Case No.

537

Application, Transcript, Small Exhibits, Etc.

[illegible] Operating Account
[illegible] rules for Petti-
[illegible] Pool, Rio [illegible]rriba County

Ex. 14 — Schlumberger —
(1) Electric Log Surveys (grey)

(2) Summary of Permeability (Blue

(3) Reservoir Study of Tocito (Amstutz - Yates) Bl.

Exhibits [illegible] Case
537 — [illegible]
[illegible]
[illegible]

Ex. 14 — Schlumberger =

(1) Electric Log Surveys (gray)

(2) Summary of Permeability (Blue

(3) Reservoir Study of Tocito (Amstutz - Yates) Bl.

Exhibit [illegible] Co.
537 — [illegible]
[illegible]
[illegible]

INTER-OFFICE TRANSMITTAL SLIP

TO..

FROM..

( ) For Approval

( ) For Signature

( ) Note and Advise

( ) Note and Return

( ) For Your Files

(For Your Handling

Remarks:

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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. 537
ORDER NO. R-326

THE MATTER OF THE APPLICATION OF LOWRY ET AL OPERATING ACCOUNT FOR THE ESTABLISHMENT OF POOL RULES FOR THE SOUTH BLANCO-TOCITO POOL (FORMERLY PETTIGREW-TOCITO POOL), RIO ARRIBA COUNTY, NEW MEXICO: FIXING THE SPACING OF WELLS; FIXING GAS-OIL RATIOS; ESTABLISHING A CASING PROGRAM; AND RELATED MATTERS

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 o'clock a.m. on May 19, 1953, at Santa Fe, New Mexico, before the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission".

NOW, on this 26th day of May, 1953, the Commission, a quorum being present, having considered the testimony adduced at said hearing and the exhibits received in this cause, and being fully advised in the premises,

FINDS:

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

(2) That the Pettigrew-Tocito Pool has been duly classified as an oil pool, embracing lands in Rio Arriba County, New Mexico, defined and described as follows:

Township 26 North, Range 6 West, NMPM
SW/4 Section 3, SE/4 Section 4,
Section 9, NW/4 and S/2 Section 10,
NW/4 Section 15, N/2 Section 16

(3) That the Commission, by virtue of Order R-321, changed the name of the Pettigrew-Tocito Pool to South Blanco-Tocito Pool.

(4) That geological and engineering data presented at the hearing, and available to the Commission, indicate that one well completed to the Tocito sand will efficiently and economically drain and develop not less than 80 acres, and that the drilling of more wells would result in economic loss and earlier reduction of reservoir pressures, without increasing the ultimate recovery of oil from the reservoir, and would constitute waste, and that correlative rights, including those of royalty owners, will be protected by a spacing program in accordance herewith.

(5) That, for the orderly development of the South Blanco-Tocito Pool, a uniform spacing pattern should be established by this Commission, on the basis of one well to each 80 acres in the pool.

(6) That, in order to maintain reservoir pressures and prevent waste of associated gas, or casinghead gas, a limiting gas-oil ratio should be established, and that a ratio of 2,000 cubic feet of gas per barrel of oil produced is a reasonable limitation.

(7) That, in order to protect the producing formation, and potable water-bearing strata encountered in the pool, a uniform casing program should be adopted.

(8) That the operator or operators of the South Blanco-Tocito Pool should present to the Commission semi-annual reports showing pool performance in relation to bottom-hole pressures and gas-oil ratios.

IT IS THEREFORE ORDERED:

(1) That this order shall be known as "The South Blanco-Tocito Pool Rules."

(a) The South Blanco-Tocito Pool Rules shall be applicable to and govern the future development and operation of the South Blanco-Tocito Pool as it now exists or may hereafter be extended by order of the Commission.

(2) That all wells hereafter drilled in the South Blanco-Tocito Pool or any extension thereof shall be located in the center of the northwest quarter or the southeast quarter of each governmental quarter section, with a tolerance of 100 feet in any direction to avoid surface obstructions, except that no well shall be located closer than 660 feet to any lease line without special order of the Commission after due notice and hearing.

(a) That no well shall be drilled or produced in said pool except in conformity with the spacing pattern set forth above without special order of the Commission after due notice and hearing.

(b) That the location of any wells heretofore drilled in the South Blanco-Tocito Pool which does not conform to the provisions of these rules shall be treated as unorthodox locations, which said unorthodox locations are hereby approved. This approval shall include Lowry et al Federal 4-13-132, NE/4 NE/4 Section 9; Federal 1-134, NE/4 NW/4 Section 10; Federal 19-34-157, SW/4 NW/4 Section 9; Federal 21-40-182, NE/4 SW/4 Section 10; Federal 22-45-207, SW/4 SE/4 Section 10; and Federal 7-35-109, SW/4 SW/4 Section 3, all in Township 26 North, Range 6 West, NMPM.

(3) That a gas-oil ratio limit is hereby set for the South Blanco-Tocito Pool at the rate of 2000 cubic feet of gas for each barrel of oil produced.

(a) Nothing herein shall be construed as prohibiting the production of oil from wells within the pool whose gas-oil ratio exceeds 2000 cubic feet of gas for each barrel of oil produced, at a reduced rate which in the best judgment of the operator is consistent with good reservoir management, until such time as the production of oil in the South Blanco-Tocito Pool is allocated, at which time the provisions of Rule 506 of the Rules and Regulations of this Commission shall apply.

(4) The casing program of all wells hereafter drilled in the pool shall consist of at least two strings of pipe set in accordance with the following regulations:

(a) The surface casing shall consist of new or reconditioned pipe with an original mill test of not less than 1000 pounds per square inch, and at least one string of surface casing shall be set at a depth sufficient to protect all potable water-bearing strata encountered, and not less than 450 feet below the surface of the ground. Sufficient cement shall be used to fill the annular space back of the pipe to the bottom of the cellar. Cement shall be allowed to stand a minimum of 24 hours before initiating tests. Before drilling the plug a pump pressure of at least 600 pounds per square inch shall be applied. If at the end of 30 minutes the pressure shows a drop of 100 pounds per square inch, or more, the casing shall be condemned, subject to corrective operations and further testing.

(b) The producing oil string shall consist of new or reconditioned pipe with an original mill test of not less than 2100 pounds per square inch. The producing string shall be set and cemented with sufficient cement to fill the calculated annular space behind the pipe to a minimum of 1000 feet above the guide shoe. Cement shall be allowed to stand a minimum of 72 hours before initiating tests. Before drilling the plug a pump pressure of at least 600 pounds per square inch shall be applied. If at the end of 30 minutes the pressure shows a drop of 100 pounds per square inch, or more, the casing shall be condemned, subject to corrective operations and further testing.

(5) That upon the completion of any well in the South-Blanco-Tocito Pool, the bottom-hole pressure of such well shall be taken, and a report thereof filed with the Commission.

(a) Semi-annual tests of bottom hole pressures of the pool and producing gas-oil ratios shall be made, said tests to be made during the months of April and October of each year. Such tests are to be made in the presence of a representative of the Commission and may be witnessed by the representative of any owner or operator of a producing well in the pool. Tests as designated herein shall apply only to flowing wells within the pool.

(b) Bottom-hole pressure tests, as provided in 5-(a), herein, shall be made as follows: The operators shall cause wells to be shut in for a minimum of 72 hours, and all pressures shall be reported at a datum of minus-100 feet, and otherwise as provided by Rule 302 of the Rules and Regulations of the Commission.

(6) That in the event the production of oil from the South Blanco-Tocito Pool is allocated, then and in that event the individual well allowables for wells drilled in conformity with the spacing pattern provided for herein shall be established in accordance with the 80-acre proportional factors as provided in the Rules and Regulations of the Commission.

(a) The operator may at his option designate the proration unit for each well as being the north half, south half, east half, or west half of the governmental quarter section in which the well is located.

(7) That this order shall cover all of the South Blanco-Tocito Pool common source of supply as discovered in the No. 2 Scott Federal Well, drilled in the NW/4 SE/4 Section 9, Township 26 North, Range 6 West, NMPM.

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

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

E L Mechem
Edwin L. Mechem, Chairman

E S Walker
E. S. Walker, Member

R R Spurrier
R. R. Spurrier, Secretary

S E A L

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. 537
ORDER NO. R-326

THE MATTER OF THE APPLICATION OF
LOWRY et al OPERATING ACCOUNT FOR
THE ESTABLISHMENT OF POOL RULES
FOR THE ~~PETTIGREW~~ TOCITO POOL, South Blanco (formerly Pettigrew-Tocito Pool)
RIO ARRIBA COUNTY, NEW MEXICO;
FIXING THE SPACING OF WELLS; FIXING
GAS-OIL RATIOS; ESTABLISHING A
CASING PROGRAM; AND RELATED MATTERS

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 o'clock a.m. on May 19, 1953, at Santa Fe, New Mexico, before the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission".

NOW, on this _______ day of _____________, 1953, the Commission, a quorum being present, having considered the testimony adduced at said hearing, and the exhibits received in this cause, and being fully advised in the premises,

FINDS:

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

(2) That the Pettigrew-Tocito Pool has been duly classified as an oil pool, embracing lands in Rio Arriba County, New Mexico, defined and described as follows:

Township 26 North, Range 6 West, NMPM

SW¼ Section 3, SE¼ Section 4,

Section 9, NW¼ and S½ Section 10,

NW¼, Section 15; N½ Section 16.

(3) That the ~~Commission now~~ has pending before it a proposal, in ~~Case~~ No. 530, to change the name of the ~~Pettigrew-~~Tocito Pool.

(4) That geological and engineering data presented at the hearing, and available to the Commission indicate that one well completed to the Tocito sand will efficiently and economically drain and develop not less than 80 acres, and that the drilling of more wells would result in economic loss and earlier reduction of reservoir pressures, without increasing the ultimate recovery of oil from the reservoir, and would constitute waste, and that correlative rights, including those of royalty owners, will be protected by a spacing program in accordance herewith. SB

(5) That, for the orderly development of the ~~Pettigrew-~~Tocito Pool, a uniform spacing pattern should be established by this Commission, on the basis of one well to each 80 acres in the Pool.

(6) That, in order to maintain reservoir pressures and prevent waste of associated gas, or casinghead gas, a limiting gas-oil ratio should be established, and that a ratio of 2,000 cubic feet of gas per barrel of oil produced is a reasonable limitation.

(7) That, in order to protect the producing formation, and potable water-bearing strata encountered in the Pool, a uniform casing program should be adopted. SB

(8) That the operator or operators of the ~~Pettigrew-~~Tocito Pool should present to the Commission semi-annual reports showing Pool performance in relation to bottom hole pressures and gas-oil ratios.

IT IS THEREFORE ORDERED: SB

(1) That this order shall be known as the "~~Pettigrew-~~Tocito Pool Rules", ~~except, however, if the name of the Pettigrew-Tocito Pool be changed by order of the Commission, any such name selected shall be substituted herein.~~ SB

(a) The ~~Pettigrew-~~Tocito Pool Rules shall be applicable to and govern the future development and operation of the ~~Pettigrew-~~ SB

Tocito Pool as it now exists or may hereafter be extended by order of the Commission. SB

(2) That all wells hereafter drilled in the Pettigrew-Tocito Pool or any extension thereof shall be located in the center of the northwest quarter or the southeast quarter of each governmental quarter section, with a tolerance of 100 feet in any direction to avoid surface obstructions, except that no well shall be located closer than 660 feet to any lease line without special order of the Commission after due notice and hearing.

(a) That no well shall be drilled or produced in said Pool except in conformity with the spacing pattern set forth above without special order of the Commission after due notice and hearing.

(b) That the location of any wells heretofore drilled in the Pettigrew-Tocito Pool which does not conform to the provisions of these rules, shall be treated as unorthodox locations, which said unorthodox locations are hereby approved. This approval shall include Lowry et al. Federal 4-13-132, NE¼NE¼, Sec. 9; Federal 1-134, NE¼NW¼, Sec. 10; Federal 19-34-157, SW¼NW¼, Sec. 9; Federal 21-40-182, NE¼SW¼, Sec. 10; Federal 22-45-207, SW¼ SE¼ Sec. 10, and Federal 7-35-109, SW¼SW¼, Sec. 3, all in Township 26 North, Range 6 West NMPM. SB

(3) That a gas-oil ratio limit is hereby set for the Pettigrew-Tocito Pool at the rate of 2000 cubic feet of gas for each barrel of oil produced.

(a) Nothing herein shall be construed as prohibiting the production of oil from wells within the pool whose gas-oil ratio exceeds 2000 cubic feet of gas for each barrel of oil produced, at a reduced rate which in the best judgment of the operator is consistent with good reservoir management, until such time as the production of oil in the Pettigrew-Tocito Pool is allocated, at which time the provisions of Rule 506, of the Rules and Regulations of this Commission shall apply.

(4) The casing program of all wells hereafter drilled in the Pool shall consist of at least two strings of pipe set in accordance with the following regulations.

(a) The surface casing shall consist of new or reconditioned pipe with an original mill test of not less than 1000 pounds per square inch, and at least one string of surface casing shall be set at a depth sufficient to protect all potable water-bearing strata encountered, and not less than 450 feet below the surface of the ground. Sufficient cement shall be used to fill the annular space back of the pipe to the bottom of the cellar. Cement shall be allowed to stand a minimum of 24 hours before initiating tests. Before drilling the plug a pump pressure of at least 600 pounds per square inch shall be applied. If at the end of 30 minutes the pressure shows a drop of 100 pounds per square inch, or more, the casing shall be condemned, subject to corrective operations and further testing.

(b) The producing oil string shall consist of new or reconditioned pipe with an original mill test of not less than 2100 pounds per square inch. The producing string shall be set and cemented with sufficient cement to fill the calculated annular space behind the pipe to a minimum of 1000 feet above the guide shoe. Cement shall be allowed to stand a minimum of 72 hours before initiating tests. Before drilling the plug a pump pressure of at least 600 pounds per square inch shall be applied. If at the end of 30 minutes the pressure shows a drop of 100 pounds per square inch, or more, the casing shall be condemned, subject to corrective operations and further testing.

(5) That upon the completion of any well in the ~~Pettigrew-~~ Tocito Pool, the bottom hole pressure of such well shall be taken, and a report thereof filed with the Commission.

(a) Semi-annual tests of bottom hole pressures of the Pool and producing gas-oil ratios shall be made, said tests to be made during the months of April and October of each year. Such tests are to be made in the presence of a representative of the Commission and may be witnessed by the representative of any owner or operator of a producing well in the Pool. Tests as designated herein shall apply only to flowing wells within the Pool.

(b) Bottom hole pressure tests, as provided in (5) (a), herein, shall be made as follows: The operators shall cause wells to be shut in for a minimum of 72 hours, and all pressures shall be reported at a datum of minus 100 feet, and otherwise as provided by Rule 302 of the Rules and Regulations of the Commission.

(6) That in the event the production of oil from the Petti-grew-Tocito Pool is allocated, then and in that event the individual well allowables for wells drilled in conformity with the spacing pattern provided for herein shall be established in accordance with the 80-acre proportional factors as provided in the rules and regulations of the Commission.

(a) The operator may at his option designate the proration unit for each well as being the north half, south half, east half, or west half of the governmental quarter section in which the well is located.

(7) That this order shall cover all of the ~~Pettigrew~~-Tocito Pool common source of supply as discovered in the No. 2 Scott Federal Well, drilled in the NW$\frac{1}{4}$SE$\frac{1}{4}$, Section 9, Township 26 North, Range 6 West, NMPM.

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

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

EDWIN L. MECHEM, Chairman

E. S. WALKER, Member

R. R. SPURRIER, Secretary

S E A L

Case 537

Lowry et al Operating Account

616 East Central Avenue

Albuquerque, New Mexico

UPBM

May 29, 1953

OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO
JUN 1 1953

Mr. W. B. Macy
Post Office Box 871
Santa Fe, New Mexico

Re: South Blanco Tocito Pool

Dear Bill:

Attached is the report which I borrowed on the joint hearing of the Dollarhide Fields, Andrews County, Texas, and Lea County, New Mexico. This report helped immensely in the preparation of our data for the recent Field Rules hearing on the South Blanco Tocito Pool.

I wish to express my appreciation for the consideration and cooperation you gave to our request for Field Rules on the South Blanco Tocito Pool. Your interest in our problem relating to this Pool was greatly appreciated.

Thanks again for the use of the attached report.

Yours very truly,

Curt.

A. F. Holland

AFH:eg
encl

Case 537

Re

Lowry et al Operating Account

616 East Central Avenue

Albuquerque, New Mexico

OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO
JUN 1 1953

May 29, 1953

Mr. R. R. Spurrier
Post Office Box 871
Santa Fe, New Mexico

Re: South Blanco Tocito Pool

Dear Mr. Spurrier:

At the recent hearing on May 19, 1953 for Field Rules pertaining to the South Blanco Tocito Pool, Rio Arriba County, New Mexico, the statement was made that Lowry et al Operating Account was having a study made to determine the proper procedure to be used for the conservation of the casing-head gas of subject Pool. Attached is a copy of the completed report, prepared by Gasoline Plant Construction Corporation of Houston, Texas, demonstrating that this Company is concerned about the conservation of this gas, and are conducting the necessary planning to arrive at the proper measures for conservation of this casing-head gas. It is believed that our decision as to whether we should construct the facilities or allow outsiders to do this, will soon be resolved, thereby allowing the sale of this gas and associated products.

I would like to express appreciation on behalf of Lowry Oil Company and myself for the consideration and the cooperation given by yourself and Mr. Macy to our Field Rule problems for the South Blanco Tocito Pool. Your interest and consideration of these problems were greatly appreciated.

Yours very truly,

A. F. Holland

A. F. Holland

AFH:eg

CLASS OF SERVICE

This is a full-rate Telegram or Cablegram unless its deferred character is indicated by a suitable symbol above or preceding the address.

WESTERN UNION

W. P. MARSHALL, PRESIDENT

1201

SYMBOLS

DL=Day Letter

NL=Night Letter

LT=International Telegram

LT=International Victory Ltr.

The filing time shown in the date line on telegrams and day letters is STANDARD TIME at point of origin. Time of receipt is STANDARD TIME at point of destination

OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO
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OIL AND GAS COMMISSION, ATTN R R SPURRIER=

SANTA FE NMEX=

Case 537

:PLEASE BE ADVISED THAT OUR COMPANY CONCURS WITH LOWRY ETAL OPERATING ACCOUNT GROUP IN THEIR APPLICATION AS TO 80 ACRE SPACING IN THE PETTIGREW TOCITO POOL AND STRONGLY URGE PASSING OF THIS APPLICATION FOR THE ECONOMIC AND COMMON RESERVOIR GOOD OF ALL PARTIES CONCERNED=

DAN W JOHNSTON JOHNSTON OIL AND GAS CO=..==

NEW MEXICO OIL CONSERVATION COMMISSION

SANTA FE, NEW MEXICO

IN THE MATTER OF THE APPLICATION OF LOWRY, ET AL OPERATING ACCOUNT FOR THE ESTABLISHMENT OF POOL RULES FOR THE PETTIGREW-TOCITO (ERKAN-TOCITO) POOL, RIO ARRIBA COUNTY, NEW MEXICO; FIXING THE SPACING OF WELLS; FIXING GAS-OIL RATIOS; ESTABLISHING A CASING PROGRAM; AND RELATED MATTERS.

CASE NO. 537

TO THE NEW MEXICO OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO.

