Lowry et al Operating Account

Ultimate Oil Recovery Estimates

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Pettigrew-Tocito Field
Rio Arriba County, N.M.

ULTIMATE OIL RECOVERY ESTIMATES

Pettigrew-Tocito Field

Rio Arriba County, New Mexico

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Factors used for Evaluating Pettigrew-Tocito Pool

	(1) Upper Portion Tocito Sand	(2) Lower Portion Tocito Sand
Connate Water Saturation, %	23.00	45.00
Average Porosity, %	13.90	11.00
Formation Volume Factor	1.52	1.52
Estimated recovery factor, %	25.00	10.00
Stock tank oil in place per acre ft.,bbls.	546.00	311.00
Recoverable Oil, Bbls./Acre Ft.	137.00	31.00

(1) Area considered represented by isopach map of net Tocito Sand.

(2) Area considered represents 160 acres, comprising N/2, N/2, Section 9, T 26N, R 6W, Rio Arriba County, New Mexico.
Sand thickness 11 ft. average - 1760 acre ft.

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Present Concept of Pettigrew-Tocito Pool

	No. Productive Acres		
	Proven Area	Semi-Proven Area	Total
Upper Portion	920	1615	2535
Lower Portion	160	-	160

	Net acre Feet of Tocito Sand		
	Proven Area	Semi-Proven Area	Total
Upper Portion	11,810	12,100	23,910
Lower Portion	1,760	-	1,760

	Stock Tank Oil in Place/ Bbls.		
	Proven Area	Semi-Proven Area	Total
Upper Portion	6,448,260	6,606,600	13,054,860
Lower Portion	547,360	-	547,360
Total:	6,995,620	6,606,600	13,602,220

	Ultimate Oil Recovery / Bbls.		
	Proven Area	Semi-Proven Area	Total
Upper Portion	1,617,970	1,657,700	3,275,670
Lower Portion	54,560	-	54,560
Totals:	1,617,970	1,657,700	3,330,230

Oil Production, inception through April 30th, 1953: 522,972 barrels

Remaining Proven oil reserves: 1,149,558 barrels

Remaining Proven and Semi-Proven oil reserves: 2,807,258 barrels

ECONOMICS OF DEVELOPMENT 40 - acre PRORATION UNITS

Pettigrew-Tocito Field - Rio Arriba County, N. M.

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Crude Oil Price	$ 2.4500 /bbl.	2.90
Less Royalty (1/8 - .3063/bbl.)	2.1437	
Less Severance Tax (.025% - .0536/bbl)	2.0901	
Less Conservation tax (.00125% - .0027/bbl)	2.0874	
Less Production tax (.020896% of 50% Value - ($.0224/bbl.)	2.0650	45 / 2.51 =
Lifting Cost		40 / 2.115 =
Number of Productive Acres	2,535	
Average Sand Thickness - Feet		
Upper Portion	9.4	
Lower Portion	11.0	
Ultimate Oil Recovery, Barrels	3,330,230	
Ultimate Oil Recovery - Barrels per acre	1,314	
Ultimate Oil Recovery - 40 acre, Barrels	52,560	
Operating Income - 40 acre tract (52,560 barrels @ $2.07/bbl) 2.11	$108,799.20	$111,100
Total Cost of Drilling and Completing Tocito wells	$110,609.34	

Note: No Operating Costs considered in computing Operating Income

COST OF DRILLING AND COMPLETING TOCITO OIL WELLS

Pettigrew-Tocito Field

Rio Arriba County, New Mexico

	Intangible Development Cost	Tangible well Equipment	Total Cost
Cost of drilling and completing Lowry et al Operating Account Federal 21-40-182	$74,872.97	$27,632.32	$102,505.29
Cost of drilling and completing Lowry et al Operating Account Federal 22-45-207	72,702.95	26,907.98	99,610.93
Cost of installing flow lines, separator and tank battery to serve Lowry et al Operating Account Federal 21-40-182 and Federal 22-45-207	1,684.76	17,418.70	19,103.46
Total Costs - Two wells, plus flow lines, separator and tank battery	$149,260.68	$71,959.00	$221,219.68

Average Total Cost per well . . . . . $ 110,609.34

Note: No overhead charges included in above completion costs.

