Marion
66	Patoka	Sohio	Patoka Rosiclare	Rosiclare	Marion
67	Patoka	Sohio	Stein Unit	Stein	Marion
68	Phillipstown Consolidated	British American	North Calvin	Penna #7	White
69	Phillipstown Consolidated	Magnolia	Schmidt-Seifried Unit	Biehl	White
70	Ste. Marie	S. Lebow	Ste. Marie	McClosky	Jasper

Location			Date First Injection	PRODUCTION AND INJECTION STATISTICS (Barrels)						Map No.
				Water Injection		Secondary Recovery Oil Production		Water Production		
Section	Township	Range		Total 1951	Cumulative 12-31-51	Total 1951	Cumulative 12-31-51	Total 1951	Cumulative 12-31-51	
19,20	-7N	-3E	October, 1950	772,156	826,616	31,812	31,812	None	None	36
2	-7N	-13W	April, 1951	59,863	59,863	1,250	1,250	4,905	4,905	37
29	-7N	-12W	August, 1951	15,752	15,752	None	None	None	None	38
20	-7N	-12W	December, 1951	7,500	7,500	None	None	None	None	39
-	-	-	-	3,553,415	6,883,963	291,283	527,430	951,736	1,284,067	40,41
29,32	-8N	-12W	August, 1951	41,000	41,000	None	None	None	None	42
10	-7N	-12W	July, 1951	15,304	15,304	None	None	300	300	43
31	-6N	-12W	September, 1951	12,974	12,974	None	None	400	400	44
36	-7N	-13W	December, 1951	1,950	1,950	None	None	15	15	45
27,34	-6N	-13W	August, 1950	351,251	433,649	6,600	7,900	21,617	23,347	46
10,15	-7N	-13W	February, 1948	443,985	1,081,851	58,534	157,800	162,156	254,576	47
19	-10N	-13W	August, 1950	335,519	409,044	689*	1,068*	5,814	17,719	48
30	-10N	-13W	January, 1951	163,143	163,143	2,410*	2,410*	2,268	2,268	49
22	-12N	-7E	November, 1950	11,155	13,996	5,287	6,285	16,000	-	50
24	-6S	-10E	August, 1947	349,876	2,019,072	46,015	685,709	213,097	692,691	51
19	-6S	-11E								
24	-6S	-10E	-	131,528	259,087	8,736	56,725	43,449	81,033	52
19	-6S	-11E								
7	-1S	-12W	February, 1950	40,592	94,942	12,999	26,906	21,808	25,711	53
9	-1S	-12W	June, 1949	-	163,813*	-	27,478*	-	58,149*	54
7	-3S	-13W	July, 1951	99,273	99,273	217	217	1,050	1,050	55
32	-1S	-13W	October, 1950	62,181	64,668	-	-	-	-	56
5	-2S	-13W								
2,10	-3S	-14W	August, 1951	52,000	52,000	None	None	3,000	3,000	57
34	-2S	-14W								
18	-5S	-14W	May, 1948	14,233	51,665	4,131	12,155	590	590	58
33	-4S	-14W	January, 1949	433,726	974,758	20,553	30,979	86,083	156,814	59
4	-5S	-14W								
33	-4S	-14W	August, 1947	121,821	489,365	25,594	43,359	23,576	100,266	60
4	-5S	-14W								
4,9,10	-5S	-14W	August, 1946	360,000	2,479,400	124,000	2,114,808	47,085	385,000	61
4	-4S	-14W	October, 1949	87,248	144,873	18,060	18,060	None	None	62
33	-4S	-14W	July, 1951	224,869	224,869	None	None	1,516	1,516	63
	-2N	-1,2E	October, 1949	480,484	739,464	292,963	337,249	None	None	64
20,21,28, 29	-4N	-1E	September, 1943	4,044,868	23,720,959	450,522	6,109,748	5,205,812	17,393,812	65
21,28,29	-4N	-1E	1948	694,786	1,645,336	219,184*	884,414*	109,739	360,387	66
28	-4N	-1E	August, 1951	17,130	17,130	1,662	1,662	5,680	5,680	67
31	-3S	-14W	April, 1949	198,600	458,000	90,300	-	50,300	-	68
30,31	-3S	-11E	September, 1947	76,389	199,572	38,568*	94,815*	9,175	30,084	69
5,6,7	-5N	-14W	October, 1948	146,000	842,000	12,200	31,000	128,000	200,000	70

TABLE 1 (Continued)