Comes the undersigned, Lowry et al Operating Account, with offices at 616 Central Avenue, East, Albuquerque, New Mexico, by its attorney, Jason W. Kellahin, P. O. Box 361, Santa Fe, New Mexico, and petitions this honorable commission for an order, fixing by appropriate rules and regulatiohs, rules for the development and operation of the Pettigrew-Tocito (Erkan-Tocito) Pool, Rio Arriba County, New Mexico, as now defined by Commission order or orders, and as the same may hereafter be extended, as follows:

1. The fixing by appropriate rules and regulations, of spacing requirements applicable to wells hereafter drilled in the Pettigrew-Tocito (Erkan-Tocito) Pool, Rio Arriba County, New Mexico, on the basis of one well on each 80-acres and setting a spacing pattern therefore with provisions for related matters, including special approval, after notice and hearing, of unorthodox well locations necessitated by the size and shape of available units or by the nature of the terrain, or for other causes.

2. The fixing, by appropriate order, of gas-oil ratios in such amount as the Commission may determine may be produced without waste.

3. The establishment of a casing and cementing program for the protection of shallow potable water strata or stratum from pollution.

In support of which Petitioner would show the Commission as follows:

I.

The Pettigrew-Tocito (Erkan-Tocito) Pool is located in Rio Arriba County, New Mexico, its boundaries being defined by order of this Commission, as more fully described in Exhibit A, which is attached hereto and made a part hereof. The Pool is productive of oil in commercial quantities from the Tocito sand, encountered at a depth of approximately 6,600 feet.

II.

There are now a total of nine wells which are productive of oil from the Tocito sand within the boundaries of the Pettigrew-Tocito (Erkan-Tocito) Pool, all of which are operated by Petitioner. These wells have beeh drilled, for the most part, to conform to an 80-acre spacing pattern, as proposed in this petition, as more fully shown by Exhibit A, attached hereto, and made a part hereof.

III.

Petitioner has been actively engaged in the drilling and operation of wells within the Pettigrew-Tocito (Erkan-Tocito) Pool. It has accumulated statistics and information bearing upon the permeability, porosity and producing characteristics of the Tocito sand and from such information and statistics it believes that one well completed in the Tocito sand will efficiently and economically drain not less than 80 acres of that formation, and that the drilling of more wells is unnecessary, would result in economic loss without increasing the ultimate recovery of oil from the reservoir, and would constitute waste, as defined by New Mexico Statutes and the rules and regulations of this Commission.

IV.

Petitioner is prepared to submit evidence pertinent to a proper spacing program which will economically and efficiently permit, without unnecessary drilling costs or operating expenses, and without impairment of the rights of others, the recovery of oil reasonably producible from the Pettigrew-Tocito (Erkan-Tocito) Pool. From information available to it, Petitioner believes, and would show, that a uniform spacing unit of not less than 80 acres should be provided with respect to wells hereafter drilled in the Pool, with such wells to be located on said drilling units to conform to present development in the Pool.

V.

Petitioner has accumulated statistics and information bearing upon the production of associated gas, or casinghead gas, in connection with the production of oil from the Tocito sand within the boundaries of the Pettigrew-Tocito (Erkan-Tocito) Pool, and from such information and statistics, believes and would show that the limiting gas-oil ratio within the Pool should reasonably be set at 2,000 cubic feet of gas for each barrel of oil produced, in accordance with Commission Rule 506 (a).

VI.

Petitioner has accumulated statistics and information bearing upon the location, depth and thickness of potable water-bearing strata within the boundaries of the Pettigrew-Tocito (Erkan-Tocito) Pool, and from such information and statistics, believes and would show that a proper casing and cementing program should be established for the protection of such strata against pollution, by requiring that the surface pipe be set through the shallow potable water-bearing beds and set with a sufficient amount of cement to circulate the cement behind the pipe to the bottom of the cellar.

WHEREFORE, Petitioner requests the Commission, after notice and hearing as required by law and the rules and regulations of the Commission, to enter its order or orders fixing the spacing of wells hereafter drilled in the Pettigrew-Tocito (Erkan-Tocito) Pool, Rio Arriba County, New Mexico, as it now exists or may hereafter be extended, on the basis of one well located on a drilling unit of approximately 80 acres substantially in the shape of a rectangle, such drilling unit to lie wholly within the same quarter section, according to the governmental survey thereof, and to consist of adjoining quarter quarter sections which have contiguous boundaries, either South or East, North or West, with wells to be located on said drilling units substantially in the center of the NW¼ and SE¼ of each quarter section, as shown by the governmental survey thereof, with an allowable tolerance of 100 feet from such location, with suitable provisions for any related matters, including special provisions, after notice and hearing, of unorthodox well locations for good cause shown; and providing for a gas-oil ratio limitation of 2,000 cubic feet of gas to each barrel of oil produced, said gas-oil ratio limitation to be enforced by the Commission by suitable order or orders as may become necessary; and providing for a casing and cementing program which would require that the surface pipe be set through the shallow potable water-bearing beds and set with a sufficient amount of cement to circulate the cement behind the pipe to the bottom of the cellar; and providing that in the event the Commission determines to institute orders prorating production of oil at some future date, that each 80-acre drilling unit shall be treated as a proration unit for such purpose.

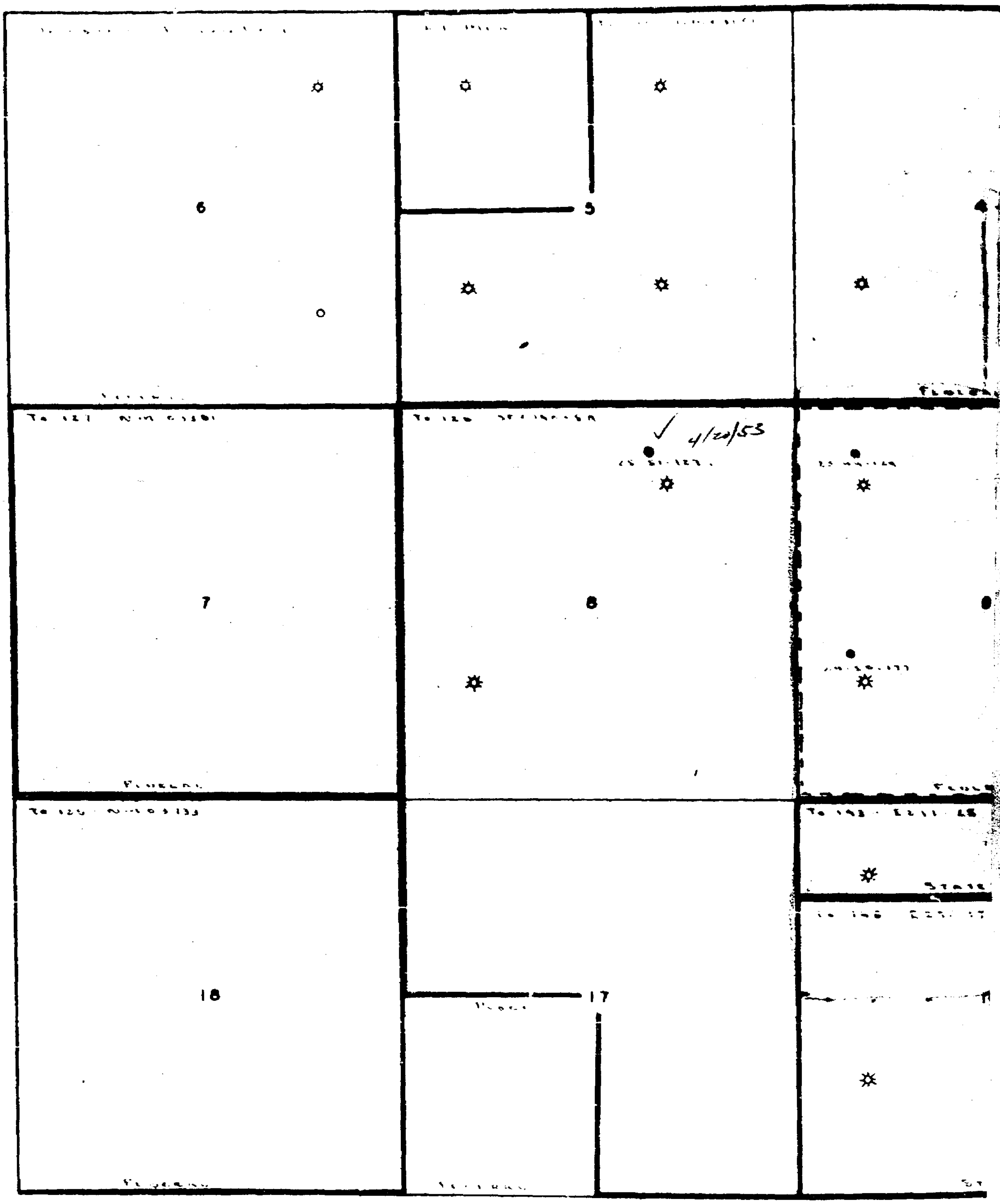
Respectfully submitted

LOWRY et al OPERATING ACCOUNT

By Jason W. Kellahin
Attorney

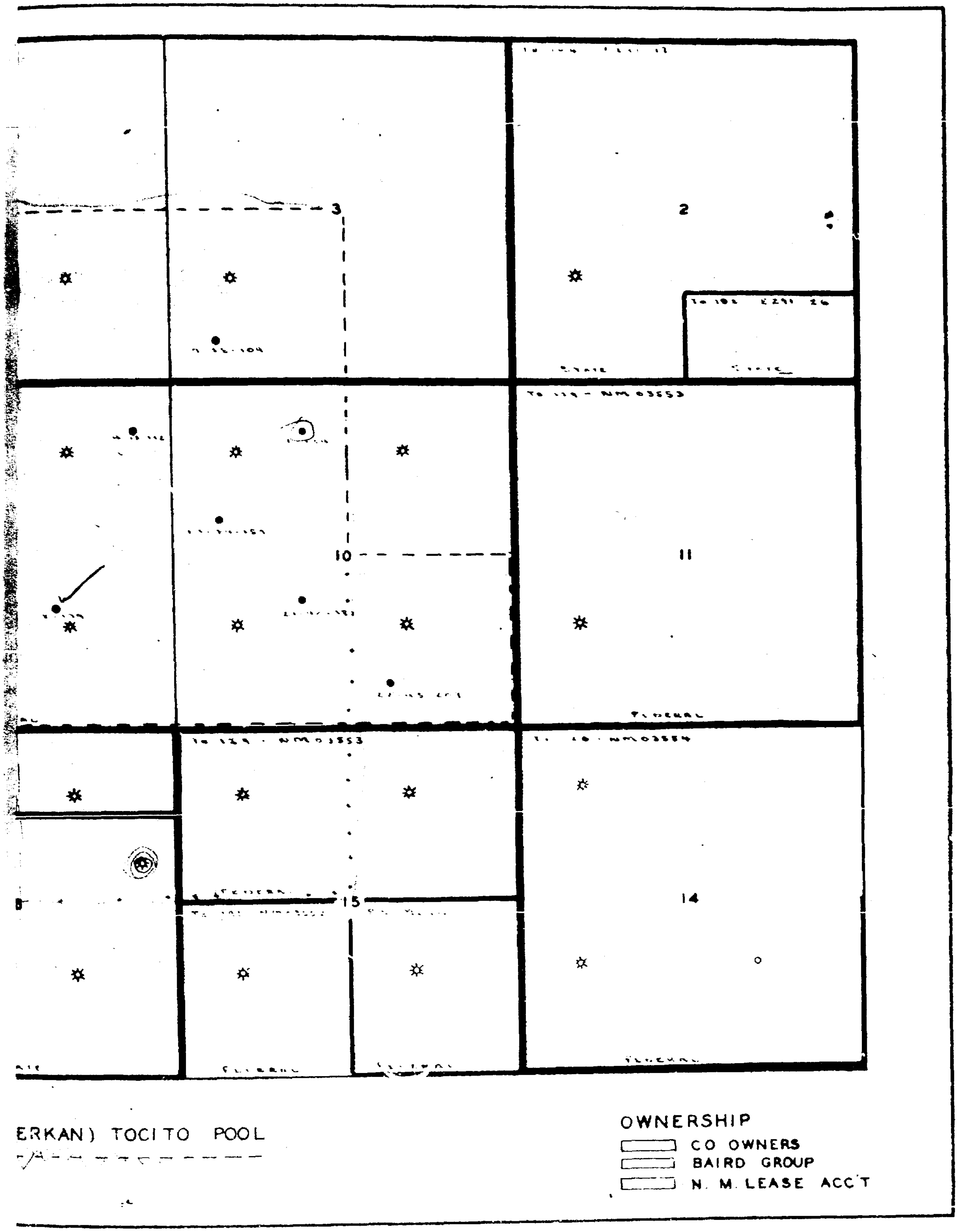
Jason W. Kellahin
P. O. Box 361
Santa Fe, New Mexico

Attorney for Petitioner



LOWRY OIL COMPANY
T 26 N — R 6 W
RIO ARRIBA COUNTY, N. M.

PETTIGREW (



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OWNERSHIP
CO OWNERS
BAIRD GROUP
N. M. LEASE ACC'T

Fresh H_2O
Page 10-450'

BEFORE THE
OIL CONSERVATION COMMISSION
STATE OF NEW MEXICO

CASE 537: Application of Lowry et al [illegible] for order establishing pool [illegible] Pettigrew-Tocito Pool, Rio Arriba County, New Mexico, with attention to spacing regulations, the fixing of gas-oil ratios, establishment of a casing program, and related matters.

TRANSCRIPT OF HEARING

May 19, 1953
Date

BEFORE: Honorable Ed. L. Mechem, Governor
[illegible] E. S. Walker, [illegible]
[illegible] R. R. Spurrier, [illegible]

STATE OF NEW MEXICO)
) ss
COUNTY OF BERNALILLO)

I HEREBY CERTIFY That the within transcript of proceedings before the Oil Conservation Commission is a true record of the same to the best of my knowledge, skill, and ability.

DONE at Albuquerque, N. M., this 29th day of May 1953.

E. E. Greeson

E. E. Greeson
Notary - Reporter

My Comm. Ex.:
August 4, 1956

NOTARY PUBLIC · BERNALILLO

OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO.
RECEIVED
JUN 1 - 1953

A-1

COMMISSIONER SPURRIER: We will move on to Case 537.

(Mr. Graham reads the call of the case.)

MR. KELLAHIN: If the Commission please, Jason Kellahin, representing Lowry et al Operating Account.

This case, as the petition states, is an application for the establishment of pool rules for the Pettigrew-Tocito Pool. As the Commission will recall, there is a case pending before the Commission at the present time having to do with the change of the name of pools, and it is our request any pool rule established for this pool be made applicable in case the name is changed.

Briefly, the application is for the establishment of a uniform spacing pattern on the basis of one well to each 80 acres; for the establishment of a uniform gas-oil ratio for the pool, and at the rate of 2000 cubic feet of gas to each barrel of oil, which is in conformance with the present statewide rule in the absence of a special setting by the Commission; and for the establishment of the uniform casing program for the protection of the producing strata and the water formations.

I would like to mention this: at the present time the Lowry et al Operating Account holds leases on the entire area which is within the defined boundaries of the pool.

We will have three witnesses: Mr. Henry Birdseye, Mr. Art Holland, and Mr. Robert Anderson.

Will you gentlemen stand and be sworn, please?

(Witnesses sworn.)

MR. KELLAHIN: I would like to call Mr. Henry Birdseye as the first witness.

o

HENRY BIRDSEYE,

having been first duly sworn, testified as follows:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q Will you state your name, please?

A Henry S. Birdseye.

Q By whom are you employed, Mr. Birdseye?

A Lowry Oil Company.

Q What position do you hold with that company?

A Geologist.

Q How long have you been connected with the Lowry Oil Company, Mr. Birdseye?

A Approximately nineteen months.

Q And have you had any special education or training to fit you as a geologist?

A Yes, sir; I have a Bachelor of Arts degree with major in geological science.

Q From what school is that?

A Harvard University.

Q Have you testified before this Commission in your capacity as a geologist before?

A I have.

MR. KELLAHIN: Will the Commission accept the witness' qualifications as an expert?

COMMISSIONER SPURRIER: It will.

Q Mr. Birdseye, as geologist for the Lowry Oil Company, have you had occasion to study and are you familiar with the Pettigrew-Tocito Pool?

A Yes, sir, I have. I have supervised the geology on all of the wells drilled in that pool, with the exception of the discovery well.

Q And you have made an intensive study of the pool since your employment?

A Yes, I have.

Q Are you familiar with the field limits of the pool as of the present time?

A As established by the Oil Conservation Commission, I am, sir.

Q Do you have a plat showing those limits?

A I do.

Q Mr. Birdseye, I hand you what has been marked as

Applicant's Exhibit 1 and ask you to state what that is.

A This is a plat showing a portion of the Lowry acreage in Rio Arriba County, and defining the limits of the Pettigrew-Tocito oil field as established by the Oil Conservation Commission.

Q How are the limits of the present Pettigrew-Tocito Pool delineated on this map?

A Includes all of Section 9, all except the NE quarter of Section 10, the SE quarter of Section 7, the SE quarter of Section 4, the North half of Section 16, the NW quarter of Section 15.

Q Now, referring to Exhibit 1, what does the colored area show?

A The colored area includes a portion of the Lowry acreage whichis shown on this plat.

Q Within the defined limits of the pool, is all the ownership of leases in the Lowry Oil Company, Lowry et al Operating Account?

A Yes, sir, all of the limits -- all of the acreage within the limits -- of the pool, as established by the Oil Conservation Commission, is operated by the Lowry et al Operating Account.

Q Now, does this map reflect the producing wells which have been drilled to the Tocito formation within the limits of the pool?

A Yes, sir, it does.

Q How are those shown on the map?

(Off the record.)

A This plat shows both the gas wells and the oil wells, which are -- which have been drilled and are operated by the Lowry et al Operating Account. The oil wells are as shown in the legend distinctly portrayed by a black dot with a small ring around them.

Q And the gas wells, are they drilled to the Tocito formation?

A No, the gas wells in that vicinity are all producing from the Pictured Cliff formation.

Q How many producing wells are there within the pool?

A There are now ten producing oil wells.

Q And are all those within the boundaries of the pool?

A They are, with the exception of the last completed well, which was completed approximately a month or five weeks ago, and has not yet been placed within the limits of the pool.

Q Have you made application to this Commission to have that well included in the pool?

A We have filed a form on that.

MR. KELLAHIN: We would like to offer Applicant's

Exhibit 1 in evidence.

COMMISSIONER SPURRIER: Without objection, it will be received.

Q Are you familiar with the lease ownership within the region of the Pettigrew-Tocito Pool, Mr. Birdseye?

A Yes, sir, I am. I have prepared a map showing the Lowry leases in relation to the leases of surrounding operators.

Q In reference to Exhibit 2, marked Applicant's Exhibit 2, what does that show, Mr. Birdseye?

A This Exhibit No. 2 shows the wells which have been drilled on and in the vicinity of the Lowry leases. It shows the ownership of the leases which are included in and surround the Lowry lease block in Rio Arriba County.

Q Does that -- What does the colored section on the exhibit show?

A The Lowry acreage is colored in in yellow.

1b Q Does that map accurately reflect who is concerned in the area of the Pettigrew-Tocito Pool and would be interested in this application?

A It does.

MR. KELLAHIN: I offer in evidence Applicant's Exhibit 2.

COMMISSIONER SPURRIER: Without objection, it will be received.

Q Now, Mr. Birdseye, have you prepared a contour map showing the Tocito formation, the top of the Tocito?

A I have.

Q I hand you what has been marked as Applicant's Exhibit 3 and ask you what that shows, Mr. Birdseye?

A This is a map of the area which includes the Pettigrew-Tocito oil pool. It is primarily a structure contour map of that pool with the contours on top of the Tocito pay sand.

