CASE 3114: Appli. of BCO, INC. for a waterflood project, San Juan and Rio Arriba Counties, N. Mex.

CASE NO.
3114

Application,
Transcripts,
Small Exhibits
ETC.

WATER INJECTION FEASIBILITY STUDY

MAYRE ZONE

Case 3114

ESCRITO GALLUP FIELD

Rio Arriba County, New Mexico

January 1, 1964

CORE LABORATORIES, Inc.
BOX 10185, DALLAS 7, TEXAS
CABLE: CORELAB

Engineering & Consulting Department
H. M. SHEARIN
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REPLY TO
SUITE 209 GULF BUILDING
BOX 223
MIDLAND, TEXAS

March 31, 1964

BCO, Inc.
P. O. Box 669
Santa Fe, New Mexico

Attention: Mr. Harry L. Bigbee

Gentlemen:

The waterflood feasibility study of the Escrito Gallup Field which you authorized on January 16, 1964, has been completed. The results of that study are presented in the attached report.

It has been concluded that water injection operations in the northwest portion (Area I) of the field would be both technically and economically feasible. Water injection operations in the southeast portion (Area II) of the field would not be economically feasible at this time.

It is recommended that the operators in Area I form a unit for the purpose of conducting water injection operations.

For further detail concerning these conclusions, recommendations, and supporting engineering calculations, please refer to the attached report.

Very truly yours,

CORE LABORATORIES, INC.

T. C. Carlson
Resident Engineer

TCC:fp

WATER INJECTION FEASIBILITY STUDY

of the

MAYRE ZONE

ESCRITO GALLUP FIELD

Rio Arriba County, New Mexico

as of

January 1, 1964

Prepared for

BCO, Inc.

Santa Fe, New Mexico

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CORE LABORATORIES, INC.
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AUTHORIZATION

The Engineering and Consulting Department of Core Laboratories, Inc., was authorized by Mr. Harry L. Bigbee of BCO, Inc., on January 16, 1964, to assist in the economic analysis, unitization, design, development, and supervision of a water injection program for the Escrito Gallup Field, Rio Arriba County, New Mexico. The total effort was divided into various phases of activity, the first of which was the determination of the injection plan and the economical and technical feasibility of waterflooding the Escrito Gallup Field. This report is considered to complete the work of Phase I as it is described in the letter agreement of January 13, 1964.

Data used in the study were obtained from the files of the client, the public record, and certain files of the Engineering and Consulting Department. The data furnished by the client and obtained from the public record were accepted and used as represented.

SUMMARY

SUMMARY

The Escrito Gallup Field, located on the south flank of the San Juan Basin in Rio Arriba County, New Mexico, produces oil and gas from several sand lenses of the Gallup sandstone or equivalent. The principal producing horizon is the Mayre zone, which appears to be a northwest-southeast-trending offshore sand bar deposit, at least in the northwest portion of the field. The sandstone grades into sandy shale and siltstone on the landward and seaward flanks and in the southeastern portion of the field. The northwest area is characterized by clean sands, high permeability, and high productivity. This part of the Field has been designated Area I. The southeastern area is characterized by shaley sands, low permeability, low productivity, and high gas saturation. This area has been designated Area II.

The effective oil in place in the Mayre zone is estimated to be 10,550,000 stock tank barrels, 8,000,000 barrels of which are in Area I. The 25 Area I wells are completed almost exclusively in the Mayre zone and, since discovery in 1957, they had produced a total of 809,248 barrels of oil as of January 1, 1964. The reservoir is virtually depleted in Area I and a remaining primary reserve of only 66,600 barrels is estimated to the economic limit of operations.

Area II, in the southeast portion of the Field where low productivities were encountered, had produced a total of 360,469 barrels of oil from 11 wells as of January 1, 1964. Wells in this area are completed in from one to five Gallup sand lenses, and they have a rather wide variety of producing characteristics. It is estimated that the remaining primary oil reserves for this area are approximately 250,500 barrels. Approximately one-half of the ultimate production from current completions should come from the Mayre zone.

Assuming that a satisfactory injection water will be obtained in sufficient quantities from Tertiary or Upper Cretaceous sands, a water injection project should be successful in Area I. Three injection wells taking a total of 3,000 barrels of water per day should be sufficient for satisfactory performance of the waterflood, provided the field is shut in approximately three months at the start of injection. Provided an injection well can be successfully completed in SE NW Sec. 12, T24N, R8W, the recovery of 1,161,000 barrels of oil after January 1, 1964, is anticipated in seven years. This projection assumes that water injection will be started by October 1, 1964.

Considering an investment of $330,000 to put the flood into operation, a total cash flow to the operators of Area I of $903,300 is anticipated after deducting all operating and development costs. The six per cent present value of this amount is $628,800. When compared

to remaining primary, the waterflood development investment will earn an average annual rate of return of 34 per cent from the incremental income. However, it will require four years to recover the investment from operating income.

Due to the wide range of productivity, multizone well completions, high gas saturations, and poor well geometry, waterflooding of Area II is considered to be a high rish venture that could not be justified at this time by potential earnings. Serious consideration of the possibility of waterflooding Area II should be delayed at least until the project is proven successful in Area I.

CONCLUSIONS

From the results of a waterflood feasibility study of the Escrito Gallup Field, the following conclusions were reached:

1. The Escrito Gallup Field can be logically divided into two Areas according to the productive characteristics of the principal producing interval, the Mayre zone.
2. The average reservoir capacity of the Mayre zone is approximately 276 millidarcy-feet in Area I and approximately 38 millidarcy-feet in Area II.
3. The effective oil initially in place in the Mayre zone was 8,000,000 stock tank barrels in Area I and 2,550,000 barrels in Area II.
4. Oil produced as of January 1, 1964, had been 809,248 barrels from Area I and 360,469 barrels from Area II. (Area II wells produce from as many as four Gallup sands in addition to the Mayre zone.)
5. The primary oil reserves remaining after January 1, 1964, were estimated to be approximately 66,600 barrels in Area I and 250,500 barrels in Area II.
6. Water injection operations undertaken this year in Area I should result in the recovery of approximately 1,161,000 barrels of oil from the Mayre zone in seven years after January 1, 1964.

7. A water injection well drilled and successfully completed in the SE NW Sec. 12, T24N, R8W should result in the recovery of 190,000 barrels of oil not otherwise recoverable from the Mayre zone.

8. Water flooding of the Mayre zone in Area I should result in a net profit of $903,300 after the deduction of all expenses and capital investment.

9. Water injection operations in the Mayre zone of Area I would be both technically and economically feasible.

10. Water injection operations in the Mayre zone of Area II would not be economically feasible at this time.

RECOMMENDATIONS

From the results and conclusions of this study, the following recommendations are respectfully submitted to the operators of the Escrito Gallup Field:

1. The portion of the Escrito Gallup Field designated in this study as Area I should be unitized for water injection operations at the earliest opportunity.
2. An injection well should be drilled in the SE quarter of the NW quarter of Section 12, T24N, R8W. (BCO-Nancy Federal 4-12).
3. The Tertiary and Upper Cretaceous water sands should be thoroughly tested for productivity and the water composition analyzed while drilling the BCO-Nancy Federal 4-12.
4. Provided the injection well in Section 12 is successfully completed, the operators should make a detailed water injection plant design that would include the conversion of the BCO-Elizabeth No. 1-18 and the Standard of Texas-Federal No. 1-3-21 to injection service.
5. Water injection at the minimum rate of 3,000 barrels per day should be commenced at the earliest opportunity.
6. Water injection operations in Area II should not be considered at this time.

DISCUSSION

INTRODUCTION

A reservoir analysis has been completed of a selected portion of the Escrito Gallup Field, Rio Arriba County, New Mexico. This analysis includes a delineation of the reservoir geology, an estimation of initial oil in place, an analysis of past reservoir performance, a prediction of future performance, the determination of a water injection plan, a discussion of probable water sources, and an economic analysis of the feasibility of water injection operations.

For reasons discussed in the following pages, the Escrito Gallup Field was divided into two separate areas in this study. These areas, designated Area I and Area II, are illustrated on Figure I. All subsequent discussion will refer to either one of the Areas or the total of the two. Except for the purpose of delineating the geology of the field, wells outside the Areas were not considered.

DEVELOPMENT HISTORY

The Escrito Gallup Field is located in the extreme southwest corner of Rio Arriba County, New Mexico, on the south flank of the San Juan Basin. It was discovered in April 1957 by the completion of the Standard of Texas-Federal 1-27 No. 1 well in the Mayre zone of the Gallup sandstone at a depth of 5700-5768 feet. The well had an initial potential of 70 barrels of 39°API oil daily after a sand-oil fracture treatment. Development of the Field was slow but continuous, with the completion of nine additional wells during the remainder of 1957 and 1958. In 1959 only two wells were completed.

Through 1959 the wells exhibited rather mediocre productive capacity. Eight of the 12 completions were either in Area II or out of the study area. Only four were completed in Area I and these were located on the flanks where productivity is poor. Then, in February 1960, the highly productive sand was found in Area I with the nearly simultaneous completion of the Dorfman-Judy 1-17 and the Compass Exploration Company-State 1-16 wells. These wells were capable of producing several hundred barrels of oil per day. During 1960 drilling activity increased, and 13 completions were made in Area I while only two were made in Area II and one outside. In 1961 the pace continued with nine completions in Area I

and six in Area II. During this year five completions were also made outside the study area. In 1962 one successful completion was made in each Area and, except for a dry hole drilled in 1963, the field development stopped.

The wells were drilled through the entire Gallup section, cased with 4-1/2" pipe for the most part, and selectively perforated. All wells were stimulated with hydraulic fracture treatments, the size of the treatment being determined by the apparent quality of the sand. In Area I the perforations were restricted almost exclusively to the Mayre zone and a sand lense immediately below it. However, in Area II the Mayre zone does not exhibit sufficient productivity, and it was the frequent practice of the operators to open all Gallup sand lenses to the well bore. Two-thirds of the wells are completed in two or more sand zones, and most of these include all productive zones of the Gallup. Although most oil wells flowed initially, most are now on artificial lift or they are shut-in. A few high gas-oil ratio oil wells continue to flow. Of 42 wells drilled in the study area, a total of 36 wells were successfully completed as oil producers. Twenty-five wells are currently producing, 15 in Area I and 10 in Area II. Table I presents the individual well completion data for wells drilled in or close to the study area.

GEOLOGY

The Escrito Gallup Field produces oil and gas at a depth of approximately 6,000 feet from the Gallup sandstone member of the Mancos Formation of the Upper Cretaceous Period. Figure 2 presents a typical section of the Upper Cretaceous Period in the Escrito Field. Regionally, the Field is located in what is known generally as the Bisti Trend. The Gallup formation is characterized by elongated sandstone lenses, the most predominant of which is known locally as the Mayre Zone. This zone is considered by most authorities to be an offshore sand bar deposit in the Bisti and Escrito Fields where it exhibits clean sands, high permeability, and porosity. The sands grade locally into shaley sands, sandy shales, and siltstones of relatively low permeability. In most instances the sands and siltstones are saturated with oil and gas, their productivity being dependent upon the sand quantity and quality and the success of artificial stimulation.

In addition to the Mayre Zone, other minor sandstone lenses are productive in the Escrito Field. For all practical purposes they are grouped with the Gallup member, but they are considered by some to be stray sands of the Middle Mancos Formation and not necessarily equivalent to the Gallup sandstone. Figure 3 presents a typical section of the productive interval in the Escrito

Field which, for the purpose of this study, is classified as Gallup. Six separate zones have been classified, five of which are included in Figure 3. Five of the six lenses are open to the well bore in various combinations at one location or another in the field. The other zone, GA3, is not productive, but it is a consistent marker which has been used as a structural datum. The zones are correlative from well to well in the Escrito Field.

Contoured upon the GA3 datum marker, the structure of the region is a monocline dipping in a north-northeasterly direction at the rate of 100 feet per mile. The Mayre zone is generally oriented with the regional strike; however, in the extreme southeast portion of the field the Gallup sands make a noticeable up-dip change in structural position due to a gentle nosing. In this portion of the field high gas saturations occur in the Mayre zone, apparently as a result of gravity segregation. The gas-oil contact has been arbitrarily placed at a datum of +1300 feet. Figure 4 presents a structure map of the Gallup member in the Escrito Field.

In the Escrito Field the principal producing zone is a stratigraphic trap formed by a loss in permeability up-dip and down-dip due to the gradation of the Mayre zone sandstone into shaley sand, siltstone, and shale. The oil reservoir is not conclusively defined in the trend direction, northwest. Even though it has not been closed by dry holes, it is effectively defined in a southeasterly trend direction by

deterioration of rock quality, lithological changes, and higher gas saturations.

The Escrito Gallup Field can be divided into two very distinct areas according to the productive quality of the Mayre zone. In the Northwest segment of the Field true offshore sand bar conditions appear to exist, and the sand is characterized by high permeabilities in core analysis and by high spontaneous potential and resistivity readings in electric log analysis. This characterization continues from the extreme northwest end of the field southeasterly through the west half of Section 21, T24N, R7W. From this point southeasterly the sand is characterized by low SP and resistivity readings and by low permeability. Figure 5 presents a reservoir capacity map (the product of average permeability and net thickness) that best illustrates the wide divergence in sand quality. (This map includes only wells which had net productive sand of 1.0 millidarcy or greater in the Mayre zone. The development of the map will be discussed in subsequent paragraphs.)

The Mayre zone consists of three sand benches, the middle of which is the most consistent and the most productive. The upper bench occurs only on the landward side (up-dip) of the bar in Area I, while it is present in all the wells in Area II. It is the second most significant of the three benches. It appears to reach a maximum

gross thickness of approximately three to four feet. The middle bench is responsible for most of the productivity and the bulk of the oil in place. This bench is present in both Areas I and II, and it reaches a gross thickness of 13 feet in Area I. It appears to have an average gross thickness throughout the Field of approximately eight feet. The lower bench is the least significant and it has only limited occurance in Area I. In Area II it appears to occur only on the landward side of the Field, and it has an average gross thickness of only two feet. In these discussions, gross thickness is considered to include only that sand which has an apparent permeability equal to or greater than 0.10 millidarcy. Table II presents the geologic data developed for this study and used in the construction of the maps presented in the following pages.

RESERVOIR CAPACITY

The effectiveness of oil recovery processes, either primary or secondary, are dependent upon the ability of the reservoir rock to transmit fluids. Permeability is a measure of that ability. Both the absolute value and the distribution of permeability has some bearing upon the efficiency of the depletion mechanism under consideration. In order to evaluate this situation it was necessary to estimate the value of permeability in the Mayre zone at each well location. Since the cleaner sands generally exhibit higher permeability, and since the

spontaneous potential measurement reflects the cleanliness of the sand, a correlation was developed between average permeability and maximum SP reading for the cored wells. This correlation was used to determine the average permeability for the non-cored wells and to determine the well capacity in millidarcy-feet. The capacity value was posted to a map and contoured. Figure 5, referred to in the geologic discussion, presents the resulting reservoir capacity map.

It can be seen from Figure 5 that Area I wells range from 3 to 1100 and have an average capacity of approximately 276 md-ft. while those in Area II average only 38 md-ft. This difference is the principal basis for separating the Field into two Areas. In considering water injection, the two Areas would require entirely different methods and would have different results.

OIL IN PLACE

In the Escrito Gallup Field the determination of oil initially in place can be difficult and the results misleading if not defined. It appears that most sands, shaley sands, and sandy shales in the Mancos formation contain hydrocarbons. This is certainly the case in the Escrito area. However, unless these hydrocarbons can be made to flow to a well, they might as well not be present. Consequently, the oil and/or gas must be associated with sufficient permeability to permit flow before they can be considered as original oil or gas in place.

Such oil reserves would be defined as effective oil in place since they are associated with effective permeability. Porosity and oil saturation in core analysis measurements do not reflect oil reserves unless the oil is associated with sufficient permeability to support flow.

Assuming a minimum permeability of approximately 0.10 millidarcy, the gross sand thickness was determined for the nine wells that had been cored in the Mayre zone. These core data were then correlated to the resistivity curve on the electric log for the well, and the correlation was used to determine net thickness in each bench of the Mayre zone. These gross intervals were summed to determine the total gross sand in the Mayre zone. These data were posted to a Field map and contoured. The total gross thickness for the Mayre zone map is presented in Figure 6.

Core analysis data indicates the average porosity to be rather constant at 12.7 per cent. However, the connate water saturation does increase with decreased permeability. From correlations it was estimated that the average connate water saturation is 25 per cent in Area I and 30 per cent in Area II due to the difference in permeabilities. The volumes of gross oil sand inside the boundaries of Area I and Area II were determined by planimetering the gross isopach map of Figure 6. Applying the average core properties and the oil formation volume factor of 1.349 to these volumes, the gross oil initially in

place was estimated to be 16,870,000 barrels in Area I and 6,909,000 barrels in Area II.

The portion of this oil that would be in effective communication with the wells under primary and secondary recovery operation is difficult to determine except by observation and analysis of actual reservoir performance. Under pressure depletion operation the effective oil in place could be equal to or less than the gross oil in place. In secondary recovery or pressure maintenance operations, the effective oil in place would undoubtedly be lower than the gross value. From an analysis of the primary performance it was apparent that the effective oil initially in place was considerably lower than the gross volumes. Consequently, a net isopach map was developed using a minimum permeability of 1.0 millidarcy. Figure 7 presents the resulting net isopach map of the Mayre zone.

Using the average porosity of 12.7 per cent and an average connate water saturation of 25 and 30 per cent for Areas I and II, respectively, the net oil in place from Figure 7 becomes 8,000,000 barrels in Area I and 2,550,000 barrels in Area II. Applying the calculated primary recovery efficiency for Area I to the 8,000,000 barrels, a very close comparison was made with actual recoveries indicated by decline curve analysis. From this comparison it was concluded that the effective initial oil in place contributing to both

primary and secondary oil recovery operations would be the net value reflected by the map on Figure 7.

PAST PERFORMANCE

The performance of the Mayre zone in Area I is typical of a highly permeable solution gas drive reservoir that was depleted at maximum rate. The primary life was short, lasting only a little more than six years. Eighty per cent of the ultimate reserves were recovered in about forty per cent of the life. In Area II the Mayre zone performance is masked by the fact that several sand zones are open in most wells. The fact that these zones produce both gas and oil in indeterminate amounts makes it difficult to estimate accurately the contribution of the Mayre zone to the production performance of Area II. However, it could be said, generally, that the performance of Area II is typical of low permeability solution gas drive reservoir being depleted at capacity rates.

In studying individual well performance it was determined that quite a wide range in producing characteristics exist, particularly in Area II wells. To minimize errors involved in projecting the rate decline of a group of unlike wells, the wells were organized into small groups having somewhat similar histories of rate performance. For the most part, these well groups also coincided with geographic areas of the Escrito Field. The use of this procedure was important

in Area II where considerable primary oil reserves remain and where the variation in producing characteristics is particularly noticeable. In Area I the wells were merely grouped into those that had remaining primary reserves and those that did not, since the reservoir is essentially pressure depleted. Table III presents the oil and gas production history for each well group, Area, and total Field, and Figure 8 presents a graph of the total production history for each Area.

Area I had produced a total of 809,248 barrels of oil and 2,325,340 MSCF of gas from 25 wells as of January 1, 1964. At that date only 15 wells were producing, and the reservoir was virtually depleted. To this date the cumulative production averaged only 32,370 barrels of oil per well, which indicates rather marginal economic success under primary production operations. Area I is developed on a density of approximately 96.8 productive acres per well.

Area II had produced a total of 360,469 barrels of oil and 1,332,497 MSCF of gas from 11 wells, as of January 1, 1964. At that time, 10 wells were producing, and a considerable primary oil reserve remained to be produced. To this date the cumulative production also averaged approximately 32,000 barrels per well, and the Area was developed on a density of approximately 116 acres per well. A higher ultimate recovery per well in Area II will probably be the result of the production from the several zones which is at present being commingled in most of the Area II wells.

FUTURE PRIMARY PERFORMANCE

The Mayre zone is considered to be a solution gas drive reservoir with little or no benefit being derived from the expansion of the limited gas cap in the southeast end of the Field. No water influx is apparent or expected. The reservoir oil was saturated with gas at the original pressure of 1842 psig and the initial solution gas-oil ratio was 687 standard cubic feet per barrel. The initial oil formation volume factor was 1.349 reservoir barrels per stock tank barrel at a reservoir temperature of 155°F. The oil viscosity at original pressure and temperature was 0.53 cp.

From theoretical calculations describing solution gas drive performance it was determined that the ultimate recovery efficiency under primary pressure depletion would be approximately 11 per cent in Area I and 12 per cent in Area II. The difference in efficiency is the result of the difference in connate water saturation. Considering the effective oil in place in Area I and II of 8,000,000 and 2,550,000 barrels, respectively, the ultimate primary reserves in the Mayre zone would be 880,000 barrels for Area I and 306,000 barrels for Area II.

From oil rate decline analysis the remaining oil reserve to an economic limit of production for Area I was estimated to be 66,600 barrels after January 1, 1964. Added to the cumulative production to that date, the ultimate primary recovery becomes 875,848 stock tank

barrels of oil. Included in this value would be a comparatively small amount of oil produced from zone GA5 and others. Considering that the relatively high economic limit of production would shorten the normal primary life, the ultimate recovery by decline analysis checks quite closely with the theoretical calculation for Area I.

Applying the theoretical efficiency of 12 per cent to the effective oil in place in the Mayre zone of Area II, an ultimate recovery of 306,000 barrels is indicated. From the sum of rate decline analysis of individual groups the actual ultimate primary reserves for all zones producing in Area II would be 610,969 barrels. Therefore, it could be concluded that the Mayre zone contributes to about one-half of the total production from all zones in Area II and, for the purposes of this study, this was considered to be the case.

Oil rate decline analysis was used to determine the future primary oil reserves and rates of production. In Area I the decline curve for the well group containing all the producing wells was projected to a minimum economic production rate of 160 barrels per well per month. This projection resulted in a remaining reserve of 66,600 barrels and a life of 19 months after January 1, 1964. It should be pointed out that this is a group average determined for the purpose of economic comparison, and that it is entirely possible that certain individual wells will exhibit a longer life.

In Area II, rate decline projections were made for each well group and summed to determine the total for the Area. The three groups each had a different period of remaining life. This difference is reflected in the plot of the number of producing wells on Figure 9, which presents a graph of the projected annual oil rate under primary depletion operations for Areas I and II. It should be pointed out that in Area I these reserves are considered to be attributable to the Mayre zone, while in Area II they include all zones currently producing. Considering that the Mayre zone would contribute about one-half of the 250,500 barrels remaining in Area II, its primary reserve would be approximately 125,000 barrels of oil, a large percentage of which would probably be recovered from the BCO-Lybrook No. 2-22 well. Table IV presents the tabulation by well groups of future primary performance for Areas I, II, and total Field.

Table V presents a summary of reservoir properties and oil reserves for Areas I and II and total Field. It can be seen from this Table that ultimate primary production per well will be approximately 35,000 barrels for Area I and 55,500 barrels for Area II, for a weighted average in the total Field of 41,300 barrels. The ultimate primary oil recovery will be approximately 362 barrels per productive acre in Area I and 477 barrels per productive acre of Area II.

WATER INJECTION OPERATIONS - AREA I

General

Due to the low reservoir pressure and high gas saturation in Area I, some problems may be encountered in water flooding the Mayre zone. Both features tend to permit rapid and extensive dispersion of the water phase away from the injection well with a minimum of oil displacement efficiency. This situation is further complicated by the narrow width of extremely high permeability running the length of the Area. This high permeability associated with the high gas saturation may permit the rapid advance of water along the axis of the reservoir, which could result in early water breakthrough in wells close to the injection wells. Close observation, prudent operation, and constant engineering supervision will be required to realize maximum income and profit from water flooding this reservoir.

Injection Plan

Because of the low pressure and high gas saturation it will require a considerable volume of water to fill the reservoir to a pressure that will permit adequate producing rates. Further, the water injection wells should be widely spaced to permit the development of oil banks and to increase displacement efficiencies. A minimum number of wells should be used for injection so that maximum producing flexibility and rate are available. Considering all of

these points, it is apparent that the injection wells must be widely spaced along the length of the Area, and they must have been high capacity oil wells so that high water injection rates per well can be achieved.

It was determined that a minimum of three injectors would be required, that they be located one at each extremity and one in the center of the Area, and that they each be capable of injecting 1,000 barrels of water per day into the Mayre zone. The wells should be completed exclusively in the Mayre zone. Considering these requirements the following wells were selected as possible injection wells under two alternate plans:

	PLAN I	PLAN II
West	BCO-Nancy 4-12	Smith-Federal 2-13
Center	BCO-Elizabeth 1-18	BCO-Coleen 1-17
East	Standard-Federal 1-3-21	Standard-Federal 2-3-21

Since the BCO-Nancy Federal 4-12 is to be drilled, the final selection of the Plan to be used will be contingent upon its successful completion in the Mayre zone. This well should be located in the SE-NW Sec. 12, T24N, R8W. If it is successful, Plan I would be followed, using the Nancy 4-12 along with the BCO-Elizabeth Federal 1-17 and the Standard-Federal 1-3-21. If it is a dry hole or low capacity well, Plan II would be recommended, using the Smith-Federal No. 2-13, the

BCO-Coleen No. 1-17, and the Standard of Texas-Federal 2-3-21 as injectors. The wells included in Plan I are indicated as proposed water injection wells on Figure 5 and others.