WELL NO. Federal Doswell 21-40-182
FIELD: Pettigrew-Tocito
LOCATION: NE SW Section 10, 26N-6W, Rio Arriba County, New Mexico

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INTANGIBLE DEVELOPMENT COST			$74,872.97
Roads & Location		$1,221.20	
1. Bulldozer	$360.00		
2. Road Grader	80.00		
3. Trucking	480.00		
4. Labor	138.00		
5. Survey location	153.00		
6. Furnish elevation	10.20		
Drilling Mud & Cement		3,969.49	
Well Services		4,549.23	
1. Schlumberger	2,503.45		
2. Halliburton	582.68		
3. Core Laboratories	1,177.50		
4. Gun Perforate	285.60		
Water & Fuel		888.28	
1. Labor - water line	206.00		
2. Labor - gas line	260.00		
3. Trucking	422.28		
Miscellaneous Drlg Material		651.25	
Welding		126.28	
Drilling		63,467.24	
1. Footage	54,680.16		
2. Daywork	8,006.43		
3. Cable Tools	780.65		
TANGIBLE WELL EQUIPMENT			27,632.32
1. Surface String (plus frt)		2,185.42	
2. Production String (plus frt)		18,433.00	
3. Tubing (plus frt)		3,843.88	
4. Well head Equipment		3,051.25	
5. Miscellaneous equipment		118.77	
TOTAL TO COMPLETE WELL (less tank battery)			$102,505.29

WELL NO.: Federal Doswell 22-45-207
FIELD: Pettigrew-Tocito
LOCATION: SW SE Section 10, 26N-6W, Rio Arriba County, New Mexico

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INTANGIBLE DEVELOPMENT COST			$72,702.95
Roads & Location		$1,087.70	
1. Bulldozer	$320.00		
2. Road Grader	80.00		
3. Trucking	360.00		
4. Labor	190.00		
5. Survey location	127.50		
6. Furnish elevation	10.20		
Drilling Mud & Cement		2,807.93	
Well Services		4,476.33	
1. Schlumberger	2,881.01		
2. Halliburton	445.86		
3. Core Lab & Analysis	690.46		
4. Diamond Coring Equip	459.00		
Water & Fuel		921.00	
1. Labor - water line	236.00		
2. Labor - Gas line	260.00		
3. Trucking	425.00		
Miscellaneous Drlg Material		620.50	
welding		213.40	
Drilling		62,576.09	
1. Footage	54,149.76		
2. Day work	7,155.83		
3. Cable tools	1,270.50		
TANGIBLE WELL EQUIPMENT			26,907.98
1. Surface String (plus frt)		1,699.95	
2. Production string (plus frt)		18,228.41	
3. Tubing		4,293.47	
4. wellhead equipment		2,374.36	
5. Miscellaneous Equipment		311.79	

TOTAL TO COMPLETE WELL (less tank battery) $99,610.93

TANK BATTERY FOR WELL NOS: Federal Doswell 21-40-182
Federal Doswell 22-45-207

FIELD: Pettigrew-Tocito

LOCATION: Section 10, 26N-6W
Rio Arriba County, New Mexico

EQUIPMENT & MATERIAL		$17,418.70
5 - 400 bbl Stell tanks w/walkways & stairways	$8,589.67	
1 - Separator	1,096.53	
1 - Steam generator	1,543.00	
Flow & Gathering Lines		
2" Line pipe, 3,142 ft.	1,503.45	
2 3/8" line pipe, 64'	36.48	
3" Line pipe, 428'	404.20	
4" Line pipe, 56'	80.06	
Valves & Misc. Fittings	2,694.13	
Steam Coils, 200' each tank	470.00	
Fencing	99.83	
Miscellaneous Material	901.35	
SERVICES		1,684.76
Bulldozer	100.00	
Road Grader	80.00	
Trucking	568.70	
Labor	761.64	
Welding	174.42	
TOTAL FOR TANK BATTERY		$19,103.46

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RESERVOIR STUDY

of the

TOCITO SAND RESERVOIR

LOWRY OIL COMPANY ET AL PROPERTIES

in the

PETTIGREW TOCITO FIELD
Rio Arriba County, New Mexico

as of

April 28, 1953

Amstutz and Yates, Inc.