Q From what information did you derive those contours?

A Primarily from an interpretation of electrical logs of those drilled oil wells.

MR. KELLAHIN: We offer in evidence Applicant's Exhibit 3.

COMMISSIONER SPURRIER: Without objection, it will be received.

Q Now, Mr. Birdseye, do you have electric logs -- I mean cross sections of the Pettigrew-Tocito formation?

A I have prepared two cross sections of the electrical logs involving representative sections of the Pettigrew-Tocito field.

Q Do you have those here?

A I have them here.

Q. I hand you what has been marked Applicant's Exhibit 4 and ask you to state what that is.

A This is an electrical log cross section of four wells along the line as specified on the previously entered exhibit, which is a contour map of the Pettigrew-Tocito field.

Q By previously entered exhibit, you mean Exhibit 3?

A Exhibit 3; yes, sir.

Q Now, what does that reflect in relation to the continuity of the Tocito field, Mr. Birdseye?

A Well, we have found in drilling this Tocito field, that the pay sand is continuous and predictable within a reasonable plan of development. And we have also found from electrical log interpretations, from core analyses, and from sample examinations, there is every reason to believe that the sand is continuous within the limitations of the Pettigrew-Tocito field.

Q Have you encountered anything in your study which would indicate it wasn't continuous?

A We haven't encountered any faulting or any permeability and porosity barriers within the limits of the field.

Q How would you describe the Tocito formation from a geologic point of view?

A Well, the producing sand in the Tocito reservoir is a sand lens of the upper cretaceous age. It is a typical shore line development which is found on the southwest flank of the San Juan Basin. It does not, as far as we have been able to determine, have any structural control in relation to the oil accumulation. Rather, it is entirely stratigraphic in nature due to the fact that the sand does not extend as a continuous formation with permeability and porosity over a wide area outside the limits of the field.

Q Have you in your study encountered any evidence of geologic barriers which would interfere with the continuity of the reservoir?

A Not within the field.

Q From your examination of the pool and the Tocito formation, do you consider that a good permeable sand?

A It appears to have remarkably high permeability in comparison with other sands found in the San Juan Basin. Core analysis shows an average permeability in the range of 125 milledarcys. And the interpretation of the electrical and micro logs substantiates the core analyses we have made, as does the performance of the wells.

Q Now, in your examination of the Pettigrew-Tocito field and your study of the geologic information, what have you found in relation to the presence of fresh, potable water-bearing strata?

A We found early in the development of the field that there is a stratum bearing fresh water at a relatively shallow depth averaging 450 feet. And we have drilled eight water wells to that stratum, which have produced all of the drilling and potable water used in the development of that area.

Q Do you have any recommendation to make to this Commission as to a casing program for the protection of that potable water strata?

A Well, we consider that that potable water should be carefully protected, as we have done already. That program of protection should continue in the future by setting a sufficient amount of surface casing in order to properly prevent -- to properly prepare for the protection of the potable water. We feel a minimum of 450 feet of surface casing is required.

Q In connection with your drilling of water wells, are any of those water wells located close to oil wells?

A Some are in close proximity. I can think of two within several hundred feet of these oil wells. The fact that our casing program has been ample, namely, setting through this water sand, is attested to by the fact that none of our water wells have shown any indication of drilling fluid whatsoever.

MR. KELLAHIN: Does the Commission have any questions?

COMMISSIONER SPURRIER: Apparently not.

MR. GRAHAM: What does the gentleman think of the closure of that pool extending northwest on the map?

MR. KELLAHIN: We will have some testimony on that from Mr. Holland, Mr. Graham, if you would care to hear it from him; although, I have no objection to this witness testifying to what he knows.

THE WITNESS: I would be pleased to say a few words on that, sir.

As you have seen, the structure map over there is probably considerably different than the Bagley Pool. As I stated earlier, this is a stratigraphic trap rather than a structural trap. Consequently, it isn't of an anticlinal or domal nature, and you cannot draw closed contours of a producing formation. In other words, the reason for the accumulation is sand conditions rather than structural position. And variations in sand thickness and porosity and permeability appear to be the defining factors in limiting the accumulation.

2 MR. GRAHAM: It could go southeast or northwest?

A Yes, sir; it could.

MR. GRAHAM: Drilling will find that out.

A Yes, sir; it will.

MR. KELLAHIN: That is all.

I would like to offer in evidence Applicant's Exhibit 4.

COMMISSIONER SPURRIER: Without objection, it will be admitted.

MR. KELLAHIN: That is all, sir.

COMMISSIONER SPURRIER: Are there any other questions of this witness? If not, the witness may be excused.

MR. KALLAHIN: I would like to call Mr. Art Holland.

(Off the record.)

o

ART HOLLAND,

having been first duly sworn, testified as follows:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q Will you state your name, pleas ?

A My name is A. F. Holland.

Q By whom are you employed, Mr. Holland?

A By Lowry Oil Company.

Q In what capacity?

A As petroleum engineer.

Q Do you hold an official position in that company?

A I do.

Q And what is that position?

A I am in charge of the engineering department.

Q Have you had any special training and experience to qualify you for that position?

A I have a BS Degree in Petroleum Engineering from the University of Oklahoma. And I have practiced my profession approximately six years.

Q Have you testified before this Commission before in your capacity as an engineer?

A I have.

MR. KELLAHIN: Will the Commission accept the witness' qualifications as an expert?

COMMISSIONER SPURRIER: It does.

Q Now, Mr. Holland, are you familiar in connection with your work with the Lowry Oil Company, with the history of the Pettigrew-Tocito Pool in Rio Arriba County?

A Yes, sir, I am. I have followed the development in the field since the time of, roughly, when the first three wells were completed. The discovery well of that field was the Lowry et al Operating Account Federal 2-17A. It is located in the center of the NW quarter of the SE quarter of Section 9, Township 26 N, Range 6 W, Rio Arriba County, New Mexico.

Thewell was completed in the Tocito formation at a total depth of 6,692 feet on July 10th, 1951. The initial potential of the well was 720 barrels per day. Since that time, Lowry has completed nine additional wells.

To April 30th, 1953, the field had produced 522,972 barrels of oil, and 810,032,000 MCF of gas.

Q Mr. Holland, have you prepared a performance history of the pool in the form of an exhibit?

A I have. The production information on the --

Q I hand you what has been marked as Applicant's Exhibit 5 and ask you if that is that exhibit.

A Yes; that exhibit gives factual data on the Pettigrew-Tocito field.

Q Continue, then, on your history.

A To continue on the history a little more: The crude oil averages approximately 43.8 degrees API, which is a relatively high gravity crude. It is a good quality crude of paraffin type. And it is suited for topping and cracking to give high yields of good quality gasoline.

The oil in the field is purchased by the Malco Refining Corporation. The oil is transported by pipe line from the Pettigrew-Tocito field to their refinery at Prewitt, New Mexico.

Q Does that include all the production of the pool, Mr. Holland?

A That includes the entire pool production.

Q Are you familiar with the field history, Mr.

Holland?

A Yes, sir; I am.

Q Referring to Applicant's Exhibit 5, will you state what that exhibit shows in connectbn with the field history?

A As to production information?

Q Yes, sir.

A In Exhibit No. 5 we have tabulated the production history of the field from inception to April 30th, 1953, showing the following information:

The monthly oil production in barrels, the monthly gas production MCF, the producing gas-oil ratio in cubic feet per barrel, the daily average oil production in barrels per month, the daily average gas production MCF per month, the cumulative oil production, and the cumulative gas production from inception through that period.

This information is also reflected in this exhibit in graphical form.

Q Does that reflect the reservoir pressures during the life history of the pool, Mr. Holland?

A It does.

Q What does it show in that connection?

A The initial reservoir pressure as determined in the discovery well at a datum of minus 100 feet was 2,109 PSI. Since the completion of the discovery well, bottomhole pressure has been taken at completion of each and every well. In addition to that, during this producing period four general bottomhole pressure surveys have been conducted.

These surveys were conducted by shutting all the wells in the field in for a minimum of 72 hours and taking bottomhole pressures at a datum of minus 100 feet. The results of these four surveys, pressure results, which are volumetric averages, were 2,130 pounds, 2,095 pounds, 2,037 pounds and 2,001 pounds.

Q Have you prepared a further exhibit reflecting the bottomhole pressure test results, Mr. Holland?

A Tabulated in the exhibit is a record of each and every test that has been conducted. That is, bottomhole pressure tests that have been conducted for this pool.

In connection with the four general surveys I mentioned, those -- the dates of those surveys were as follows:

The original pressure was determined on July the 26th, 1951, the first general survey was taken May the 1st, 1952, and the second survey was taken August the 18th to 20th, 1952. The third general survey was taken January the 12th to the 14th, 1952. And the fourth general survey, which is a very recent survey, was conducted April the 27th to 28th, and the exhibit shows 1952; it should be '53.

Q Were you present when these surveys were made, Mr. Holland?

A I was present and conducted -- We conducted the surveys with our own equipment with the exception of the first survey and initial test.

2b Q Would you describe to the Commission the procedure that was followed in making those surveys, briefly?

A Our procedure was toleave the well shut in at least 72 hours to obtain the proper stabilization and build up pressure. After the 72-hour period, we determined the bottomhole pressure of each well with an Amerada type surface pressure guage. And this guage was calibrated for the existing reservoir temperature.

Q Have you prepared a further exhibit showing the isobaric map reflecting the bottomhole pressures?

A In Exhibit 5 there are four isobaric maps reflecting the pressure conditions determined on each of the four general pressure surveys. This isobaric plat or map was used to determine the average pressure of each 40-acre tract considered productive for the field. And the pressures obtained on each 40-acre tract were volumetrically weighed, with sand volumes determined by a sand isopac map, which will be presented later in this hearing. And the results of the average pressures represent volumetric pressure determinations.

Q Did you find in connection with your studies there was a higher pressure on one side of the field than on the other?

A On the east side of the field the pressures are somewhat lower than on the west side of the field. The density of drilling has been somewhat greater on the east side of the field. However, from our pressure behavior, we do not think that the field will extend to an appreciable distance in the east or southeasterly direction.

Q Have you been able to enclose the field on the west side?

A We --

Q Under your present information.

A From our present information, we have assumed that the field -- the sand lens -- disappears in that direction. And this will be reflected on the isopac map, which will be presented later in the hearing.

Q Yes.

A We have continued the sand -- we have estimated the extent of the sand -- in the east or southeasterly direction by a continuation of the isopac lines determined from wells that have been drilled.

Q Have you prepared a further exhibit reflecting the gas-oil ratio information, Mr. Holland?

A I would like to elaborate a little more on these isobaric maps.

Q Pardon me.

A They are not closed on the westerly or northwesterly edge of the field, because the field limits have not been determined in that direction as yet. And we believe that the field -- the sand lens -- will continue in that direction. We have made -- attempted to delineate -- the actual field outline in that direction.

Q To go back to the tabulation of bottomhole pressures on the individual wells, does that reflect a drop in pressure in later wells as compared to earlier wells?

A During the development program of this field, we have determined that the initial pressure of each well drilled subsequent to the drilling of the discovery well has been considerably lower than the initial reservoir pressure.

Q And could you state to the Commission how much lower?

A I can. However, we have an exhibit showing that. We have a later exhibit.

Q I am sorry, sir. Now, have you prepared an exhibit reflecting gas-oil ratio information?

A Contained in the Exhibit 5 is a tabulation of all the gas-oil ratio tests conducted for wells of the Pettigrew-Tocito Pool. We have a fairly complete record of each and every well here. We have spent considerable time obtaining the data for these tests in order that we might properly determine the production characteristics of the pool. And tabulated in this exhibit are those tests.

Q By reference to your exhibit and your experience in the pool, do you have any recommendation to make to this Commission in regard to producing gas-oil ratios?

A For the efficient operation of this pool, we believe that a limiting gas-oil ratio of 2000 cubic feet per barrel should be established.

Q Have you prepared an exhibit reflecting the core records of the Pettigrew-Tocito Pool?

A Also contained in Exhibit 5 is a description of the coring that has been done by Lowry et al Operating Account in the field.

Q How many wells have you cored?

A Four wells out of ten, representing forty percent of the wells, have been cored.

Q Were they cored through the entire section?

A The entire section was cored. And approximately 100 percent recovery was achieved, except for one well, Federal 23-24-129. I believe there was about three feet of core in a relatively unimportant portion of the sand that wasn't recovered.

Q In selecting the wells to be cored, were they dispersed through the producing field?

A They are pretty well -- the four wells cored are a representative -- represent a representative area of the field there. The wells were: Federal 413-132, Federal 22-45-207, Federal 23-49-129, and Federal 24-50-177.

Now, those wells will be detailed on a plat to show what dispersion was achieved.

Q Have you prepared a record of the history of the individual wells?

A Exhibit 5 also contains a summary of the pertinent information on the ten producing wells of the Pettigrew-Tocito field showing the -- among other things -- the location, the elevation, the time at which drilling commenced and was completed, when the well was put to production, the pipe program, the total depth, and any special completion procedure that was performed on the wells.

Q In that connection, Mr. Holland, are all the producing wells in the Pettigrew-Tocito Pool drilled and operating by the Lowry et al Operating Account?

A Lowry et al Operating Account operates the ten producing wells in the Pettigrew-Tocito Pool.

3 Q And that is all the wells in the pool?

A That represents the entire field production.

Q Have you prepared an exhibit reflecting drill stem test results?

A Drill stem test results are also included in this Exhibit No. 5. And our procedure recently where the sand can fairly well be predicted by the use of electric logs has not necessitated drill stem testing. However, we recently drill stem tested a portion of the Tocito sand. This test was conducted on Federal 25-51-127 to determine if the lower portion of the sand zone was productive.

Q And what was the result of that test?

A On that test there was no oil recovery and no gas recovery. And it is concluded that the lower portion of the Tocito sand in that immediate area wasn't productive.

Our core analysis has shown that in some wells this lower portion has porosity and permeability development of a low magnitude. And in certain areas we consider it productive, but in the immediate area of this well, as proved by drill stem test, it wasn't.

Q I hand you what has been marked as applicant's Exhibit 6 and ask you what that reflects, Mr. Holland.

A That exhibit is a core analysis report on the Lowry Federal 4-13-132.

Q Now, do you have other core analysis reports?

A We have, and are submitting our complete core analysis record, which represents core analyses on the four wells previously mentioned, and in some cases an analysis by three different laboratories.

Q Now, I hand you what has been marked as Applicant's Exhibits 6 to 13, inclusive, and ask you if those are the core analyses reports.

A Exhibit 7 represents a core analysis -- that is Federal 4-13-132 -- performed by Oil Research Field Laboratories at Chanute, Kansas.

Q The next exhibit, Mr. Holland, is on Federal well No. 4-13-132, prepared by the Oil Field Research Laboratories.

A That is the one I just finished describing.

Q That is Exhibit 6A.

(Off the record.)

Q You were referring -- When you referred to Exhibit 7, you meant Exhibit 6A?

A Yes, sir.

Q And Exhibit No. 7.

A Exhibit No. 7 represents a core analysis on Federal 22-45-207, performed by Core Laboratories, Incorporated.

Exhibit No. 8 isthe core analysis report by Oil Field Research Laboratories on the same well, Federal 22-

45-207.

Exhibit No. 9 represents the porosity determinations performed for Federal No. 4-13-132, and Federal 22-45-207, performed by Petroleum Products Laboratories of Dallas, Texas.

Exhibit No. 10 is a core analysis and water permeability report for the same two wells, Federal No. 4-17-132 and Federal No. 22-45-207. And this report was performed by Oil Field Research Laboratories.

Exhibit No. 11 is a core analysis report on Federal No. 23-49-129 of the Pettigrew-Tocito field, performed by Petroleum Products Laboratories.

Exhibit No. 12 is a core analysis report prepared by Petroleum Products Engineering Company for Federal No. 24-50-177.

In those exhibits, Nos. 6 to 12, inclusive, they represent all of the core information that has been assembled by Lowry et al Operating Account for wells of the Pettigrew-Tocito Pool.

Q How many laboratories, then, made the analyses for you, Mr. Holland?

A We had three different laboratories.

Q Have you had occasion to study those core analyses that were presented by those laboratories?

A I spent considerable time reviewing and analyzing and compiling statistics reflecting the contents contained in those core analysis reports.

Q Now, in connection with your study, have you prepared an exhibit summarizing the information reflected by those core analyses?

A Exhibit 13 is a summary of the extracts from the core analysis information presented that the Lowry Oil Company uses in evaluating the Pettigrew-Tocito Pool.

The first item presented in this exhibit is the porosity data. The average, the weighted average porosity, is tabulated by wells, and varies from 14.90 percent to 13.18 percent. In addition, the porosity was volumetrically, was weighed, it wasn't volumetrically weighed, as to each well. And to each of the four wells cored, the weighted field average was determined. And this field weighted average is 13.90 percent.

Now, those statistics relate to the upper portion of the Tocito sand, which is the principal producing portion of the sand.

Also presented in the report is porosity data for the lower portion of the sand, which is considered productive for two wells of the field. Those wells are Federal No. 4-13-132 and Federal No. 23-49-129. The porosity values are considerably lower than those previously elaborated on.

Q You mean for the lower portion of the field?

A The lower portion of the sand, the porosity values are low. And the field weighted average is 10.96 percent.

Q Have you had any occasion to study the situation in regard to the lower portion of the sand in that vicinity?

A For the area of the two wells mentioned, that is Federal No. 4-13-132 and Federal No.23-49-129, porosity and permeability was developed of a low order for the lower portion of the sand. In addition to that, the sand was fractured. There were good vertical fractures. And for that reason, in spite of the low permeabilities, we do consider that we will salvage some oil from the lower portion of the sand in that area.

3b Q What do these reports reflect in regard to the permeability of the individual wells?

A The permeability data is tabulated in Exhibit 13 as to both horizontal and vertical permeability measurements, which were determined. For the principal producing portion of the sand, the permeabilities recorded were high. For instance, Federal No. 4-13-132 had permeabilities as high as 622 milledarcys. The weighted average for that well was 138 milledarcys.

For Federal No. 22-45-207, permeabilities as high as 413 milledarcys were measured. The weighted average for that well was 77.93 milledarcys.

For Federal No. 23-49-129, permeabilities as high as 425 milledarcys were measured on cores from that well. The weighted average permeability was 83.17 milledarcys.

For Federal No. 24-50-177, the maximum permeability measured was 981 milledarcys. The average, the weighted average, for this well was 205.68 milledarcys.

Weighting the four wells, the field weighted average was determined to be 121 milledarcys.

Also, the exhibit shows vertical permeability measurements from cores of two of the four wells. Those wells were Federal No. 23-49-129 and Federal No. 24-50-177.

Vertical permeabilities in the upper portion of the sand were measured as high as 82 milledarcys for Federal No. 23-49-129. And the weighted average for that well was 20.43 milledarcys.

For Federal No. 24-50-177, the highest vertical permeability measured was 418 milledarcys. The weighted average was 48.99 milledarcys, resulting in a field weighted average, as determined from these two wells, as 31.61 milledarcys.

That data reflects that within the sand there is good vertical communication and with good horizontal permeability, good horizontal communication.

The lower portion of the sand horizontal permeabilities were measured for two wells, Federal No. 4-13-132 and Federal No. 23-49-129. Now, as this data reflects, the sand is highly -- is not very permeable. The highest permeability measured for Federal No. 4-13-132 was 2.5 milledarcys. That is horizontal permeability.

And the horizontal permeability maximum for Federal No. 23-49-129 was 2.8 milledarcys.

The weighted average of those two wells respectively are .73 milledarcys and 1.32 milledarcys.