The injection well to be drilled under Plan I can be justified by the increased sweep efficiency it will permit. If it proves the net isopach map of Figure 7 to be reasonably correct, the drilling of the BCO-Nancy Federal 4-12 could result in the recovery of an additional 190,000 stock tank barrels of oil if used as a water injection well under Plan I. In order to assist in the evaluation of future injection rates and the quality of the sand, the entire Mayre zone in this well should be cored and analyzed. The well should also be surveyed with an induction-electrical log.

Under Plan I one new producing well might be drilled in the future to improve the sweep efficiency. This well would be located approximately 660 from the South line and 2640 from the East line of Section 17, T24N, R7W. The well could possibly contribute considerably to the sweep efficiency, but it should not be drilled until the flood is underway and reservoir fill-up has been attained. The drilling expenditure should be justified only by the success of the flood after it has been proven. The well would probably not be needed until the latter stages of flood life.

Under Plan II no additional development is anticipated at this

time. However, as the flood progresses and the degree of sweep efficiency can be determined, additional development may be warranted to increase the sweep efficiency. Such development should be thoroughly analyzed and justified before it is undertaken.

With the possible exception of the Standard-Federal 2-3-21 well, all the injection wells should adequately take 1,000 barrels of water per day. The injection capacity of the Standard 2-3-21 wells has been estimated to be about 500 barrels per day. However, chances are quite good that it would inject at a higher rate during the fill-up period. During the fill-up period the central injector should be made to inject 50 to 80 per cent more water than the average of the other two injectors. Total injection volume of more than 3,000 barrels per day would be desirable during the fill-up period if the wells exhibit the capacity. However, care should be taken to balance the injection rate between wells.

Water Source

The key to waterflooding Area I of the Escrito Gallup Field is, undoubtedly, an adequate supply of satisfactory injection water. Surface water is apparently not available. It is apparent from a search of the electric logs of the area that there is no single, shallow subsurface source bed from which an adequate supply could be obtained. Fresh water sands occur at depths from 1,200 to 1,800 feet and, in

the Val Reese-Connie No. 5-21 well, about 200 feet of sand occurs in this interval. However, it appears to be rather shaley, and the sand productivity might not be sufficient to supply 3,000 or more barrels per day from a single well.

In the type section of the Upper Cretaceous presented in Figure 2 several salt water sands appear in the Pictured Cliff, Lewis, and Mesa Verde Formations. A total of approximately 400 feet of gross sand is present in these formations at most points in the Escrito Field. These sands appear to be cleaner than the fresh water sands, but they are known to be rather tight where they are productive in other areas of the San Juan Basin. Although the salt water sands would probably provide a preferable injection water, they would be more expensive to develop than the fresh water and there is some question as to their ability to produce.

It is recommended that while drilling the Nancy 4-12 injection well the water sands be thoroughly tested. An attempt should be made to determine the capacity of the fresh water apart from the salt water sands. If possible the Pictured Cliff, Lewis, and Mesa Verde waters should be tested separately. Adequate uncontaminated samples should be taken to determine the treating requirements of each water and the compatibility one with another. Operators in the Bisti field report heavy scaling in producing wells, with attendant loss in productivity

after water breakthrough. The proper choice and treatment of injection water may permit this problem to be minimized in Escrito.

If the Nancy 4-12 is dry in the Mayre zone, it should be completed as a water supply well. If it is satisfactorily completed as an injector, one or possibly two other wells should be completed for water supply, or a new well drilled for that purpose. There are no wells not presently listed as plugged that could justifiably be converted to water supply within Area I. However, there are some dry holes that might be in a satisfactory condition to re-enter if the plugging record is accurate and available. If an old hole cannot be reclaimed, a new water source well should be drilled. It is recommended that the new water supply well be located in the vicinity of the Judy No. 1 well so that maximum advantage can be gained by the elevation of the terrain.

Water Plant

A water treating and injection plant with a minimum capacity of 3,000 barrels per day delivered against a surface wellhead pressure of 2,000 psig will be required. A closed system will probably be the more desirable. It should be located as close to both the water supply well and the central injector as possible. The specific detailed design of the water treating and injection plant and the distribution system is beyond the scope of this study. It should not be finalized until the Nancy No. 4-12 well has been completed and the water samples analyzed.

For the purpose of economic feasibility analysis, a total of $185,000 has been estimated as the cost necessary to develop a water supply and to construct the water plant and distribution system.

Water Injection Performance

The oil and water production performance of the Escrito Gallup under water injection operations will be determined by the ability of the reservoir oil to form a bank ahead of the injected water. Although the relative mobility of oil compared to water is sufficiently favorable for this to occur, the high gas saturation may preclude its occurence by permitting the water to disperse rapidly throughout the reservoir. In addition, the oil recovery efficiency of the flood will be determined principally by the degree to which the low capacity, edge areas of the reservoir can be swept by water. The net income developed by the flood will be determined by both the resulting performance and the final displacement efficiency.

Utilizing the rather limited laboratory data available on the reservoir rock, a performance projection was developed based upon the proposed injection pattern of Plan I. An areal sweep efficiency was estimated from the configuration of wells and the distribution of reservoir capacity in Area I. The final position of the water front was estimated and the net reservoir volume inside the front was determined from the net isopach map in Figure 7. This volume was

estimated to be 60 per cent of the total net volume of the reservoir, and it was assumed to be the ultimate areal sweep efficiency.

Considering that two sand benches of varying rock properties occur in the Mayre zone in Area I, the flooding efficiency could be further reduced. This inefficiency may occur because the water will probably flow into the bench of higher permeabilities preferentially. However, it does not necessarily follow that oil will not be displaced from the bench of lower permeability. The data available are not sufficient to determine accurately the degree of vertical or intersand efficiency. From experience and the general character of the reservoir, it was assumed that the vertical efficiency would be 75 per cent.

The product of these values of efficiency would result in a total volumetric efficiency of 45 per cent. To this volume of reservoir oil a conventional frontal advance calculation procedure was applied to determine the water-oil ratio performance of the project. In this calculation it was considered that the residual oil saturation at 100 per cent water production would be 37.4 per cent of total pore space.

It was assumed that water injection operations would be started on October 1, 1964. At this time it was estimated that the cumulative oil production from Area I would be 826,900 stock tank barrels, the producing gas-oil ratio would be 7,500 standard cubic feet per barrel, the average reservoir pressure would be 600 psig, and the free gas

saturation would be 11.35 per cent of pore space. It was assumed that the field would be shut in at this time for a period of three months while water is injected at the rate of 3,000 barrels per day. The estimated rate of reservoir voidage on October 1, 1964, is such that no gain in pressure would occur by the injection of 3,000 barrels of water per day unless the field is closed in. The length of the shut-in period would be determined by the actual injection rates attained initially and by the actual voidage rate measured at the start of injection. It is possible that the shut-in period will be reduced.

After resumption of production on or about January 1, 1965, the oil rate should continue to decline until the reservoir fill-up is approximately 30 to 50 per cent complete. At this time a gradual increase followed by a sharp increase in oil rate should occur. Maximum oil rates of approximately 40,000 stock tank barrels per month are estimated when the reservoir reaches fill-up of gas space and restoration of original pressure approximately three years after the start of injection. Subsequent to this time, the oil production rate will decline rather rapidly due to increasing water production. Because of the high gas saturation, water breakthrough into the first offset wells will probably occur rather rapidly after injection starts. However, on a total field basis the water production can probably be held to a low level during the reservoir fill-up period.

Figure 10 presents the predicted oil rate and water-cut performance for water injection operations in Area I after January 1, 1964. Approximately 1,161,000 barrels of stock tank oil should be recovered to the economic limit of water injection operations in the seven years following this date.

WATER INJECTION OPERATIONS - AREA II

Water injection operations in Area II of the Escrito Gallup Field will be unusually difficult to undertake successfully. The principal difficulties are: 1) the fact that two to five sand lenses over a 300-foot interval are open in most of the wells, 2) these lenses have a low permeability and, apparently, a varying degree of gas saturation, 3) the area has a rather erratic well arrangement that would detract considerably from the sweep efficiency, and 4) the area has a wide range of reservoir capacity in the Mayre zone, which is the principal producing zone.

Due to the number of sand lenses open or potentially open for water flooding, the interzonal waterflooding efficiency would be rather difficult to maintain at reasonable levels. This fact is further complicated by the variable permeability between lenses and the obvious range of gas saturation between lenses. The erratic well geometry and the locally high capacity of the Mayre zone when compared to other lenses would make the operating control of injected water quite difficult. This can be seen generally from the fact that three of the 11 oil

wells have produced nearly 50 per cent of the total oil from all zones of Area II, and they have 67 per cent of the total Mayre zone reservoir capacity. These three wells are perforated in one zone (Mayre), three zones (GA1, 2, 4), and four zones (GA1, 2, 4, 5). The well that is open in three zones (BCO-Lybrook 2-22) probably will account for 40 per cent of the remaining primary reserve of Area II.

Considering the Mayre zone separately and assuming that all injected water would be confined to that zone, a waterflood oil recovery projection was made. The Val Reese-Kenney 3-23 and the Standard of Texas--1-6-22 were assumed to be injectors. Due to the well geometry and the locally high reservoir capacity, the volumetric sweep efficiency when the three key wells are overcome by water would be less than 25 per cent of the total pore volume. Considering other efficiencies to be normal, the ultimate oil recovery at minimum economic rates of production would be 153,000 barrels of oil, assuming injection to start by October 1, 1964.

It was previously estimated that the Mayre zone should contribute approximately 125,000 barrels of oil to the total remaining primary from Area II. With a remaining primary plus secondary of only 153,000 barrels after October 1, 1964, the waterflood investment could not be justified from the incremental income from secondary oil. By extrapolating these results to all zones, and by taking into account the

probably low interzone displacement efficiency, it was concluded that serious consideration of a water injection plan for Area II should not be undertaken by the operators at this time. Consideration of this Area for water injection operations should be delayed at least until waterflooding has been proven successful in Area I At this time the prospects for waterflooding success in Area II should be re-examined.

ECONOMIC ANALYSIS - AREA I

The economic factors considered in determining the feasibility of water injection operations were determined for the most part from the operating records of BCO, Inc. These data were furnished by BCO, Inc., and they were accepted for use as presented. The posted crude oil price of $2.75 was reduced to $2.71 per barrel due to a 2°API gravity penalty, assuming the average gravity in Area I to be 38°API. It was also assumed that an average transportation charge of $0.30 per barrel would continue over the life of the project. The average working interest for all leases was estimated to be 75 per cent, and the direct operating expense was estimated to be $305 per well per month. In addition, a compression charge of $95 per well per month plus $0.01 per MCF was applied to each producing well in Area I. An average gas price of $0.135 per MCF including natural gas liquids was used.

These economic factors were applied to the performance

projection under both continued pressure depletion and water injection operations for Area I. The resulting cash flow schedules are presented in Table VI and VII, respectively. From Table VI it can be seen that the remaining primary oil and gas reserves will result in a total cash flow of $37,500 after deducting the cost of operating the Area I wells for 19 months. This income has a present value of $35,900 when discounted at six per cent per year. It should be pointed out that there will undoubtedly be additional income beyond this period from occasional wells. However, for the purpose of economic comparison with the proposed water injection project, the producing wells were treated as a group. This requires the assumption that when the producing rate does not support the cost of operating the entire group, all wells in the group would be abandoned.

From Table VII it can be seen that a water injection operation in Area I would be economically feasible. Considering a total investment of $330,000, the water injection project should result in a net income before federal income taxes of $903,300 after seven years of operation. Due to the long fill-up period required to return Area I to high production rates, four years are required to recover the investment. While this is a rather long payout period for a project of this type, investment is subsequently returned 3.6 times from operating income. Included in this cash flow is a water plant operating charge of $0.03 per

barrel which, when added to the well operating charge, results in a total operating expense of over $120,000 per year. This is a rather high figure for a project of this size, but it could very easily be realistic, due to the possible production problems that could result after breakthrough of the injection water.

From the cash flow schedules of Tables VI and VII, Table VIII was developed to illustrate the incremental value of the waterflood over continued primary depletion. Due to the short economic life of primary production, the economic yardsticks that are used to gauge the worth of a project are essentially unchanged for the incremental income. It can be seen from Table VIII that the economic feasibility of waterflooding Area I is indicated in spite of a relatively long pay-out period of four years. The capital investment is returned 2.6 times out of total cash flow, and the six per cent present worth profit to investment ratio is 1.8. Further, the average annual rate return on the incremental capital invested will be 34 per cent.

The engineering projection and the economic analysis of that projection indicate that a water injection project should be both technically and economically feasible for the Mayre zone in Area I of the Escrito Gallup Field. However, close operational and engineering control of the project will be necessary to insure economic success.

TABLES

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TABLE I
WELL COMPLETION DATA
ESCRITO GALLUP FIELD
RIO ARRIBA COUNTY, NEW MEXICO

OPERATOR / LEASE	Well No.	Location: Spot	Sec.	TWP	RNG	Completion Date	Elevation (Ft.)	Log TD (Ft.)	PBTD	Production Casing: Size (In.)	Depth (Ft.)	Perforations: Stage	Depth Interval (Ft.)	Zone	Treatment: Gallons	Pounds	Type	Cored Interval
Marvin Ake																		
Ake	1	I	11	24-N	8-W	10-61	7195-KB	6120										
BCO																		
Bigbee	1-16	O	16	24-N	7-W	11-3-60	7084-KB	5966		4-1/2	5999	(1)	5916-38	GA-4	39,890	40,500	SOF	
												(2)	5782-90, 5800-04	GA-2	23,620	24,500	SOF	
Bobby B	2	B	31	24-N	6-W		6745-KB	5612										
Coleen Federal	1	J	17	24-N	7-W	5-17-60	7301-KB	6207	6180	4-1/2	6215		6128-56	GA-4	50,000	50,000	SOF	6128-6203
	2	L	17	24-N	7-W	6-15-60	7172-KB	6071	6069	4-1/2	6102		5990-6014, 6033-44	GA-4, 5	65,225	70,000	SOF	6010-60
Elizabeth Federal	1	H	18	24-N	7-W	10-7-60	7268-KB	7220	7100	5-1/2	7227	(1)	7156-94, 7165-80 (squeezed)	Dakota			Frac	
												(2)	6108-33	GA-4			Frac	
	2	C	18	24-N	7-W	11-11-60	7142-KB	6046	6030	4-1/2	6110		5974-86, 6014-22	GA-4, 5			SOF	
	3	E	18	24-N	7-W	12-61	7104-KB	6022		4-1/2	6038		5917-26, 5930-42, 5663-70	GA-4, 5	15,000	15,000	SOF	
	4	G	18	24-N	7-W	1-62	7293-KB	6236		4-1/2	6238		6128-44, 6172-78	GA-4, 5	49,000	48,000	SOF	
	5	I	18	24-N	7-W	12-61	7172-KB	6112		4-1/2	6100		5986-6016, 6036-42	GA-4, 5	46,000	50,000	SOF	
Federal	1-7	P	7	24-N	7-W	6-60	7343-KB	7321		4-1/2	7330		7186-94, 7204-10, 7238-66	D & A	54,768	60,000	SWF	
	2-7	M	7	24-N	7-W	4-4-61	7175-KB	6154		5-1/2	6148		6006-22	GA-4	30,000	43,000	SOF	
Judy Federal	1-17	P	17	24-N	7-W	2-20-60	7313-KB	7239	6279	5-1/2	6313	6110-40		GA-4	26,700	40,000	SOF	6926-34, 6981-7034 7075-7105
	2-17	K	17	24-N	7-W	(1) 10-8-60 (2) 4-25-63	7204-KB	6105	6080	4-1/2	6110	(1)	6024-74 (BP)	GA-4	65,772	65,000	SOF	
												(2)	5832-50, 5896-5906 5926-36	GA-1, 2 GA-2	27,670	38,000	SWF	
Lybrook	2-22	I	22	24-N	7-W	12-15-60	6760-KB	5669		4-1/2	5674	(1)	5564-92	GA-4	30,000	40,000	SWF	
												(2)	5378-94, 5434-60	GA-1, 2	33,576	40,000	SWF	
	4-22	J	22	24-N	7-W	3-22-61	6772-KB	5651		4-1/2	5663	(1)	5566-82, 5592-5600, 5614-28	GA-4 GA-5	66,300	90,000	SWF	
												(2)	5380-5400, 5440-70	GA-1, 2	45,000	60,000	SWF	
	6-22	G	22	24-N	7-W	5-20-60	6816-KB	5738		4-1/2	5747	(1)	5646-66, 5682-98 5710-24	GA-4, 5 GA-6	51,460	60,000	SWF	
												(2)	5450-70, 5508-36	GA-1, 2	31,145	40,000	SWF	
	7-27	A	27	24-N	7-W	5-62	6941-KB	5790		4-1/2	5788		5710-40	GA-4	41,990	40,000	SOF	5670-5746
Nancy Federal	1	P	12	24-N	8-W	2-61	7256-IB	6165		4-1/2	6203		6104-20, 6147-53	GA-4, 5	50,000	50,000	SOF	
	2	O	12	24-N	8-W	12-61	7204-KB	6143		4-1/2	6148		6056-70, 6097-6104	GA-4, 5	60,400	48,000	SOF	
	3	N	12	24-N	8-W	12-22-61	7215-KB	6167						D & A				
State	1-16	M	16	24-N	7-W	2-1-60	7273-KB	6345	6319	5-1/2	6350		6070-96	GA-4	31,600	35,000	SOF	
	2-16	L	16	24-N	7-W	10-60	7087-KB	6138		4-1/2	6140		5905-32	GA-4	18,000	18,000	SOF	
															30,000	30,000	SOF	
Stephenson	1-22	D	22	24-N	7-W	9-60	7151-KB	6022		4-1/2	6059	(1)	5972-6004 (BP)	GA-4	44,130	45,000	SOF	
												(2)	5782-5804, 5846-76	GA-1, 2	33,600	40,000	SOF	
Byrd	1-23	A	23	24-N	7-W	11-60	6745-KB	5648		4-1/2	5684	(1)	5562-5600	GA-4	38,876	59,000	SWF	
												(2)	5386-5408, 5444-74	GA-1, 2	39,522	60,000	SWF	
	5-23	O	23	24-N	7-W	9-6-61	6693-KB	5631		4-1/2	5630		5322-52, 5442-76	GA-2, 4	42,850	60,000	SOF	
Eastern																		
Federal	1-22	N	22	24-N	7-W	5-58	6789-KB	5645		5-1/2	5649		5560-90	GA-4	50,000	50,000	SOF	
Pan American																		
John S. Dashko	1	M	15	24-N	7-W	6-11-58	7090-KB	6021		5-1/2	6139	(1)	5936-66		9,232	4,000	SOF	
												(2)	5936-66 (Re-Perf.) 5977-91, 6005-15		50,000	50,000		
R. R. Zanotti	1	C	34	24-N	7-W	2-58	6937-KB	5743										

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TABLE I
WELL COMPLETION DATA
ESCRITO GALLUP FIELD
RIO ARRIBA COUNTY, NEW MEXICO

OPERATOR / LEASE	Well No.	Location Spot	Sec.	TWP	RNG	Completion Date	Elevation (Ft.)	Log TD (Ft.)	PBTD	Production Casing Size (In.)	Depth (Ft.)	Perforations Stage	Depth Interval (Ft.)	Zone	Treatment Gallons	Pounds	Type	Cored Interval
Val Reese																		
Blakely Federal	6-23	E	23	24-N	7-W	10-31-61	6761-KB	5694		4-1/2	5700	(2)	5598-5630	GA-6	42,700	40,000	SWF	5449-5509, 5586-5622
												(2)	5412-30, 5470-82	GA-1, 2	25,900	30,000	SWF	
Connie	1-21	I	21	24-N	7-W	7-4-59	6860-KB	5734		5-1/2	5732	(1)	5642-70, 5680-98	GA-1, 2	60,000	60,000	SOF	
												(2)	5450-74, 5516-48	GA-1, 2	36,628	33,000	SOF	
	2-21	D	21	24-N	7-W	4-27-60	7292-KB		6243	5-1/2	6241		6072-98	GA-4	28,770	22,500	SOF	
	4-28	B	28	24-N	7-W	4-1-61	6880-KB		5705	4-1/2	5712	(1)	5582-94, 5622-50, 5660-78	GA-3, 4 GA-5	66,000		SWF	
												(2)	5440-56, 5492-5522	GA-1, 2	50,000		SWF	
	5-21	G	21	24-N	7-W	3-2-61	7112-KB	5978		4-1/2	6000	(1)	5906-40	GA-4	45,053	35,000	SOF	
												(2)	5720-40, 5780-5810	GA-1, 2	28,170	42,000	SOF	
Goff	5	E	30	24-N	6-W	8-1-61	6943-KB	5830		4-1/2	5854		5586-5722, 5732-46 5764-74	GA-4 GA-4, 5	43,516		SWF	
Kenny Federal	3-23	K	23	24-N	7-W	7-14-61	6710-KB	5688		4-1/2	5682		5516-40	GA-4	24,600	30,000	SWF	
Love Federal	2-23	L	23	24-N	7-W	4-10-61	6726-KB	5628		4-1/2	5640	(1)	5526-58, 5568-88	GA-4, 5	49,260	60,000	SWF	
												(2)	5340-60, 5398-5428	GA-1, 2	43,294	60,000	SWF	
Mesa Federal	1-25	D	25	24-N	7-W	5-24-60	6721-KB	6555		5-1/2	6557	(1)	6264-77, 6286-92, 6352-60 6364-68, 6392-6400, 6416-36	Dakota (BP)	47,759	85,600	SWF	
												(2)	5442-70, 5484-92, 5502-06, 5514-24	GA-4, 5 GA-5, 6 (BP)	65,500	105,000	SWF	
												(3)	5274-94, 5326-32, 5338-50	GA-1, 2	64,436	80,000	SWF	
	2-25	I	25	24-N	7-W	4-30-61	6888-KB	5788		4-1/2	5868	(1)	5714-40, 5770-78, 5788-5800	GA-4, 5, 6	43,960	60,000	SWF	
												(2)	5544-66, 5596-5622	GA-1, 2	34,292	44,000	SWF	
Sperling Federal	1-30	I	30	24-N	6-W	12-5-59	6671-KB	6524			6524	(1)	6402-08, 6430-54	Dakota	54,894		SWF	
												(2)	5448-80	GA-4	61,530		SWF	
												(3)	5280-5316, 5364-58	GA-1, 2	51,660		SWF	
Ray Smith																		
Federal	1	I	13	24-N	8-W	8-13-63	7062-KB	5936						D & A				
	2	A	13	24-N	8-W	11-60	7100-KB	6016		4-1/2	6024		5926-34	GA-4	45,000	60,000	SOF	
Southern Union																		
Ernest Federal	1-27	D	27	24-N	7-W	2-58	6826-KB	5751		5-1/2	5747		5507-5601	GA-4	39,060	25,000	SOF	
Standard of Texas																		
Federal	1-3-21	C	21	24-N	7-W	2-61	7275-KB	6180		4-1/2	6188		6076-96	GA-4	50,000	50,000	SOF	
	2-3-21	H	21	24-N	7-W	8-61	7113-KB	6200		4-1/2	6196		5926-46	GA-4	45,000	62,500	SWF	
	1-1-27	O	27	24-N	7-W	6-10-57	7023-KB	6950		7	6941	(1)	5690-5765	GA-4, 5, 6			SOF	5512-63, 5603-49,
												(2)	5512-5650	GA-1, 2			SOF	5688-5704, 5718-65
	1-2-26	C	26	24-N	7-W	1-27-58	6735-KB	5639		5-1/2	5639		5464-80, 5688-98, 5522-26, 5536-40	GA-4 GA-5, 6	15,000 10,000 7,000 32,000		Oil Frac (Three Stages) Total	
	1-3-19	A	19	24-N	7-W	11-57	7291-KB	6200		5-1/2	6200		6054-80, 6090-6104	GA-4, 5	30,000	30,000	SOF	
	1-3-20	A	20	24-N	7-W	8-57	7346-KB	6269		7	6277	(1)	6126-43	GA-4	30,000	30,000	SOF	6105-15, 6115-66
												(2)	6113-21		15,000	15,000	SOF	6166-6217
												(3)	6128-43 (Re-Perf.)					
	1-4-26	G	26	24-N	7-W	9-57	6727-KB	6650		5-1/2	6625		6402-30	Dakota	12,200	12,000	SOF	5420-70, 5470-5520, 6241-90
	1-6-22	K	22	24-N	7-W	12-57	7068-KB	6018		5-1/2	6020	(1)	5855-76, 5881-89	GA-4	25,000	25,000	SOF	
												(2)	Re-Perf. as above					