May 14, 1953

Mr. Gail F. Moulton
Rockefeller Brothers, Inc.
30 Rockefeller Plaza
New York 20, N. Y.

Dear Mr. Moulton:

The reservoir study of the Pettigrew Tocito Field, located in Township 26North, Range 6 West, Rio Arriba County, New Mexico, which you authorized on February 6, 1953, has been completed and is submitted herewith. It includes the reservoir performance data to April 28, 1953.

In the preparation of this report all of the data used in our previous report on the reservoir, made as of August 18, 1952, have been re-examined in light of the additional performance history available for this analysis. This report supplements the previous one, and although there are some minor differences in the figures calculated in this report, it is interesting to note that there have been no major changes in our conclusions and recommendations. This results from the fact that the reservoir performance during the interim has been substantially as anticipated.

If you so desire, we will be glad to meet with you and the other interested parties at your convenience to discuss any aspects of our analysis.

We have again appreciated the opportunity to be of service to you.

Very truly yours,

AMSTUTZ AND YATES, INC.

/s/ George L. Yates

George L. Yates

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Amstutz and Yates, Inc.

OBJECT

The purpose of this engineering report is as follows:

(a) To attempt to determine the size of the Pettigrew Tocito Sand Reservoir, and the amount of stock tank oil originally contained therein by material balance calculations.

(b) To make preliminary estimates of the gas-oil ratios and oil and gas production for a two-year period beginning May 1, 1953, under the proposed field rules.

(c) To make recommendations regarding the most efficient production rates from the standpoint of the utilization of reservoir energy.

CONCLUSIONS AND RECOMMENDATIONS

(1) It is our opinion that the Pettigrew Tocito Sand Reservoir originally contained approximately 17,000,000 barrels of stock tank oil in place. This conclusion is based upon the reservoir performance in the field from its discovery to April 28, 1953. In view of the fact that the reservoir is still partially undeveloped, our present opinion of its magnitude must be considered a preliminary estimate and may be subject to some revision when additional data are available.

(2) The performance of the field to date indicates a primary recovery under the present operations on the order of 15 per cent of the stock tank oil originally in place or 2,600,000 barrels of oil. Approximately 520,000 barrels of this recoverable oil has been produced to May 1, 1953, leaving a reserve of 2,080,000 barrels.

(3) The anticipated ultimate recovery of casinghead gas from the reservoir is approximately 14,000,000,000 standard cubic feet measured at 14.7 psia and 60° Fahrenheit. Since an estimated 800,000,000 standard cubic feet have been produced to May 1, 1953, the indicated reserve at that time was 13.2 billion cubic feet. This gas should be saved and marketed since it has considerable potential value.

(4) The preliminary estimate of the gas-oil ratios and daily gas production, under present operations for a two-year period beginning May 1, 1953, is set forth below by six-month averages. This estimate is based on the gas-oil ratio performance to date and a daily oil allowable rate of 150 barrels, a penalty gas-oil ratio of 2,000 cubic feet per barrel, and the present number of producing wells.

Period	Average Gas/Oil	Estimated Allowed Daily Production	
		Oil Bbls.	Gas MCF *
5/1/53 - 11/1/53	1893	1070	2026
11/1/53 - 5/1/54	2357	952	2244
5/1/54 - 11/1/54	2793	845	2360
11/1/54 - 5/1/55	3266	772	2521

* Measured at 14.7 psia and 60° F.

(5) Production tests at various flowing rates should be made immediately on all wells and at intervals thereafter to determine the production rate for each well which will result in the lowest gas-oil ratio. Each well should be produced at this rate, in so far as the economics of the situation will allow.