The vertical permeabilities of this lower portion of the sand were determined for Federal No. 23-49-129, and the maximum recorded was .6 milledarcys. And the weighted average of that well was .41 milledarcys.

Now, this data doesn't reflect the permeability of the fracture system. We consider that the zone is productive in the two wells representative -- represented by these analyses. And is productive because the sand was fractured.

Q I hand you what has been marked as Applicant's Exhibit 14 and ask you what that is.

A Exhibit 14 represents a portion of all the electrical logs and all of the micro log surveys performed by Schlumberger Electrical Log Company. Included in this exhibit are these logs from the ten producing wells of the field, and from one well which is producing from a deeper horizon, that penetrated the Tocito formation.

Q Does that exhibit consist of an extract from the complete well log?

A It shows just the Tocito sand section.

Q Do you have logs --

A Perhaps forty or fifty feet above and below.

Q Do you have micro logs on all the wells?

A We have micro logs on all the wells except one. Federal No. 1-134. We do not have a micro log.

I might mention from the electrical logs, in conjunction with the core information presented, we have determined what we consider to be the net effective productive sand for each well. And these extracts are presented to the Commission for their review to show the net effective sand that has been assigned to each well.

Q In connection with your study of the reservoir, Mr. Holland, have you made a study of the reservoir fluids?

A We have had two analyses performed on samples, on bottomhole samples, obtained from wells of the Pettigrew-Tocito field.

Q I hand you what has been marked Applicant's Exhibits 15 and 16, and ask you if those are the reports and who made them.

A Exhibit 15 represents a reservoir fluid study of a subsurface sample obtained from Federal No. 1-134. This-- as reflected in this exhibit --

Q By whom was that exhibit prepared?

A The exhibit and the test were performed by the West Texas Engineering Service of Midland, Texas.

This exhibit reflects that the saturation or bubble point pressure of the reservoir was 2,054 PSI guage.

The reservoir temperature was 175 degrees Fahrenheit.

The gas contained in solution with the oil was 862 cubic feet per barrel.

That the oil -- That the formation volume factor of the oil at saturation pressure was 1.526.

Q At what pressure does that come out of solution, Mr. Holland?

A That is -- That would be at the saturation pressure.

Now, Exhibit 16 is a reservoir fluid study for Federal No. 21-40-182, performed by Core Laboratories, Incorporated. This exhibit reflects that the saturation pressure of the reservoir was 2,051 PSI, which is three
4 pounds difference than that determined by the West Texas Engineering Service.

The gas in solution was determined to be 862 cubic feet per barrel, which is exactly the same as determined by the West Texas Laboratory. The formation volume factor was determined to be 1.512 at saturation pressure.

And the oil viscosity was determined to be .39 centerpoise at saturation pressure.

As reflected by this exhibit, the oil is highly fluid. The viscosity is low, which means that the transmission of the fluid through the reservoir will require a minimum amount of reservoir energy.

Q Do those reports, in your opinion, support your recommendation for a gas-oil ratio of 2000 cubic feet of gas per barrel of oil?

A The data reflects that the fluid has a relatively high solution gas-oil ratio; that with a relatively high shrinkage factor will mean that the producing gas-oil ratio for the Pettigrew-Tocito field will be relatively high. It is a depletion type reservoir. And as depletion proceeds, gas-oil ratios will increase. The 2000 to 1 gas-oil ratio limit will safeguard reservoir gas energy, and will aid the ultimate oil recovery achieved from the pool.

Q Would you characterize the Pettigrew-Tocito Pool as a gas energy reservoir?

A It is a depletion type reservoir, solution gas drive.

Q Have you encountered any evidence of a water drive in connection with your studies of the pool?

A To date, we have encountered no water-oil contact. We have one well drilled low on structure. The sand apparently, instead of being saturated, has shaled, has low permeability, because of the shaling condition of the sand. We do not believe there is any water influx into the reservoir.

Q In connection with your study of the pool, have you had any occasion to study the drainage?

A Among the tests that have been conducted for wells of this pool are productivity index tests. Exhibit 17 represents a productivity index test for Federal No. 2-179, performed by the West Texas Engineering Service.

That exhibit reflects the producing characteristics of the well at various producing rates, and records the bottomhole pressure drop per barrel of oil produced at these different production rates; which is termed the productive index test of the well.

For this well, that is Federal No. 2-179, the productivity index varied from .842 barrels per pound drop in pressure to 1.162 pounds per pound drop in reservoir pressure.

And this data in my opinion reflects what has previously been demonstrated by core analyses, that the sand is highly permeable and the productivity index is relatively good.

Exhibit 18 also is a productivity index test, conducted for Federal No. 4-13-132. The data reflected by this exhibit is the same as that for Federal No. 2-179.

The productivity index figures are somewhat lower and are lower than we had expected for this well. And we believe that during the drilling of the well, the mud, due to the high permeability, penetrated the producing formation. Considerable trouble and delay was occasioned by this fact in the completion of the well. Therefore, the low PI, we believe, is the result of the completion problem, completion difficulty caused by mud infiltration.

Q I hand you what has been marked as Applicant's Exhibit 19 and ask you what that is.

A Exhibit 19 is a pictorial representation of the initial pressures achieved or measured for wells of the Pettigrew-Tocito field.

As we developed the field, we noticed that the initial reservoir pressures on all the wells were considerably lower than that measured for the discovery well, Federal No. 2-179. As an example of this, picking at random Federal No. 23-49-129, the well was located 3,663 feet from any other producing well of this pool. At the time of completion the pressure of this well was 86 pounds lower than the initial reservoir pressure.

This exhibit reflects that there is good communication in the reservoir, and that good drainage over a wide area can be and has been achieved.

Q I notice, Mr. Holland, that one of the wells is very -- shows a very low bottomhole pressure. Would you identify the well and explain to the Commission the reason for that?

A That well is Federal No. 1-134. It is a marginal well. It produces roughly ten barrels of oil per day. It was initially drilled to the Dakota formation, but during the drilling to the deeper formation, the drilling fluid was exposed to the Tocito zone. And the producing interval was fairly well mudded off. A considerable amount of time and money was spent in attempting to successfully complete this well in the Tocito zone.

There evidently is a low permeability portion of the reservoir there. It is on the edge. And the data reflected on that well is not representative, as a great amount of time was spent trying to complete the well.

4b Q Mr. Holland, would you state to the Commission what the bottomhole pressure of the most recent well completed is as reflected by Exhibit 19 -- as compared to the bottomhole pressure of the initial well?

A The most recent well completed was the Lowry Federal No. 25-51-127. The completion date for that well was April 20, 1953. The initial bottomhole pressure was

2,108 PSI, representing an 89 PSI drop from the initial reservoir pressure. And it should be noted this well is located 2,740 feet from any other producing well of the Pettigrew-Tocito Pool.

COMMISSIONER SPURRIER: Let's take a five-minute recess.

(Recess.)

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MR. KELLAHIN: If the Commission please, we will call Mr. Anderson as a witness in this case as he is anxious to get away and return to Roswell. And with the consent of the Commission, we would like to interrupt Mr. Holland and take Mr. Anderson's testimony at this time. It will be very brief.

COMMISSIONER SPURRIER: Very well.

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ROBERT ANDERSON,

having been first duly sworn, testified as follows:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q Willyou state your name, please?

A Robert Anderson, president of Malco Refineries, Incorporated, Roswell, New Mexico.

Q Mr. Anderson, in your capacity as president of the Malco Refineries, have you any interests in the vicinity of the Pettigrew-Tocito Pool?

A Yes, sir; we constructed a pipe line in to serve the field and completed it in Februaryof this year.

Q Are you purchasing all of the oil produced in that pool?

A Yes, sir.

Q Have you had any occasion to make a study of the productivity of the Pettigrew-Tocito Pool from an economic standpoint?

A Yes, sir; we had a very substantial investment in the pipe line and had to make some capital investments at the refinery to handle the oil from the Pettigrew-Tocito field. And we made a very careful study of the reservoir before we went ahead with the investment.

Q In connection with that study, did you arrive at any conclusion as to the quality of the Pettigrew-Tocito Pool from an economic standpoint?

A Yes. We concur almost one hundred percent in the findings Lowry Oil Company has presented here today as far as reservoir characteristics, with the only possible exception that in the opinion of our engineers and our geologists, their reservoir estimates could be somewhat on the optimistic side. Our people -- The big difference between our two thinkings -- is the average acre feet of pay throughout the reservoir.

Q And from the basis of your studies have you reached any conclusion as to whether a well could be economically drilled on a 40-acre spacing pattern?

A Assuming the 1500-barrel per acre recovery that Lowry Oil Company have estimated as against ours of eleven or twelve hundred barrels, a well on a 40-acre location would not pay out, after deducting royalty, lifting cost and taxes.

Q Would it be feasible to drill on an 80-acre spacing pattern?

A Yes; we feel that the characteristics of the reservoir and the extreme permeability and communication are very fortunate, and an 80-acre spacing is an economic necessity. And the field can be developed without any significant loss of recoverable oil through such a pattern.

Q In your opinion, on the basis of the studies you made in connection with this pool, would one well economically drain and develop 80 acres?

A We feel that the reservoir can be developed and drained on an 80-acre pattern as effectively as any reservoir.

Q And in your opinion would such a pattern adequately protect correlative rights, including those of royalty owners?

A Yes. It is a very fortunate area inasmuch as the royalty is primarily held by the federal government, one royalty owner; and the leasehold by one operating corporation. And there really isn't too much danger of any difference of ownership of drainage involved in the area.

MR. KELLAHIN: I believe that's all. Does the Commission have any questions?

Thank you, Mr. Anderson.

(Witness excused.)

MR. KELLAHIN: Will you take the stand again, Mr. Holland.

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ART HOLLAND,

having been previously duly sworn, resumed the stand and testified further as follows:

DIRECT EXAMINATION

(continued)

BY MR. KELLAHIN:

Q Mr. Holland, have you anything to add to your testimony in regard to the Exhibit No. 19?

A Just that in a review of those exhibits, it is demonstrated that good communication exists in the reservoir.

and good drainage can be achieved on the proration plan advocated by the Lowry Operating -- Lowry et al Operating Account.

Q Now, Mr. Holland, have you made any interference test in the Pettigrew-Tocito Pool?

A Exhibit 20 --

Q Just a moment. Have you made such a test?

A Yes.

Q Were you present when those tests were made?

A I was present when the tests were conducted under my supervision by the West Texas Engineering Service, Incorporated.

Q And do you have the report fromthe West Texas Engineering Service, Incorporated?

A The report of this West Texas Engineering Service is contained in Exhibit 20. The exhibit also describes the method of conducting the interference test.

Q Would you describe briefly to the Commission how the test was made?

A At the time of the interference test, May 1 to 3, 1952, four wells had been completed in the Pettigrew-Tocito field, and one well, Federal No. 1-134, was in the process of completion. All the wells in the field, with the exception of the well being completed, Federal No. 1-134, were shut in for at least 72 hours. And the bottomhole pressure of these wells, determined by the West Texas Engineering Service, Incorporated.

The results of these tests are detailed in Exhibit 20.

And the volumetric reservoir pressure at that time was determined to be 2,150 PSI.

Now, I would like to correct the exhibit in that more recent isopac studies have resulted in the average reservoir pressure at that time being determined as 2,130 PSI. This 2,150 PSI reflects a survey or a determination prior to the completion of wells subsequently drilled in this pool.

After the wells had been shut in 72 hours, all the wells in the field were placed on production, with the exception of Federal No. 19-34-157. This well was left shut in and the subsurface pressure guage was lowered in the tubing to approximately the top of the Tocito sand for that well. The guage was left in the well 40 hours with the well shut in and the other wells in the field producing at high production rates. At the completion of 40 hours, the guage was removed from the well and it was determined over the 40-hour period the pressure in Federal No. 19-34-157 as measured at the top of the Tocito formation had decreased 7 PSI.

Q What was the closest well to the well in which the pressure guage was left, Mr. Holland?

A The distance of all the wells from the well used for the interference test, Federal No. 19-34-151, is detailed on the plat which represents part of Exhibit 20. And the nearest well to Federal No. 19-34-157 is 1,867 feet away.

Q And what would be the maximum distance that a well drilled on the 80-acre pattern, which is proposed in Lowry's application, would be?

A On a typical 80-acre spacing pattern the maximum drainage radius for any well is 1,320 feet.

Q And these tests reflect drainage on 1,867 feet?

A That is correct; it represents an area considerably in excess of the 80-acre pattern we are requesting.

Q Do the initial bottomhole pressure tests reflect a drainage of a larger area than that?

A They represent a drainage over a radius of at least 1,867 feet which I believe is roughly 160-acre spacing.

Q Are the wells that have been drilled in the Pettigrew-Tocito Pool drilled on a 160-acre pattern at the present time?

A They are drilled -- Some of the wells are drilled on a 160-acre spacing pattern and some on 80. In an attempt to define the limits of the Pettigrew-Tocito field and establish field reserves, theprincipal drilling program has been to make step-outs on a 160-acre basis.

Q Mr. Holland, in connection with your studies of the Pettigrew-Tocito Pool, have you made any estimates on the ultimate oil recovery?

A Yes, sir, I have. These studies are reflected by Exhibit 21, which represents our present conception of the Pettigrew-Tocito Pool.

Presented in this exhibit is a sand isopac map of this pool, whichis based on the core analysis data and the electrical log data which has been previously presented in this hearing.

Q Does that reflect the thickness of the Tocito formation?

A Yes; the isopac map is a sand thickness map.

Q What factors were used by you in evaluating the ultimate production of the pool, Mr. Holland?

A These factors are set out in the first page of this exhibit. For the upper portion of the sand, the connate water saturation was 23 percent. The average porosity of 13.90 percent. The formation volume factor of 1.52 percent. A recovery factor of 25 percent.

For the lower portion of the sand, a connate water saturation of 45 percent was used. Average porosity was 11 percent. Formation volume factor of 1.52 percent, and an estimated recovery factor of ten percent.

Using these factors, it was determined for the upper portionthat there were 546 stock tank barrels of oil in place per acre foot. And the reccverable oil for this upper portion was estimated at 137 barrels per acre foot.

For the lower portion, the stock tank oil in place was estimated as 311 barrels per acre foot, with an oil recovery of 31 barrels per acre foot.

Now, the area considered productive in the upper sand is represented by the isopac map.

And the area considered productive as to the lower portion of the sand was considered to be 160 acres, comprising the north half of the north half of Section 9, Township 26 N, Range 6 W, Rio Arriba County, New Mexico.

And the sand thickness used for the estimation of the reserves in the north portion of the sand was 11 feet.

Q Is that an average thickness according to your estimation?

A That is an average thickness for the two wells considered productive.

Q Did you give the Commission your estimate of the total amount of oil in place?

A It is reflected in a barrel per foot basis. It is reflected in the exhibit.

Contained in the exhibit, for the upper portion, we consider 920 acres is proven area. And the semi-proven area consists of 1,615 acres.

Q Making a total of 2,535 acres?

A Making a total of 2,535 acres.

The lower portion considered productive is 160 acres, which is a portion of the 2,535 acres previously outlined.

Q On the basis of your studies, what do you estimate the total recovery to be expected from that pool?

A The total recovery estimated for the Pettigrew-Tocito field is 3,330,230 barrels. Of this, 1,617,970 barrels is considered as proven reserve. And 1,657,700 is considered as semi-proven reserve.

Oil production from inception of the field to April 30th, 1953, was 522,972 barrels, leaving a remaining proven oil reserve of 1,149,588 barrels; and a remaining proven and semi-proven oil reserve of 2,807,258 barrels.

Q Now, have any other studies been made of the ultimate oil recovery of the Pettigrew-Tocito Pool, Mr. Holland?

5b A There have. A consulting firm by the Amstatz & Yates, Incorporated, of Wichita, Kansas, have made a material balance and core analysis basis report on the oil reserve of the Pettigrew-Tocito Pool.

Q What does that exhibit reflect in comparison to your studies in regard to the ultimate oil recovery?

A The estimates are considerably lower than the estimates I have presented to the Commission.

Q How many acres did they consider proven or semi-proven?

A At the date of this report they considered -- Their analysis attempted to delineate the entire field -- They considered 2,730 acres would be proven in this pool; that there were 15,000,000 barrels of stock tank oil in the pool, a recovery factor of 15 percent, which represents 2,200,000 barrels of recoverable oil.

Q Have any later surveys been made?

A This firm has just recently finished another complete review of all the data on the Pettigrew-Tocito field.

Q Do you have a copy of that report, Mr. Holland?

A I have a copy of the report, which is dated May the 14th, 1953, and it gives the field dataas of April 28th, 1953.

Q In view of the fact that this is the only copy of the report that is available at this time, we ask permission of the Commission to use it in the testimony and file it as a late exhibit, file a copy of this report as a late exhibit.

COMMISSIONER SPURRIER: Very well.

Q What does this most recent report reflect, Mr. Holland, in comparison with your estimates?

A I would like to read into the record some of their conclusions.

Their conclusions and recommendations, No. 1: "It is our opinion that the Pettigrew-Tocito field reservoir originally contained approximately 17,000,000 barrels of stock tank oil in place. This conclusion is based upon the reservoir performance in the field from its discovery to April 28th, 1953."

The other portion of their conclusions: "The performance of the field to date indicates a primary recovery under present operations on the order of 15 percent of the stock tank oil originally in place, or 2,600,000 barrels of oil. Approximately 520,000 of this recoverable oil had been produced to May 1, 1953, leaving a reserve of 2,800,000 barrels."

That's all.

Q Now, Mr. Holland, in connection with your studies of the Pettigrew-Tocito Pool, have you made any analysis of the economic conditions and cost of development?

A I have compiled a development costs for typical wells of the Pettigrew-Tocito field.

Q Yes.

A And have made economic estimates of the drilling of the pool considered on a 40-acre proration unit plan.

Q I hand you what has been marked Applicant's Exhibit 23 and ask you if that is the report to which you refer.

A That is correct. Exhibit 23 reflects the average cost per well for drilling and completing wells of the Pettigrew Tocito field.

Q And what is that cost, Mr. Holland?

A The costs detailed in this exhibit are actual costs with the exception of reliable estimates for minor services, such as bulldozing work, road grading work, trucking, labor, and I believe that's all. Those are estimates. The rest are cost data, actual cost, obtained from records of the Lowry et al Operating Account. These minor items were estimated to save a great amount of time in running down the charges, as they do not represent a material proportion of the cost, and they are reliable estimates.

The costs are presented for the completion of two wells of the field, Federal No. 21-40-182 and Federal No. 22-45-207.

In addition, the cost of the tank battery which is utilized by these two wells is also detailed.

It was presented on this basis because our present completion procedure has one tank battery for each two wells.

From this review, we determined that the average cost for drilling and completing a Tocito well is approximately $110,000.

Reviewing the economics relating to oil recovery on a 40-acre field development plant, it is shown in this Exhibit 21 in detail, and shows that the oil recovery expected on a 40-acre tract amounts to 52,560.

The net income per barrel of oil amounts to $2.06, approximately.

Q Does that include any deduction for operating expense?

A No operating expense has been includedin this cost analysis.

Q All right.

A From the crude oil price received has been deducted royalty, severance tax, conservation tax and production tax.

Q And on the basis of that net income per barrel and a recovery of 1,314 barrels per acre as you have testified, what would be the ultimate income from one well, Mr. Holland?

A A well drilled ona 40-acre tract, an average well, would recover$108,799.

Q That is compared to the cost of the well of $110,000; is that correct?

A Approximately $2000 less than the cost of drilling and completing Tocito wells without any deductions for operating expense.