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TABLE II

GEOLOGICAL DATA

ESCRITO GALLUP FIELD

RIO ARRIBA COUNTY, NEW MEXICO

OPERATOR / LEASE	Well No.	Location Spot	Sec.	TWP	RNG	Elevation Ft.-Datum	Log TD	Gallup Marker Log Depth (Ft.)	Gallup Marker Sea Level Datum (Ft.)	MAYRE ZONE — Electric Log Analysis: Gross Thickness (Ft. -Perm.>0.1 md.) Upper (Ft.)	Middle (Ft.)	Lower (Ft.)	Total (Ft.)	Net Thickness (Perm.>1.0 md.) (Ft.)	MAYRE ZONE — Core Analysis: Net Thickness Perm. 1.0 md.	Average Porosity (%)	Average Perm. (md.)	Connate Water Saturation (%)	Average Permeability* (md.)	Floodable Reservoir Capacity (md.-Ft.)
																				0
Marvin Abe	1	I	11	24	8	7195-KB	6120	6000	+ 1195	2	3	0	5	0						
Abe																			2.7	10.8
																			3.4	27.2
BCO																			64	320
Bigbee	1-16	O	16	24	7	7084-KB	5966	5876	+ 1208	0	5	4	9	4	8	13.0	1.30	18.1	100	1000
Bobby B	2-51	B	31	24	6	6745-KB	5612	5438	+ 1307	4	5	5	14	4	4	15.6	43.7	21.8	34	306
Coleen Federal	1-17	J	17	24	7	7301-KB	6207	6093	+ 1210	4	8	0	12	5					38	342
	2-17	L	17	24	7	7272-KB	6071	5955	+ 1217	1	10	0	11	10	9	13.5	33.8	22.9	15	150
Elizabeth Federal	1-18	H	18	24	7	7268-KB	7220	6074	+ 1194	3	13	0	16	9					100	1100
	2-18	C	18	24	7	7142-KB	6046	5933	+ 1208	0	11	0	11	9					5.3	10.6
	3-18	E	18	24	7	7104-KB	6022	5882	+ 1222	6	7	0	13	10					-	-
	4-18	G	18	24	7	7293-KB	6236	6059	+ 1204	0	12	0	12	11					42	294
	5-18	I	18	24	7	7172-KB	6112	5951	+ 1221	6	7	0	11	2					22	220
	4-7	P	7	24	7	7343-KB	7321	6177	+ 1166	0	7	0	9	0					52	520
Federal	2-7	M	7	24	7	7175-KB	6154	5956	+ 1209	0	0	0	8	7					18	108
	1-17	P	17	24	7	7313-KB	7239	6078	+ 1237	1	7	0	16	10					2	4
Judy Federal	2-17	K	17	24	7	7234-KB	6105	5987	+ 1247	5	11	0	16	10					6.0	42
	2-22	I	22	24	7	6760-KB	5669	5527	+ 1233	4	12	0	16	6					3.4	20.4
Lybrook	4-22	I	22	24	7	6772-KB	5651	5531	+ 1241	2	4	4	10	2					100	1100
	6-22	G	22	24	7	6816-KB	5790	5602	+ 1214	4	7	0	11	7	7	12.2	3.58	21.2	25	175
	7-27	A	27	24	7	6941-KB	5790	5668	+ 1273	4	8	2	14	6					-	-
	1	P	12	24	8	7256-KB	6165	6066	+ 1190	0	13	0	13	11					42	378
Nancy Federal	2	O	12	24	8	7204-KB	6143	6017	+ 1187	0	9	0	9	7					2.4	6.8
	3	N	12	24	8	7215-KB	6167	6019	+ 1196	1	2	0	3	0					4.8	14.4
	1-16	M	16	24	7	7273-KB	6345	6031	+ 1242	4	9	0	13	9					-	-
State	2-16	L	16	24	7	7087-KB	6248	5868	+ 1219	1	3	4	8	2					3.4	17
	1-22	D	22	24	7	7151-KB	6062	5938	+ 1213	2	5	0	7	3						
Stephenson	1-23	A	23	24	7	6745-KB	5648	5533	+ 1212	4	3	0	7	0						
Byrd	5-23	O	23	24	7	6693-KB	5631	5410	+ 1283	5	5		8	5					8.4	25.2
Eastern Federal	1-22	N	22	24	7	6789-KB	5645	5523	+ 1264	4	9	1	14	3					3.0	?
																			-	-
Pan American	1	M	15	24	7	7090-KB	6021	5902	+ 1188	3	5	0	8	3						
John S. Dashko	1	C	36	24	7	6937-KB	5745	5565	+ 1372	2	2	0	4	0						
R. R. Zanotti																			1.4	5.6
															4	12.4	9.0	25.0	2.4	7.2
																			52	364
Val Reese																			10.0	50
Blakely Federal	6-23	E	23	24	7	6761-KB	5691	5565	+ 1196	6	10	0	16	1					-	-
Connie	1-21	I	21	24	7	6860-KB	5734	5604	+ 1256	2	4	2	8	3					6.6	46.2
	2-21	D	21	24	7	7292-KB	6243	6039	+ 1258	3	8	0	11	7					15	120
	5-21	G	21	24	7	7112-KB	5978	5870	+ 1242	2	7	3	12	5					6.6	52.8
	4-28	B	28	24	7	6890-KB	5705	5582	+ 1298	1	3	1	7	0					16	64
	5	E	30	24	6	6943-KB	5830	5651	+ 1292	2	10	4	16	7					6.0	24
Goff	3-23	K	23	24	7	6710-KB	5688	5473	+ 1237	2	4	0	10	8					1.9	1.9
Kenney Federal	2-23	L	23	24	7	6726-KB	5628	5493	+ 1236	4	8	0	12	6						
Love Federal	1-25	D	25	24	7	6721-KB	6555	5408	+ 1312	2	6	0	9	4						
Mesa Federal	2-25	I	25	24	7	6888-KB	5788	5676	+ 1212	2	7	8	12	1	1	9.0	1.7	38.9	18	72
	1-30	I	30	24	6	6671-KB	5524	5414	+ 1267	4	3								58	348
Sperling Federal																				
Ray Smith	1	I	13	24	8	7062-KB	5936	5776	+ 1286	4	0	0	4	4						
Federal	2	A	13	24	8	7100-KB	6016	5879	+ 1221	3	9	0	12	6					6.2	12.6
Federal																				
Southern Union										3	9	3	15	3					25	250
Ernst Federal	1	D	27	24	7	6826-KB	5751	5542	+ 1284										33	330
																			.24	8
Standard of Texas																			4.8	19.2
Federal 3-24	1	C	21	24	7	7275-KB	6181	6036	+ 1239	2	12	0	14	10					5.5	10.8
Federal 3-21	2	H	21	24	7	7113-KB	6200	5884	+ 1229	2	10	0	12	10					3.0	3.0
Federal 1-27	1	O	27	24	7	7023-KB	6950	5653	+ 1370	2	3	2	7	0					1.9	1.9
Federal 2-26	1	C	26	24	7	6735-KB	5639	5428	+ 1307	1	4	3	8	4					3.8	15.2
Federal 3-19	1	A	19	24	7	7291-KB	6200	6013	+ 1278	1	5	2	8	2	1	12.1	-	25.6		
Federal 3-20	1	A	20	24	7	7346-KB	6269	6077	+ 1269	5	9	2	16	1	1	13.7	1.0	35.0		
Federal 4-26	1	G	26	24	7	6727-KB	6650	5381	+ 1346	3	6	5	12	1	4					
Federal 4-22	1	K	22	24	7	7068-KB	6018	5819	+ 1249	1	8	5	14	4					0	0
Compass Federal	1	F	8	24	7	7324-KB	7325	6226	+ 1098	0	0	0	0	0						
																			9.4	37.6
Val Reese										-	-	-	8	4					3.8	15.2
Zamora	1	C	29	24	6	6629-KB	5579	5425	+ 1203	-	-	-	6	4					10.5	42.0
Largo Spur	1-A	I	14	24	7	6860-KB	5849	5742	+ 1118	-	-	-	9	4					6.0	
Miller	1-A	A	13	24	7	6933-KB	6896	5820	+ 1113	-	-	-	8							
Lybrook	1	C	19	24	6	6644-KB	6634	5455	+ 1183											

* Weighted average permeability from correlation.

TABLE II

TABLE III

PRODUCTION HISTORY
ESCRITO GALLUP FIELD
RIO ARRIBA COUNTY, NEW MEXICO

		AREA I								AREA II									
		Well Group A		Well Group B		Well Group C		Total Area I		Well Group D		Well Group E		Well Group F		Total Area II		Field Total	
Date		Oil (Bbls.)	Gas (MSCF)	Oil (Bbls.)	Gas (MSCF)	Oil (Bbls.)	Gas (MSCF)	Oil (Bbls.)	Gas (MSCF)	Oil (Bbls.)	Gas (MSCF)	Oil (Bbls.)	Gas (MSCF)	Oil (Bbls.)	Gas (MSCF)	Oil (Bbls.)	Gas (MSCF)	Oil (Bbls.)	Gas (MSCF)
	1957			2,529				2,529										2,529	
	1958	3,582		10,973				14,555		21,916						21,916		36,471	
	1959	10,508	20,499	10,897	15,177	2,268	11,160	23,673	46,836	19,044	24,570					19,044	24,570	42,717	71,406
	1960	55,617	56,796	84,975	27,615	1,961	6,248	142,553	90,659	15,550	25,847			573	851	16,123	26,698	158,676	117,357
	1961	283,565	456,005	104,304	171,281	1,505	3,879	389,374	631,165	9,604	21,297	38,107	91,060	83,076	258,866	130,787	371,223	520,161	1,002,388
	1962	143,465	870,308	27,203	191,434	634	1,956	171,302	1,063,698	8,993	50,686	28,081	140,416	62,453	316,269	99,527	507,371	270,829	1,571,069
Jan.	1963	3,845	30,916	834	7,973	1	163	4,680	39,052	723	2,791	1,992	6,557	3,903	22,535	6,618	31,883	11,298	70,935
Feb.		4,432	32,013	629	4,200	15	163	5,076	36,376	627	2,779	1,780	6,081	3,586	19,408	5,993	28,268	11,069	64,644
March		4,380	32,638	1,015	5,700	23	163	5,418	38,501	567	3,035	1,808	9,205	4,239	27,779	6,614	40,019	12,032	78,520
April		4,114	31,579	686	3,253	70	163	4,870	34,995	800	4,004	1,805	8,666	3,885	25,903	6,490	38,571	11,360	73,566
May		4,455	33,988	697	3,135	56	163	5,208	37,286	736	3,824	2,086	8,159	4,064	26,399	6,886	38,382	12,094	75,668
June		4,497	32,173	567	2,318	94	163	5,158	34,654	626	3,194	2,199	12,634	3,742	23,459	6,567	39,287	11,725	73,941
July		4,570	39,410	479	1,380	81	163	5,130	40,953	589	2,902	1,508	7,538	3,964	19,469	6,061	29,909	11,191	70,862
August		4,918	38,384	378	5,737	3	163	5,299	44,284	630	3,296	1,086	7,169	3,861	24,652	5,577	35,116	10,876	79,400
Sept.		6,684	45,486	140	3,259	20	163	6,844	48,908	552	1,615	1,524	8,351	3,473	23,526	5,549	33,492	12,393	82,400
Oct.		6,932	51,487	139	2,277	33	163	7,104	53,927	852	2,622	1,468	7,161	3,656	22,123	5,976	31,906	13,080	85,833
Nov.		5,147	46,523	165	2,138	-	163	5,312	48,824	636	1,803	1,413	6,151	3,578	20,730	5,627	28,684	10,939	77,508
Dec.		5,005	33,949	158	1,272	-	-	5,163	35,221	306	834	1,545	7,218	3,263	19,066	5,114	27,118	10,277	62,339
Total	1963	58,979	448,546	5,887	42,643	396	1,793	65,262	492,982	7,644	32,699	20,214	94,889	45,214	275,047	73,072	402,635	138,334	895,617
Grand Total		555,716	1,852,154	246,768	448,150	6,764	25,036	809,248	2,325,340	82,751	155,099	86,402	326,365	191,316	851,033	360,469	1,332,497	1,169,717	3,657,837

TABLE III

LIST OF WELLS BY GROUP

AREA I

Well Group A		Well Group B		Well Group C	
Operator Lease	Well No.	Operator Lease	Well No.	Operator Lease	Well No.
BCO		BCO		Pan American	
Coleen	1-17	Bigbee	1-16	John S Dashko	1-15
	2-17	Elizabeth	5-18		
Elizabeth	1-18	Federal	2-7		
	2-18	Judy	1-17		
	3-18		2-17		
	4-18	State	1-16		
Nancy	1-12		2-16		
	2-12				
Stephenson	1-22	Val Reese			
		Connie	2-21		
Val Reese					
Connie	1-21	Standard of Texas			
	5-21	Federal	1-3-20		
Ray Smith					
Federal	2-13				
Standard of Texas					
Federal	1-3-19				
	1-3-21				
	2-3-21				

AREA II

Well Group D		Well Group E		Well Group F	
Operator Lease	Well No.	Operator Lease	Well No.	Operator Lease	Well No.
Eastern		BCO		BCO	
Federal	1-22	Lybrook	7-27	Byrd	5-23
				Lybrock	2-22
Southern Union		Val Reese			4-22
Ernest	1-27	Kenny	3-23		6-22
		Love	2-23		
Standard of Texas				Val Reese	
Federal	1-6-22			Blakely	6-23

TABLE IV
FUTURE PRIMARY PERFORMANCE
ESCRITO GALLUP FIELD
Rio Arriba County, New Mexico

	AREA I		AREA II								TOTAL FIELD	
	Total (15 wells)		Group D (2 wells)*		Group E (3 wells)		Group F (5 wells)		Area II Total			
Year	Oil (Bbls.)	Gas (MSCF)	Oil (Bbls.)	Gas (MSCF)	Oil (Bbls.)	Gas (MSCF)	Oil (Bbls.)	Gas (MSCF)	Oil (Bbls.)	Gas (MSCF)	Oil (Bbls.)	Gas (MSCF)
Cumulative to 1-1-64	809,248	2,325,340	82,751	155,099	86,402	326,365	191,316	851,033	360,469	1,332,497	1,169,717	3,657,837
1964	47,400	356,000	6,700	17,420	13,100	65,500	35,400	178,120	55,200	261,040	102,600	617,040
1965	19,200	144,000	5,500	14,300	9,000	45,000	28,600	146,400	43,100	205,700	62,300	349,700
1966			5,000	13,000	7,000	35,000	23,900	125,050	35,900	173,100	35,900	173,100
1967			4,500	11,700	5,000	25,000	19,500	103,700	29,000	140,400	29,000	140,400
1968			4,000	10,400	4,000	20,000	15,400	82,350	23,400	112,800	23,400	112,800
1969			4,000	10,400			13,400	73,200	17,400	98,600	17,400	98,600
1970			3,500	9,100			10,600	57,950	14,100	77,100	14,100	77,100
1971			3,000	7,800			8,800	48,800	11,800	61,600	11,800	61,600
1972			3,000	7,800			7,100	39,650	10,100	52,500	10,100	52,500
1973			3,000	7,800					3,000	40,800	3,000	40,800
1974			2,500	6,500					2,500	34,000	2,500	34,000
1975			2,500	6,500					2,500	30,900	2,500	30,900
1976			2,500	6,500					2,500	27,900	2,500	27,900
Total Future Reserve	66,600	500,000	49,700	129,220	38,100	190,500	162,700	855,220	250,500	1,316,440	317,100	1,816,440
Ultimate Reserve	875,848	2,825,340	132,451	284,319	124,502	516,865	354,016	1,706,253	610,969	2,648,937	1,486,817	5,474,277

* No future primary reserves assigned to Standard-Federal 1-6-22

TABLE IV

TABLE V

SUMMARY OF RESERVOIR PROPERTIES
AND OIL RESERVES
ESCRITO GALLUP FIELD

Rio Arriba County, New Mexico

As of January 1, 1964

Mayre Zone	Area I	Area II	Total Field
Initial Reservoir Pressure, psig	1842	1842	1842
Reservoir Temperature, °F	155	155	155
Oil Formation Volume Factor, vol/vol	1.349	1.349	1.349
Initial Oil Viscosity, cp	0.53	0.53	0.53
Average Porosity, per cent	12.7	12.7	12.7
Average Water Saturation, per cent	25.0	30.0	26.2
Effective Capacity Range, md-ft	3 to 1100	1 to 120	1 to 1100
Average Capacity, md-ft	276	38	203
Net Reservoir Volume, acre-feet	14,569	4,988	19,557
Initial Oil in Place, STB	8,000,000	2,550,000	10,550,000
Theoretical Efficiency - Primary Oil, per cent	11.0	12.0	11.24
Ultimate Theoretical Primary Reserves, STB	880,000	306,000	1,186,000
Production Summary - (Includes All Producing Zones)			
Number of Oil Wells	25	11	36
Productive Surface Acres	2420	1280	3700
Well Density - Acres per well	96.8	116.4	102.8
Cumulative Production, STB	809,248	360,469	1,169,717
Remaining Primary Oil Reserves, STB	66,600	250,500	317,100
Ultimate Primary Oil Recovery, STB	875,848	610,969	1,486,817
Cumulative Production per well, STB	32,370	32,770	32,492
Ultimate Primary Production per well, STB	35,003	55,543	41,300
Ultimate Primary Production per acre	362	477	402

TABLE V

TABLE VI
CASH FLOW SCHEDULE FOR AREA I
PRIMARY DEPLETION OPERATIONS
ESCRITO GALLUP FIELD
Rio Arriba County, New Mexico
January 1, 1964

Project life, months	19
Oil Production, MBbls.	66.6
Gas sales, MMCF (1)	462
Gross oil revenue to working interest, M$ (2)	111.3
Gross gas revenue to working interest, M$ (3)	40.2
Total gross working interest revenue, M$	151.5
Operating expenses, M$ (4)	114.0
Operating income, M$	37.5
Capital investment, M$	0.0
Cash flow, M$	37.5
Present worth at 6%, M$	35.9
Present worth at 12%, M$	34.4
Present worth at 18%, M$	33.2
Present worth at 30%, M$	31.0

(1) Estimated lease gas usage at 2 MMCF/month

(2) Gross price, 38° API oil = $2.71/Bbl.
Working interest = 75%
State and local taxes = 6.71415%
Transportation charges = $0.30/Bbl.
Working interest revenue after taxes and transportation = $1.671/Bbl.

(3) Average gas price after compression = $0.135/MCF, including liquids.
Compression costs = $0.01/MCF
State and local taxes = 6.71415%
Working interest revenue after compression and taxes = $0.08%/MCF

(4) Operating expense = $305/well/mo. + $95/well/mo. additional compression charge.

TABLE VII

TABLE VII
CASH FLOW SCHEDULE FOR AREA I
WATER INJECTION OPERATIONS BEGINNING OCTOBER 1, 1964
ESCRITO GALLUP FIELD
RIO ARRIBA COUNTY, NEW MEXICO
January 1, 1964

Year	Oil Production (MBbls)	Gas Sales[1] (MMCF)	Water Production (MBbls)	Gross Oil Revenue to W. I.[2] (M$)	Gross Gas Value to W. I.[3] (M$)	Total Gross W. I. Revenue (M$)	Expenses[4] Wells (M$)	Plant and Water Handling (M$)	Additional Fuel (M$)	Total (M$)	Operating Income (M$)	Capital Investment[5] (M$)	Cash Flow (M$)	Cumulative Cash Flow (M$)	Present Worth (M$) at 6 per cent (M$)	at 12 per cent (M$)	at 18 per cent (M$)	at 30 per cent (M$)
1964	27.9	164.3	0.0	46.6	14.3	60.9	54.0	8.2	0.0	62.2	(1.3)	265.0	(266.3)	(266.3)	(258.6)	(251.6)	(245.2)	(233.6)
1965	30.3	191.0	3.5	50.6	16.6	67.2	96.0	32.9	0.0	128.9	(61.7)	0.0	(61.7)	(328.0	(56.5)	(52.0)	(48.1)	(41.6)
1966	76.5	123.0	29.6	127.8	10.7	138.5	120.0	32.9	0.0	152.9	(14.4)	65.0	(79.4)	(407.4)	(68.6)	(59.8)	(52.5)	(41.2)
1967	315.0	0.0*	226.2	526.4	0.0	526.4	91.5	32.9	0.0	124.4	402.0	0.0	402.0	(5.4)	327.8	270.4	225.2	160.5
1968	440.1	0.0	531.6	735.4	0.0	735.4	91.5	32.9	0.0	124.4	611.0	0.0	611.0	605.6	470.1	366.9	290.1	187.6
1969	218.7	0.0	795.2	365.4	0.0	365.4	65.9	32.9	4.0	102.8	262.6	0.0	262.6	868.2	190.6	140.8	105.7	62.0
1970	52.5	0.0	1,114.6	87.7	0.0	87.7	36.0	10.0	6.0	52.6	35.1	0.0	35.1	903.3	24.0	16.8	12.0	6.4
Totals	1,161.0	478.3	2,703.7	1,939.9	41.6	1,981.5	555.5	182.7	10.0	748.2	1,233.3	330.0	903.3		628.8	431.5	287.2	100.1

1. Estimated lease gas usage at 50 MMCF/year during waterflooding. *Gas sales no longer economical.

2. Net oil price = $2.71/Bbl for 38° API oil less $0.30/Bbl Transportation costs = $2.41/Bbl.
   Working interest = 75.0 %; state and local taxes = 6.71415 %
   Working interest revenue after taxes and transportation % $1.671/Gross Bbl produced.

3. Average gas price after compression = $0.135/MCF, including liquids
   Compression costs = $0.01/MCF; state and local taxes = 6.71415%
   Working interest revenue after compression and taxes = $0.0870/MCF

4. Operating expense = $305/well/month + $95/well/month additional compression charge during gas sales;
   injection plant and water handling @ $0.03/Bbl. injected.