(6) The increased oil recovery and economic benefits which may be realized through a successful pressure maintenance project appear to be greater than normal in the subject reservoir. It is recommended that a thorough analysis of pressure maintenance by gas and/or water injection be made.

SCOPE OF INVESTIGATION

This report supplements our previous report entitled "Material Balance Analysis of the Tocito Sand Reservoir" as of August 18, 1952, and includes the reservoir performance history up to April 28, 1953. Mr. A. F. Holland of the Lowry Oil Company in Albuquerque, New Mexico has furnished us with the basic data used in our analysis. This information consisted of the complete monthly oil production history of each well, all gas-oil ratio tests, the initial bottom hole pressures on each well and four bottom hole pressure surveys

of the field made on May 1, and August 20, 1952, and on January 13, and April 28, 1953, two bottom hole fluid sample analyses, core analyses on four of the Tocito sand wells, electric logs on all of the wells drilled, two productivity tests, interference tests between some of the wells, a map of the field, and other pertinent data. The basic statistics concerning the performance history of the entire Tocito Sand Reservoir are set forth in Schedule 1, which includes the number of producing wells, the oil and gas production histories by months, the average monthly and cumulative gas-oil ratios, the areally weighted average bottom hole pressures at the various survey dates, the reservoir pressure decline, and the oil production in barrels per pound drop in reservoir pressure. A graphic history of the reservoir pressure and oil and gas production rates versus time is shown in Figure No. 1.

DISCUSSION

Volumetric Calculation of Oil in Place

Since our last report, three additional oil wells have been completed in the Tocito Sand Reservoir making a total of ten producing wells in the field. The reservoir has not yet been defined to the west and northwest, and it appears that there may be several additional locations in those directions. In order to areally weight the bottom hole pressure surveys to arriva at a more accurate average reservoir pressure on each survey date, the isopachous map of the net oil pay sand used in our previous report was revised to include the later data developed, and this map is included as Figure No. 6. The area within the zero contour is 3,156 acres. The total number of acre feet of net pay sand indicated by the isopachous map is 29,710, which gives an average thickness of net pay sand for the entire reservoir of 9.4 feet. Figure No. 5 is a structural map using a datum on the top of the Tocito sand as indicated from a correlative point picked from the electrical logs.

The Tocito sand section has been diamond cored using an oil emulsion mud in three wells and a water base mud in a fourth well. These cores were analyzed and the weighted average values as determined from the analyses are as follows: Porosity of 15 per cent, connate water saturation 28 per cent, average permeability 118 millidarcys. Using these figures and a formation volume factor at the original reservoir pressure of 1.545, the stock tank oil originally in place was calculated to be 542 barrels per acre foot of net pay sand. Thus, the volumetric calculations indicate that there were

originally 16,100,000 barrels of stock tank oil in place in the total Tocito Sand Reservoir.

Material Balance Calculations of Oil in Place

Prior to beginning the material balance calculations of the oil in place, all of the basic data were carefully reanalyzed. Figure No. 3 shows the solubility and shrinkage relationships as determined by the two bottom hole fluid sample analyses. The actual control points taken from the bottom hole samples are indicated on the graph and the solid line reveals our estimate of the more accurate relationship for each. New isobaric maps (Figure Nos. 7 - 10) were constructed for each bottom hole pressure survey using the tentative outline of the reservoir, as determined from the isopachous map. These maps were planimetered to determine the areally weighted average reservoir pressure at the time of the four different surveys. The average pressures are shown on the isobaric maps, on Figure No. 1, and on Figure No. 2. Figure No. 2 is a graphical representation of the average reservoir pressure, instantaneous and cumulative gas-oil ratios versus the cumulative oil production from the entire reservoir.

Certain basic conditions are assumed in all of the material balance calculations. These are: (1) The oil was saturated at the original reservoir pressure of 2200 pounds per square inch gauge (psig), (2) there was no initial gas cap present, and (3) there has been no water encroachment into the oil reservoir.