Q Mr. Holland, on the basis of your engineering studies and economic studies which you have made, in your opinion will one well efficiently and economically drain and develop 80 acres?

A In my opinion one well will efficiently and economically drain at least 80 acres. The data we have presented has shown good communication in the reservoir, good permeabilities, better than average porosities, and that, with the interference tests, in my opinion, is conclusive that we can expect good drainage on the pattern proposed.

Q Would it be economic to drill wells in the Pettigrew-Tocito Pool on a 40-acre pattern?

A Our studies have indicated that the return would be less than the cost of completion without any deduction for operating costs.

Q Is ityour recommendation to this Commission, then, that a uniform 80-acre proration unit be established for the Pettigrew-Tocito Pool in the event of proration?

A We urgently request that the Commission grant an 80-acre proration plan for the Pettigrew-Tocito field.

Q And do you recommend uniform 80-acre spacing?

A We recommend the uniform 80-acre spacing pattern with wells to be located in the northwest and southeast quarter of each governmental quarter section.

Q Now, do the wells which have heretofore been drilled in the Pettigrew-Tocito Pool conform to that spacing pattern?

A We have six wells that do not conform to that pattern.

6 Q Are they earlier wells or wells more recently drilled?

A They are earlier wells of the field. The recent wells have been on this proposed spacing pattern, on this proposed location pattern.

Q Why do you recommend the spacing pattern which you do, Mr. Holland?

A As far as our position is concerned, it isn't mighty material as to the location of the wells. However as far as our offset operators are concerned, it is probably preferable that the location of the wells be in the northwest and southeast quarters of the governmental quarter sections.

Q And for what reason?

A The present trend of the Tocito sand in the direction of these offset operators gives evidence that they probably will have the better completions in these locations.

Q And do you ask that the Commission approve as unorthodox locations the wells which do not conform to this spacing pattern?

A Yes, we make that request.

Q In your opinion, Mr. Holland, if the Commission--if the recommendations which you have made to the Commission are adopted, would the correlative rights, including those of royalty owners, be protected?

A The plan I have proposed would protect the correlative rights of operators and royalty owners.

Q Have you anything you wish to add to your testimony?

A I have nothing further.

MR. KELLAHIN: If the Commission please, we would like at this time to offer Applicant's Exhibits Nos. 5 to 23, inclusive, in evidence and will offer the report of Amstatz & Yates as a late filed exhibit as the Commission has granted permission to do so.

COMMISSIONER SPURRIER: Is there objection? Without objection, they will be admitted.

MR. KELLAHIN: That is all the questions. If you have any questions of this witness --

MR. GRAHAM: May I ask what is the significance of the blue colored land in there?

A Lowry operates for three different interests. And the colors merely represent, differentiate, between the different interests.

MR. GRAHAM: But no one else is interested in that as a working owner, just the Lowry under their interests?

A All the acreage that we have presented during the hearing has been colored in yellow. We represent the three different corporations that we operate for.

MR. GRAHAM: But you are the operator.

A Yes, sir.

MR. GRAHAM: Of the entire --

A Yes, sir, and we speak for the three different corporations.

MR. WHITE: This blue group is the Barrett?

A Yes, sir.

MR. WHITE: And do they recommend this 80-acre spacing pattern?

A Yes, sir; we speak for the three different groups.

MR. GRAHAM: You mentioned a while ago about considerable gas being produced. What is being done with that?

A I am sorry. Would you repeat your question?

MR. GRAHAM: I say you mentioned a while ago about considerable gas being produced.

A We're at present flaring all gas produced in the field. However, we have made plans and are continuing to make plans, as to the proper disposition of that gas.

We have two different concerns interested in the possibility of building a plant, a compression plant, for the field to boost the gas to enough pressure to interest gas pipe lines in the area.

And we ourselves are considering the installation of such facilities. We expect to resolve those plans at an early date.

MR. GRAHAM: Is there any other -- anyone -- objecting to your 80-acre proposal? Why do you want --

A We are -- The field limits are now approaching other operators. And, as you can see, the economics of drilling the field on 40 acres are prohibitive. Well, we need at least an 80-acre pattern for protection on the offset boundaries of our lease.

MR. GRAHAM: I don't recall your saying how long it took one of those wells to pay out. Say the best well.

A Well, some of the wells we have drilled have paid out. That will be reflected in your production figures. However, drainage from a wide area in the field is being achieved and the production from our present wells has been obtained from outlying tracts. And the figure overall is prohibitive, as the testimony and data we have presented -- prohibits drilling on 40-acre basis.

MR. GRAHAM: According to your map, there is only one interest that may be drained and that would be the NE NE of Section 16. Is that the only other royalty owner concerned? Or, do you have numerous overrides?

A There are some overriding royalties on this area.

MR. WHITE: Have those people been notified of this thing?

A The official notice is the only notice that I know of.

MR. KELLAHIN: The official notice, Mr. White.

MR. WHITE: When do you think the gas will be able to be marketed?

A Sir, I can't answer the question. I do not know. We have a meeting scheduled this week, attempting to resolve that question. We are having a plant study made now by an individual consulting firm. Their report will be ready tomorrow. We have a meeting the last part of the week in an attempt to work out what our program should be.

76b MR. WHITE: If the gas should be marketed, that would increase the income of your wells, wouldn't it?

A It would increase our income; yes, sir. However, in addition to the costs that were presented here, we would have our operating costs to consider. At such time as pumping equipment is needed -- that is another capital expenditure. The building of a plant is an expenditure on its own.

MR. WHITE: The main advantage you would be given, if the Commission granted an order, would be to give you protection against offset operators; is that right?

A Yes, sir.

MR. MACEY: How much casinghead gas are you flaring, Mr. Holland, approximately, a day?

A Roughly 1,800,000.

MR. MACEY: Isn't it a pretty close economic venture to construct a gasoline plant on 1,800,000 feet a day?

A We have contacted quite a number of people trying to sell them on the idea of building a plant. Roughly ten. And of those, we have two that are considering building a plant. It is a small, as you mentioned, a small thing as far as gasoline plant considerations are. We do think it will be an economic situation on a small scale. And do plan to conserve the casinghead gas.

MR. MACEY: You are not going to make a fortune at it.

A I don't think so.

MR. WHITE: One other question. What way would the State of New Mexico profit or benefit by the granting of an 80-acre spacing pattern as against the existing 40-acre pattern?

A In the overall view, the drilling on the 40-acre pattern is prohibitive. If you can't pay out your wells, you can't drill wells.

MR. GRAHAM: The first well drilled on a 40-acre paid out, didn't it?

A Has paid out?

MR. GRAHAM: Has it?

A It is true it was drilled on a 40-acre tract.

MR. GRAHAM: Came in about 700 barrels.

A Drilled on a 40-acre tract.

MR. KELLAHIN: I would like to point out for the benefit of counsel the Pettigrew-Tocito Pool isn't prorated. And I believe our testimony reflects we are getting drainage over considerably more than 40 acres. And there has been no limit on our production except the good judgment and the management of the company itself.

MR. MACEY: Mr. Holland, in your PI test I notice you have pretty high well potentials even today; is that true?

A Yes, sir; we have potentials, Mr. Macey, as high as roughly 1700 barrels per day.

MR. MACEY: But approximately how much oil are you producing per day per well, an average?

A The average figure we are producing at the present time is 400 barrels from ten wells which is 40 barrels per well.

MR. MACEY: You have arbitrarily reduced the daily production in order to control your reservoir energy. Is that the primary purpose?

A Yes, sir; we have.

MR. MACEY: You are not restricted by present conditions or pipe line outlet, are you?

A No. In fact, Malco Refining Company, as they presented their testimony today, want to make it -- their demand is 7200 barrels. They are connected to approximately 500 barrels per day from the Hospah field, and the balance, without exception, I believe they are making up from distillate, comes from the -- the demand is for the Pettigrew-Tocito oil.

MR. MACEY: That is all I have.

COMMISSIONER SPURRIER: Anyone else have a question?

MR. WHITE: One other question. If this proposed order is to protect you as against offset operators, that means this: that you set up -- your pattern is already set up on the 80-acre spacing pattern, isn't it?

A Yes, sir.

MR. KELLAHIN: For the most part on 160.

MR. WHITE: And if an offset operator came in and drilled on a 40, and then another 40, it would force you to go and drill on a 40.

A That's right.

MR. WHITE: If what you say is true economically and geologically and otherwise, it isn't feasible for them to go in and drill on a 40. Then you would have nothing to worry about. They would go ahead and drill on an 80-acre pattern too.

A If it were not feasible.

MR. WHITE: Yes.

A That is not always the case.

MR. KELLAHIN: Also, there would be no control over location of wells and you would have a direct offset on the 40-acre pattern. At least that possibility.

MR. GRAHAM: Does the USGS have any requirements as to spacing?

A As far as I know, they have no proration pattern. I believe their requirements are 330 from property lines.

MR. GRAHAM: They are not demanding you drill on

40 acres, 80 acres or 160 or anything?

A As far as I know, no, sir.

COMMISSIONER SPURRIER: Are there any other questions? If not, the witness may be excused.

MR. KELLAHIN: If the Commission please, that presents the presentation of our case. And we appreciate the patience with which the Commission has heard this somewhat lengthy presentation.

I don't want to take up any further time in summarizing this except to point out, I believe, our request for the pool rules, for the 80 acre spacing, the gas-oil ratio limitation, the casing program, and the uniform spacing pattern are amply supported by the geological information; that the rights of royalty owners will be adequately protected, and that the economics most certainly justify the order in this particular case.

I have prepared a form of an order for the convenience of the Commission which they may be able to use in reference to this case. I thank you.

MR. SPURRIER: If there is no further comment in this case, we will take it under advisement and move on to Case 540.

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Lowry et al Operating Account

Factual Data Report

South Blanco Tocito Pool

Rio Arriba County, N. M.

POOL INFORMATION

SOUTH BLANCO TOCITO POOL

Rio Arriba County, N. M.

Pool Information:

Sixteen wells had been completed in the South Blanco Tocito Pool as of December 1, 1953. Three of these wells are presently operated by the Johnston Oil and Gas Company, and the remaining thirteen wells are operated by Lowry et al Operating Account.

Of the thirteen wells completed by Lowry in the South Blanco Tocito Pool, eleven are currently oil productive, one well is a gas well and one well is being used as a water injection well. Cumulative oil and gas production from inception through November 30, 1953 for the Lowry et al Operating Account wells is as follows:

	Cumulative Production		
	Oil, Barrels		*Gas, MCF
T-85	2,489		4,284
T-109	40,623		72,562
T-157	123,794		150,729
T-123	0	(Gas well - S.I.)	0
T-125	5,976		6,430
T-127	36,143		32,673
T-129	54,814		51,234
T-132	90,436		108,101
T-134	6,213	(W.I.well-10/7/53)	19,239
T-177	35,319		127,753
T-179	216,767		307,461
T-182	76,747		235,339
T-207	91,791		174,926
	781,112		1,290,731

* Estimated

The completion of Lowry et al Operating Account T-123, located in the NW/4, NE/4, Section 7, Township 26 North, Range 6 West, as a gas well confirmed the existance of a gas-cap for the South Blanco Tocito Pool. Prior to the drilling of this well, the Pool was considered to be a depletion type reservoir. The gas-oil contact is estimated to be at approximately a subsea datum of -110 feet at the present time for the South Blanco Tocito Pool.

A pressure maintenance program by the injection of water was commenced for the Lowry et al Operating Account properties of the South Blanco Tocito Pool on October 7, 1953. Lowry's T-134 well, located in the NE/4 NW/4 Section 10, Township 25 North, Range 6 West, was converted from an oil producing well to a water injection well. Current injection rate into this well approximates 1500 barrels of water per day at a surface injection pressure of approximately 1900 p.s.i. Cumulative water injection from inception through December 11, 1953, is as follows:

	Water injected, barrels
October, 1953	14,511
November, 1953	41,607
12-1 thru 12-11-53	16,716
	72,834

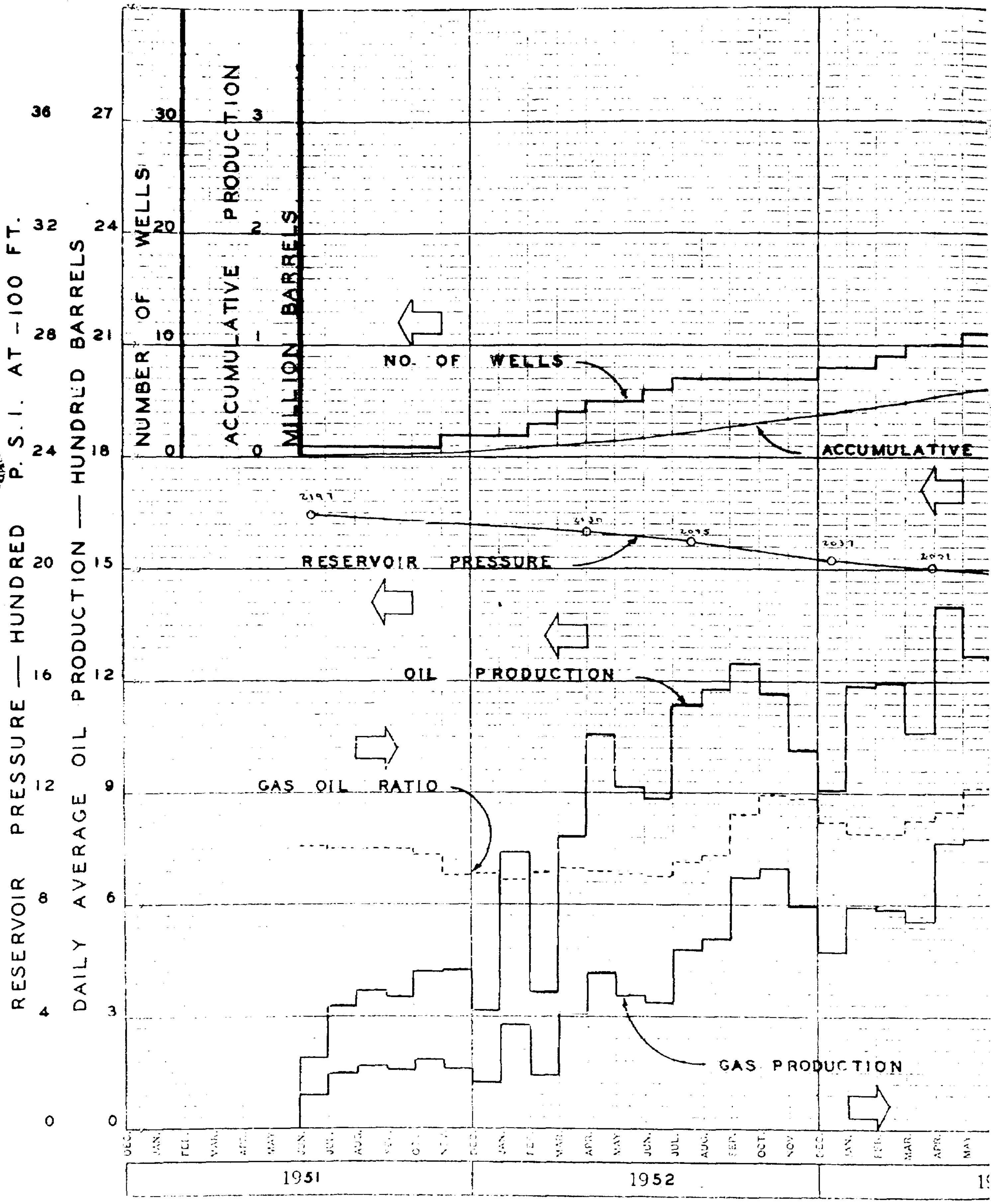
There has been a substantial reduction in the producing gas-oil ratios for some of the wells offsetting the water injection well. These wells that have been affected are presently producing at approximate solution gas-oil ratios. It is too early in the life of the pressure maintenance program to evaluate results, and the program is being continued on an experimental basis.

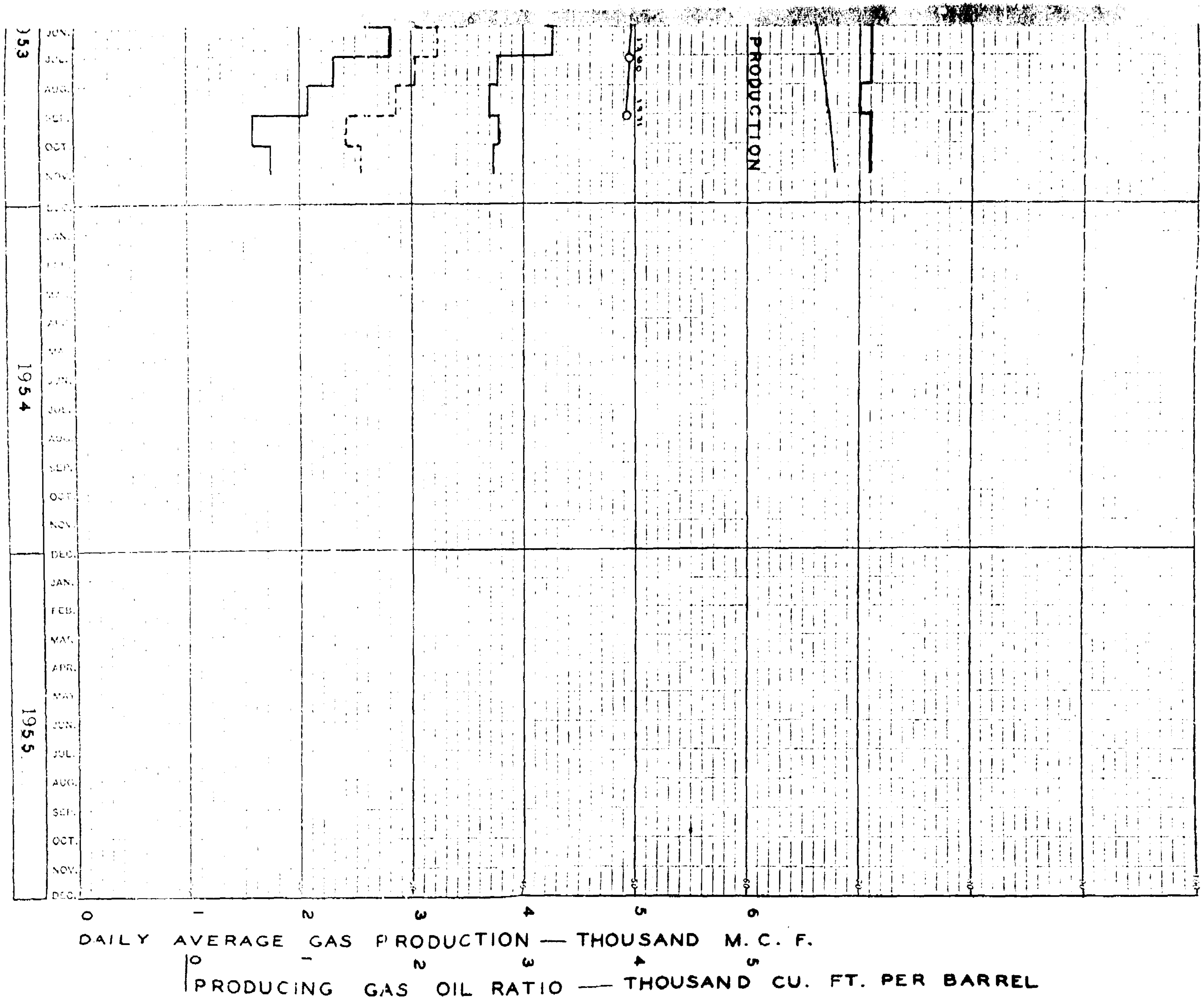
PRODUCTION INFORMATION

South Blanco Tocito Pool - Ri[illegible] Arriba County, NM

Month & Year	Monthly Oil Production, Barrels	Monthly Gas Production, M.C.F.	Gas-Oil Ratio Cu.Ft./Bbl.	Daily Average Oil Production, Barrels	Daily Average Gas Production M.C.F.	Cumulative Oil Production Barrels	Cumulative Gas Production, MCF
1953							
May	43,318	79,376	1832	1397	2561	566,290	889,403
June	38,026	77,806	2046	1268	2594	604,316	967,214
July	39,490	87,591	2218	1274	2825	643,806	1,054,805
August	35,224	71,287	2024	1136	2300	679,030	1,126,092
September	33,285	62,733	1885	1110	2091	712,315	1,188,825
October	35,254	49,392	1401	1137	1593	747,569	1,238,217
November	33,543	52,514	1566	1181	1750	781,112	1,290,731

SOUTH BLANCO TOCITO POOL
RIO ARRIBA COUNTY N M




PRODUCTION
1953
1954
1955
JUN.
JUL.
AUG.
OCT.
NOV.
DEC.
JAN.
FEB.
MAR.
APR.
MAY
SEP.
0
1
2
3
4
5
6
DAILY AVERAGE GAS PRODUCTION — THOUSAND M. C. F.
PRODUCING GAS OIL RATIO — THOUSAND CU. FT. PER BARREL

BHP INFORMATION

BOTTOMHOLE PRESSURE TESTS

Datum -100 ft.