5. Capital investment - 1964: Drill and equip one injection well: $ 65,000
   Convert 2 producers to injectors 15,000
   Develop water supply 50,000
   Water plant and lines 135,000
   $265,000

   1966: Additional lift equipment 5 wells = $65,000

TABLE VIII

COMPARISON OF CASES FOR AREA I

ESCRITO GALLUP FIELD

Rio Arriba County, New Mexico

January 1, 1964

	Primary Depletion	Waterflood Operations	Incremental
PROJECTED AFTER JANUARY 1, 1964			
Project life, years	1.6	7.0	5.4
Oil production, MBbls.	66.6	1161.0	1094.4
Sales gas, MMCF	462.0	478.3	16.3
Gross working interest income, M$	151.5	1981.5	1830.0
Operating expense, M$	144.0	748.2	634.2
Operating income, M$	37.5	1233.3	1195.8
Capital investment, M$	0.0	330.0	330.0
Total cash flow, M$	37.5	903.3	865.8
Present worth at 6 per cent, M$	35.9	628.8	592.9
Present worth at 12 per cent, M$	34.4	431.5	397.1
Present worth at 18 per cent, M$	33.2	287.2	254.0
Present worth at 30 per cent, M$	31.0	101.1	70.1
ECONOMIC YARDSTICKS			
Payout time, years		4.0	4.1
Ratio of operating income to investment		3.7	3.6
Ratio of cash flow to investment		2.7	2.6
Ratio of 6 per cent present worth to investment, M$		1.9	1.8
Recovery costs, $/barrel		0.93	0.88
Average Annual Rate of Return, per cent			34

FIGURES

LIST OF FIGURES

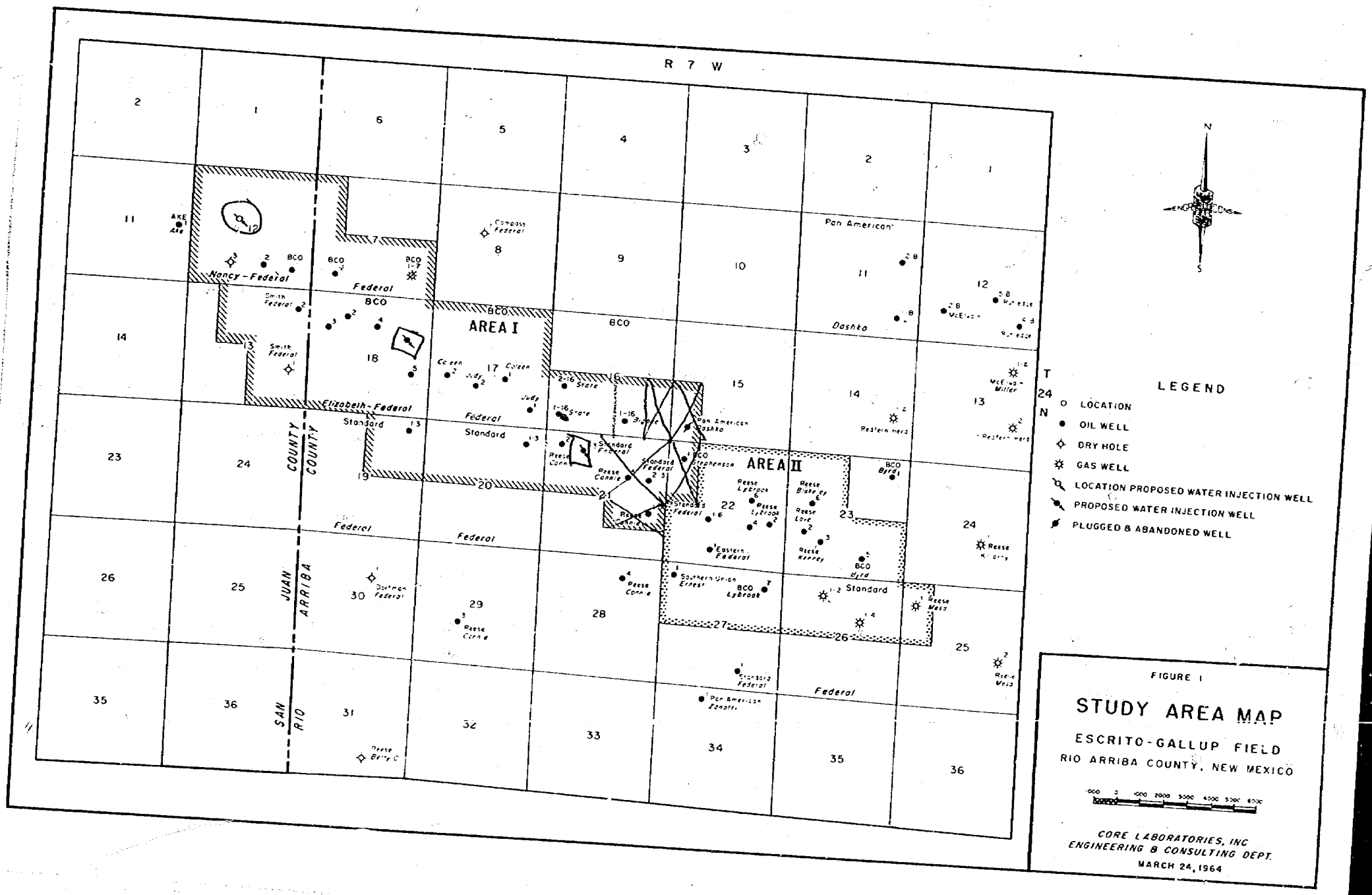


FIGURE 1

STUDY AREA MAP

ESCRITO-GALLUP FIELD

RIO ARRIBA COUNTY, NEW MEXICO

CORE LABORATORIES, INC
ENGINEERING & CONSULTING DEPT.
MARCH 24, 1964

FIGURE 2

TYPE SECTION
UPPER CRETACEOUS PERIOD
ESCRITO GALLUP FIELD
RIO ARRIBA COUNTY
NEW MEXICO

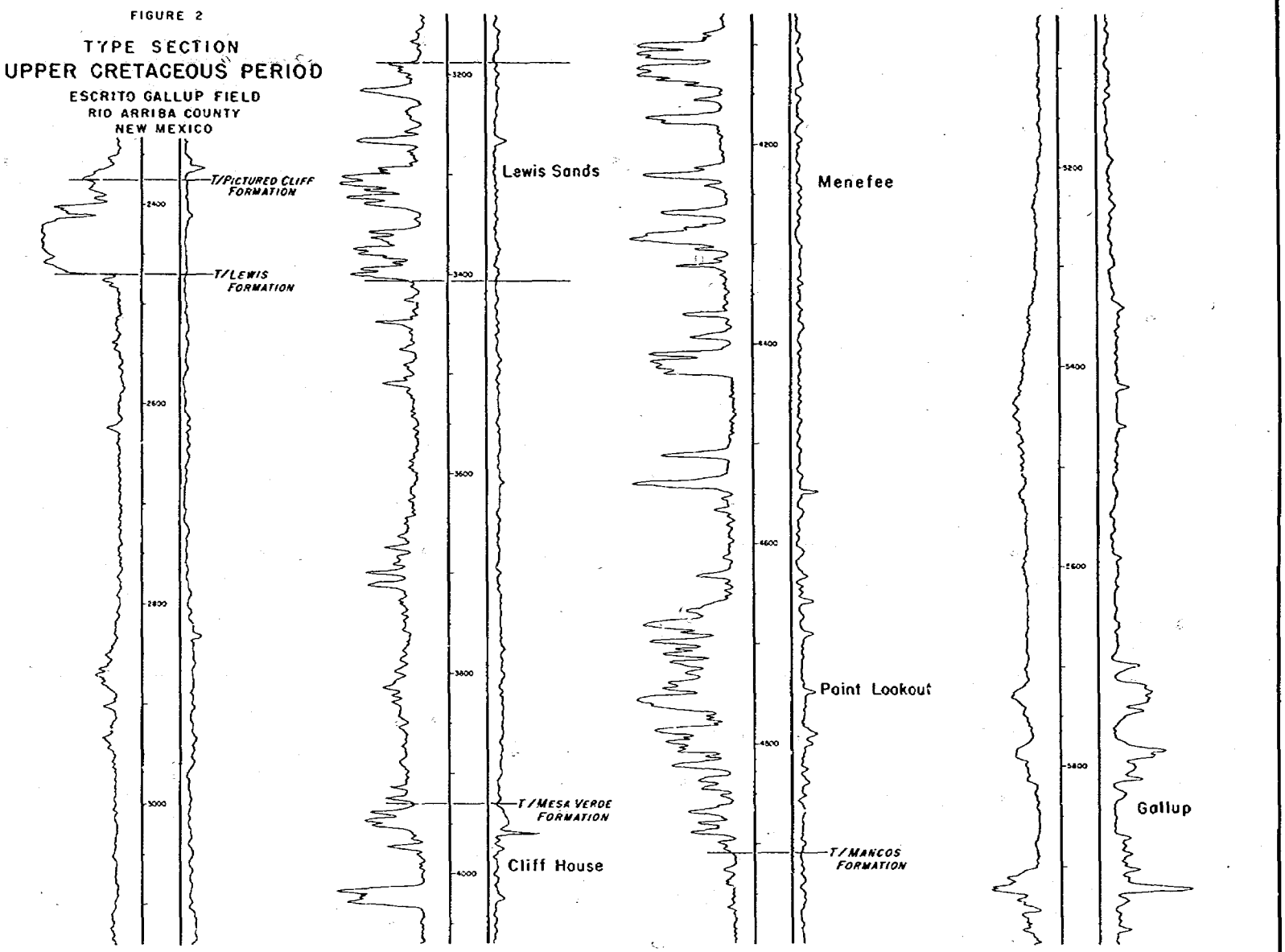


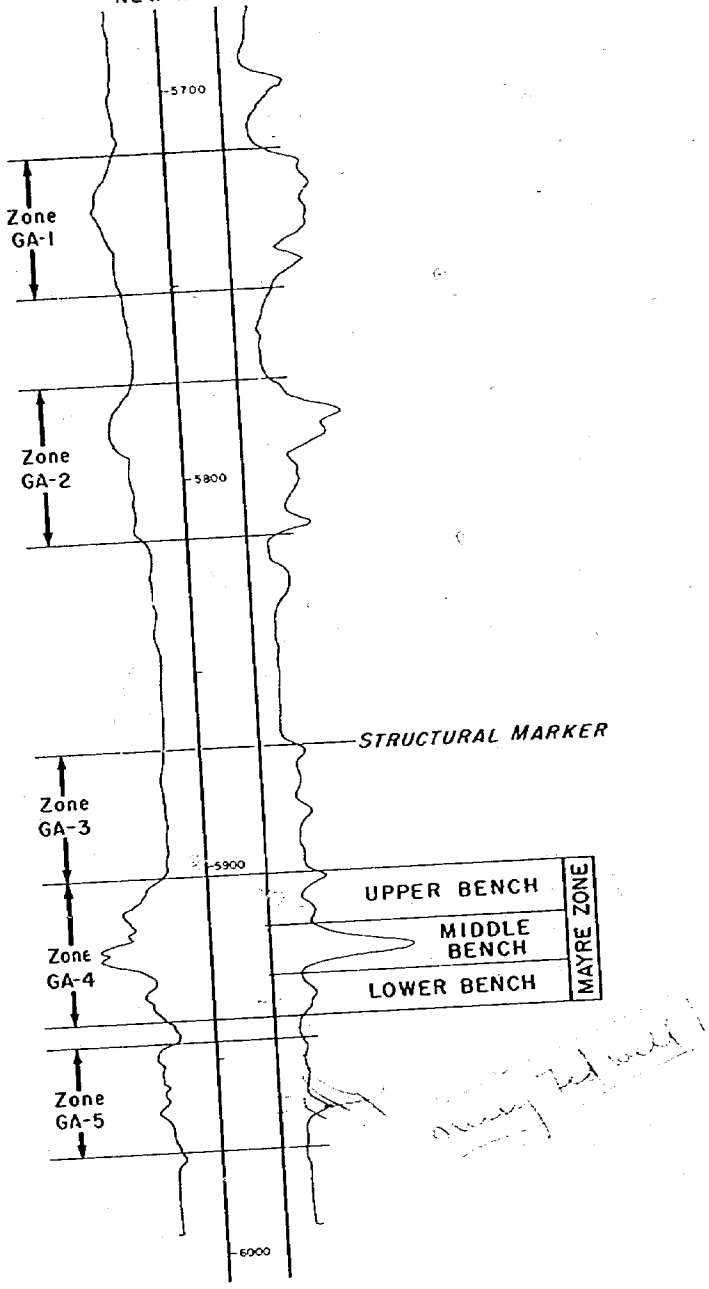
FIGURE 3

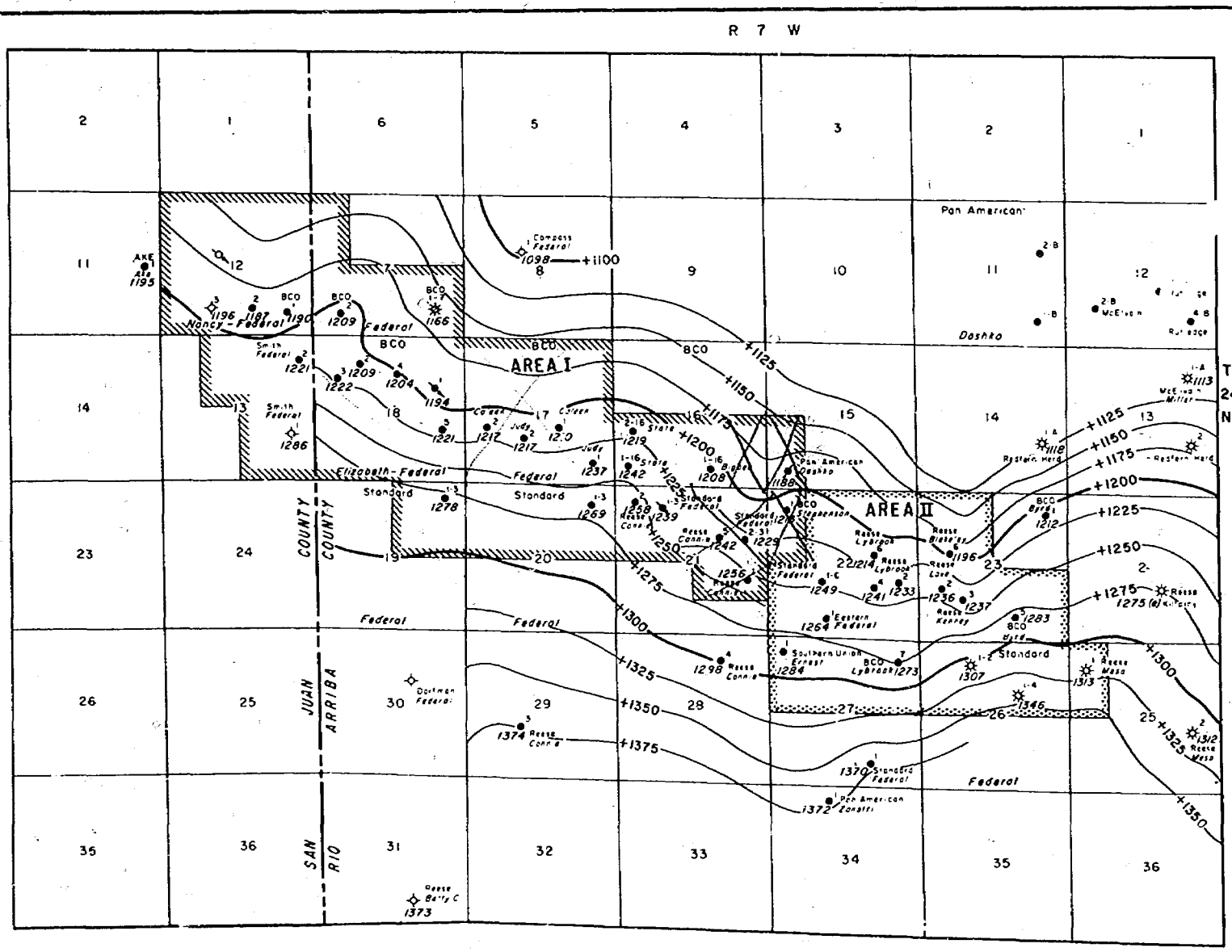
TYPE SECTION

GALLUP MEMBER

MANCOS FORMATION

ESCRITO GALLUP FIELD
RIO ARRIBA COUNTY
NEW MEXICO





LEGEND

- LOCATION
- OIL WELL
- DRY HOLE
- GAS WELL
- LOCATION PROPOSED WATER INJECTION WELL
- PROPOSED WATER INJECTION WELL
- PLUGGED & ABANDONED WELL

FIGURE 4

STRUCTURE MAP
LOWER GALLUP MARKER
ESCRITO-GALLUP FIELD

RIO ARRIBA COUNTY, NEW MEXICO

CONTOUR INTERVAL: 25 FEET

-1000 0 1000 2000 3000 4000 5000 6000

CORE LABORATORIES, INC
ENGINEERING & CONSULTING DEPT.

MARCH 24, 1964

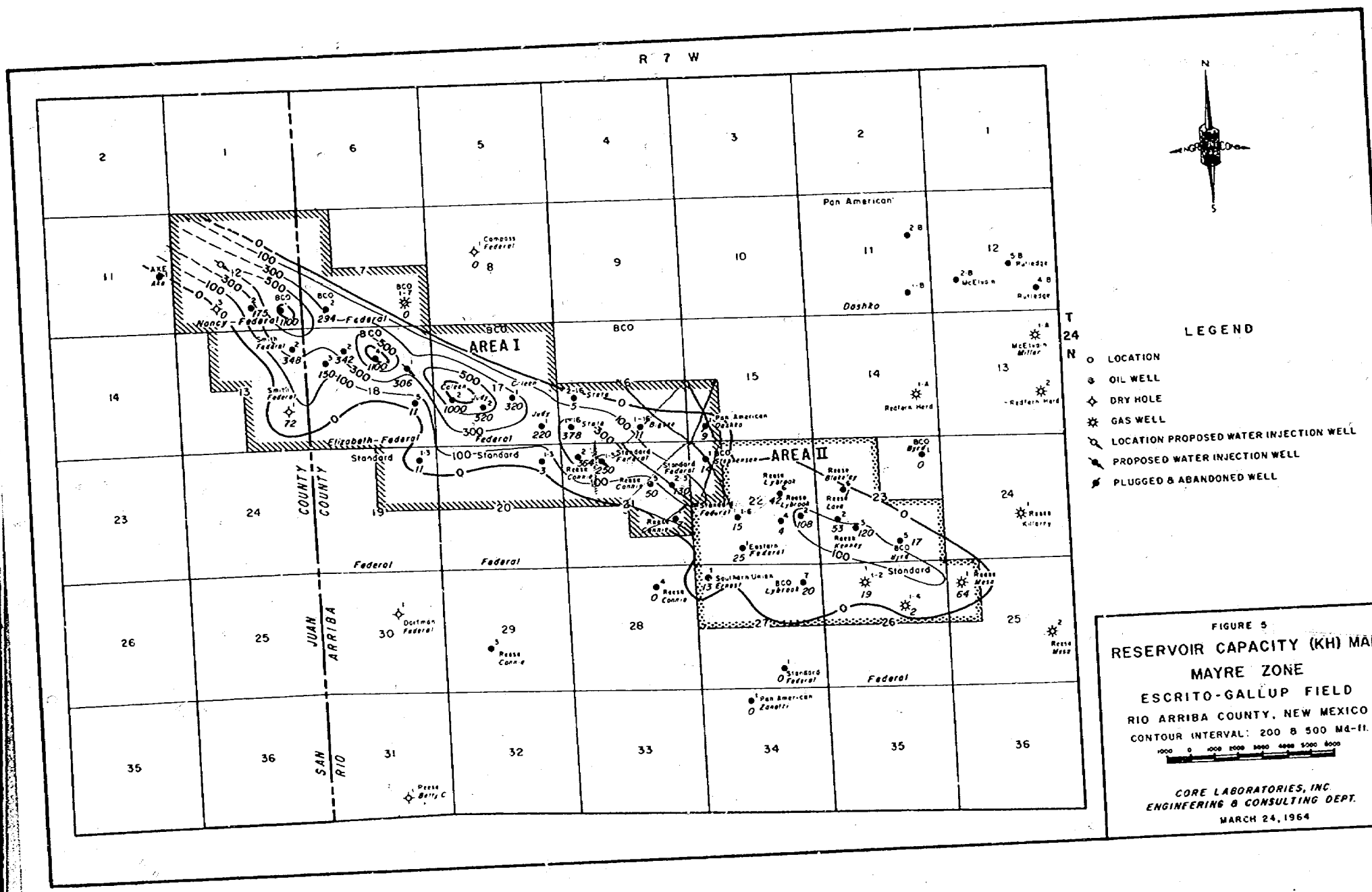


FIGURE 5

RESERVOIR CAPACITY (KH) MAP

MAYRE ZONE

ESCRITO-GALLUP FIELD

RIO ARRIBA COUNTY, NEW MEXICO

CONTOUR INTERVAL: 200 & 500 Md-ft.

1000 0 1000 2000 3000 4000 5000 6000

CORE LABORATORIES, INC.
ENGINEERING & CONSULTING DEPT.
MARCH 24, 1964

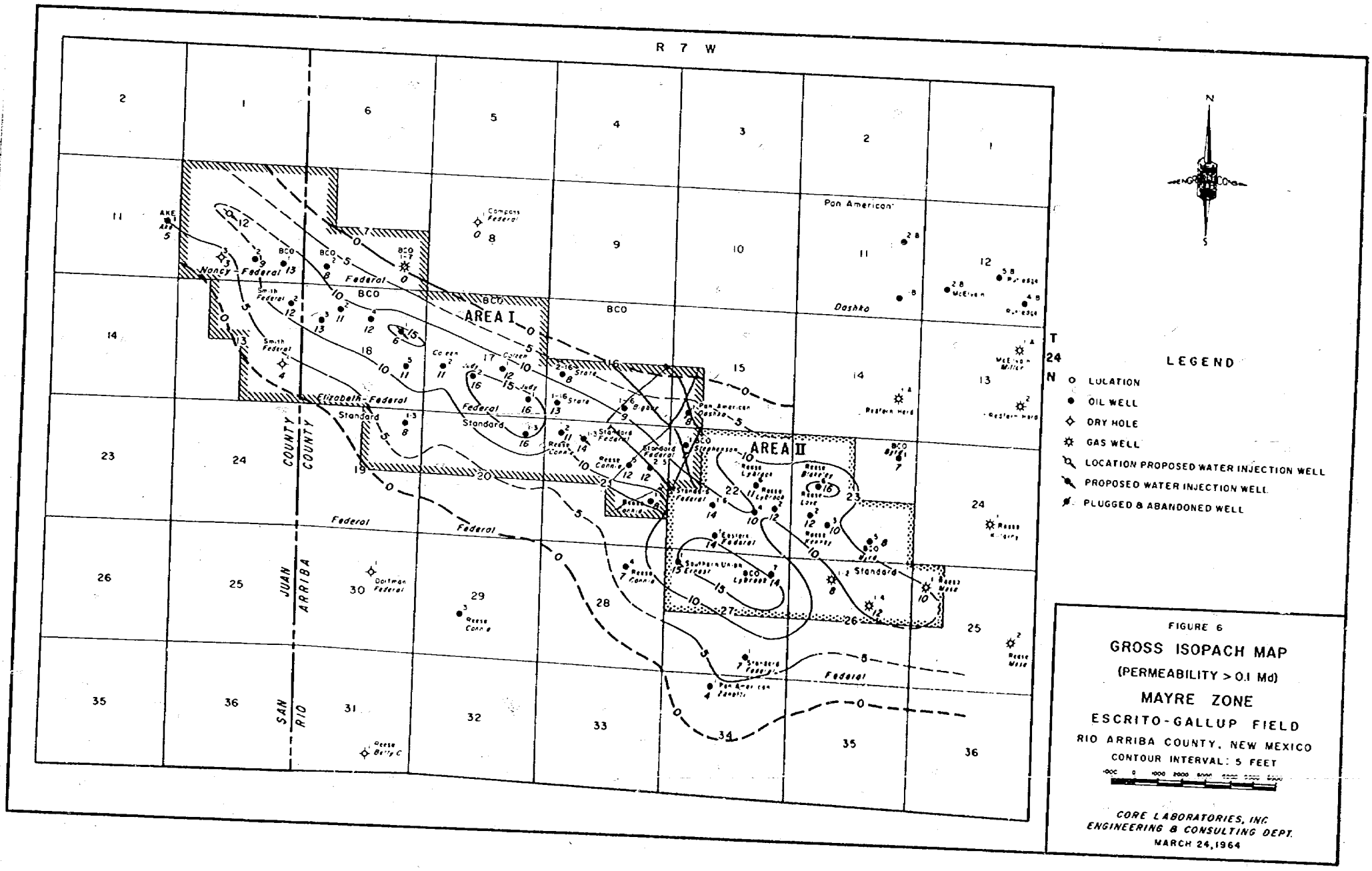


FIGURE 6

GROSS ISOPACH MAP

(PERMEABILITY > 0.1 Md)

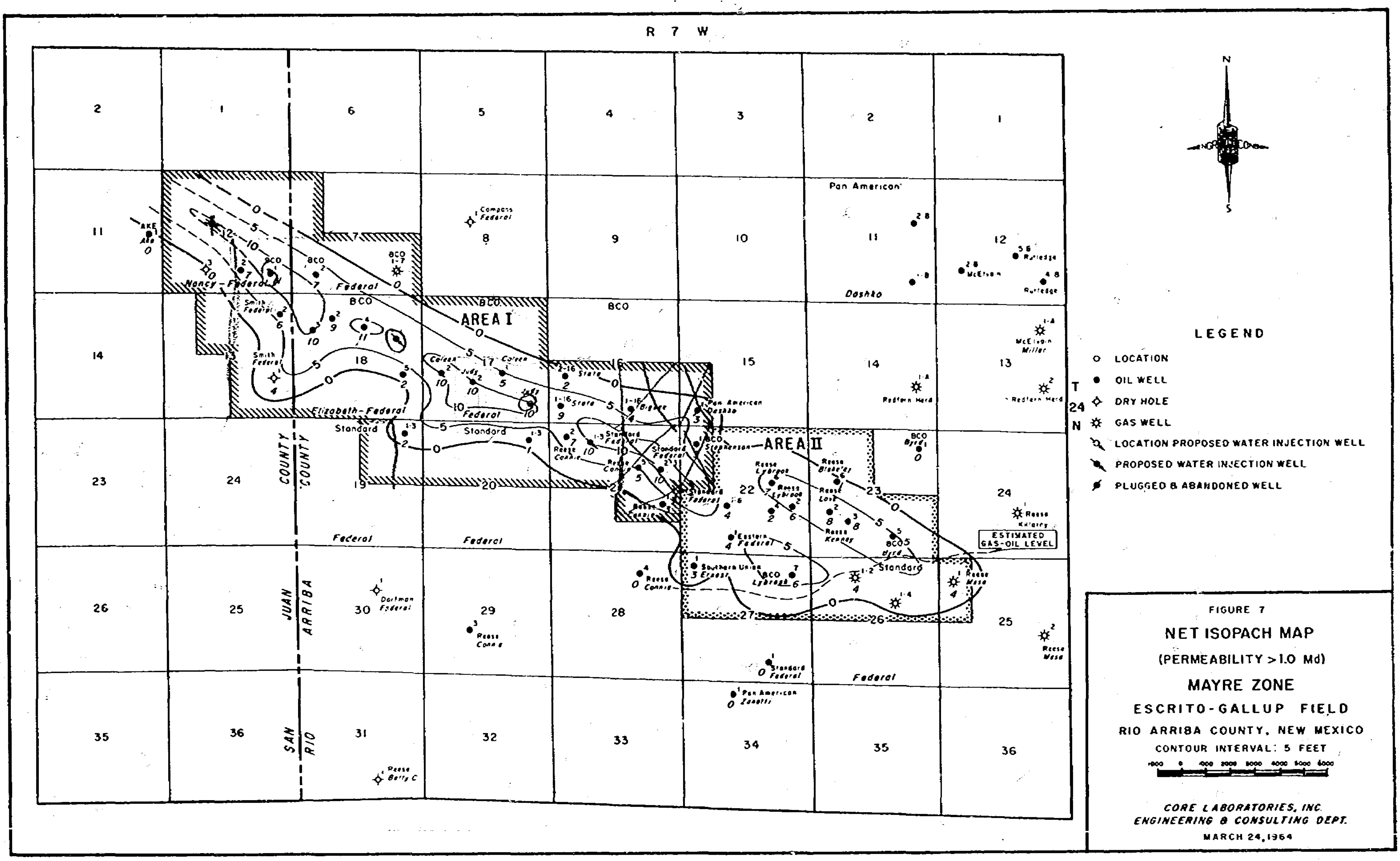
MAYRE ZONE

ESCRITO-GALLUP FIELD

RIO ARRIBA COUNTY, NEW MEXICO

CONTOUR INTERVAL: 5 FEET

CORE LABORATORIES, INC.
ENGINEERING & CONSULTING DEPT.
MARCH 24, 1964


R 7 W
T 24 N
AREA I
AREA II
COUNTY
COUNTY
SAN JUAN
RIO ARRIBA
Federal
Standard
ESTIMATED GAS-OIL LEVEL
LEGEND
LOCATION
OIL WELL
DRY HOLE
GAS WELL
LOCATION PROPOSED WATER INJECTION WELL
PROPOSED WATER INJECTION WELL
PLUGGED & ABANDONED WELL
FIGURE 7
NET ISOPACH MAP
(PERMEABILITY >1.0 Md)
MAYRE ZONE
ESCRITO-GALLUP FIELD
RIO ARRIBA COUNTY, NEW MEXICO
CONTOUR INTERVAL: 5 FEET
CORE LABORATORIES, INC.
ENGINEERING & CONSULTING DEPT.
MARCH 24, 1964