A series of ten material balance calculations of the original volume of stock tank oil in place in the entire Tocito Sand Reservoir were made. These included: four calculations of the entire performance history from original reservoir conditions to each of the four pressure surveys; and all possible combinations of performance increments between the four surveys. The results of these calculations are tabulated on the following page.

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Period Covered	Total Stock Tank Oil Originally in Place (Barrels)
Initial to May 1, 1952	18,100,000
Initial to Aug. 20, 1952	19,300,000
May 1 to Aug. 20, 1952	16,000,000
Initial to Jan. 13, 1953	21,700,000
May 1, 1952 to Jan 13, 1953	16,300,000
Aug. 20, 1952 to Jan. 13, 1953	17,200,000
Initial to April 28, 1953	23,700,000
May 1, 1952 to April 28, 1953	17,500,000
Aug. 20, 1952 to April 28, 1953	17,700,000
Jan 13, to April 28, 1953	17,800,000

The arithmetic average of all ten calculations gives a value of 18,500,000 barrels of stock tank oil in place originally in the reservoir. However, it is believed that some of the calculations give more accurate results than others, and for this reason should be more heavily weighted in arriving at the best estimate of the oil in place.. For example, the four calculations involving the period from the initial reservoir conditions to the four bottom hole pressure surveys all are predicated upon solution gas-oil ratios and formation volume factors at the original reservoir conditions which have been extrapolated for approximately 150 pounds. Since material balance calculations are very sensitive to the formation volume factors, it is believed that these four calculations are probably the least accurate of the entire group. The arithmetic average of the six incremental calculations is 17,100,000 barrels. It is our opinion, at this time, that the most reliable figure for the total volume of stock tank oil originally in place in the Tocito Sand Reservoir is 17,000,000 barrels. This figure differs by 5.6 per cent from the volumetric calculation, and at this stage in the development of the field, this difference is believed to be well within the accuracy of the calculations.

Since the reservoir is not yet fully developed and the cumulative pressure decline in the reservoir has been only 7.7 per cent of the original reservoir pressure, our estimate must be considered as preliminary and subject to some correction when the field is fully developed and more performance history is available.

Future Production Rates

Preliminary estimates of the gas-oil ratios and the daily oil and gas production rates were made for a two-year period beginning May 1, 1953. These estimates were made in increments of six months and are averages for each increment. They are based on the following assumptions:

(1) All the production will be derived from the ten presently producing wells.

(2) The basic allowable will be 150 barrels per well per day.

(3) The penalty gas-oil ratio will be 2,000 cubic feet per barrel, and no well will be allowed to produce in excess of 300,000 standard cubic feet of gas per day.

The above conditions are those included in the proposed field rules as covered under Mr. Lowry's letter to the co-owners dated March 24, 1953, except for the limitation to the present number of producing wells.

Since there are no relative permeability ratio (Kg/Ko) data available on the Pettigrew Tocito Sand, the estimates of the future gas-oil ratios are based upon the gas-oil ratio trends exhibited by the individual wells up to and including the April 1953, gas-oil ratio tests. The procedure used in estimating these ratios was to plot the gas-oil ratio tests versus the cumulative production for each individual well and extrapolate these trends. If the wells current ratio is less than 2,000 cubic feet per barrel, the total cumulative production was figured at the end of a six-month period assuming an oil production rate of 150 barrels per day. If this cumulative figure, when checked against the extrapolated gas-oil ratio trend, indicated that the well's average gas-oil ratio would be less than 2,000 cubic feet per barrel, the allowed production during that period would be 150 barrels per day. The daily gas production was then calculated by multiplying the average gas-oil ratio by 150. When the ratio was in excess of 2,000 cubic feet per barrel, a trial and error procedure was used to calculate the average allowed production and the resulting average gas-oil ratio. The figures shown on the following page are the summation of the estimated individual well allowed gas and oil production rates. These estimates are also plotted as extrapolations versus time in Figure No. 1 and versus cumulative oil production in Figure No. 2.