Map No.	DEVELOPMENT AS OF 12-31-51						INJECTION WATER			
	Number of Wells		Injection Pattern	Spacing Acres Per Input Well	Productive Acreage Subjected To injection	Total	Source	Type	Avg. Bbls. Per Day Per Well Per Foot	Average Wellhead Pressure PSI
	Injection	Producers								
36	9	16	5-spot	10	90	16,000	Tar Springs	Brine	5.6	12
37	4	8	Modified 5-spot	4.4	44	400	Buchanan	Brine	4.9	300
38	4	0	5-spot	10	10	100	1,325 ft. sand	Brine	-	0
39	1	17	5-spot	Irregular	10	305	Cypress	Brine	-	0
40,41	123	164	-	-	767	-	-	-	-	-
42	4	2	5-spot	10	40	700	Shallow sand and pond	Fresh	4.5	20
43	6	8	5-spot	10	60	80	Pennsylvanian sands	Brine	-	150
44	3	8	5-spot	10	30	80	Upper Pennsylvanian	Brine	-	0-400
45	2	5	5-spot	10	20	50	Pennsylvanian sands	Brine	-	5
46	9	18	5-spot	10	85	93	Gravel bed	Fresh	3.1	300
47	24	25	5-spot	4.4	100	115	Pennsylvanian sand	Brine	3.2	300
48	8	3	-	-	23	-	-	-	-	250
49	4	1	5-spot	10	10	-	Gravel bed	Fresh	-	400
50	1	5	-	10	30	30	Produced	Brine	3.1	-
51	11	13	-	-	230	230	-	-	-	950
52	3	2	-	-	50	50	-	-	-	400
53	1	3	Spot	10	30	30	Shallow sand and produced	Fresh and brine	7.0	1,150
54	2	9	-	-	120	-	-	-	-	-
55	2	4	-	10	21	40	Shallow river sand and produced	Fresh and brine	13.9	-
56	7	11	5-spot	20	140	186	Hardinsburg sand	Brine	2.1	1,000
57	16	22	5-spot	20	330	380	Gravel bed	Fresh	1.5	30
58	1	1	Spot	-	40	40	Gravel bed	Fresh	5.6	53
59	6	10	5-spot	20	130	-	Gravel bed	Fresh	8.4	1,200
60	1	2	Spot	20	100	-	Gravel bed	Fresh	67.0	1,350
61	3	32	Line Drive	-	525	525	Shallow sand and produced	Fresh and brine	7.7	0
62	4	5	5-spot	20	40	-	-	Fresh	-	400
63	6	9	-	10	-	-	-	Fresh	-	150
64	10	22	Perimeter	-	196	290	Tar Springs	Brine	8.8	390
65	66	72	5-spot	10	527	527	Tar Springs	Brine	6.2	190
66	14	11	Perimeter	-	445	445	Tar Springs	Brine	15.1	400
67	4	6	Peripheral	-	61	61	Tar Springs	Brine	2.9	433
68	9	18	5-spot	10	206	206	1,300 ft. sand and produced	Brine	-	300
69	4	8	5-spot	20	120	120	Upper Pennsylvanian	Brine	-	1,250
70	1	15	Spot	-	360	480	Cypress	Brine	57.2	-

RESERVOIR STATISTICS (Average Values)						REMARKS	Map No.
Depth Feet	Net Pay Thickness Feet	Porosity Per Cent	Permeability Millidarcys	Oil Gravity API	Oil Viscosity Centipoises		
1,500	42	21	144	38	-	Pilot flood; Viscosity at original reservoir conditions 2.6 cp.	36
983	12	21	243	32	7.3 @ 65° F.	Pilot flood; Previously subjected to gas injection.	37
913	22	22.5	51.5	34	-	Pilot flood; Delayed drilling of producing wells.	38
940	22	20.5	167	36	7 @ 80° F.	Pilot flood.	39
-	-	-	-	-	-		40,41
1,000	15	20	75	-	-		42
1,035	20	22.2	100	33	13.5 @ Reservoir Temp.	Previously subjected to gas injection.	43
830 940	10 30	21.5	50	32	12		44
950 1,010	10 15	20.1	93	36	12.5 @ Reservoir Temp.		45
875	34	19.8	175	32.7	-	Subjected to gas injection 1932-50.	46
935	14	21.0	175	35.0	7.0 @ 60° F.	Subjected to gas injection 1934-48.	47
-	-	-	-	-	-	Pilot flood; *Includes primary production.	48
1,334	-	-	-	-	-	*Includes primary production.	49
1,952	10	15	990	37	-	Area affected by natural water drive.	50
-	-	-	-	-	-		51
-	-	-	-	-	-		52
1,375	16	-	-	40.2	4.7 @ 70° F.		53
-	7	-	-	-	-	*As of 9-1-52.	54
2,500	20	18	50	-	-		55
2,620	12	17.2	57	37	4.6 @ Reservoir Temp.		56
2,680	18	17	75	36.5	3.8 @ 81° F.		57
2,900	7	-	-	38.0	-		58
2,750	23.2	18.0	20	38.0	-	Previously subjected to gas injection.	59
2,900	5.0	-	-	35.0	-		60
2,200	43	19.2	190	36.8	2.9 @ 86° F.	Includes Indiana data. Original BHP 949 psi. Gas currently injected into 5 wells.	61
2,800	-	-	-	-	-	Previously subjected to gas injection.	62
-	-	-	-	-	-	Previously subjected to gas injection.	63
1,700	15	20	78	38	8.3 @ 69° F.		64
1,410	27	19.0	110	39.0	-		65
1,550	9	18.8	223	40.0	4.1	*Includes primary production.	66
1,280	10	21	32	39	3-4 @ 60° F.		67
1,550	29	17.6	86	29	20 @ Reservoir Temp.	Pilot flood started April, 1949, and extended June, 1951.	68
1,830	-	-	-	-	-	Pilot flood started September, 1947, and extended May, 1951; *Includes primary production.	69
2,860	7	-	-	-	-	Dump flood.	70