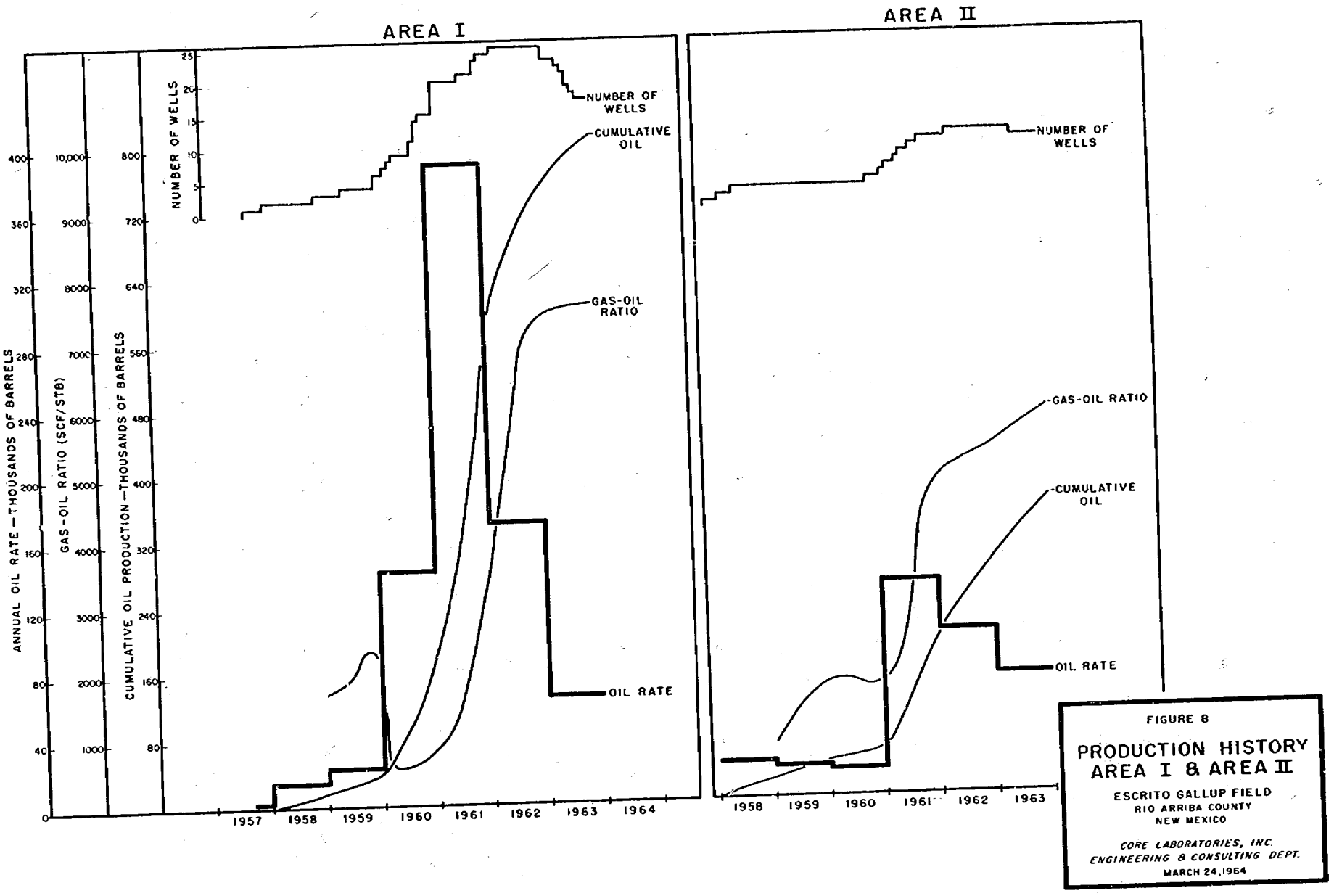


FIGURE 8

PRODUCTION HISTORY
AREA I & AREA II

ESCRITO GALLUP FIELD
RIO ARRIBA COUNTY
NEW MEXICO

CORE LABORATORIES, INC.
ENGINEERING & CONSULTING DEPT.
MARCH 24, 1964

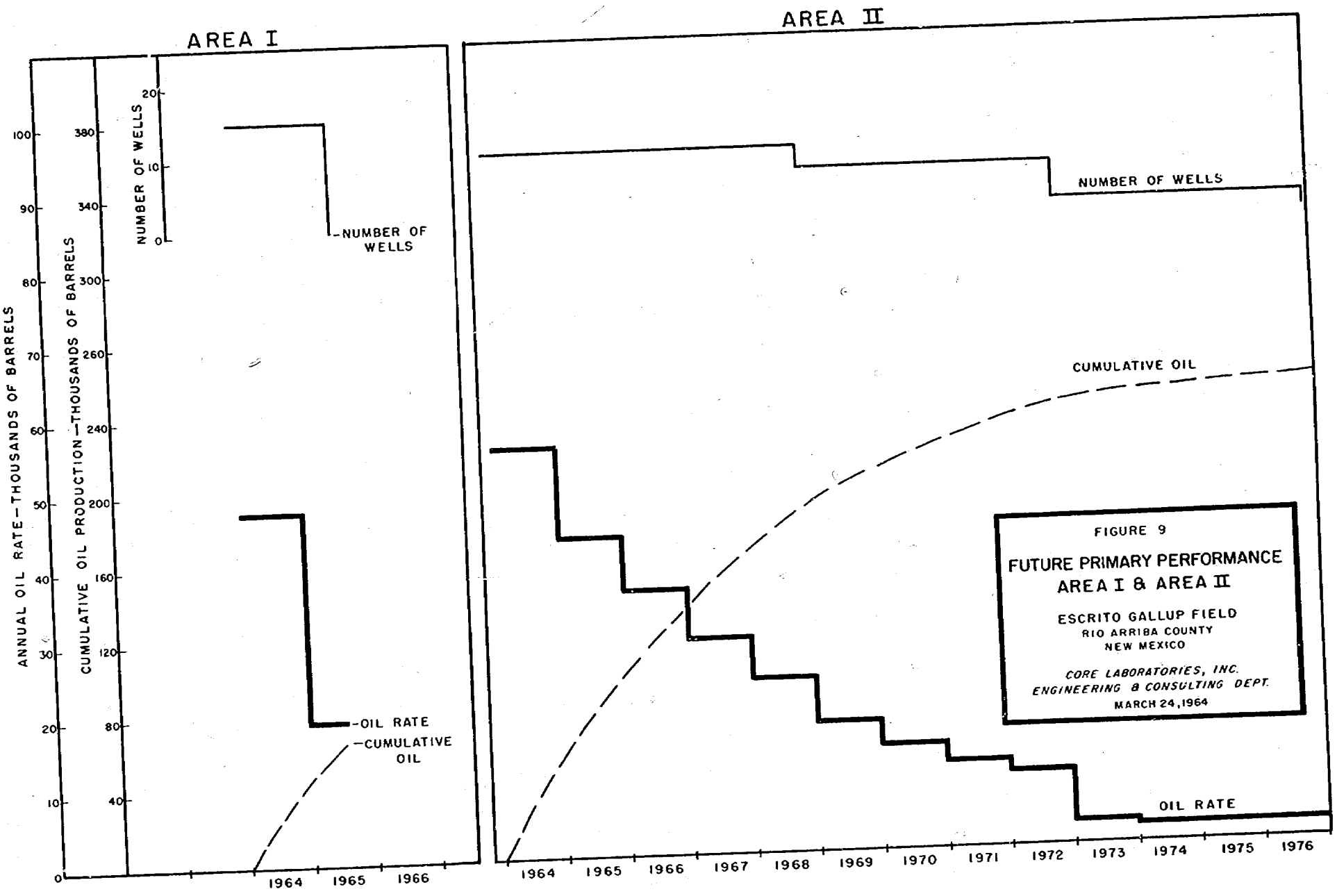
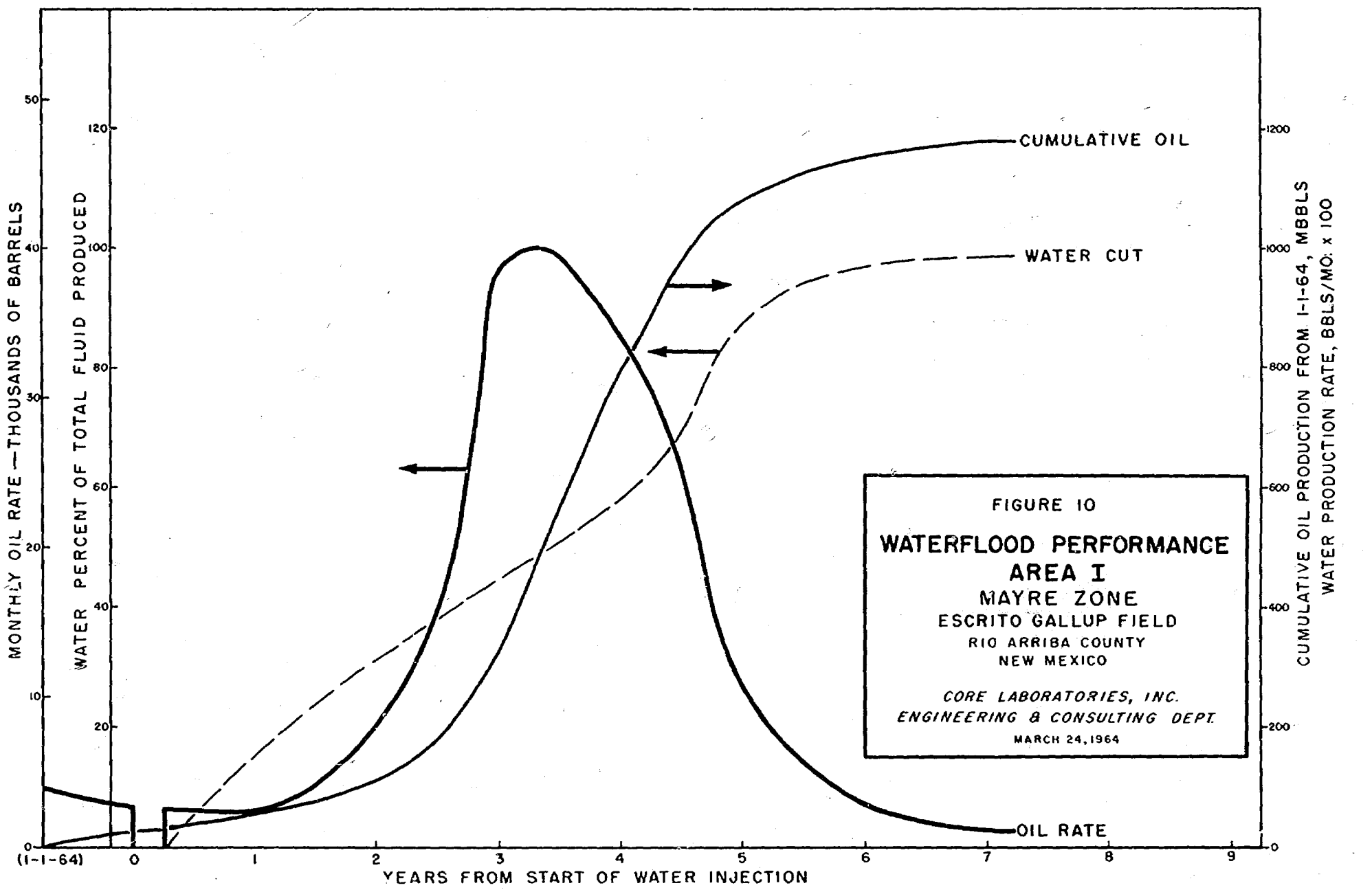


FIGURE 9

FUTURE PRIMARY PERFORMANCE
AREA I & AREA II

ESCRITO GALLUP FIELD
RIO ARRIBA COUNTY
NEW MEXICO

CORE LABORATORIES, INC.
ENGINEERING & CONSULTING DEPT.
MARCH 24, 1964


MONTHLY OIL RATE—THOUSANDS OF BARRELS
WATER PERCENT OF TOTAL FLUID PRODUCED
CUMULATIVE OIL PRODUCTION FROM 1-1-64, MBBLS
WATER PRODUCTION RATE, BBLS/MO. x 100
CUMULATIVE OIL
WATER CUT
OIL RATE
(1-1-64)
YEARS FROM START OF WATER INJECTION
FIGURE 10
WATERFLOOD PERFORMANCE
AREA I
MAYRE ZONE
ESCRITO GALLUP FIELD
RIO ARRIBA COUNTY
NEW MEXICO
CORE LABORATORIES, INC.
ENGINEERING & CONSULTING DEPT.
MARCH 24, 1964

BEFORE THE OIL CONSERVATION COMMISSION OF NEW MEXICO

IN THE MATTER OF THE APPLICATION OF BCO, INC., FOR APPROVAL OF THE ESCRITO GALLUP POOL UNIT AGREEMENT EMBRACING 3123.88 ACRES, MORE OR LESS, LOCATED IN TOWNSHIP 24 NORTH, RANGES 7 and 8 WEST, N.M.P.M., SAN JUAN AND RIO ARRIBA COUNTIES, NEW MEXICO; FOR ADMINISTRATIVE PROVISION FOR EXPANSION OF SAID UNIT; AND FOR APPROVAL OF A WATER FLOOD PROJECT WITHIN SAID UNIT AND FOR PERMISSION TO PRODUCE UNIT WELLS INTO A CENTRAL TANK BATTERY.

3114

A P P L I C A T I O N

Comes now applicant BCO, Inc., and respectfully requests approval of the Oil Conservation Commission of New Mexico of the Escrito Gallup Pool Unit Agreement, with administrative procedure for expansion of the unit area, permission to install and operate a water flood within said unit, and permission to produce the unit wells into a central tank battery. The Escrito Gallup Pool Unit Agreement embraces the following described acreage:

TOWNSHIP 24 NORTH, RANGE 7 WEST, N.M.P.M.

Section 7 - S/2
Section 16 - S/2
Section 17 - All
Section 18 - All
Section 19 - E/2 NE/4
Section 20 - N/2
Section 21 - N/2

TOWNSHIP 24 NORTH, RANGE 8 WEST, N.M.P.M.

Section 12 - SE/4
Section 13 - E/2

containing 3123.88 acres, more or less, in San Juan and Rio Arriba Counties, New Mexico, and in support thereof would show:

1. That the Escrito Gallup Pool Unit Agreement is filed with the Commission as a separate exhibit, and made a part of this application.

2. That the Escrito Gallup Pool Unit Agreement has been submitted to the United States Geological Survey and the office of the Commissioner of Public Lands of the State of New Mexico for approval.

3. That the attached plat, marked as Exhibit 1, shows the Escrito Gallup Pool Unit Area, and the surrounding area.

4. That production in the Escrito Gallup Pool is at an advanced stage of depletion and that recovery by primary methods is at or near the economic limit.

5. That engineering investigations indicate that water-flooding of the area embraced within the Escrito Gallup Pool Unit Agreement is physically and economically feasible and that the proposed unitization and secondary recovery operations within the unit area will result in the recovery of hydrocarbons which could not otherwise be recovered and is therefore in the interests of conservation and the prevention of waste.

6. That all operators of producing properties within the unit area have been given an opportunity to participate in the Escrito Gallup Pool Unit and that a sufficient proportion of the working interest has been committed to the unit to effectively control secondary recovery operations.

7. That the formation to be unitized and waterflooded is the Gallup Sandstone member of the Mancos Formation of the Upper Cretaceous Period, as found between the subsurface depths of 5910 feet and 6170 feet, measured from the Kelly bushing in the BCO, Inc., Elizabeth Federal No. 1 Well, located 990 feet from the East line and 1950 from the North line of Section 18, Township 24 North, Range 7 West, N.M.P.M., Rio Arriba County.

8. All proposed injection wells are or will be completed in

such manner that injected water will be confined to the Gallup Sandstone member of the Mancos Formation. A schematic diagram of the proposed completion of the injection wells is submitted herewith as Exhibit 2.

9. Applicant proposes to inject approximately 3000 barrels of water per day into the Gallup injection wells. The water will be obtained from a water well drilled in the NE/4 of Section 18, Township 24 North, Range 7 West, N.M.P.M.

10. A copy of this application, together with exhibits, has been furnished to the office of the New Mexico State Engineer as required by Rule 701.

11. Applicant proposes to operate its secondary recovery project under the provisions of Commission's Rule 701.

WHEREFORE, applicant requests that this application be set for hearing before the Commission's duly qualified Examiner, and that after notice and hearing as required by law, the Commission enter its order approving the Escrito Gallup Pool Unit Agreement, granting permission to install and operate a waterflood project within the unit area, and permitting the production of the unit wells into a central tank battery and for such other and further orders as may be appropriate in the case.

Respectfully submitted,

BCO, INC.,

By Jason W. Kellahin

KELLAHIN & FOX
P. O. Box 1769
Santa Fe, New Mexico

ATTORNEYS FOR APPLICANT

Case 31 1C

Unit Boundary

Injection Well

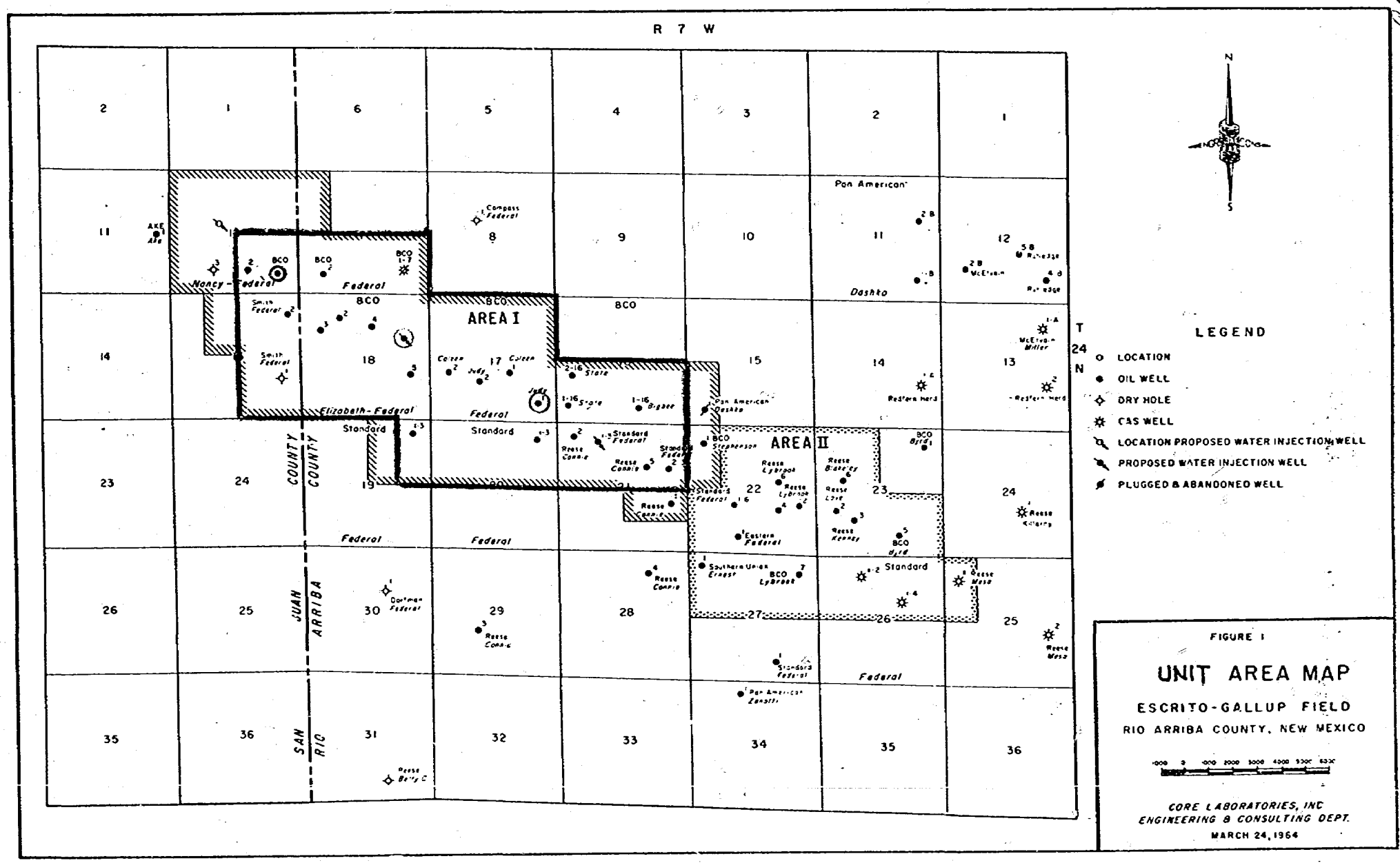


FIGURE 1

UNIT AREA MAP

ESCRITO-GALLUP FIELD

RIO ARRIBA COUNTY, NEW MEXICO

CORE LABORATORIES, INC.
ENGINEERING & CONSULTING DEPT.

MARCH 24, 1964

MAIN OFFICE
'64 SEP 23 PM 1

STATE OF NEW MEXICO

STATE ENGINEER OFFICE

SANTA FE

S. E. REYNOLDS
STATE ENGINEER

September 22, 1964

ADDRESS CORRESPONDENCE TO:
STATE CAPITOL
SANTA FE, N. M.

87501

Mr. A. L. Porter, Jr.
Secretary-Director
Oil Conservation Commission
Santa Fe, New Mexico

Dear Mr. Porter:

Reference is made to the application of BCO, Inc., which seeks approval of a waterflood project in the Escrito Gallup Pool located in Township 24 North, Ranges 7 and 8 West. The proposed water injection wells are the BCO, Inc., Elizabeth-Federal No. 1, BCO, Inc., Judy-Federal No. 1 and BCO, Inc., Nancy-Federal No. 1. The diagrammatic sketches which were attached to the application indicate that injection will be down 2 3/8-inch tubing in each well under a packer set below the top of the cement surrounding the production casing.

It appears that from examination of the information submitted that no threat of contamination to the fresh waters which may exist in the area will occur. Therefore, this office offers no objection to the granting of the application.

Yours truly,

S. E. Reynolds
State Engineer

By: Frank E. Irby
Frank E. Irby
Chief
Water Rights Div.

FEI/ma
cc-Jason Kellahin

DOCKET MAILED
Date 11-15-64

need 3 pcs ltr

DRAFT
JMD/esr

BEFORE THE OIL CONSERVATION COMMISSION
OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
COMMISSION OF NEW MEXICO FOR
THE PURPOSE OF CONSIDERING:

CASE No. 3114

Order No. R- 2796

APPLICATION OF BCO, INC.,
FOR A WATERFLOOD PROJECT, SAN JUAN AND ~~COUNTY,~~
~~NEW MEXICO~~ RIO ARRIBA COUNTIES, NEW MEXICO.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 o'clock a.m. on October 28, 1964, at Santa Fe, New Mexico, before Examiner Daniel S. Nutter.

NOW, on this _____ day of Nov, 1964, the Commission, a quorum being present, having considered the testimony, the record, and the recommendations of the Examiner, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Commission has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, BCO, Inc., seeks permission to institute a waterflood project in the Escrito-Gallup Oil Pool in the Escrito Gallup Pool Unit Area by the injection of water into the Gallup formation through three injection wells in Sections 17 and 18, Township 24 North, Range 7 West, ~~South~~ and Section 12, Township 24 North, Range 8 West ~~West~~ NMPM, San Juan ~~County, New Mexico~~ and Rio Arriba Counties, New Mexico.

(3) That the wells in the project area are in an advanced state of depletion and should properly be classified as "stripper" wells.

(4) That the proposed waterflood project should result in the recovery of otherwise unrecoverable oil, thereby preventing waste.

(5) That the subject application should be approved and the project should be governed by the provisions of Rules 701, 702, and 703 of the Commission Rules and Regulations.