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Period	Average Gas/Oil	Estimated Allowed Daily Production Oil Bbls.	Gas MCF*
5/1/53 to 11/1/53	1893	1070	2026
11/1/53 to 5/1/54	2357	952	2244
5/1/54 to 11/1/54	2793	845	2360
11/1/54 to 5/1/55	3266	772	2521

*Measured at 14.7 psia and 60° F.

From the foregoing it is apparent that, under the proposed field rules, the present wells will not be allowed to produce the 1,200 barrels of oil per day which the co-owners are committed to supply to the Malco Refinery. It also points out the necessity of additional development to help maintain the desired production rate. The material balance calculations discussed elsewhere in this report indicate that the field is not fully developed and that there are two or possibly three semi-proved undeveloped 160-acre drill sites remaining on the co-owner's acreage. Early development of these tracts is suggested. The production from the additional wells will increase the estimated daily oil and gas production and the lower gas-oil ratios of these wells will decrease the average ratio of the total reservoir.

Most Efficient Production Rates

A solution gas drive reservoir such as the Pettigrew Tocito Reservoir is less sensitive to withdrawal rates than is a water drive reservoir. However, the key to the conservation of energy is, of course, the efficient use of the solution gas. At any given time in the depletion history of a well there is a single back pressure and its corresponding oil production rate that will yield the minimum gas-oil ratio and gas production. The most efficient production rate for the pool can only be determined by productivity tests of the individual wells. The sum of the individual well production rates at their minimum gas-oil ratios will give the total pool rate which will result in the conservation of the gas and the most efficient use of the reservoir energy. In so far as is practical, operating methods and production schedules should be made to conform to the most efficient rates thus to be determined at reasonable intervals.

In our previous report it was suggested that productivity tests should be made on the individual wells to determine their most efficient production rate. Since these tests have not been made, it is impossible to determine the current and most efficient production rate of the field.

Anticipated Primary Recovery

A calculation of the "apparent" relative permeability ratio (Kg/Ko) to total liquid saturation relationship was made for April 1953, assuming that the total volume of stock tank oil originally in place in the reservoir was 17,000,000 barrels. The Kg/Ko ratio obtained was 0.041 and the corresponding average free gas saturation in the reservoir at that time was 3.5 per cent of the total pore space. When compared with the published "apparent" permeability ratio-liquid saturation data determined from total reservoir performance, the Pettigrew Tocito field "apparent" permeability ratio is appreciably higher for the free gas saturation calculated than any of the other fields.

The above mentioned calculation corroborates the preliminary conclusion reached in our previous report, that the primary recovery to be anticipated is low, i.e., on the order of 15 per cent of the original stock tank oil in place. This is equivalent to an ultimate recovery of 2,600,000 barrels of stock tank oil.

Pressure Maintenance

Experience with other solution gas drive reservoirs of this type has revealed that the inherently low primary recoveries can usually be increased by the application of pressure maintenance operations by the injection of gas and/or water. In our previous report it was pointed out that pressure maintenance by gas injection did not appear too attractive. This statement was made because of the high "apparent" relative permeability ratio of gas to oil inferred by our calculations. As discussed in the preceding section of this report, this situation has not changed during the interim but has in fact been aggravated. However, all such calculations assume that the reservoir is in equilibrium and this is not true in the subject reservoir as revealed by the recent bottom hole pressure and gas-oil ratio surveys. These show a pressure gradient across the reservoir of approximately 480 pounds per square inch and a variation in measured gas-oil ratios of from 723 to 3923 cubic feet per barrel. The possible economic benefits from pressure maintenance of the Pettigrew Tocito Sand Reservoir appear to be greater than normal due

to the low primary recovery anticipated, and no possible method of increasing the primary oil recovery should be ignored in any analysis of pressure maintenance operations. When the reservoir is more completely defined by additional development and the relative permeability data are available, a detailed analysis of pressure maintenance by gas and/or water injection should be made and possibly a pilot injection program should be attempted prior to making any commitment for a particular program for the entire field.