South Blanco Tocito Pool

Rio Arriba County, N. M.

Lowry et al Operating Account

Well No.	Date	Hours Shut In	Bottomhole Pressure
T-134	8-3-53	116	1782 p.s.i.
T-179	8-3-53	95	1969 p.s.i.
	10-19-53	116	1963 p.s.i.
T-132	8-3-53	90	1928 p.s.i.
	10-5-53	137	1912 p.s.i.
T-157	8-4-53	82	1885 p.s.i.
	10-5-53	144	1883 p.s.i.
T-109	8-3-53	103	1826 p.s.i.
	10-5-53	152	1828 p.s.i.
T-182	8-3-53	89	1934 p.s.i.
	10-7-53	48 days	1922 p.s.i.
T-207	8-3-53	77	1903 p.s.i.
	10-7-53	171	1906 p.s.i.
T-129	8-4-53	111	2020 p.s.i.
	10-7-53	168	1989 p.s.i.
T-177	8-3-53	81	2041 p.s.i.
	10-7-53	199	2004 p.s.i.
T-127	8-4-53	112	2091 p.s.i.
	10-5-53	76	2070 p.s.i.
T-[illegible]	8-4-53	142	1885 p.s.i.
	10-7-53	219	1892 p.s.i.
T-125	10-19-53	240	2108 p.s.i.

Johnston Oil & Gas Company

Rincon 6	10-5-53	72	2114 p.s.i.

Weighted Average Reservoir Pressure

Datum -100 feet

	Date	Bottomhole Pressure, p.s.i.
Original reservoir pressure:	7-26-51	2197
1st General Survey:	5-1-52	2130
2nd General Survey:	8-18 - 8-20-52	2095
3rd General Survey:	1-12 - 1-14-53	2037
4th General Survey:	4-27 - 4-28-53	2001
5th General Survey:	8-3 - 8-4-53	1980
6th General Survey	10-6 - 10-7-53	1971

- - - - - - - - - - - - - - - - - -

OIL & GAS PRODUCTION DATA

South Blanco Tocito Pool

Date	Oil Production Barrels	Gas Production MCF - 15.025 p.s.i.a
5-1-52	130,008	176,439
8-20-52	234,402	311,446
1-14-53	400,133	600,774
4-28-53	518,909	802,889
8-4-53	643,806	1,054,805
10-7-53	716,094	1,194,311

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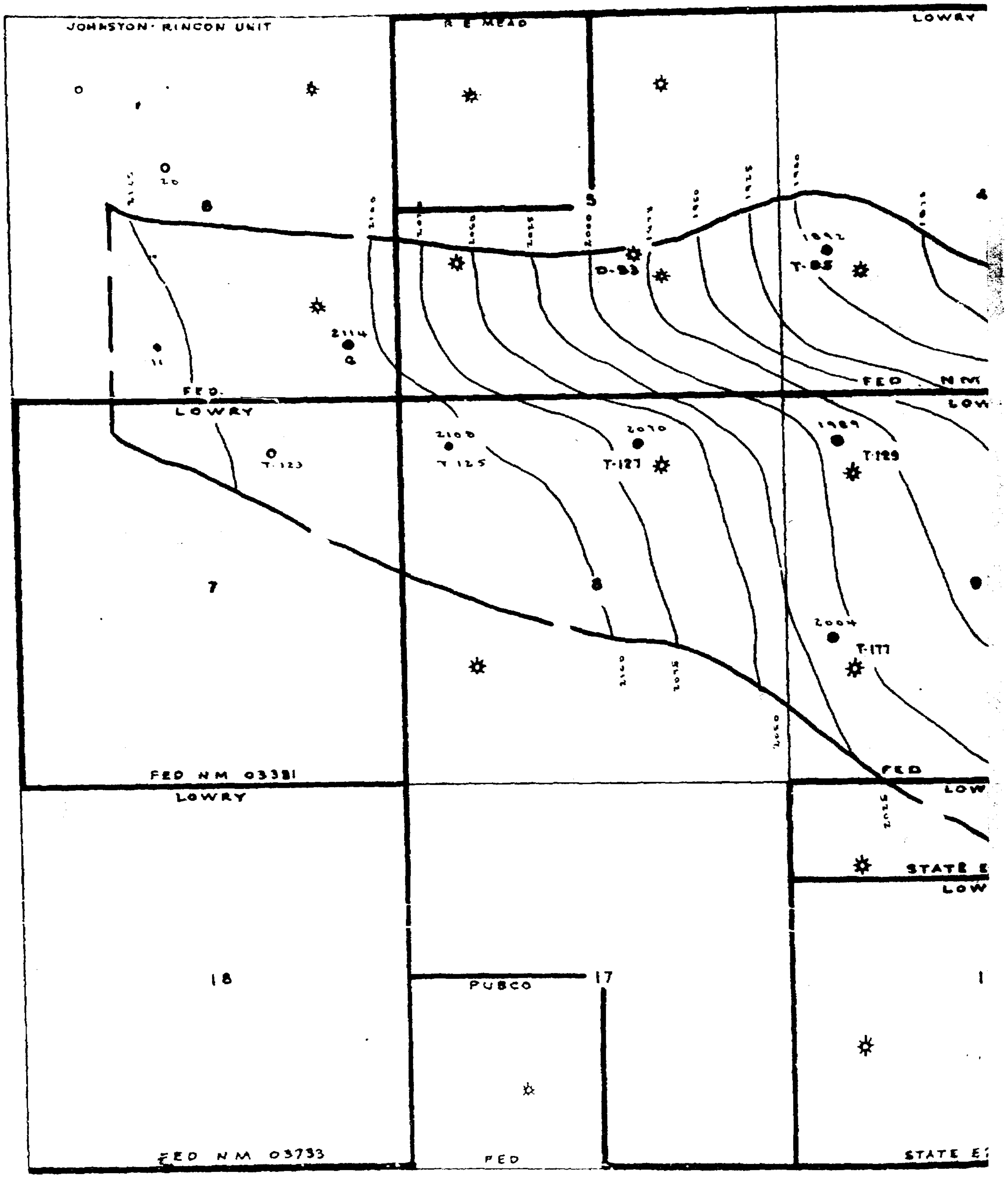


LOWRY OIL COMPANY

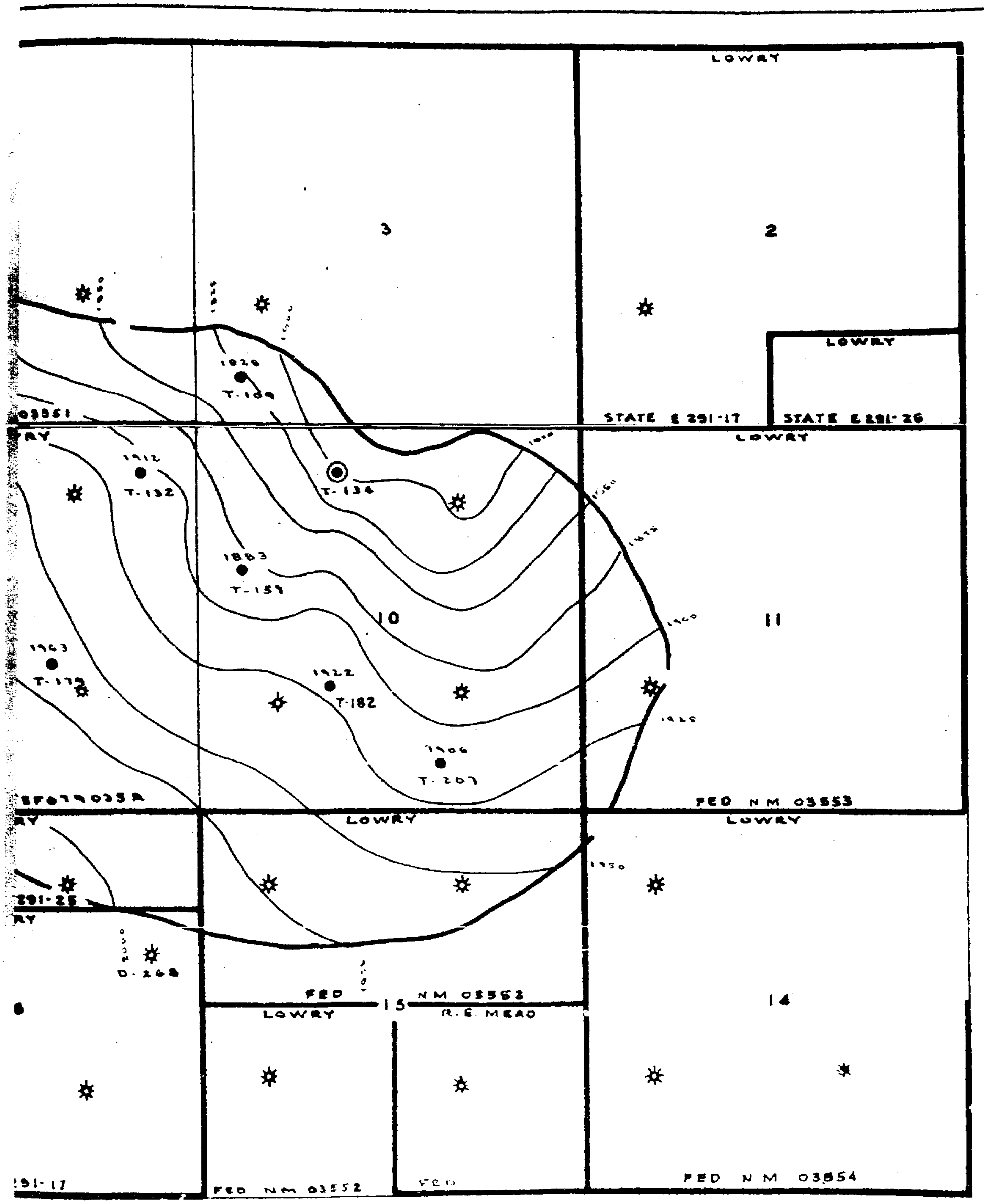
T26N - R6W

RIO ARRIBA COUNTY, N. M.

SOUTH BLANCO

RIO ARRIBA

ISOBARIC

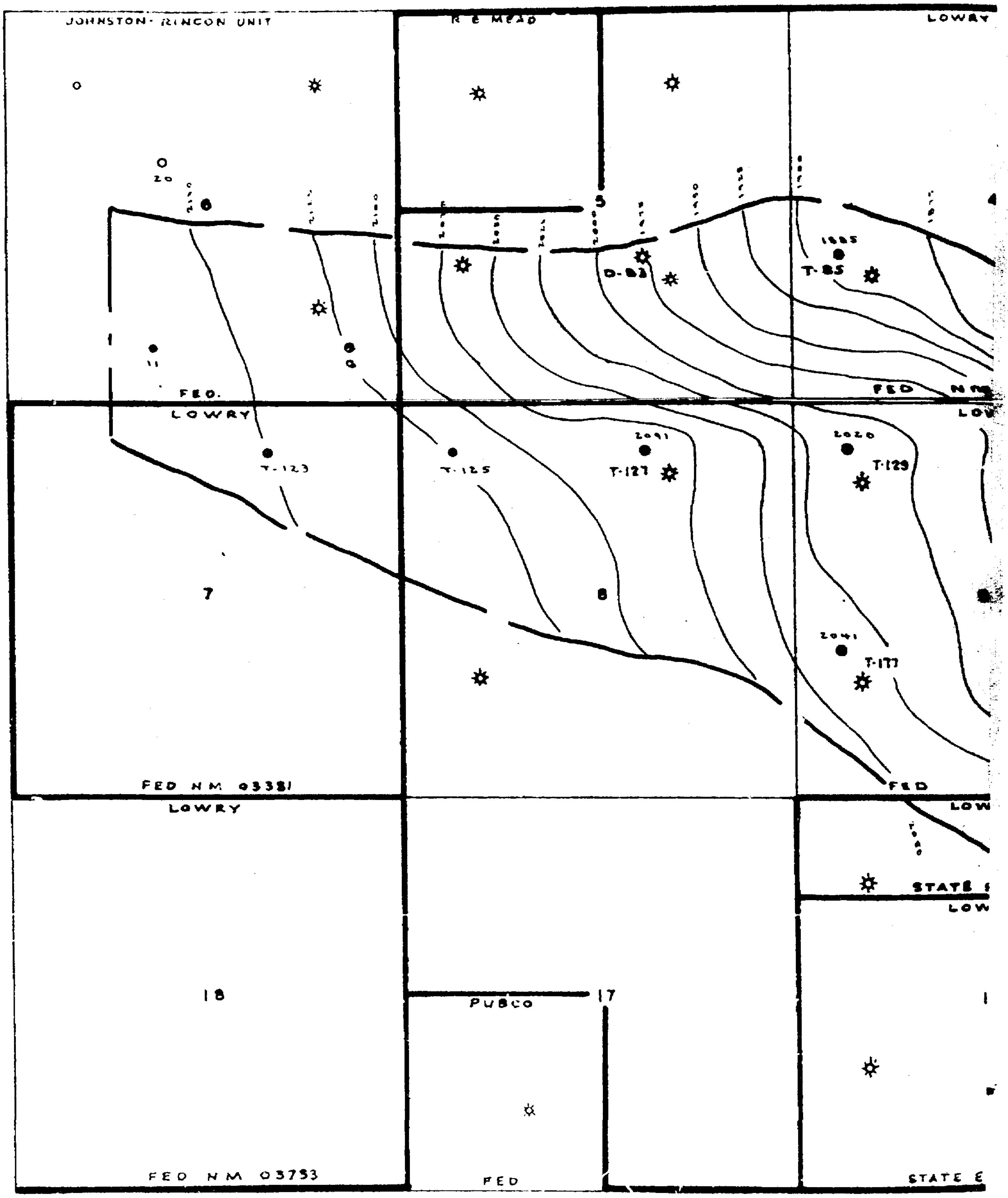


TOCITO POOL
COUNTY, N. M.
MAP

6 TH GENERAL SURVEY
OCTOBER 5–7 1953

AVG RESERVOIR PRESS.
1971 PSI – 100 FT

⊙ W.I. WELLS



LOWRY OIL COMPANY

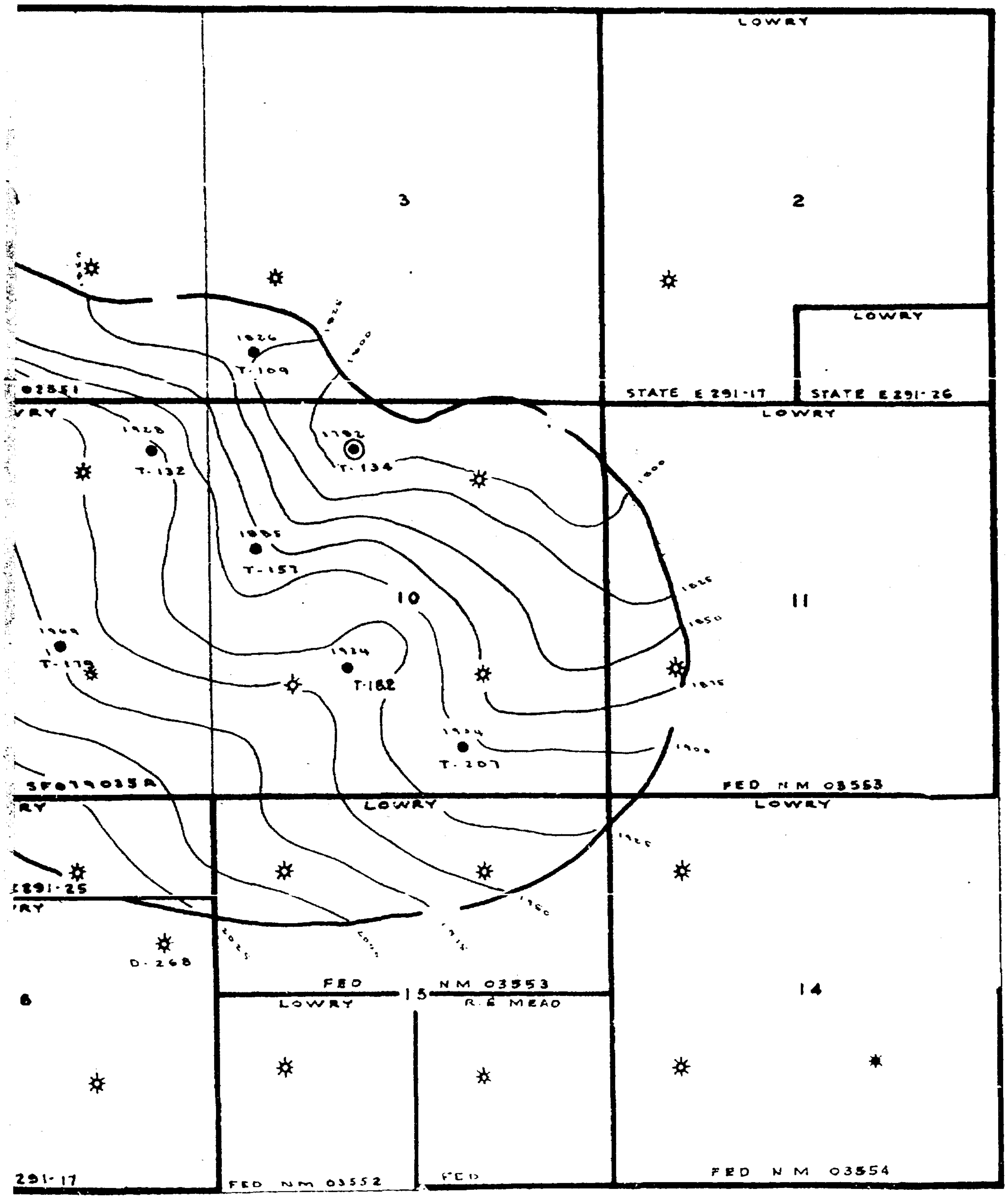
T26N - R6W

RIO ARRIBA COUNTY, N. M.