IT IS THEREFORE ORDERED:

(1) That the applicant, BCO, Inc., is hereby authorized to institute a waterflood project in the Escrito-Gallup Oil Pool Pool in the Escrito Gallup Pool Unit Area by the injection of water into the Gallup formation through the following-described wells in Township North, Range West, South East NMPM, County, New Mexico:

Judy Federal Well No. 1, Unit P of Section 17, Township 24 North, Range 7 West
Elizabeth Federal Well No. 1, Unit H of Section 18, T 24 N R 7 W
Nancy Federal Well No. 1, Unit P of Section 12, T 24 N, R 8 W

(2) That the subject waterflood project shall be governed by the provisions of Rules 701, 702, and 703 of the Commission Rules and Regulations.

(3) That monthly progress reports of the waterflood project herein authorized shall be submitted to the Commission in accordance with Rules 704 and 1119 of the Commission Rules and Regulations.

(4) That jurisdiction of this cause is retained for the entry of such further orders as the Commission may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

State of New Mexico
Oil Conservation Commission

P. O. BOX 2088
SANTA FE
87501

Injection is to be through the three authorized injection wells which shall be equipped with 2 3/8-inch tubing and with packers which shall be set within 100 feet of the uppermost perforation.

Mr. Jason Kellahin
Kellahin & Fox
Attorneys at Law
Post Office Box 1769
Santa Fe, New Mexico

Gentlemen:

Enclosed herewith is Commission Order No. R- 2796, entered in Case No. 3114, approving the BCO Escrito Gallup Water Flood Project.

As to allowable indicate that ~~According to~~ our calculations, when all of the authorized injection wells have been placed on active injection, the maximum allowable which this project will be eligible to receive under the provisions of Rule 701-E-3 is 2120 barrels per day.

Please report any error in this calculated maximum allowable immediately, both to the Santa Fe office of the Commission and the appropriate District proration office.

In order that the allowable assigned to the project may be kept current, and in order that the operator may fully benefit from the allowable provisions of Rule 701, it behooves him to promptly notify both of the aforementioned Commission offices by letter of any change in the status of wells in the project area, i.e., when active injection commences, when additional injection or producing wells are drilled, when additional wells are acquired through purchase or unitization, when wells have received a response to water injection, etc.

Your cooperation in keeping the Commission so informed as to the status of the project and the wells therein will be appreciated.

Very truly yours,

A. L. PORTER, Jr.
Secretary-Director

cc: OCC - Hobbs & Aztec
Mr. Frank Irby

BEFORE THE OIL CONSERVATION COMMISSION
OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
COMMISSION OF NEW MEXICO FOR
THE PURPOSE OF CONSIDERING:

CASE No. 3114
Order No. R-2796

APPLICATION OF BCO, INC., FOR A
WATERFLOOD PROJECT, SAN JUAN AND
RIO ARRIBA COUNTIES, NEW MEXICO.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 o'clock a.m. on October 28, 1964, at Santa Fe, New Mexico, before Examiner Daniel S. Nutter.

NOW, on this 14th day of December, 1964, the Commission, a quorum being present, having considered the testimony, the record, and the recommendations of the Examiner, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Commission has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, BCO, Inc., seeks permission to institute a waterflood project in the Escrito-Gallup Oil Pool in the Escrito Gallup Pool Unit Area by the injection of water into the Gallup formation through three injection wells in Sections 17 and 18, Township 24 North, Range 7 West, and Section 12, Township 24 North, Range 8 West, NMPM, San Juan and Rio Arriba Counties, New Mexico.

(3) That the wells in the project area are in an advanced state of depletion and should properly be classified as "stripper" wells.

(4) That the proposed waterflood project should result in the recovery of otherwise unrecoverable oil, thereby preventing waste.

(5) That the subject application should be approved and the project should be governed by the provisions of Rules 701, 702, and 703 of the Commission Rules and Regulations.

IT IS THEREFORE ORDERED:

(1) That the applicant, BCO, Inc., is hereby authorized to institute a waterflood project in the Escrito-Gallup Oil Pool in the Escrito Gallup Pool Unit Area by the injection of water into the Gallup formation through the following-described wells:

Judy Federal Well No. 1, Unit P of Section 17, Township 24 North, Range 7 West

Elizabeth Federal Well No. 1, Unit R of Section 18, Township 24 North, Range 7 West

Nancy Federal Well No. 1, Unit P of Section 12, Township 24 North, Range 8 West

(2) That the subject waterflood project shall be governed by the provisions of Rules 701, 702, and 703 of the Commission Rules and Regulations.

(3) That monthly progress reports of the waterflood project herein authorized shall be submitted to the Commission in accordance with Rules 704 and 1119 of the Commission Rules and Regulations.

(4) That jurisdiction of this cause is retained for the entry of such further orders as the Commission may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

Jack M Campbell
JACK M. CAMPBELL, Chairman

E. S. WALKER, Member

A. L. PORTER, Jr., Member & Secretary

esr/

OIL CONSERVATION COMMISSION
P. O. BOX 871
SANTA FE, NEW MEXICO

December 14, 1964

C
O
P
Y

Mr. Jason Kellahin
Kellahin & Fox
Attorneys at Law
Post Office Box 1769
Santa Fe, New Mexico

Dear Mr. Kellahin:

Enclosed herewith is Commission Order No. R-2796, entered in Case No. 3114, approving the BCO Escrito Gallup Waterflood Project.

Injection is to be through the three authorized injection wells which shall be equipped with 2 3/8-inch tubing and with packers, which shall be set within 100 feet of the uppermost perforation.

As to allowable, our calculations indicate that when all of the authorized injection wells have been placed on active injection, the maximum allowable which this project will be eligible to receive under the provisions of Rule 701-E-3 is 2120 barrels per day.

Please report any error in this calculated maximum allowable immediately both to the Santa Fe office of the Commission and the appropriate district proration office.

In order that the allowable assigned to the project may be kept current, and in order that the operator may fully benefit from the allowable provisions of Rule 701, it behooves him to promptly notify both of the aforementioned Commission offices by letter of any change in the status of wells in the project area, i.e., when active injection commences, when additional injection or producing

OIL CONSERVATION COMMISSION
P. O. BOX 871
SANTA FE, NEW MEXICO

wells are drilled, when additional wells are acquired through purchase or unitization, when wells have received a response to water injection, etc.

Your cooperation in keeping the Commission so informed as to the status of the project and the wells therein will be appreciated.

Very truly yours,

A. L. PORTER, Jr.
Secretary-Director

COPY

ALP/ir

cc: Oil Conservation Commission:
Hobbs
Astec

Mr. Frank Irby

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

WATER ANALYSIS

File IWTL-6412

Company BCO, Inc. Well Name _____ Sample No. 1

Formation _____ Depth _____ Sampled From Water Source Well

Location _____ Field Escrito County _____ State _____

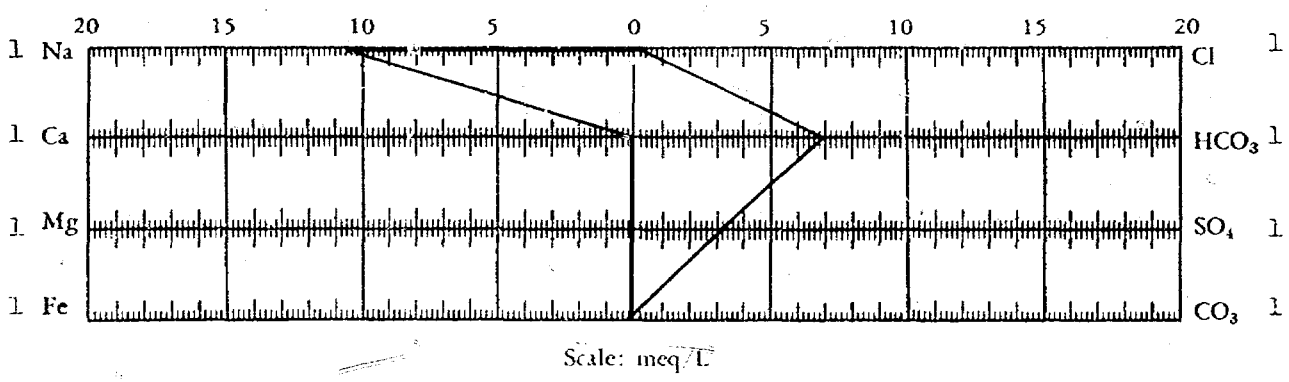
Date Sampled 10-22-64 Date Analyzed 10-28-64 Engineer RAL

Total Dissolved Solids 828 mg/L calculated Sp. Gr. 1.001 @ 75 °F.

Resistivity 10.70 ohm-meters @ 76 °F. measured Hydrogen Sulfide 0.0

pH 7.4

Constituents	meq/L	mg/L	Constituents	meq/L	mg/L
Sodium	10.42	239.59	Chloride	0.34	12.06
Calcium	0.0	0.0	Bicarbonate	6.92	422.12
Magnesium	0.0	0.0	Sulfate	3.19	153.49 (Grav.)
Iron	0.036	1.0	Carbonate	0.0	0.0
Barium	0.0	0.0 (Grav.)	Hydroxide	0.0	0.0



Scale: meq/L

All analyses except iron determination performed on a filtered sample.

H. M. SHEARIN
MANAGER, DOMESTIC OPERATIONS
W. P. SCHULTZ
MANAGER, FOREIGN OPERATIONS
JAMES L. MOORE
ASSISTANT MANAGER
I. F. ROEBUCK, JR.
ASSISTANT MANAGER

CORE LABORATORIES, INC.
BOX 10185, DALLAS 7, TEXAS · CABLE: CORELAB

Engineering & Consulting Department

REPLY TO
SUITE 209 GULF BUILDING
BOX 223
MIDLAND, TEXAS

November 4, 1964

64-499.2

Del Case
3114

New Mexico Oil Conservation Commission
Post Office Box 871
Santa Fe, New Mexico

Attention: Mr. Daniel S. Nutter, Examiner

Gentlemen:

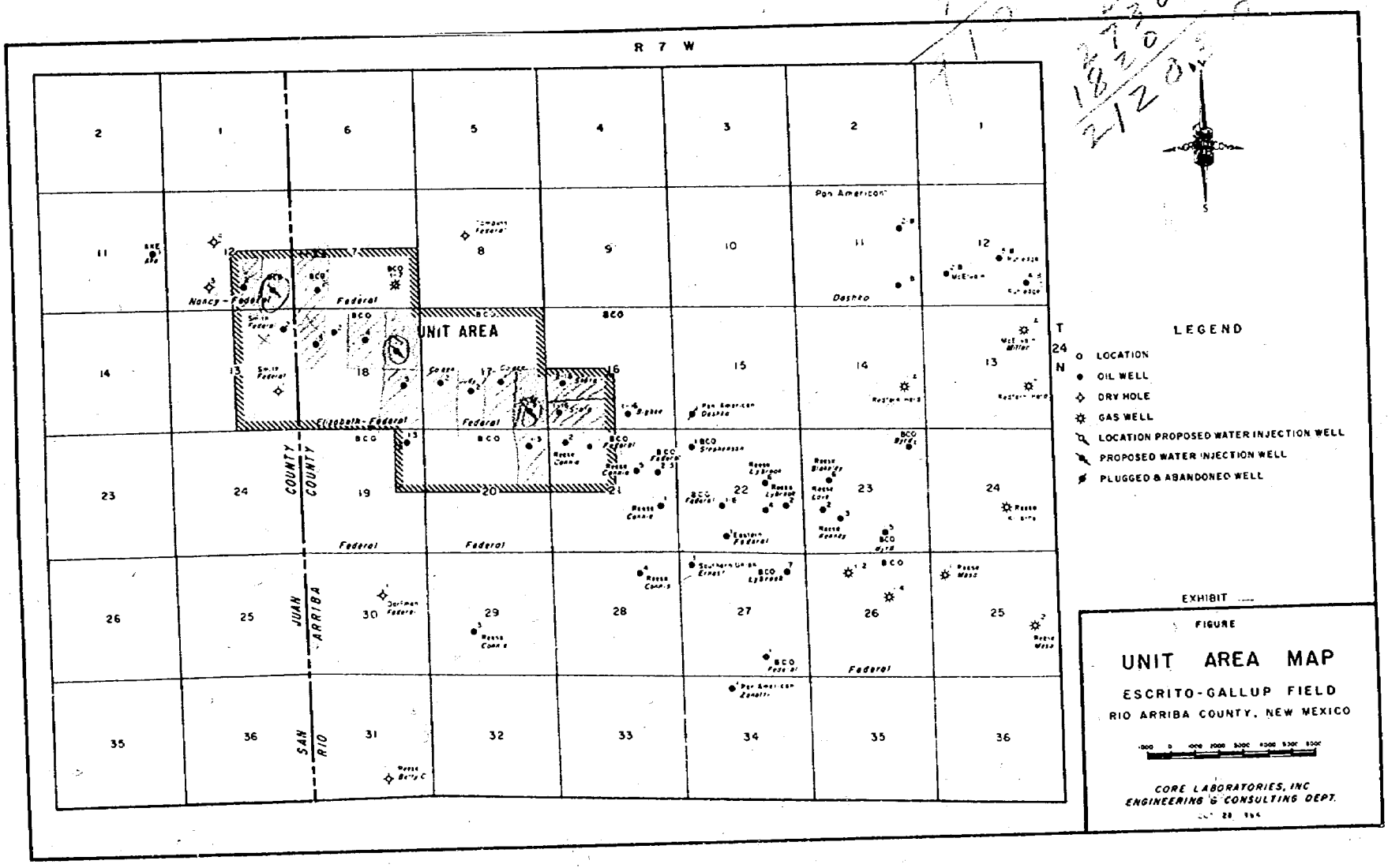
Pursuant to the request of Examiner in the hearing of the application of BCO, Inc., for authority to perform a water injection operation in a portion of the Escrito Gallup Pool, San Juan and Rio Arriba Counties, New Mexico, we submit a copy of the analysis performed on a water sample taken from the BCO water supply well located in Section 18, Township 24 North, Range 7 West, Rio Arriba County, New Mexico. As you recall, this is water taken from a sand located approximately 1900 feet below the surface, and it is water that the operator plans to use in the proposed waterflood operation. By a copy of this letter we are also transmitting a copy of the water analysis to Mr. Frank Irby, State Engineer of New Mexico.

Very truly yours,

CORE LABORATORIES, INC.

T. C. Carlson
Resident Engineer

TCC:fp
cc: Mr. Frank Irby
Mr. Harry L. Bigbee
Mr. Harry R. Bigbee
Mr. Jason W. Kellahin
USGS, Roswell
Enclosure


R 7 W
T 24 N
UNIT AREA
COUNTY
COUNTY
JUAN
ARRIBA
SAN
RIO
Federal
Dashko
Pan American
LEGEND
LOCATION
OIL WELL
DRY HOLE
GAS WELL
LOCATION PROPOSED WATER INJECTION WELL
PROPOSED WATER INJECTION WELL
PLUGGED & ABANDONED WELL
EXHIBIT
FIGURE
UNIT AREA MAP
ESCRITO-GALLUP FIELD
RIO ARRIBA COUNTY, NEW MEXICO
CORE LABORATORIES, INC
ENGINEERING & CONSULTING DEPT.

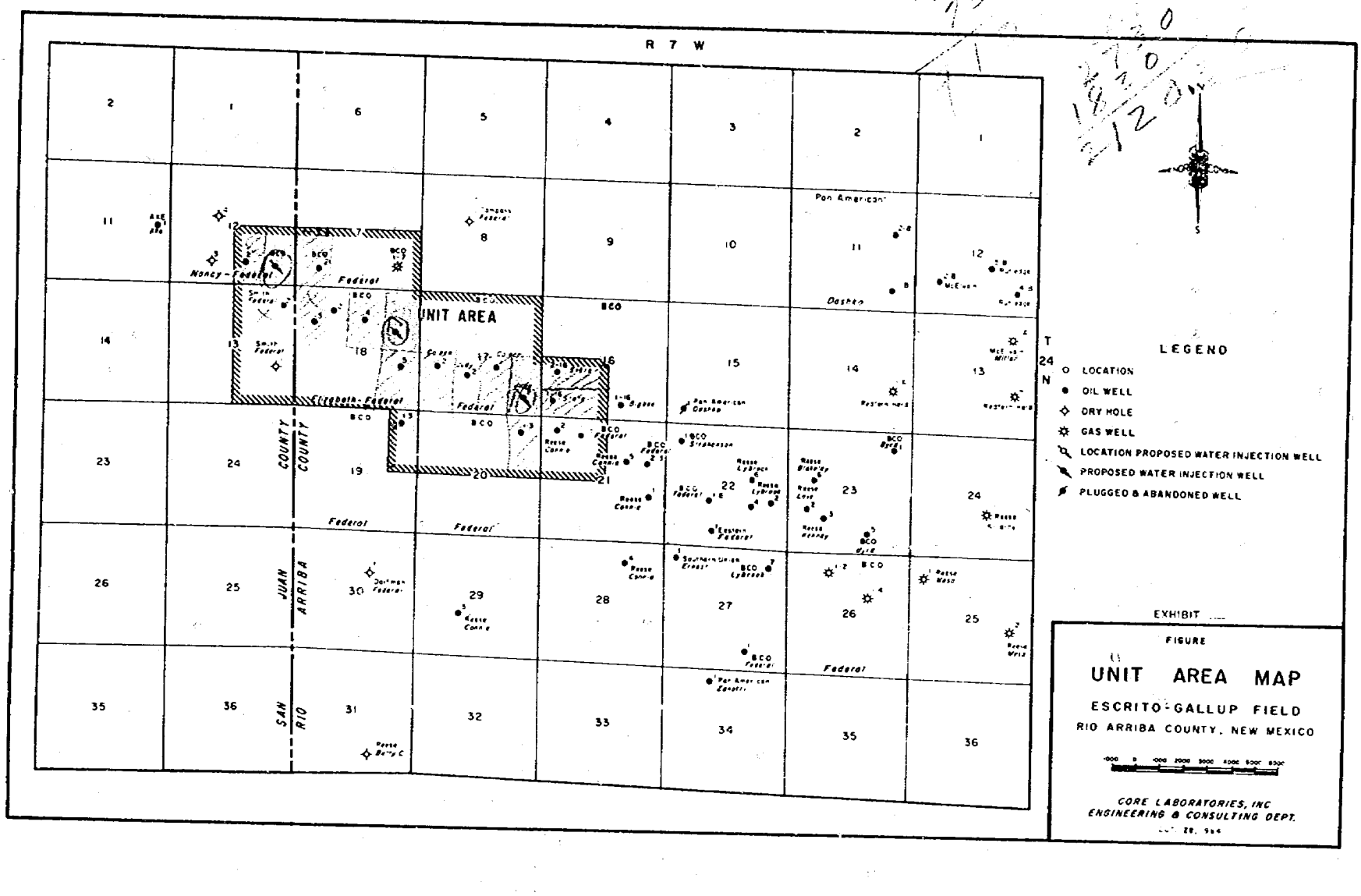


EXHIBIT ___

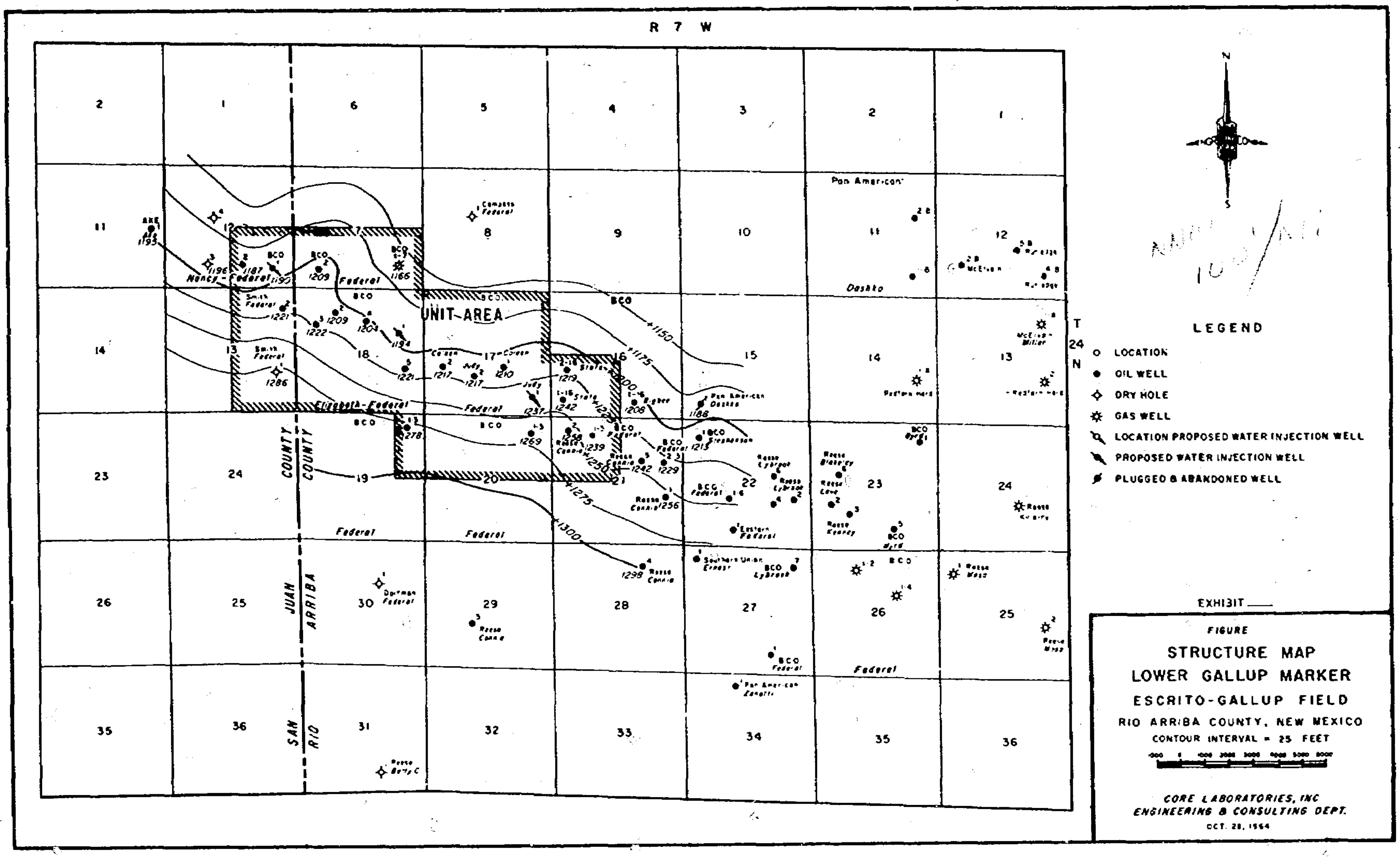
FIGURE

UNIT AREA MAP

ESCRITO-GALLUP FIELD

RIO ARRIBA COUNTY, NEW MEXICO

CORE LABORATORIES, INC
ENGINEERING & CONSULTING DEPT.



R 7 W
T 24 N
UNIT AREA
SAN JUAN COUNTY
RIO ARRIBA COUNTY
LEGEND
LOCATION
OIL WELL
DRY HOLE
GAS WELL
LOCATION PROPOSED WATER INJECTION WELL
PROPOSED WATER INJECTION WELL
PLUGGED & ABANDONED WELL
EXHIBIT ___
FIGURE
STRUCTURE MAP
LOWER GALLUP MARKER
ESCRITO-GALLUP FIELD
RIO ARRIBA COUNTY, NEW MEXICO
CONTOUR INTERVAL = 25 FEET
CORE LABORATORIES, INC
ENGINEERING & CONSULTING DEPT.
OCT. 28, 1964

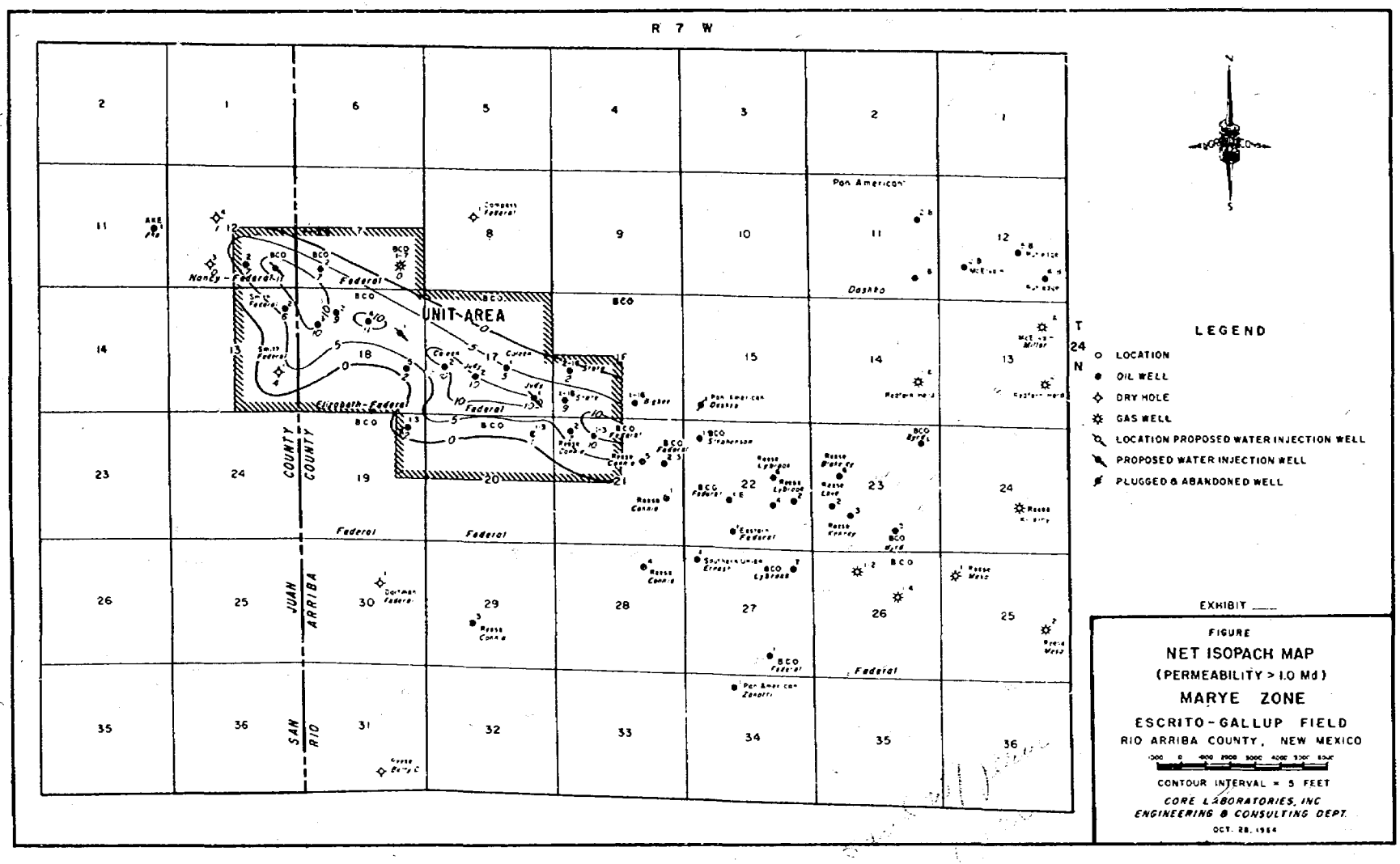


EXHIBIT ____

FIGURE

NET ISOPACH MAP

(PERMEABILITY > 1.0 Md)

MARYE ZONE

ESCRITO - GALLUP FIELD

RIO ARRIBA COUNTY, NEW MEXICO

CONTOUR INTERVAL = 5 FEET

CORE LABORATORIES, INC
ENGINEERING & CONSULTING DEPT.