Calculations were made to determine the volume of gas or water required to fully maintain the current reservoir pressure, assuming a daily oil production rate of 1,200 barrels. These calculations revealed that 3,100 barrels of reservoir space would be voided daily. Therefore, to completely maintain the pressure would require the injection of approximately 3,100 barrels of water or 2,500,000 standard cubic feet of gas per day. These injection requirements will vary with the reservoir pressure and gas-oil ratio, and specific figures are included here merely to give some idea of the total volume of gas or oil required. Further analysis of the problem may reveal that it would be undesirable to maintain the pressure fully.

It is probable that two or more injection wells would be necessary to inject gas or water at the daily rate required. Well No.s 134 and 109 should be considered for this purpose since they are located in the low pressure area of the reservoir where a gas cap has already formed, and the current production lost by converting them would be only 90 barrels per day. The injectivity characteristics of Well No. 134 in its present condition must be very poor. A procedure for improving the productivity and injectivity of this well is proposed in another section of this report.

If the Tocito Sand Reservoir extends over into the Meade-Scott and Ralph Johnston - Rincon Unit, it may be advisable, or necessary, to unitize the entire field prior to the inauguration of any pressure maintenance program.

Remedial Work on Well No. 1-134

One of the operational problems involving the Tocito Sand Reservoir is the peculiar behavior of Well No. 1-134. This well was originally completed as a small gas well in a deeper formation during the summer of 1950. It apparently produced from this formation or remained shut in until September 1951, at which time it was plugged back to the Tocito formation and tested five barrels of oil

per hour from this zone after the casing was perforated. The well was then acidized with 500 gallons of mud acid with apparently no improvement in its performance. Rotary tools were moved in and the seven inch casing was milled out from 6728 to 6770 feet. A six-hour drill stem test from this zone, after milling out the casing, recovered gas to the surface in 16 minutes and 1620 feet of gas cut mud with a very small show of oil. Rotary tools were then moved out during December 1951, and cable tools moved in. On February 4, 1952, the hole was shot with 120 quarts, the results of which are not known to the writer. In March 1952, it was acidized with 2,000 gallons of mud acid, and under the results is noted "no recovery". On April 27, 1952, 1000 barrels of distillate and 1000 barrels of oil were pumped into the formation after which tubing was run and the well put on production. The test recorded on August 21, 1952, indicated that the well flowed 38 barrels of oil in 55 minutes. However, the production history reveals that the well has never produced over 664 barrels of oil in any one month, an average of 22 barrels per day. The cumulative production from the well to April 28, 1953, was 5,166 barrels. This well is currently producing approximately 10 barrels of oil per day. On each bottom hole pressure survey it has had the lowest pressure of any well in the field, and its pressure had decreased to 1721 psig on April 28, 1953. During 1953, three gas-oil ratio tests have been made on the well and the results of these tests varied from 2867 cubic feet per barrel to 3460 cubic feet per barrel.

The bottom hole pressure map of the April 1953, survey (Figure 7) and the April 1953, gas-oil ratio map (Figure 4) indicate that the well is in a portion of the field where the depletion has been considerably greater than the remainder of the reservoir. Since it contributes very little to the current field production and since it is in a low pressure area, it would be logical to use Well No. 134 as an injection well if a pilot pressure maintenance project were to be started. However, it is evident that the formation surrounding the well has been blocked possibly by drilling mud, water, or by an emulsion. It would be necessary to remedy this situation, because the present injectivity characteristics of the well to gas or water are undoubtedly so low that no appreciable volumes of these fluids could be pumped into the reservoir. It is our opinion that the results obtained under similar conditions by Halliburton's "mud clean-out agent" are such that a treatment with this chemical on a trial basis is warranted here. We therefore recommend that a 500-gallon treatment of the "mud clean-out agent" be made, and if any mud or water are recovered from the well and any improvement is noted in its performance after this treatment, a second treatment using the

same amount of chemical might be tried. The total cost of one treatment would be approximately $330, and it would not be necessary to move a rig over the hole for the job. If the foregoing procedure does not greatly increase the capacity of the well, it is suggested that a sand-oil formation fracture job be performed. This procedure, although not as desirable in our opinion as the chemical treatment first recommended, should fracture the formation surrounding the well a sufficient distance from the bore hole to break through the existing mechanical block. The cost of the sand-oil fracture job would be approximately $750. The results achieved by one or both of the above mentioned procedures should improve the productivity and the injectivity characteristics of the well.