TABLE I (Continued)

Map No.	Field	Operator	Project	Formation "Sand"	County
			GENERAL INFORMATION		
71	Salem	Texas	Salem Unit	Benoist	Marion
72	Salem	Texas	Salem Unit	Renault	Marion
73	Salem	Texas	Salem Unit	Aux Vases McClosky	Marion
74	Salem	Texas	Salem Unit	Devonian	Marion
75	Salem	Texas	Rosiclare Sand Unit	Rosiclare	Marion
76	Siggins	Bell Brothers	Flood No. 1	Upper Siggins	Cumberland
77	Siggins	Leland Fikes	Vevay Park	Siggins	Cumberland
78	Siggins	Forest	Siggins	First Siggins	Cumberland
79	Siggins	Hammonds and Wheless	-	Casey	Clark and Cumberland
80	Siggins	Pure	Union Group	First Siggins Second Siggins	Clark and Cumberland
81	Storms	Mabee	-	Waltersburg	White
82	Westfield	Forest	Parker	Gas Sand	Clark
83	Woburn Consolidated	Arrow	Spindler	Benoist	Bond
84	York	Trans Southern	York	Casey	Cumberland

TABLE II

ILLINOIS PRESSURE MAINTENANCE PROJECTS USING WATER INJECTION DURING 1951

Map No.	Field	Operator	Project	Formation "Sand"	County
			GENERAL INFORMATION		
85	Boyd	Superior	Boyd	Bethel	Jefferson
86	Dix	Carter	Dix	Bethel	Jefferson
87	Louden	Carter	Louden Devonian	Devonian	Fayette
88	Omaha	Carter	Omaha	Palestine	Gallatin

PRODUCTION AND INJECTION STATISTICS (Barrels)

Location ection	Township	Range	Date First Injection	Water Injection Total 1951	Water Injection Cumulative 12-31-51	Secondary Recovery Oil Production Total 1951	Secondary Recovery Oil Production Cumulative 12-31-51	Water Production Total 1951	Water Production Cumulative 12-31-51	Map No.
	-1N	-2E	October, 1950	273,493	341,922	7,028	7,792	12,945	14,220	71
	-2N	-2E								
	-1N	-2E	October, 1950	432,050	488,267	None	None	None	None	72
	-2N	-2E								
	-1N	-2E	April, 1951	1,007,176	1,007,176	27,253	27,253	102,279	102,279	73
	-2N	-2E								
	-1N	-2E	October, 1950	3,644,884	3,982,087	8,285	8,285	408,936	408,936	74
	-2N	-2E								
	-1N	-2E	April, 1950	127,158	252,775	10,283	15,288	20,951	-	75
	-10N	-10E	September, 1950	-	182,500	6,800*	9,000*	-	-	76
	-10N	-10E	December, 1950	99,530	100,534	545	545	27,515	27,515	77
	-10N	-10,11E	June, 1942	5,449,100	23,513,000	703,820	3,870,760	2,500,000*	9,500,000*	78
	-10N	-14W	December, 1951	1,539	1,539	-	-	-	-	79
	-10N	-11E								
	-10N	-14W	December, 1946	1,384,033	6,834,794	308,007	1,402,904	1,256,084	3,461,116	80
	-10N	-11E								
	-6S	-9E	July, 1951	24,035	24,035	None	None	None	None	81
	-11N	-14W	June, 1950	-	-	-	-	-	-	82
	-6N	-2W	September, 1951	19,095	19,095	-	-	-	-	83
	-9N	-11E	October, 1950	153,873	197,802	5,603	5,603	50,436	50,436	84
otal				57,146,945	148,279,296	6,672,008	21,889,880			

PRODUCTION AND INJECTION STATISTICS (Barrels)

Location ection	Township	Range	Date First Injection	Water Injection Total 1951	Water Injection Cumulative 12-31-51	Oil Production† Total 1951	Oil Production† Cumulative 12-31-51	Water Production Total 1951	Water Production Cumulative 12-31-51	Map No.
9	-1S	-2E	June, 1945	447,700	4,162,400	-	4,422,890	-	3,365,561	85
4,9,10	-1S	-2E	January, 1948	322,039	775,820	316,792	6,683,402	195,901	2,452,774	86
	-8N	-3E	September, 1943	10,348,480	64,460,813	729,600	13,916,000	9,530,500	68,300,000	87
3	-7S	-8E	October, 1944	99,813	568,313	107,395	1,637,457	89,262	701,265	88
	-8S	-8E								

Includes both primary recovery and any additional oil obtained by pressure maintenance.