OCT. 28, 1964

Appl. Ex. 4
Case 3411

WELL STATUS AND PRODUCTION SUMMARY
UNIT AREA
ESCRITO GALLUP POOL

Rio Arriba County, New Mexico

Operator Lease	Well No.	Location UL	S	T	R	Completion Date	Total Depth (Ft.)	Production Casing Size (in.)	Depth (ft.)	Perforated Interval	CURRENT STATUS Well	Production - August, 1964 Oil (bbls.)	Water (bbls.)	Gas (MCF)	Cum. Oil Prod. to 9-1-64
BCO, Inc.															
Coleen Federal	1	J	17	24	7	5-17-60	6215	4-1/2	6215	6128-56	Pump	-	-	-	54,127
	2	L	17	24	7	6-15-60	6102	4-1/2	6102	5990-6014, 6032-44	Gas Lift	535	-	5,580	65,320
Elizabeth Federal	1	H	18	24	7	10-7-60	7227	5-1/2	7227	6108-33	Pump	-	-	-	57,275
	2	C	18	24	7	11-11-60	6110	4-1/2	6110	5974-86, 6014-22	Pump	369	-	3,720	69,003
	3	E	18	24	7	12-61	6038	4-1/2	6038	5917-26, 5930-42, 5663-70	Gas Lift	-	-	-	21,765
	4	G	18	24	7	1-62	6238	4-1/2	6238	6128-44, 6172-78	Pump	-	-	-	12,931
	5	I	18	24	7	12-61	6112	4-1/2	6100	5986-6016, 6036-42	Shut-In	-	-	-	2,174
Federal	2	M	7	24	7	4-4-61	6154	5-1/2	6148	6006-22	Flow	59	-	-	5,396
Federal - 3	1	C	21	24	7	2-61	6188	4-1/2	6188	6076-96	Flow	448	-	6,296	48,475
	1	A	19	24	7	11-57	6200	5-1/2	6200	6054-80, 6090-6104	Pump	165	-	330	16,289
Federal-3, Report 2	1	A	20	24	7	8-57	6277	7	6277	6113-21, 6128-43	Shut-In	-	-	-	34,752
Judy Federal	1	P	17	24	7	2-20-60	7239	5-1/2	6313	6110-40	Shut-In	-	-	-	55,023
	2	K	17	24	7	10-8-60	6110	4-1/2	6110	5832-50, 5896-5906 5926-36	Gas Lift	-	-	-	50,192
Nancy Federal	1	P	12	24	8	2-61	6203	4-1/2	6203	6104-20, 6147-53	Pump	-	-	-	62,683
	2	O	12	24	8	12-61	6148	4-1/2	6148	6056-70, 6097-6104	Flow	437	-	2,480	24,955
State	1	M	16	24	7	2-1-60	6350	5-1/2	6350	6070-96	Shut-In	-	-	-	35,644
	2	L	16	24	7	10-60	6140	4-1/2	6140	5905-32	Shut-In	-	-	-	1,382
Val Reese & Associates, Inc.															
Connie Federal	2	D	21	24	7	4-27-60	6243	5-1/2	6241	6072-98	Pump	186	-	2,732	56,458
Ray Smith															
Federal	2	A	13	24	8	11-60	6024	4-1/2	6024	5926-34	Flow	412	-	-	47,885
Total	19 wells											2,611	0	21,138	721,729

EXHIBIT
10-28-64

SUMMARY OF RESERVOIR PROPERTIES
UNIT AREA
ESCRITO GALLUP POOL

Rio Arriba County, New Mexico

Initial Reservoir Pressure, psig	1842
Reservoir Temperature, ^{o}F	155
Initial Formation Volume Factor, vol/vol	1.349
Initial Oil Viscosity, cp.	0.53
Initial Gas-Oil Ratio, cf/bbl.	687
Average Porosity, per cent	12.7
Average Water Saturation, per cent	25.0
Average Capacity, md-ft	276
Net Reservoir Volume, Acre-feet	10,069.7
Net Effective Oil Initially in Place, Bbls.	5,516,000
Maximum Oil Producing Rate (April 1961) Bbl/Day	1,512
Current Oil Producing Rate (August 1964) Bbl/Day	84.2
Current Reservoir Pressure (May 1964) psig	470
Current Gas-Oil Ratio (August 1964) cf/bbl.	8096
Current Water-Oil Ration (August 1964) Bbl/Bbl	0.0
Cumulative Oil Produced to 9-1-64, Bbl.	721,729
Number of wells	19

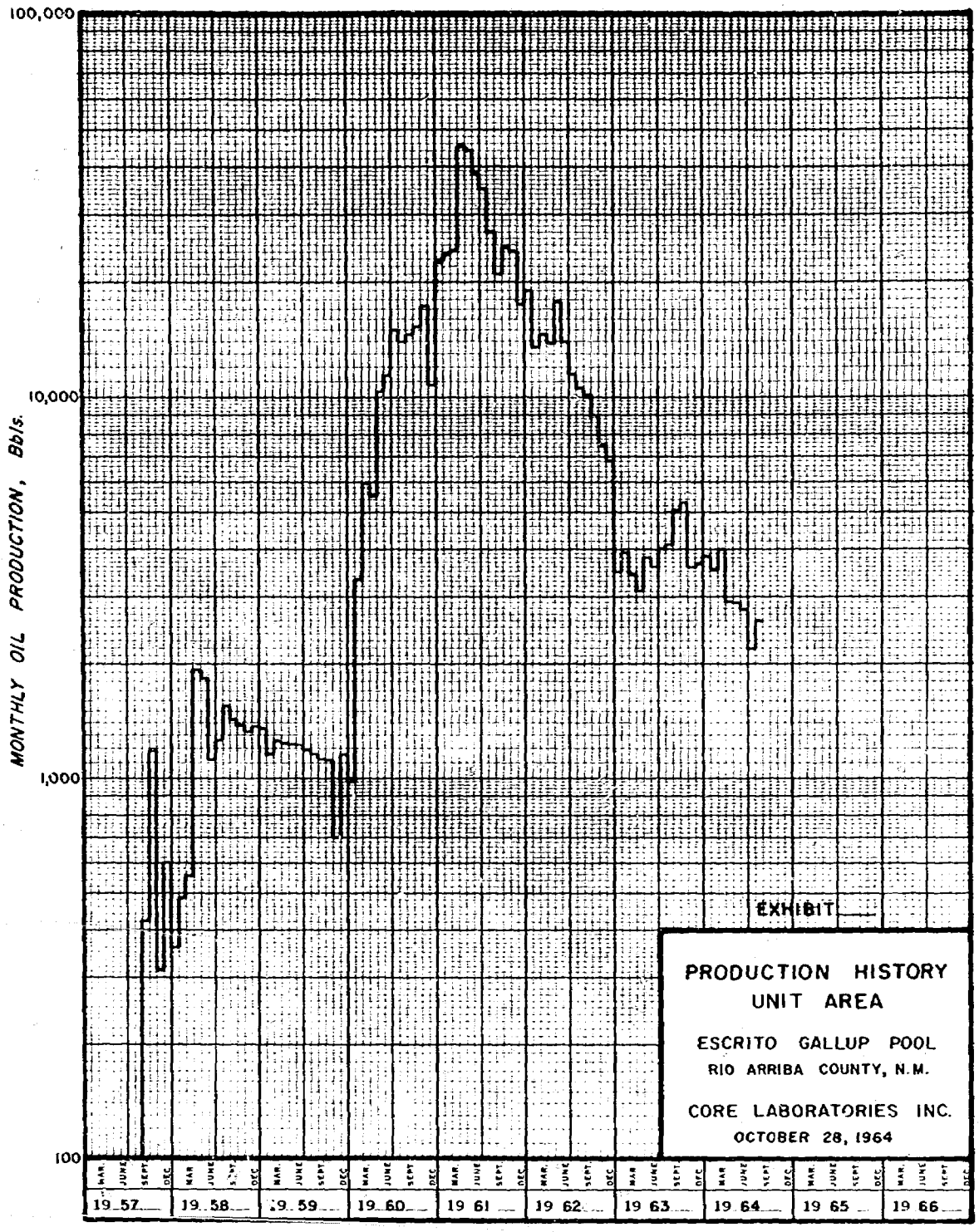
EXHIBIT _____
10-28-64

PRODUCTION HISTORY
UNIT AREA
ESCRITO GALLUP POOL

Rio Arriba County, New Mexico

Date	No. Wells	Oil (Bbls)	Water (Bbls)	Gas (MCF)
9-57	1	422		
10	1	1,194		
11	1	313		
12	1	600		
Annual Total		2,529	0	0
1-58	1	360		
2	2	486		
3	2	556		
4	2	1,925		
5	2	1,825		
6	2	1,113		
7	2	1,261		
8	2	1,556		
9	2	1,419		
10	2	1,378		
11	2	1,307		
12	2	1,369		
Annual Total		14,555	0	0
1-59	2	1,350		1,742
2	2	1,160		1,531
3	2	1,254		1,657
4	2	1,236		1,586
5	2	1,223		1,579
6	2	1,206		1,571
7	2	1,193		1,557
8	2	1,159		1,549
9	2	1,132		1,147
10	2	1,106		1,118
11	2	699		697
12	2	1,176		1,206
Annual Total		13,894	0	16,940
1-60	2	972		983
2	4	3,315		1,448
3	4	5,958		754
4	5	5,507		1,096
5	6	10,227		1,043
6	7	11,385		2,958
7	7	14,955		3,224
8	7	13,938		3,250
9	7	14,403		3,411
10	9	15,309		3,727
11	10	17,313		4,478
12	11	10,692		4,053
Annual Total		123,974	0	30,425
1-61	11	22,592		8,260
2	11	23,445		9,866
3	15	24,099	11	9,953
4	15	45,408	18	19,146
5	15	44,152		19,840
6	15	38,005		28,233
7	15	34,931		46,270
8	15	26,938	7	46,244
9	15	20,930	70	47,150
10	15	24,743		48,085
11	15	23,997		60,367
12	17	17,387		56,473
Annual Total		346,627	106	399,887
1-62	18	18,997	16	43,154
2	18	13,478	10	54,537
3	18	14,578	1	63,226
4	19	13,839	9	60,894
5	19	17,883		107,063
6	19	13,891	5	110,880
7	19	11,389		90,396
8	19	10,547	2	91,359
9	19	10,159		72,437
10	19	8,830		80,025
11	19	7,478		61,618
12	19	6,826	4	59,963
Annual Total		147,895	47	895,552
1-63	19	3,513		29,979
2	19	3,919	7	29,501
3	19	3,545	30	25,910
4	19	3,102		23,552
5	19	3,817		28,403
6	19	3,607	64	23,374
7	19	4,019		35,125
8	19	4,135		36,690
9	19	5,086		37,975
10	19	5,330		42,823
11	19	3,649		38,705
12	19	3,679		27,651
Annual Total		47,401	101	379,688
1-64	19	3,889		26,585
2	19	3,576		18,966
3	19	3,985		28,135
4	19	2,899		26,252
5	19	2,892		17,828
6	19	2,800		20,821
7	19	2,202		18,389
8	19	2,611		21,138
Annual Total		24,854	0	178,114
Cum. to 9-1-64		721,729	254	1,900,606

EXHIBIT_____
10-28-64


100,000
10,000
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100
MONTHLY OIL PRODUCTION, Bbls.
EXHIBIT ___
PRODUCTION HISTORY
UNIT AREA
ESCRITO GALLUP POOL
RIO ARRIBA COUNTY, N.M.
CORE LABORATORIES INC.
OCTOBER 28, 1964
MAR.
JUNE
SEPT.
DEC.
19 57
19 58
19 59
19 60
19 61
19 62
19 63
19 64
19 65
19 66

PROPOSED WATER INJECTION WELL

BCO, INC., ELIZABETH FEDERAL NO. 1
Escrito Gallup Pool, Sec. 18, T 24N, R 7W
Rio Arriba County, New Mexico

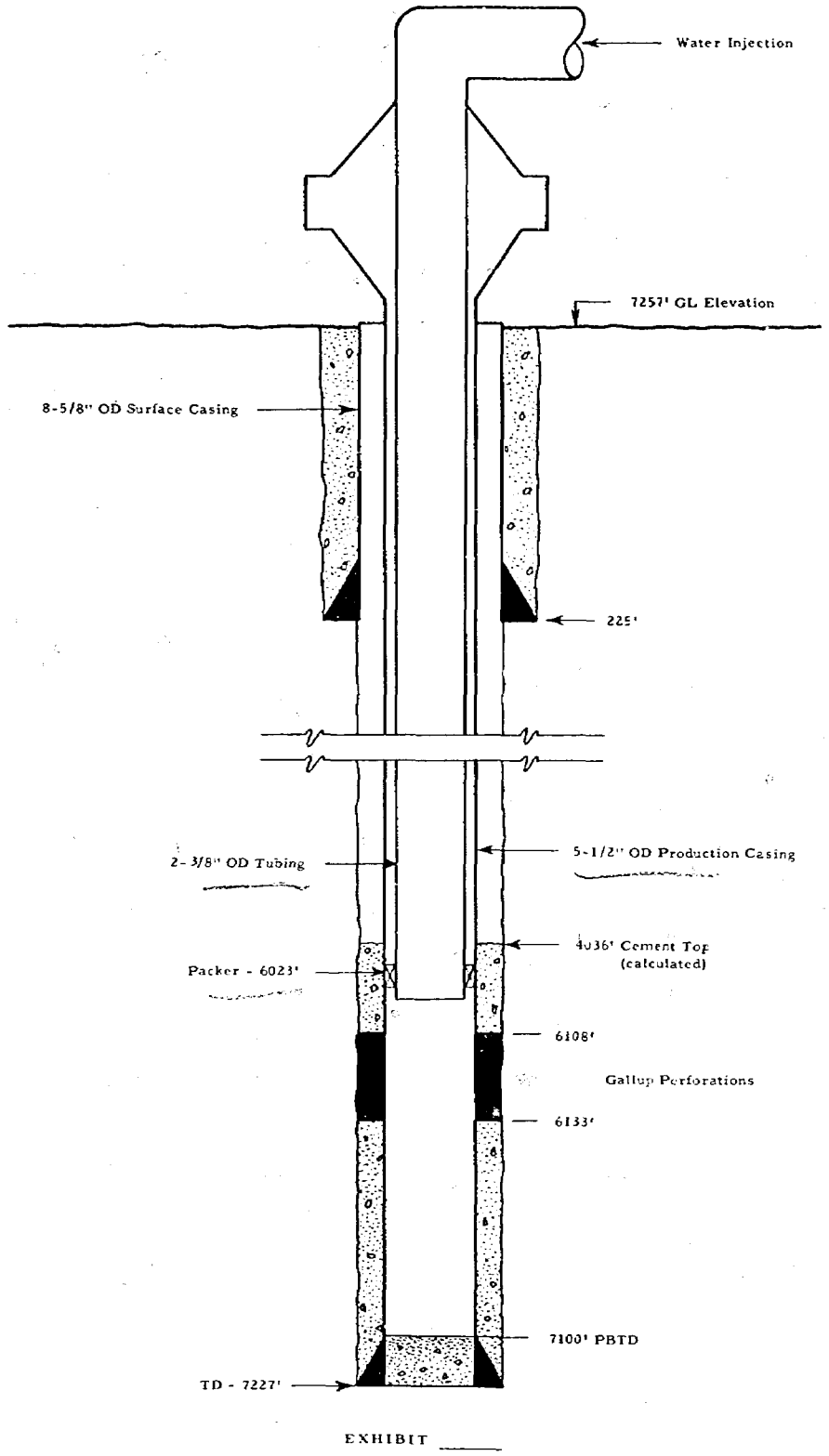


EXHIBIT _____

PROPOSED WATER INJECTION WELL

BCO, INC., JUDY FEDERAL NO. 1
Escrito Gallup Pool, Sec. 17, T 24N, R 7W
Rio Arriba County, New Mexico

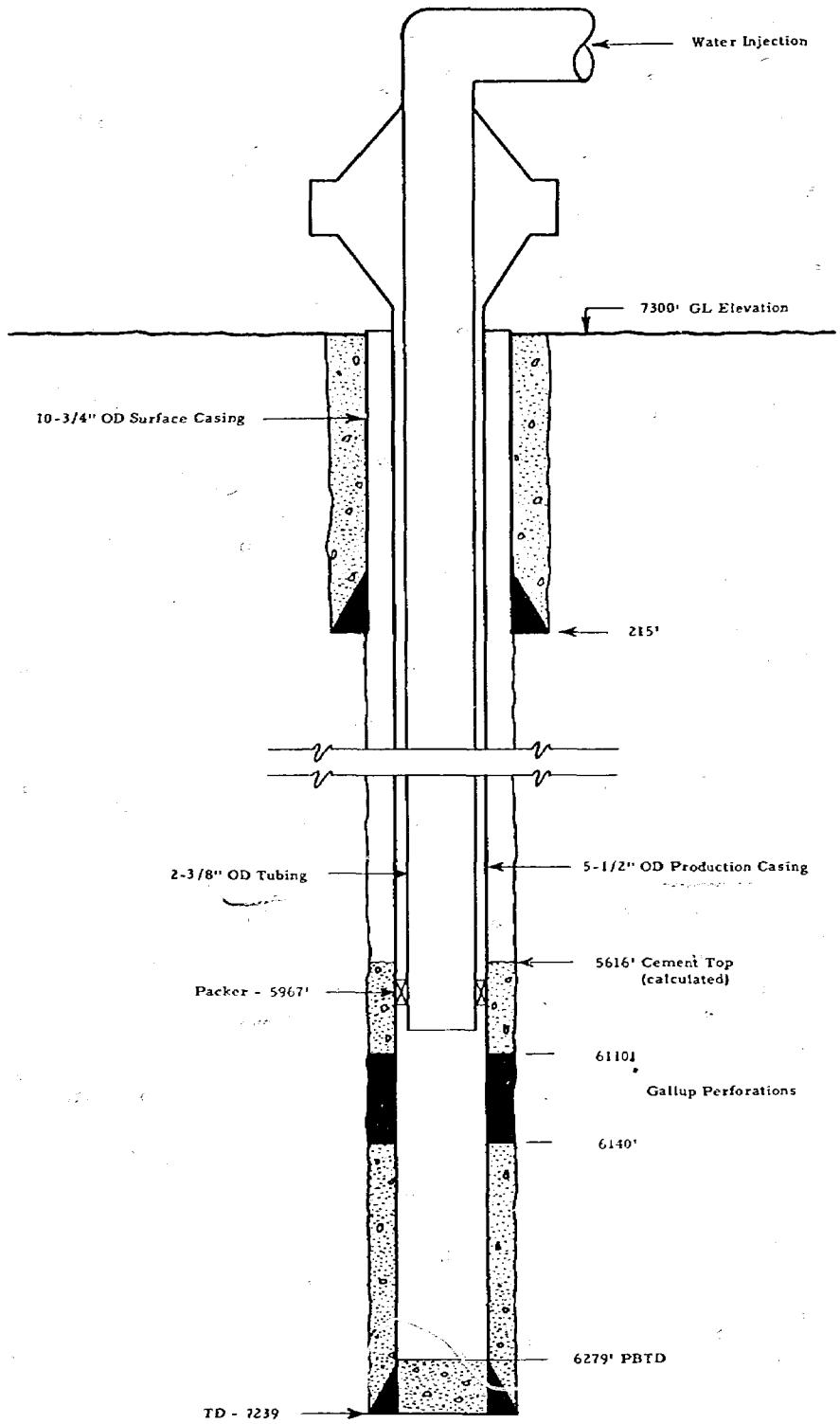
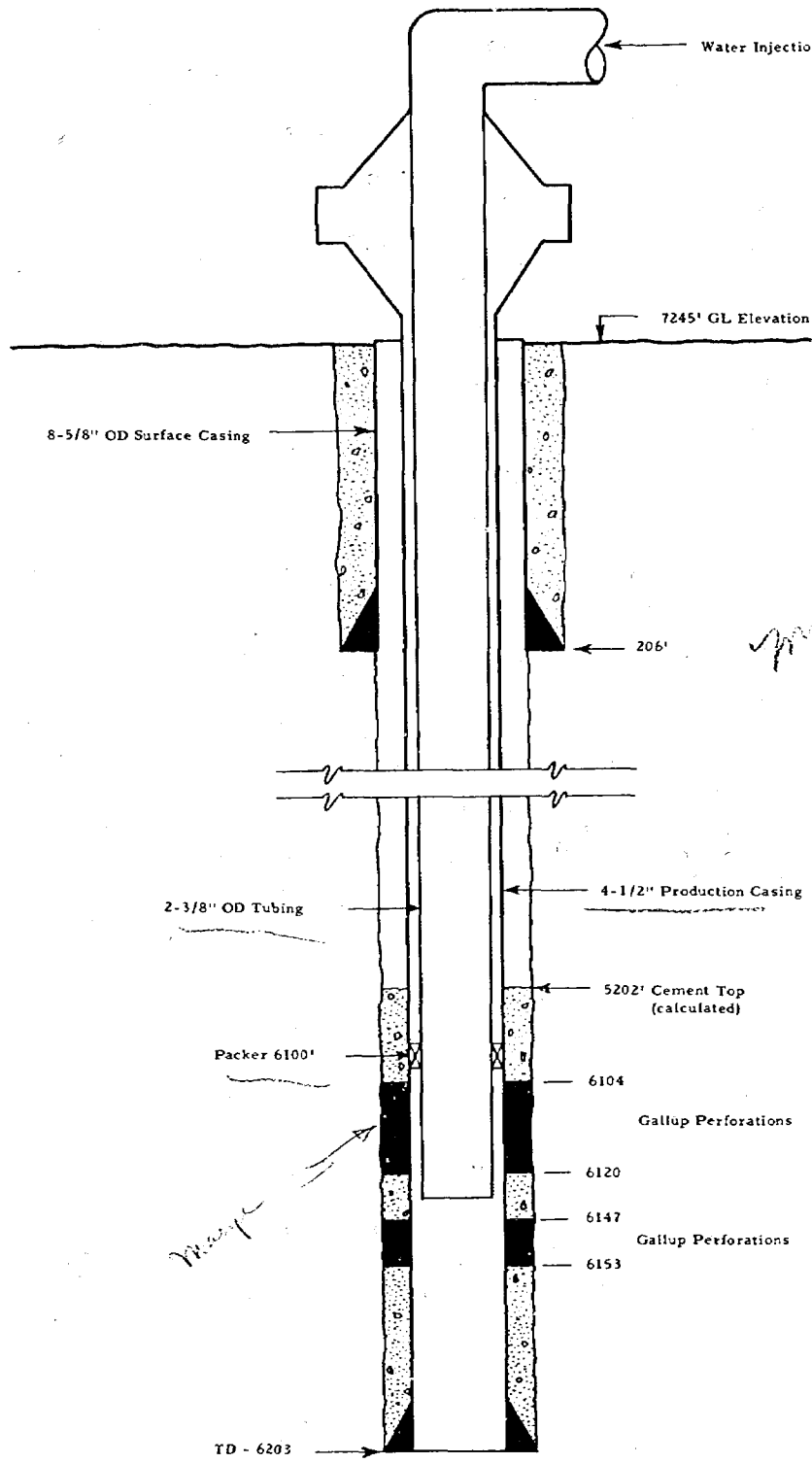


EXHIBIT _____

PROPOSED WATER INJECTION WELL

BCO, INC., NANCY FEDERAL NO. 1
Escrito Gallup Pool, Sec. 12, T 24N, R 8W
San Juan County, New Mexico



EXHIBIT_____

BEFORE THE
NEW MEXICO OIL CONSERVATION COMMISSION
Santa Fe, New Mexico

October 28, 1964

EXAMINER HEARING

IN THE MATTER OF:

Application of BCO, Inc. for a unit agreement, San Juan and Rio Arriba Counties, New Mexico.