SOUTH BLANCO

RIO ARRIBA

ISOBARIC



TOCITO POOL
COUNTY, N. M.
MAP

5 TH GENERAL SURVEY
AUGUST 3-4 1953

AVG RESERVOIR PRESS.
1980 PSI -100 FT

◎ W.I. WELLS

GOR INFORMATION

Gas-Oil Ratio Tests

Well No.	Date	Gas-Oil Ratio	Accumulative Oil Production
T-134	6-26-53	4036:1	5833
	7-13-53	3412:1	6012
	7-26-53	4879:1	6151
T-179	6-14-53	1128:1	190,733
	6-24-53	1227:1	192,232
	7-8-53	1271:1	194,460
	8-8-53	1133:1	199,026
	10-1-53*	1415:1	210,370
	10-29-53	1898:1	211,863
	11 - 53*	1304:1	214,670
T-132	6-13-53	1752:1	73,383
	6-24-53	1626:1	74,484
	7-13-53	1573:1	76,373
	7-29-53	1622:1	77,973
	8-11-53	1548:1	78,934
	10-28-53	1653:1	85,868
	11 - 53*	1375:1	88,353
	12-4-53	1306:1	91,340
T-157	6-10-53	1976:1	96,581
	6-27-53	1540:1	99,176
	7-15-53	1644:1	102,293
	7-28-53	1503:1	104,295
	7-31-53	1768:1	104,806
	8-11-53	1339:1	106,150
	10-31-53	1441:1	119,822
	11-27-53	886:1	123,269
	12-4-53	739:1	124,358
T-109	6-9-53	1494:1	28,882
	6-26-53	1601:1	30,148
	7-14-53	1830:1	31,490
	7-27-53	2608:1	32,453
	8-12-53	2280:1	33,197
	10-28-53	1370:1	38,253
	11-28-53	1379:1	40,550
	12-4-53	682:1	41,016
T-182	6-12-53	4826:1	68,513
	6-25-53	5142:1	69,810
	7-5-53	5326:1	70,874
	7-21-53	5615:1	72,463
	8-15-53	5405:1	74,575
	11-30-53	3661:1	76,747

Well No.	Date	Gas-Oil Ratio	Accumulative Oil Production
T-207	6-25-53	2015:1	67,756
	7-6-53	2027:1	69,427
	7-21-53	2399:1	71,962
	8-13-53	2898:1	75,158
	8-23-53	2613:1	77,199
	8-26-53	2288:1	77,710
	8-27-53	2112:1	77,880
	8-28-53	2271:1	78,050
	8-31-53	2108:1	78,366
	10- 53 *	2390:1	85,941
	10-30-53	2311:1	88,135
	12-1-53	2283:1	91,791
T-129	6-12-53	1138:1	27,654
	6-26-53	1231:1	29,857
	7-6-53	1173:1	31,098
	8-19-53	1129:1	38,110
	10-29-53	880:1	50,024
	12-1-53	681:1	54,923
	12-2-53	733:1	55,111
T-177	6-3-53	3287:1	13,888
	6-24-53	4186:1	17,499
	7-6-53	4483:1	19,306
	7-29-53	4577:1	23,125
	8-19-53	4128:1	26,009
	10-31-53	4313:1	33,466
	11-30-53	7252:1	35,319
T-127	5-4-53	818:1	1,721
	6-4-53	951:1	7,160
	6-26-53	883:1	10,845
	7-4-53	883:1	11,879
	8-20-53	988:1	19,225
	10-2-53	870:1	26,541
	12-4-53	789:1	36,552
T-85	6-30-53	1192:1	278
	7-1-53	1256:1	298
	7-29-53	2199:1	788
	8-17-53	2241:1	1068
	10-31-53	1563:1	1993
T-125	10-28-53	1076:1	968

* Monthly production values - measured.
Cumulative oil values include only 1/2 of subject months production.

WELL DATA

Location:	1980' FSL, 1980 FEL, Section 5, T26N, R6W
Elevation:	6,570' DF
Drilling Commenced:	June 15, 1953
Drilling Completed:	July 28, 1953
Commenced Producing:	Well was not commercially productive in the Tocito formation and was completed in the Dakota formation.
Surface Pipe:	10-3/4" OD casing set @ 478', with 175 sks cement.
Production Pipe:	7" OD casing set @ 7,446' with 200 sks cement.
Tubing:	2" EUE set @ 7,273'.
Total Depth:	7,452'
Acid Treatment:	None
Shot Record:	Not shot
Initial Potential:	Completed in the Dakota Formation. 1,670 MCF of gas per day.

T - 85

Location:	1980 FSL, 660 FWL, Section 4, T26N, R6W
Elevation:	6,471' GL
Drilling Commenced:	May 6, 1953
Drilling Completed:	June 4, 1953
Commenced Producing:	June 21, 1953
Surface Pipe:	10-3/4" OD casing set @ 445', with 175 sks cement.
Production Pipe:	7" OD casing set @ 6,641' with 200 sks cement.
Tubing:	2" EUE set @ 6,640'
Total Depth:	6,691'
Acid Treatment:	None
Shot Record:	Not shot
Initial Potential:	23.05 barrels of oil per day

Location:	700' FNL, 1800' FEL, Section 7, T26N, R6W
Elevation:	6,680' GL
Drilling Commenced:	October 25, 1953
Drilling Completed:	November 24, 1953
Commenced Producing:	December 1, 1953

Surface Pipe: 10-3/4" OD casing set @ 470 feet with 175 sacks of cement.

Production Pipe: 7" OD casing set @ 6843 feet with 200 sacks of cement.

Casing Perforation:	6797 - 6812 feet with 90 shots.
Tubing:	2" E.U.E. set @ 6817 feet.
Total Depth:	6845 feet
Acid Treatment:	None
Shot Record:	Not shot.
Initial Potential:	Flowed 4,635 MCF gas per day through 20/64" choke. CP: 1000 p.s.i. TP: 750 p.s.i.

Location:	660 FNL, 660 FWL, Section 8, T26N, R6W
Elevation:	6,693' GL
Drilling Commenced:	September 4, 1953
Drilling Completed:	October 3, 1953
Commenced Producing:	October 9, 1953
Surface Pipe:	10-3/4" OD casing set @ 455', with 175 sks cement.
Production Pipe:	7" OD casing set @ 6,881' with 200 sks cement.
Tubing:	2" EUE set @ 6,859'.
Total Depth:	6,889'.
Acid Treatment:	None
Shot Record:	Not shot
Initial Potential:	612 barrels of oil per day.
Casing Perforation:	6831 - 6846 feet with 90 shots.

CORING RECORD

CORING RECORD

South Blanco Tocito Pool

Rio Arriba County, N. M.

- -

T-85

Core No. 1:	6644.0 - 6691.5:	Cored 47.5 feet. Recovered: 47.5 feet: 13.5 feet black shale; 16 feet tight Tocito sandstone; 18 feet black shale.

D-83

Core No. 1:	6737.0 - 6759.0:	Cored 22 feet. Recovered: 21.2 feet: 3 feet black shale; 7 feet tight shaly sandstone; 1 foot porous sandstone; 8.5 feet tight shaly sand; 1.5 feet shale.
Core No. 2:	6759.0 - 6778.0:	Cored 19 feet. Recovered 19 feet: 19' shale.

T-125

Core No. 1:	6818.0 - 6858.0:	Cored 40 feet. Recovered 19.4 feet: 15.8 feet shale; 3.6 feet sandstone.
Core No. 2:	6858.0 - 6889.0:	Cored 31 feet. Recovered: 30.2 feet: Black shale.

T-123

Core No. 1:	6795.0 - 6845.0:	Cored 50 feet. Recovered: 21.5 feet: 2 feet shale; 14.5 feet sandstone; 5 feet shale.

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DST RECORD

RECORD OF DRILL STEM TESTS

South Blanco-Tocito Pool

Rio Arriba County, N. M.

D-83:

Drill Stem Test: 6728 - 6778'. Tool open 3-1/2 hours. Weak blow air when tool opened. Died in 32 minutes. After 1 hour, had weak blow air for remainder of test. Recovered: 180' drilling mud. Very small show of oil. Hydrostatic pressure: 3320 p.s.i. Flowing pressure: 0-95 p.s.i. 30-minute shut in bottomhole pressure: 190 p.s.i.

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ABE R. PETERSON
TOM LEEMING
OWEN RALL
HENRY P. C. W. BARBER
WALTER W. ROSS, JR.
TIMOTHY G. LOWRY
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RICHARD V. HENRY, JR.
J. HAYDEN MACDONALD
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JOHN W. GILLIGAN

LAW OFFICES
ECKERT, PETERSON & LEEMING
FIELD BUILDING
135 SOUTH LA SALLE STREET
CHICAGO 3

WALTER H. ECKERT
1923-1944

TELEPHONE
ANDOVER 3-7300

KS
WBM

May 25, 1953

OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO.
RECEIVED
MAY 28 1953

Mr. R. R. Spurrier
Secretary-Director
New Mexico Oil Conservation Commission
P.O. Box 871
Santa Fe, New Mexico

Re: Case 537 - New Mexico Oil Conservation Commission

Dear Mr. Spurrier:

Thank you for your letter of May 21st. It is of course very gratifying to us when our people do an outstanding job and I appreciate your calling it to my attention.

You have our permission to use the case in such fashion as you believe will be useful.

Sincerely yours,

Tim G. Lowry

TGL/H

cc: Mr. A. A. Hunt
Mr. A. C. McLee
Mr. Gail F. Moulton

C O P Y

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

May 21, 1953

Mr. Tim G. Lowry
616 Central Avenue, NE
Albuquerque, New Mexico

Dear Mr. Lowry:

On May 19th Mr. A. A. Hunt, Art Holland and Harry Birdseye with Counsel Jason Kellahin put on Case 537 before the New Mexico Oil Conservation Commission.

As you well know this case involves spacing of what is now called the South Blanco-Tocito Pool. Since I became a member of this Commission in October 1945 the Commission has heard about four hundred and seventy cases. Similar cases have been presented by the major oil companies such as Magnolia, Phillips, Amerada, Stanolind and Gulf but, never has a case been more thoroughly and competently presented in every detail than Case 537. Your organization is to be highly commended for the presentation and the efforts.

We would like permission to use your Case as an example for cases to be presented in the future.

Sincerely yours,

R. R. Spurrier
Secretary-Director

RRS/vc
bc: Mr. Kellahin
Mr. Hunt
Mr. Holland
Mr. Birdseye

Case 537

JASON W. KELLAHIN
ATTORNEY AT LAW
100 CORDOVA LANE
P. O. BOX 361
SANTA FE, N. M.

June 4, 1953

New Mexico Oil Conservation Commission,
State Capitol,
Santa Fe, New Mexico

Gentlemen:

Attached is a copy of a report by Amstutz and Yates on the Pettigrew Tocito (now South Blanco Tocito) Pool, Rio Arriba County, New Mexico. Permission was granted by the Commission to file this report as a late-filed exhibit in Commission Case No. 537, heard by the Commission last month.

Your courtesy in hearing the somewhat lengthy presentation of this case, and your consideration of it, is greatly appreciated.

Yours very truly,

Jason W. Kellahin

Jason W. Kellahin

Petroleum Production Engineering Co.

Reservoir and Engineering Analyses

P. O. BOX 4111
TULSA, OKLAHOMA

April 22, 1953

FILE NO.
LO-853

Lowry Oil Company
616 East Central Avenue
Albuquerque, New Mexico

Attention: Mr. A. F. Holland

Subject: Routine Permeability and
Porosity Determinations
Tocito Sandstone Reservoir
Federal 24-50-177
Pettigrew Tocito Field
Rio Arriba County, New Mexico

Gentlemen:

The following pages present the results of the routine permeability and porosity determinations made on samples of cores from the Tocito Sandstone Reservoir in the Federal 24-50-177 Well in the Pettigrew Tocito Field. Both tabular and graphical presentations of the data will be found.

The core was taken between the depths of 6604.2 feet and 6616.4 feet using rotary coring tools. Samples of the recovered core were selected in the field by a representative of the Lowry Oil Company, sealed in cans, and submitted for combination special and routine analysis.

As was requested, an analysis was performed on each section of core received. The following measurements were made:

1. Vertical permeability measurement on a full size section of core.

2. Porosity measurement on the full size section of core used in Test 1 above.

3. Horizontal permeability measurement on a $1\frac{1}{2}$ inch diameter plug drilled from the original full size section of core.

4. Porosity measurement on a plug drilled from the original full size section of core.

The results are arranged on the tabular data sheets in the order of increasing depth. A summary of the results follows:

1. The first column of figures lists the sample numbers.

2. The second column indicates the depths from which the samples were taken.

Petroleum Production Engineering Co.

File No. LO-853

3. The next column gives the lithology of the samples.

4. The fourth column of figures lists the vertical permeabilities to air as measured on the full size core section. These values range from a minimum of 0.01 md. to a maximum of 418 md. and average 40 md.

5. The fifth column lists the porosities as measured on the full size core section. These values vary from 4.3% to 23.2% and average 11.7%.

6. Permeabilities to air as measured on the 1½ inch diameter horizontal plug drilled from the full size core section appear in the next column. These values vary from a minimum of 0.06 md. to a maximum of 981 md. and average 146 md.

7. The last column lists the porosities as measured on a plug taken from the original full size core section. These values vary from 4.6% to 23.8% and average 12.6%.

The graphical presentations of the results will be found following the tabular data. The first graph depicts the results determined from the full size core analysis and the second graph depicts the results determined from the plug analysis.

We sincerely appreciate this opportunity to be of service to you and hope that we may have the opportunity to serve you again in the future.

Yours very truly,

Harold S. Deyo

HSDeyo:gad
Enclosures

Petroleum Production Laboratories, Inc.
TELEPHONE Victor-0871
Dallas, Texas

ADDRESS ALL CORRESPONDENCE TO P. O. BOX 2926

ADDRESS ALL SHIPMENTS TO 407 SOUTH HASKELL

April 21, 1953

File No. LO-853

Petroleum Production Engineering Co.
P. O. Box 4111
Tulsa, Oklahoma

Gentlemen:

You will find enclosed the tabular data and graphs showing the results of the combination special and routine core analysis made on samples of cores from the Tocito Sandstone Reservoir in the Federal 24-50-177 Well, Pettigrew Tocito Field, Rio Arriba County, New Mexico.

Yours very truly,

Tom Halliburton

Enclosures

Petroleum Production Laboratories, Inc.

DALLAS, TEXAS

ROUTINE PERMEABILITY AND POROSITY DETERMINATIONS

Company: Lowry Oil Company
Date: April 22, 1953
Well: Federal 24-50-177
File No.: LO-853
Reservoir: Tocito Sandstone
County: Rio Arriba
Field: Pettigrew Tocito
State: New Mexico

Sample Number	Depth (Ft.)	Description of Formation	Full Size Core Analysis: Vertical Air Permeability (md.)	Full Size Core Analysis: Porosity (%)	Plug Analysis: Horizontal Air Permeability (md.)	Plug Analysis: Porosity (%)
1	6604.2-04.7	vy fg cal ss	0.01	5.7	0.10	7.2
2	6604.7-05.2	shy ls - dense	0.04	4.3	0.25	4.7
3	6605.2-05.7	shy ls - dense	0.05	6.2	0.22	5.6
4	6605.7-06.2	shy ls - dense	0.05	8.7	0.26	7.3
5	6606.2-06.5	sdy shy ls - dense	0.03	5.4	0.11	7.8
6	6606.5-06.7	sdy shy ls - dense	*0.04	*6.1	***0.06	6.0
7	6606.7-07.2	shy ls - dense	0.03	8.0	0.10	6.5
8	6607.2-07.6	vy fg shy cal ss	0.04	9.8	0.43	12.0
9	6607.6-08.0	vy fg silty ss	0.22	10.3	0.78	11.3
10	6608.0-08.3	vy fg shy ss	*0.19	*11.1	***0.35	12.5
11	6608.3-08.5	vy fg shy ss	0.06	12.7	0.41	11.0
12	6608.5-09.0	fg shy ss	0.08	10.5	0.42	11.0
13	6609.0-09.5	vy fg shy ss	0.05	10.4	0.24	11.5
14	6609.5-10.5	vy fg shy ss-fractured	**8.1	11.9	0.38	13.5
15	6610.5-10.8	fy shy ss	0.07	10.2	0.20	13.0
16	6610.8-11.0	vy fg shy cal ss	*0.04	*6.3	***0.07	6.2
17	6611.0-11.5	vy fg shy cal ss	0.43	7.0	0.23	9.3
18	6611.5-11.9	fg shy ss	*0.12	*7.3	0.17	7.7

Petroleum Production Laboratories, Inc.

DALLAS, TEXAS File No. LO-853

ROUTINE PERMEABILITY AND POROSITY DETERMINATIONS

Sample Number	Depth (Ft.)	Description of Formation	Full Size Core Analysis		Plug Analysis	
			Vertical Air Permeability (md.)	Porosity (%)	Horizontal Air Permeability (md.)	Porosity (%)
19	6611.9-12.2	fg shy ss	*0.09	*5.5	0.17	4.6
20	6612.2-12.7	fg ss	*14	*18.2	46	19.0
21	6612.7-13.0	fg ss	0.71	19.8	10	21.8
22	6613.0-13.3	fg ss	183	23.2	442	23.8
23	6613.3-13.9	fg ss	12	21.0	760	22.8
24	6613.9-14.2	fg ss	418	22.0	778	23.1
25	6614.2-14.5	fg ss	335	21.5	981	22.1
26	6614.5-15.0	fg sl shy ss	221	20.2	821	23.8
27	6615.0-15.4	fg ss	9.2	18.6	247	21.6
28	6615.4-15.8	fg ss	8.1	18.3	289	18.1
29	6615.8-16.1	shy ls - dense	0.04	6.9	0.24	8.4
30	6616.1-16.4	ls - dense	0.07	5.1	0.13	5.2
Arithmetic Averages			40	11.7	146	12.6

Note: In the two columns falling under the heading of "Full Size Analysis", several of the results are preceded by the symbol *. This indicates that it was not possible to perform an analysis on the full size core section and $1\frac{1}{2}$ inch diameter vertical permeability plugs were drilled and analyzed. The sample preceded by the symbol ** had a vertical fracture extending through the entire length of the section which caused the permeability to be high in comparison with the other samples of similar structure.

In the "Air Permeability" column under "Plug Analysis" the symbol ***, indicates that 3/4 inch diameter horizontal permeability plugs were drilled and analyzed instead of $1\frac{1}{2}$ inch diameter plugs.