TABLE I (Continued)

Map No.	DEVELOPMENT AS OF 12-31-51						INJECTION WATER			
	Number of Wells		Injection Pattern	Spacing Acres Per Input Well	Productive Acreage		Source	Type	Avg. Bbls. Per Day Per Well Per Foot	Average Wellhead Pressure PSI
	Injection	Producers			Subjected To Injection	Total				
71	2	1,103*	-	-	20	8,092	Produced	Brine	13.3	253
72	2	1,103*	-	-	20	4,892	Produced	Brine	17.9	203
73	16	711	-	-	160	7,711	Produced	Brine	11.4	55
74	10	340	-	-	100	5,414	Produced	Brine	52.6	0
75	3	6	Flank	-	100	100	Pennsylvanian sand	Brine	8.3	350
76	15	30	5-spot	4.4	80	80	Surface and produced	Fresh and brine	-	200
77	2	4	5-spot	4.4	7	1,000	Surface pond and produced	Fresh and brine	8.5	200
78	363	315	5-spot	4.4	1,500	-	Gravel bed and produced	Fresh and brine	1.3	200
79	23	20	5-spot	4.4	135	227	Surface and produced	Fresh and brine	-	200
80	127	121	5-spot	4.4	468	468	Gravel bed	Fresh	1.0	245
81	1	2	-	-	40	40	Pennsylvanian sand	Brine	10.0	45
82	9	4	5-spot	2.5	10	-	Gravel bed	Fresh	-	-
83	1	4	Spot	-	20	20	Produced	Brine	3.7	190
84	3	7	Line Drive	-	10	350	Shallow sand and produced	Brine	14.1	300
					17,646					

TABLE II (Continued)

Map No.	DEVELOPMENT AS OF 12-31-51				INJECTION WATER		
	Number of Wells		Injection Pattern	Productive Acreage	Source	Type	Average Wellhead Pressure PSI
	Injection	Producers					
85	3	57	Flank	1,800	Produced	Brine	-
86	4	74	Periphery	1,740	Produced and Tar Springs	Brine	50
87	6	74	Periphery	3,200	Produced	Brine	100
88	1	17	Flank	420	Produced	Brine	0

RESERVOIR STATISTICS (Average Values)

Depth Feet	Net Pay Thickness Feet	Porosity Per Cent	Permeability Millidarcys	Oil Gravity API	Oil Viscosity Centipoises
270	28	17.9	150	-	3.9 @ 93° F.
125	7) 26)	16.5) 16.3)	18) 28)	-	4.8 @ 93° F. 4.4 @ 93° F.
150	20	15.8	700	-	-
400	19	16.8	300	-	-
993	14	11.5	43	36.5	-
520	16	18.9	73	34	12 @ 63° F.
500	16	20.3	349	30.1	-
400	32	17.5	56	36.6	8 @ 60° F.
447	56	21.5	40.2	33.8	10.5 @ 69° F.
404) 464)	25) 6)	18.5) 18.3)	45) 66)	36	8.8 @ 68° F.
241	15	-	-	-	-
270	25	17.9	153	28.1	54 @ 60° F.
006	14	-	-	-	-
590	10	21.9	231	30.3	10 @ 75° F.

REMARKS	Map No.
*Dually completed with Renault-Aux Vases.	71
*Dually completed with Benoist.	72
	73
	74
	75
*Includes primary production; Previously subjected to gas injection.	76
Pilot flood.	77
*Estimated.	78
Previously subjected to gas injection.	79
Original BHP 200 psi.	80
	81
Previously subjected to gas injection.	82
	83
Pilot flood.	84

RESERVOIR STATISTICS (Average Values)

Depth Feet	Net Pay Thickness Feet	Porosity Per Cent	Permeability Millidarcys	Oil Gravity API
-	19	17.5	175	-
950	12	16.4	128	39
100	-	-	-	29
700	17	18.9	427	27

REMARKS	Map No.
Gas currently being injected.	85
Viscosity at original reservoir conditions 2.5 cp.	86
Viscosity at original reservoir conditions 6.5 cp.	87
Viscosity at original reservoir conditions 17.3 cp.	88