Application of BCO, Inc. for a waterflood project, San Juan and Rio Arriba Counties, New Mexico.

Case No. 3113 &
Case No. 3114

BEFORE:

MR. DANIEL S. NUTTER, Examiner

TRANSCRIPT OF HEARING

MR. NUTTER: The hearing will come to order, please. The first case this morning will be Case 3113.

MR. DURRETT: Application of BCO, Inc. for a unit agreement, San Juan and Rio Arriba Counties, New Mexico.

MR. KELLAHIN: Jason Kellahin, Kellahin and Fox, Santa Fe, representing the Applicant. We would like to ask at this time that the case be consolidated, for the purposes of testimony, with Case 3114.

MR. NUTTER: We will call Case 3114.

MR. DURRETT: Application of BCO, Inc. for a waterflood project, San Juan and Rio Arriba Counties, New Mexico.

MR. NUTTER: Cases 3113 and 3114 will be consolidated for the testimony.

MR. KELLAHIN: We have two witnesses we would like to have sworn, please. Mr. Bigbee and Mr. Carlson.

(Witnesses sworn.)

H A R R Y R. B I G B E E, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q Would you state your name, please?

A My name is Harry R. Bigbee.

Q What business are you engaged in, Mr. Bigbee?

A I work for BCO, Inc., more like manager.

Q Do you hold an office in BCO, Inc?

A Yes, sir.

Q What is that office?

A Vice-President.

Q In connection with your position as Vice-President of BCO, Inc., have you had anything to do with the formation of a proposed unit for an Escrito Gallup Oil Pool?

A Yes.

Q Are you familiar with the unit agreement that has been proposed in this Application?

A Yes, sir.

(Whereupon, Exhibit Number 1 marked for identification.)

Q I hand you what has been marked as Exhibit Number 1. Would you state what that is?

A That's the Unit Agreement that's been submitted to the United States Geological Survey and the State for this proposed Unit.

Q Is it pending approval from the United States Geological Survey and State?

A Yes.

Q It has not yet been approved?

A No.

Q Is this Unit Agreement in a form that has heretofore

been approved by this Commission and the United States Geological Survey and the State Land Office?

A I believe it is.

Q Would you say that it is substantially in that form?

A Yes, sir.

Q What areas are proposed to be covered in this unit?

A Basically, it's the west end of the Escrito-Gallup Pool.

Q Would you outline the acreage since it is somewhat different from that stated in the Application in this case?

A The Southeast of Section 12, the East Half of Section 13, both of those in Township 24 North, Range 8 West, the North Half of Section 7, all of Section 18.

Q South Half of Section 7?

A Yes, South Half. All of Section 18, all of Section 17, the East Half of the Northeast Quarter of Section 19, the North Half of Section 20, the Southwest Quarter of Section 16, and the Northwest Quarter of Section 21, all in 21 North, 7 West.

Q Was the acreage deleted from the proposed unit after conferences with the United States Geological Survey?

A Yes, sir.

Q Have all of the working interest owners in the proposed area agreed to join the Unit?

[illegible]

[illegible]

[illegible] with [illegible] Reese and Associates, who have an interest in Section [illegible], and Ray Smith who has a well in Section 15, and so far, it doesn't look favorable on either side.

Q As of the present time, have they indicated that they did not want to join?

A Mr. Jamison who represents Reese and Associates has told me that he does not think he can get his people together and Ray Smith, well, his accountant has told me that they aren't interested in it.

Q Is there provision in the proposed Unit Agreement for subsequent joinder?

A Yes, sir.

Q And in the event that they elect to join at some later date, there would be provision for such joinder, is that correct?

A Yes.

Q In your opinion, would the proposed Unit Agreement protect the correlative rights of all the parties involved?

A Yes, sir.

Q Is it in the interest of conservation and the production of oil that would not otherwise be recovered?

A I believe so, but I don't know anything about it.

MR. KELLAHIN: At this time I would like to offer in evidence, Exhibit Number 1.

MR. NUTTER: Exhibit 1 will be admitted in evidence.

(Thereupon, Applicant's Exhibit No. 1 was offered and admitted in evidence.)

MR. KELLAHIN: That's all the questions I have of this witness.

MR. NUTTER: I have a question, please.

CROSS EXAMINATION

BY MR. NUTTER:

Q What acreage are you speaking of now, that is going to be left out of the Unit?

A It's the East Half of Section 13.

Q That would be Tract 15?

A Yes, sir. Also Tract Number 9. That amounts to about nine percent of the Unit.

Q Tract 9 in Section 21?

A Yes, sir.

MR. NUTTER: Thank you.

MR. KELLAHIN: Do you have any further questions of this witness?

MR. NUTTER: Are there further questions of the

witness? He may be excused.

(Witness excused.)

MR. KELLAHIN: I call Mr. Carlson, please.

* * *

T H O M A S C. C A R L S O N, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q Would you state your name, please?

A Thomas C. Carlson.

Q By whom are you employed and in what position?

A Employed by Core Laboratories, Inc. in a position of reservoir engineer in Midland, Texas.

Q Have you ever testified before the Oil Conservation Commission of New Mexico?

A No, sir.

Q For the benefit of the Examiner, would you briefly outline your education and experience as a petroleum engineer?

A I'm a graduate petroleum engineer from the University of Tulsa. I have been practicing for approximately ten years, and I'm registered in the State of Texas as a professional engineer.

Q Where have you practiced as a petroleum engineer?

A In Texas and New Mexico.

Q In connection with your work, have you had anything to do with the San Juan Basin area of New Mexico?

A Yes, sir.

Q Have you handled work in the San Juan Basin for Core Laboratories?

A Yes, sir, I have.

MR. KELLAHIN: Are the witness' qualifications acceptable?

MR. NUTTER: Yes, sir.

Q (By Mr. Kellahin) In connection with your work, have you made a study of the Escrito-Gallup Pool?

A Yes, sir. I made a petroleum engineering study of the reservoir.

Q For whom did you made this study?

A For BCO, Inc.

Q As a result of that study, did you make any recommendations to BCO, Inc.?

A Yes, sir. I recommended that they form a Unit with the operators approximately in the area that has been proposed here today, and that they institute water injection operations.

Q You did not recommend, as I understand it, that the entire pool be included in the flood, is that correct?

A That was our recommendation, that it be confined

essentially to the [illegible]

Q [illegible] you [illegible] for [illegible] recommendation?

A Well, primarily [illegible] lithological change in the reservoir itself from northwest to southeast, and due to the difference in the characteristics of the rock and the completion practices of the operators, we felt, and the stage of completion of the reservoir itself, we felt the logical boundary for unitization purposes existed in approximately Sections 21 and 16.

(Whereupon, Exhibits 2 through 11 marked for identification.)

Q Referring to what has been marked as Exhibit Number 2, will you state what that is, please?

A Exhibit Number 2 is a unit area map showing the general area of the Escrito-Gallup Field and that area that has been confined to the proposed unit area.

Q Does it also show insofar as you know, the lease ownership in the area?

A It shows the lease ownership in the area within the developed portion. It also shows schematically the location of the proposed injection wells.

Q They're indicated by the wells with the arrow through them?

A Yes, sir.

Q Subsequent to the filing of the Application in this case, did BCO acquire an interest from the Standard Oil Company, to your knowledge?

A To my knowledge, they did. That has been reported to me by BCO.

Q You have changed the ownership on this plat to reflect that acquisition?

A To the extent of my knowledge of the acquisition, the map has been changed.

Q Insofar as it affects the unit area?

A Insofar as it affects the unit area.

Q Referring to what has been marked as Exhibit Number 3, will you identify that exhibit and discuss it?

A Exhibit Number 3 is a structure map on a marker in the lower Gallup formation in the vicinity and through the area of the proposed unit. This map indicates that the structure of the reservoir has a monocline dipping to the north, northwest about a hundred feet per mile. The reservoir occurs at a depth of approximately 6,000 feet.

Q Referring to what has been marked as Exhibit Number 4, would you identify that exhibit and discuss it?

A Exhibit Number 4 is a net isopachous map of the Marye Zone of the Gallup formation in the unit area. The

definition of net for the purpose of this map is that pay that in our estimation, has permeability of one millidarcy or greater.

Q In connection with the preparation of the proposed Unit agreement, Mr. Carlson, it is proposed that a participation factor based on net pay be used, did you have anything to do with that?

A Yes, sir. We prepared the maps for it and we discussed with the operator the various perameters that might be considered and as a result of that discussion and review of their perameters that would be considered, we agreed and recommended that acre feet be used as the unitization pattern.

Q Did you make the calculations of the acre feet to be allocated to each tract?

A Yes, sir.

Q Was it based on the net isopach map as shown in Exhibit Number 4?

A Yes, it was.

Q Referring to what has been marked as Exhibit Number 5, would you identify that exhibit and discuss it?

A Exhibit Number 5 is a well status and production summary chart or table of the wells that exist in the unit area of the Escrito-Gallup Pool. I would like to point out one typographical error on the second line of the perforated

interval shown for the BCO Elizabeth Federal Number 3; the present reading is 5663-70. The corrected reading should be 5963-70. This table is a listing for the wells' locations, their completion date, total depth, production casing size and depth setting, perforated interval in the well. The current status of the well in August, 1964, and the cumulative oil produced from each well to September 1st, 1964.

Q As to the current status of the wells, would you say they are in a stage of substantial depletion?

A Yes, sir, they are.

Q And the reservoir is substantially depleted at this time on primary recovery?

A Yes.

Q Is it your recommendation the, that secondary recovery be instituted?

A Yes.

Q Referring to what has been marked as Exhibit Number 6, would you please identify that exhibit?

A Exhibit Number 6 is a summary of reservoir properties of the unit area Escrito-Gallup Pool. From this table it can be seen that the original conditions of the reservoir indicated that a pressure of 1842 psig and a temperature of 155 degrees Fahrenheit. The oil was saturated at initial pressure with a volume factor of 1.349 and viscosity of 0.53 cp. The initial

solution gas-oil ratio was approximately 687. We've estimated the porosity in the unit area is approximately 12.7 percent. The average water saturation, approximately 25 percent, the estimated capacity, average capacity of the wells, approximately 276 millidarcy feet. From this data, we have established this data and isopach maps previously submitted, we have determined the net reservoir volume to be approximately 10,069.7 acre feet. From the average properties of the rock and the properties of the oil, we estimate the oil initially in place to be 5,516,000 barrels. The maximum oil-producing rate occurred during the month of April, 1961, at a rate of 1512 barrels per day, an average rate, the current oil-producing rate in August, 1962 was approximately 84.2 barrels per day, the reservoir pressure in May, 1964 was estimated to be 470 psig from both sonic and bottom hole pressure measurements.

Current gas-oil ratio is approximately 8,096 cubic feet per barrel. Water-oil ratio during August was zero, no water was reported. The cumulative oil produced to September 1st, 1964 was 721,729 barrels from 19 wells.

MR. NUTTER: All these figures are for the unit area?

A Yes, sir, they apply to the unit area.

Q (By Mr. Kellahin) The current producing rate, what would that average per well, approximately?

A Point to five barrels per well.

Q Just fair, coupled with the reservoir pressure and other conditions, again, does that indicate that this reservoir is at a stage of substantial depletion?

A It's at a stage of pressure depletion.

Q Now, referring to what has been marked as Exhibit Number 7, would you identify that exhibit and discuss it?

A Exhibit Number 7 is a production history of the unit area Escrito Gallup Pool, indicating the number of wells, the oil produced in each consecutive month, all water and gas produced in each consecutive month from September, 1957 to August, 1964. It indicates cumulative oil produced, total to September 1st, 1964, of 721,729 barrels, 254 barrels of water reported and 1,900,606,000 cubic feet of gas.

Q Referring to what has been marked as Exhibit Number 8, would you state what that is?

A This is a production history chart of the unit area, indicating the monthly production versus time of oil, and it indicates the severe decline in production since 1961, indicating that the primary life is essentially completed.

Q Now, referring to Exhibits 9, 10 and 11, would you identify those and discuss them, please?

A 9, 10, and 11 are schematic diagrams of the proposed water injection wells. They are the Nancy Federal Number 1,

the Elizabeth Federal Number 1, the Judy Federal Number 1, all operated by BCO, Inc. This indicates, these schematics indicate the piping, production string, tubing and packer setting, and the perforated interval of the injection wells.

Q Do you plan any treatment of the well bore prior to the injection of water?

A We have discussed, although we haven't completed the engineering design, a stimulation treatment using solvents to precede the water, the injected water. This is to be considered a stimulation treatment rather than a displacement process.

Q In other words, it will be a treatment of the interface of the well bore for the purpose of increasing injectivity, is that the purpose of it?

A Right.

Q Mr. Carlson, what plan of injection do you propose BCO follow in instituting secondary recovery in this field, briefly?

A I propose that they inject water from their water supply well through a suitable plant into the three wells indicated on the last three exhibits at a pressure not to exceed two thousand pounds and a maximum rate capacity of the well.

Q And you are not recommending a periphery flood?

A No, sir, this is an internal injection plan.

Q Is that because of the nature of the reservoir?

A It has definitely to do with the nature of the reservoir and the configuration of the wells.

Q What is the source of the water to be used?

A The water to be used in this project is produced from a fresh water sand at approximately 1900 feet and they have completed a well for this purpose.

Q Would you give the location of the well, please?

A It's in the Northeast Quarter of Section 18, 24 North, 7 West, although I don't have the exact dimension. It's in the vicinity of No. 1 Elizabeth Federal.

Q In your opinion, is there a sufficient supply of water available for the purpose of carrying out the flood proposed?

A Production tests to date indicate that there is.

Q Is it fresh water or salt water?

A Fresh water.

Q Do you have an analysis?

A I have a contaminated analysis, but at the present time we're performing an analysis that was taken from the well this last Thursday. We'll be happy to furnish that analysis to the Commission.

Q Would you also furnish a copy of it to the office of

the State Engineer?

A Yes, sir.

Q In connection with the proposed waterflood and unit agreement, in your opinion, will the area that is proposed to be unitized give effective control over the waterflood performance?

A Yes, sir.

Q Were Exhibits 2 through 11 prepared by you or under your supervision?

A Yes, sir, they were.

MR. KELLAHIN: At this time, I would like to offer in evidence, Exhibits 2 through 11 inclusive.

MR. NUTTER: Applicant's Exhibits 2 through 11 will be admitted into the record.

(Whereupon, Exhibits 2 through 11 offered and admitted in evidence.)

MR. KELLAHIN: That's all I have.

CROSS EXAMINATION

BY MR. NUTTER:

Q You estimate that in the unit area there was originally five and a half million barrels of oil in place. What percent of the original oil in place has been recovered to date?

A I haven't calculated the exact number, but it's 12 or 13 percent. If I could dig out my slide rule, I could get

you the number.

Q The cumulative production to date is a little over 700,000?

A Yes.

Q Do you have any estimates on what will be recovered as a result of the water injection program?

A We estimate that approximately 780,000 barrels will be restored.

Q 78?

A 780,000.

Q A little better than primary?

A Slightly. This would be remaining primary plus secondary.

Q And the tract participation under the unit agreement is based on one perameter, that's the net sand thickness under each tract, is that right?

A Yes, sir, one hundred percent acre feet.

Q That's taken from your isopach map, your exhibit 4?

A Yes, sir.

Q Is it your thought, Mr. Carlson, that as time goes on, additional wells will be converted to water injection or do you believe that these three initial wells will effectively flood the area?

A If they're able to take the water that we anticipate at the rate that we anticipate, I feel that these wells will be sufficient.

Q Have any tests been made or any calculations been made as to what the rate of injection will be? I note that you mentioned that you would inject at the capacity of the well.

A We've estimated on the basis of rock properties that approximately a thousand barrels a day would be injected in each well. We realize, of course, that as time goes on, this number could be reduced.

Q And your anticipated maximum pressure would be 2,000?

A Yes, sir.

Q And injection in each of the three wells will be through tubing which will be set on a packer, is that correct?

A That's my understanding of the operator's plan, and that would be our recommendation.

Q Do you know whether any plastic coating will be used in that tubing or not?

A We haven't made a recommendation in that regard to the operator pending the results of our water analysis.

Q You do propose to use fresh water, however, is that right?

A Yes, sir. The water is essentially fresh.

Q And later on you would be recycling produced water, is that right?

A Well, I don't know the answer to that right now. I would think that if it were recycled that it would be separated and handled separately from the storage water, the fresh water.

Q I notice that the one well, the Nancy Federal Number 1, has two perforated intervals, the others have only the one perforated interval. Is that Nancy Federal Number 1 completed in a zone other than the Marye Zone of the Gallup?

A The Nancy Federal Number 1 is completed; I failed to pass out logs of each of the injection wells.

(Whereupon, Exhibits Number 12, 13 & 14 were marked for identification.)

A The Nancy Number 1 is completed in what is known locally as the Marye Zone, plus a small lens that occurs just below the Marye Zone. In most of the wells that exhibits very little or no productivity where it's been cored. The practice of the operators in this end of the field has been to confine their perforations to the Marye Zone and this lens that occurs just below it. However, this is the only injection well that has been perforated in that lower zone.

Q It's the only one of the injection wells?

A Yes.

Q I wonder if either of the wells, particularly the producing wells, have been perforated in that zone, do you know?

A Yes, some of them have.

MR. NUTTER: Are there any other questions of this witness?

MR. IRBY: Yes.

CROSS EXAMINATION

BY MR. IRBY:

Q I would like to ask the witness what he proposes to do with the proposed water if he doesn't reinject it.

A Well, it would certainly be disposed of by the operator in a manner commensurate with the wishes of the regulatory bodies. I would assume, though, if the economics would justify a return system that the water would be brought back to one of the injection wells or to one or more of the injection wells, or it may be used to expand the operations to additional injection wells. We haven't really made a thorough analysis of that point.

Q The approval you seek here would require you to come in for administrative approval for each additional well that's put on?

A Yes.

MR. KELLAHIN: That's right.

Q (By Mr. Irby) And that is in addition to these three?

A Yes.

Q The point that's disturbing me is how are we going to know when you start making water and what you do with it and what the analysis of it is.

MR. PORTER: Is there any fresh water in the area?

MR. KELLAHIN: We have a fresh water well there.

A Surface water, you mean?

MR. PORTER: No, any underground water.

A Yes, the source for injection is an underground sand.

MR. PORTER: I see.

MR. KELLAHIN: Under the normal procedure on salt water disposal, don't you have a form that requires the reporting of the amounts produced?

MR. NUTTER: The monthly injection reports on this waterflood would show the amounts produced. The disposition of the water would not be shown, but that could be ascertained.

MR. KELLAHIN: It is my suggestion that you could determine that a volume of water sufficient to cause concern was being produced, at which time you can inquire as to what was being done. Of course, that report, I understand, does not go to the State Engineer's Office and he would have to

rely on the Oil Conservation Commission for notice.

MR. IRBY: Would your client be agreeable to notifying our office when they start making water, what the analysis is and what they propose to do with it?

MR. KELLAHIN: He would.

MR. IRBY: I think that would expedite it and save both of us trouble.

MR. KELLAHIN: You will do that, will you not, Mr. Bigbee?

MR. BIGBEE: Yes, sir.

MR. IRBY: Thank you.

MR. NUTTER: Do you have any further questions, Mr. Irby?

MR. IRBY: No further questions.

MR. NUTTER: Are there any further questions of Mr. Carlson?

If not, the witness may be excused.

(Witness excused.)

MR. KELLAHIN: We would like to offer at this time Exhibits 12, 13 and 14 into evidence.

MR. NUTTER: Applicant's Exhibits 12, 13, and 14 will be admitted into evidence.

(Whereupon, Exhibits 12, 13, & 14 were offered and admitted into evidence.)

MR. KELLAHIN: I would like to state, as brought out by the first witness, that the proposed form of agreement has been submitted to the United States Geological Survey and State Land Commissioner. There may be minor changes prior to it's final okays and, of course, a conformed copy will be filed with the Commission at that time.

MR. NUTTER: Does anyone have anything they wish to offer in Cases 3113 or 3114. We will take the cases under advisement.

* * *

STATE OF NEW MEXICO)
) ss
COUNTY OF BERNALILLO)

I, ADA DEARNLEY, Notary Public in and for the County of Bernalillo, State of New Mexico, do hereby certify that the foregoing and attached Transcript of Hearing before the New Mexico Oil Conservation Commission was reported by me; and that the same is a true and correct record of the said proceedings, to the best of my knowledge, skill and ability.

Witness my Hand and Seal this 11th day of November, 1964.

Ada Dearnley
NOTARY PUBLIC

My Commission Expires:
June 19, 1967.

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 3113-3114 heard by me on 10/28, 1964.

....., Examiner
New Mexico Oil Conservation Commission

I N D E X

E X H I B I T S

Number	Marked for Identification	Offered	Admitted
1	3	6	6
2--11	9	17	17
12,13,14	20	23	23

NEW MEXICO OIL CONSERVATION COMMISSION

EXAMINER HEARING

SANTA FE, NEW MEXICO

REGISTER

HEARING DATE OCTOBER 28, 1964 TIME: 9 A.M.

NAME:	REPRESENTING:	LOCATION:
Marshall Smith	Statehouse Reporting	Santa Fe
J. O. Darlan	BCO, Inc	Midland, Texas
[illegible]	[illegible] Inc	[illegible]
WC Steinman	[illegible]	Roswell
[illegible]	Independent	Albuquerque
Jason Kellahin	Kellahin & Fox	Santa Fe
Richard B[illegible]	USGS	[illegible]
Ewell N. Walsh	[illegible] Products Co.	Farmington
Ralph L. Gray	Wm A & Ed. R. Hudson	Artesia
Richard S. Morris	Seth, Montgomery, Federici & Andrews	Santa Fe
Gilbert D. Noland	Southern Union Prod Co	Farmington
G. M. Andreen	Texstar Petroleum Co.	San Antonio, Texas
A.L. Porter Jr.	OCC	Santa Fe
Jim Sperling	Kern County Land Co.	Alb.
Phil Tomlinson	[illegible] Ref. Co.	Roswell
[illegible]	[illegible]	Santa Fe
B.V. Vandersluce	Southern Union Prodn.	Farmington

NEW MEXICO OIL CONSERVATION COMMISSION

EXAMINER HEARING

SANTA FE, NEW MEXICO

REGISTER

HEARING DATE OCTOBER 28, 1964 TIME: 9 A.M.

NAME:	REPRESENTING:	LOCATION:
M. Carroll [illegible]	United States [illegible] Co.	Abilene, Texas
Jack R McGraw	[illegible]	[illegible]
W. M. Sargent, Jr.	Cabot Corp	Pampa Texas
[illegible]	[illegible]	[illegible]
[illegible] Ochsner	Lone Star Producing Co	[illegible], Tex
C. K. [illegible]	[illegible]	Midland, Tex
John E. Davis	G.W. Strake	Midland, Texas
Sim B Christy IV	Hinkle, Bondurant & Christy	Roswell, NM
Ronald McWilliams	Continental [illegible]	[illegible], N.M.

BEFORE THE
NEW MEXICO OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
September 30, 1964

EXAMINER HEARING

IN THE MATTER OF: Application of BCO, Inc. for a unit agreement, San Juan and Rio Arriba Counties, New Mexico.) Case No. 3113

and

Application of BCO, Inc. for a water-flood project, San Juan and Rio Arriba Counties, New Mexico.) Case No. 3114

BEFORE: Elvis A. Utz, Examiner

TRANSCRIPT OF HEARING

MR. UTZ: We will call Case 3113.

MR. DURRETT: Application of BCO, Inc. for a unit agreement, San Juan and Rio Arriba Counties, New Mexico.

MR. KELLAHIN: Jason Kellahin. I would like to request on behalf of BCO that Case 3113 and 3114 both be continued to the last Examiner Hearing in October.

MR. UTZ: Cases 3113 and 3114 will be continued to the October 28th Examiner Hearing.

STATE OF NEW MEXICO)
) ss.
COUNTY OF BERNALILLO)

I, ADA DEARNLEY, Court Reporter, do hereby certify that the foregoing and attached transcript of proceedings before the New Mexico Oil Conservation Commission Examiner at Santa Fe, New Mexico, is a true and correct record to the best of my knowledge, skill and ability.

IN WITNESS WHEREOF I have affixed my hand and notarial seal this 5th day of October, 1964.

Ada Dearnley
Notary Public - Court Reporter

My Commission Expires:
June 19, 1967

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 3113 & 3114 heard by me on Sept. 30 64.

New Mexico Oil Conservation Commission