AMSTUTZ AND YATES, INC.

By /s/ George L. Yates

George L. Yates

Date Signed: May 14, 1953

Schedule 1
PERFORMANCE HISTORY
TOTAL TOCITO SAND RESERVOIR
Pettigrew Tocito Field
Rio Arriba County, New Mexico

Year and Month	No. of Producing Wells	Oil Production - Barrels				Gas Production-Mcf @ 14.7 psia and 60°			Average Gas/Oil Cubic Feet/Barrel		Average Reservoir Pressure @ - 1001 - psig	Reservoir Pressure Decline - psi		Oil Production Barrels / 1 psi Pressure Drop	
		Per Well Per Day	Per Day	Per Month	Cumulative	Per Day	Per Month	Cumulative	Per Month	Cumulative		Period	Cumulative	Period	Cumulative
1951 June		0	0	0	0				0	0	2,200 Est.				
July	1	193	193	5,970	5,970	335	10,376	10,376	1,738	1,738					
August	1	327	327	10,143	16,113	507	15,722	26,098	1,550	1,620					
September	1	366	366	10,973	27,086	516	15,472	41,570	1,410	1,535					
October	1	356	356	11,027	38,113	462	14,335	55,905	1,300	1,467					
November	2	210	420	12,599	50,712	480	14,405	70,310	1,143	1,386					
December	2	213	426	13,215	63,927	416	12,905	83,215	977	1,302					
1952 January	2	158	315	9,761	73,688	291	9,011	92,226	923	1,252					
February	2	385	769	21,540	95,228	697	20,208	112,434	938	1,181					
March	4	10	363	11,245	106,473	368	11,406	123,840	1,014	1,163					
April	5	157	785	23,535	130,008	848	25,442	149,282	1,081	1,148					
BHP Survey 5/1/52 Totals for Period			428	130,008		489	149,282		1,148		2,154	46	46	2,826	2,826
May	5	211	1,057	32,772	162,780	1,382	42,854	192,136	1,308	1,180					
June	6	152	914	27,426	190,206	1,180	35,402	227,538	1,291	1,196					
July	7	126	885	27,425	217,631	1,377	35,243	262,781	1,285	1,207					
August 1 - 19	7	125	877	16,664	234,295	1,199	22,790	285,571	1,368	1,219					
BHP Survey 8/20/52 Totals for Period			940	104,287		1,228	136,289		1,307		2,116	38	84	2,744	2,789
August 20 - 31	7	220	1,539	18,471	252,766	2,177	26,120	311,691	1, 414	1,233					
September	7	168	1,181	35,428	288,194	1,679	50,360	362,051	1,421	1,256					
October	7	177	1,242	38,510	326,704	1,929	59,804	421,855	1,553	1,291					
November	7	166	1,161	34,827	361,531	1,953	58,584	480,439	1,682	1,329					
December	7	145	1,018	31,572	393,103	1,938	60,088	540,527	1,903	1,375					
1953 January 1 - 12	8	98	781	7,030	400,133	1,152	13,826	554,353	1,967	1,385					
BHP Survey 1/13/53 Totals for Period			1,136	165,838		1,841	268,782		1,621		2,065	51	135	3,252	2,964
January 13 - 31	8	143	1,142	21,169	421,302	1,919	36,459	590,812	1,722	1,402					
February	8	149	1,193	33,394	454,696	2,004	56,114	646,926	1,680	1,423					
March	9	123	1,111	34,438	489,134	1,754	54,376	701,302	1,579	1,434					
April 1 - 27	10	111	1,106	27,641	516,775	2,000	50,007	751,309	1,809	1,454					
BHP Survey 4/28/53 Totals for Period			1,144	116,642		1,931	196,956		1,689		2,030	35	170	3,333	3,040