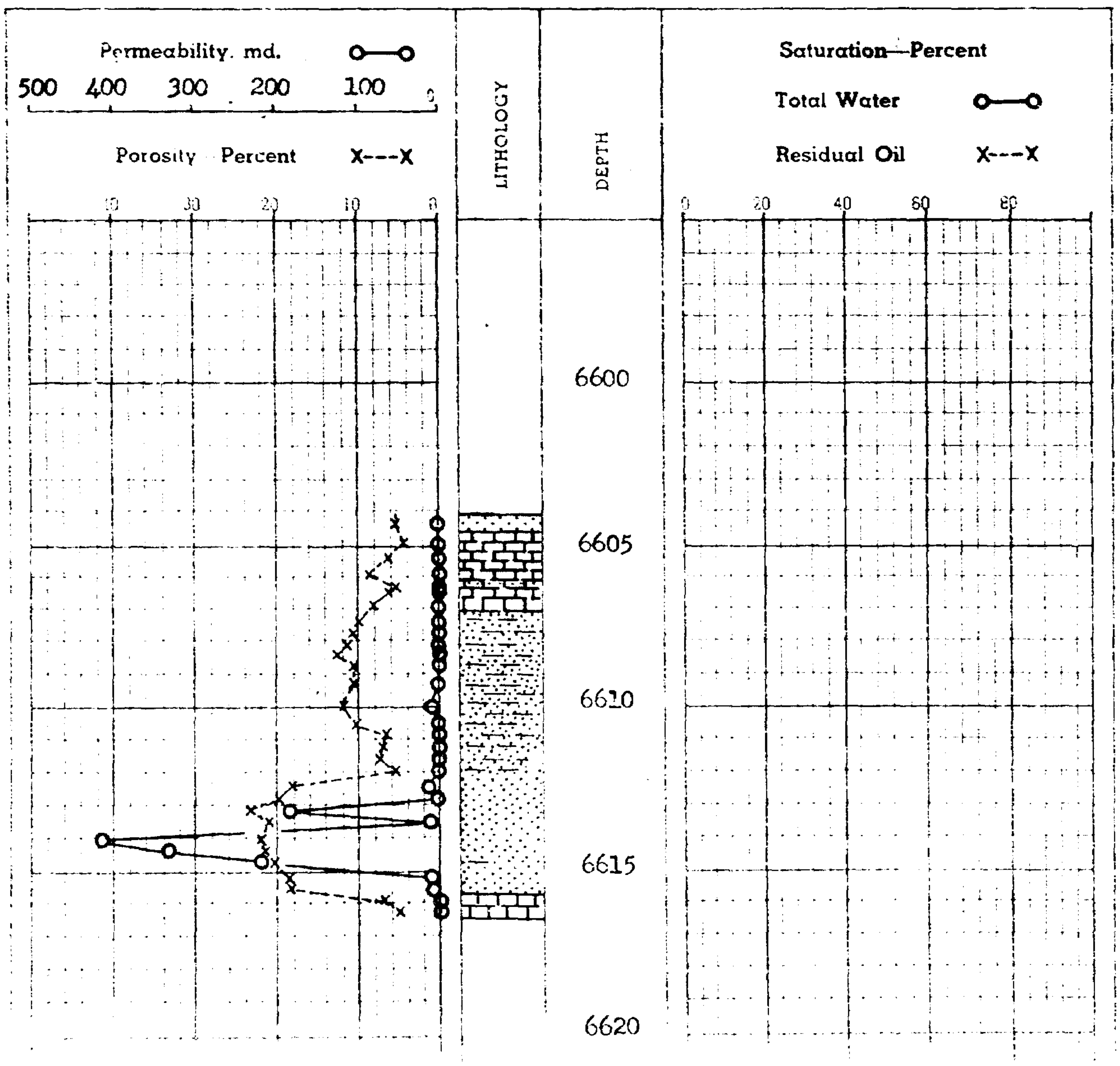
Petroleum Production Laboratories, Inc.

LABORATORY AND RESERVOIR ENGINEERING ANALYSES

DALLAS, TEXAS

COREGRAPH

Company:	Lowry Oil Company	Elev:	
Well:	Federal 24-50-177	File:	LO-853
Field:	Pettigrew Tocito	Date:	April 21, 1953
Reservoir:	Tocito Sandstone	Drilling Fluid:	
County:	Rio Arriba	Remarks:	Results obtained from full size
State:	New Mexico		core analysis

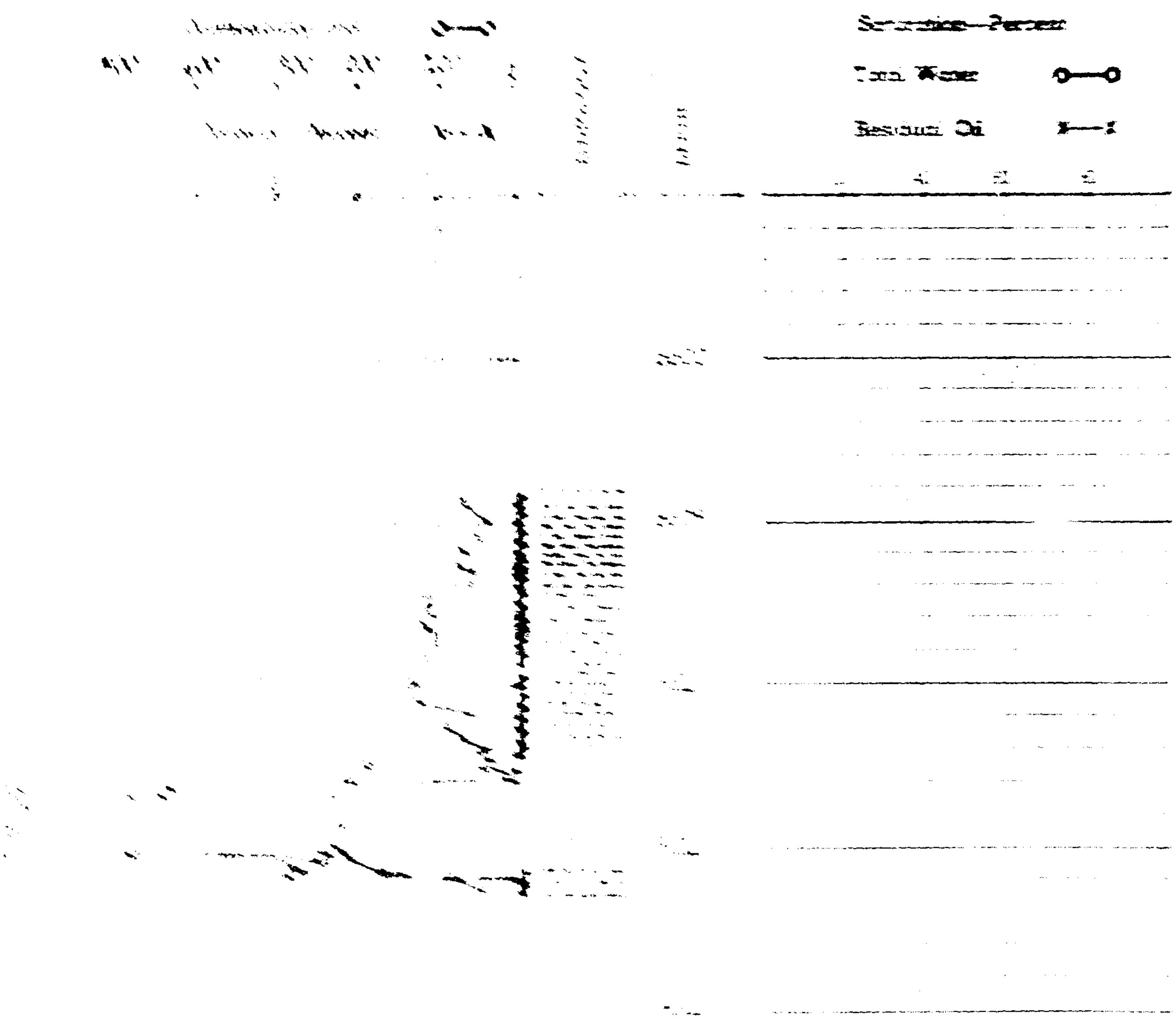


Petroleum Production Laboratories, Inc.

DALLAS, TEXAS

COREGRAPH

Company:	Lowry Oil Company	Elev:	
Well:	Federal 21-30-17	File:	LO-853
Field:	Pettigrew Tocito	Date:	April 21, 1953
Formation:	Tocito Sandstone	Drilling Fluid:	
County:	Rio Arriba	Remarks:	Results obtained from plug analysis
State:	New Mexico		



Petroleum Production Laboratories, Inc.

TELEPHONE View-[illegible]

ADDRESS ALL CORRESPONDENCE TO P. O. BOX [illegible]

Dallas, Texas

October 7, 1952

ADDRESS ALL SHIPMENTS TO [illegible] SOUTH HASKELL

File No. LO-790

Lowry Oil Company
616 East Central Avenue
Albuquerque, New Mexico

Attention: Mr. A. F. Holland

Subject: Porosity Determinations
Tocito Sandstone Reservoir
Federal 22-45-207
Federal 4-13-132
Pettigrew Tocito Field
Rio Arriba County, New Mexico

Gentlemen:

You will find enclosed the results of the porosity determinations on 39 samples of cores from the Tocito Sandstone Reservoir in the Federal 22-45-207 and the Federal 4-13-132 Wells in the Pettigrew Tocito Field. The samples used for the measurements were drilled samples of approximately 3/4 of an inch in diameter and of varying lengths.

The results are arranged on two tabular data sheets in the order of increasing depth. Table I lists the results for the 19 samples from the Federal 22-45-207 Well and Table II lists the results for the 20 samples from the Federal 4-13-132 Well. A discussion of the tabular data follows:

1. The first column of figures indicates the sample numbers.

2. The second column indicates the depths from which the samples were taken.

3. The last column lists the effective porosities (expressed as a percent of the bulk volume) as determined using an air expansion type porosimeter.

Arithmetic averages of the results of the analyses are shown below. An average is shown for the combined results of the samples from both wells and also for the separate results from each individual well.

Well	Number of Samples	Porosity (% bulk volume)
Federal 22-45-207	19	11.4
Federal 4-13-132	20	13.0
Combined	39	12.2

Petroleum Production Laboratories, Inc.

DALLAS, TEXAS

File No. LO-790

We sincerely appreciate this opportunity to be of service to you and hope that we may have the opportunity to serve you again in the future.

Yours very truly,

Harold S. Deyo

Laboratory Manager

HSDeyo:gad
Enclosures

Petroleum Production Laboratories, Inc.

DALLAS, TEXAS

POROSITY DETERMINATIONS

Company: Lowry Oil Company Date: October 7, 1952

Well: Federal 22-45-207 File No: 10-790

Reservoir: Tocito Sandstone County: Rio Arriba

Field: Pettigrew Tocito State: New Mexico

Sample Number	Depth (Ft.)	Porosity (%)
2	6643.5	6.1
3	6644.5	13.0
4	6645.5	6.4
5	6646.5	8.9
6	6647.5	9.9
7	6648.5	9.5
8	6649.5	10.9
9	6650.5	10.7
10	6651.5	18.1
11	6652.5	16.6
12	6653.5	18.3
13	6654.5	7.0
14	6655.5	5.5
15	6656.5	9.0
16	6657.5	15.8
17	6658.5	11.2
18	6659.5	19.0
19	6660.5	11.5
20	6661.5	9.1
Arithmetic Average		11.4

Table I

Petroleum Production Laboratories, Inc.

DALLAS, TEXAS

POROSITY DETERMINATIONS

Company: Lowry Oil Company | Date: October 7, 1952

Well: Federal 4-13-132 | File No: LO-790

Reservoir: Tocito Sandstone | County: Rio Arriba

Field: Pettigrew Tocito | State: New Mexico

Sample Number	Depth (Ft.)	Porosity (%)
27	6675.5	7.0
28	6676.5	5.2
29	6677.5	7.9
30	6678.5	6.5
31	6679.5	13.2
32	6680.5	9.9
33	6681.5	18.4
34	6682.5	17.3
35	6683.5	15.5
36	6684.5	9.8
37	6685.5	15.7
38	6686.5	18.1
39	6687.5	8.9
40	6688.5	17.5
41	6689.5	21.3
42	6690.5	21.3
43	6691.5	16.6
44	6692.5	8.0
45	6693.5	13.4
46	6694.5	7.7
Arithmetic Average		13.0

Table II

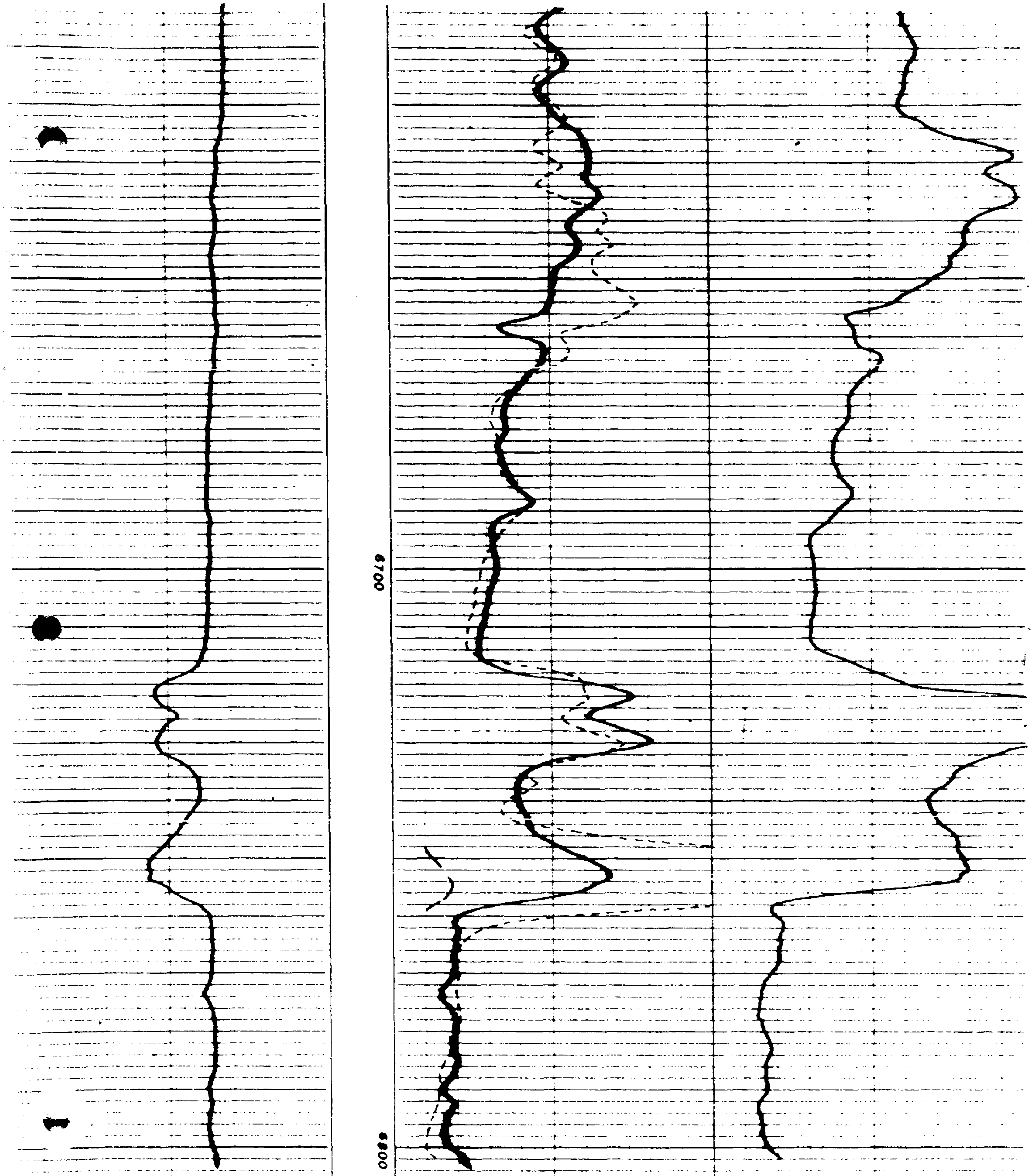
Lowry et al Operating Account

Schlumberger Electric Logs Surveys
and
Schlumberger Microlog Surveys
of
Tocito Sand

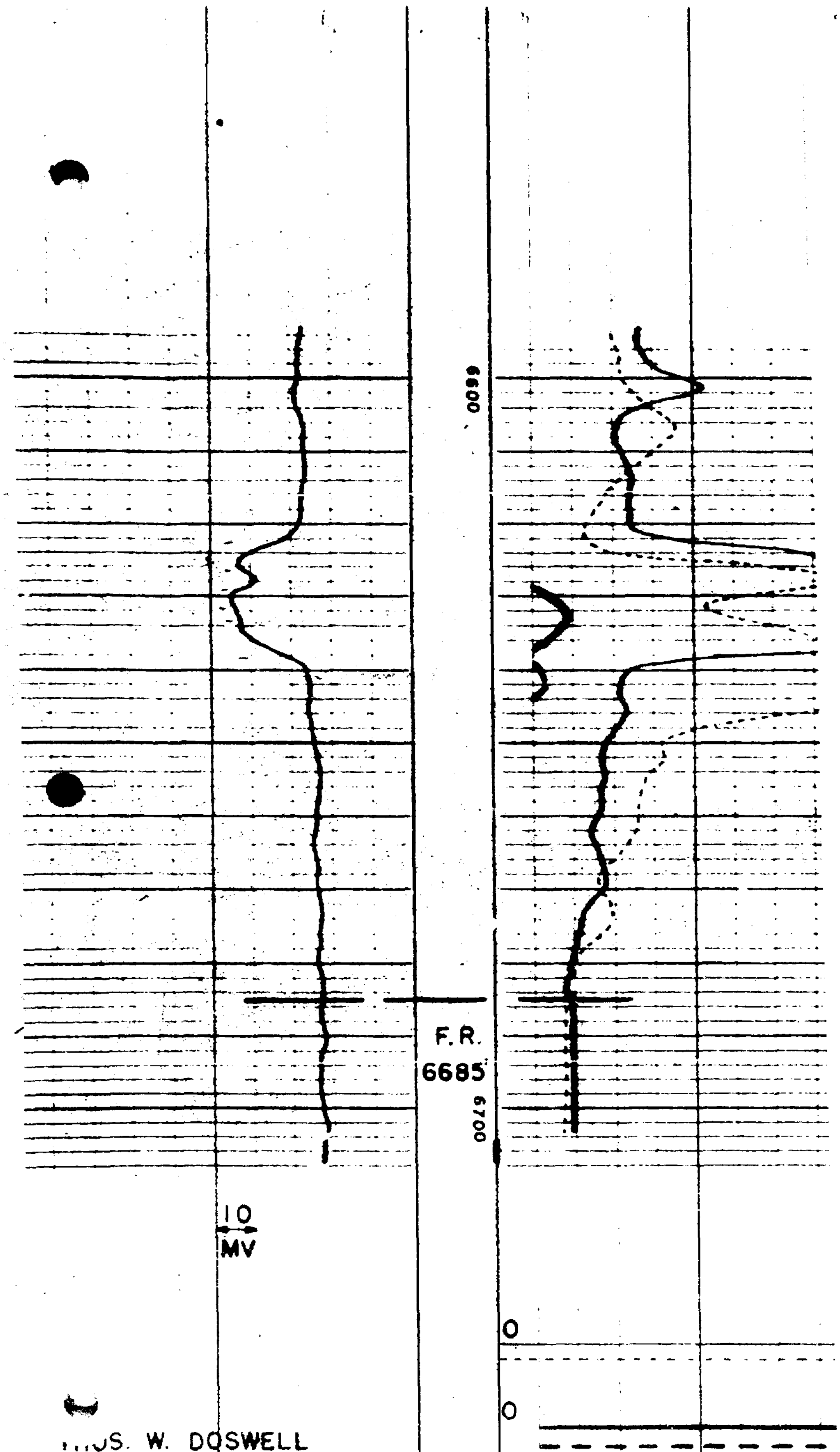
- - - - - - - - - - -

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

Well No.	Top of Tocito Sand	Elevation	Subsea Datum Top of Tocito Sand
Federal 1-134	6,718	6,550	-168
Federal 2-179	6,622	6,507	-115
Federal 4-13-132	6,676	6,515	-161
Federal 19-34-157	6,819	6,654	-165
Federal 7-35-109	6,682	6,494	-188
Federal 21-40-182	6,705	6,561	-144
Federal 22-45-207	6,643	6,506	-137
Federal 23-49-129	6,583	6,423	-160
Federal 24-50-177	6,605	6,477	-128
Federal 25-51-127	6,629	6,493	-136
State 1-268	6,602	6,514	-88



LOWRY ET AL
FEDERAL 1-134
ELEV 6550 DF

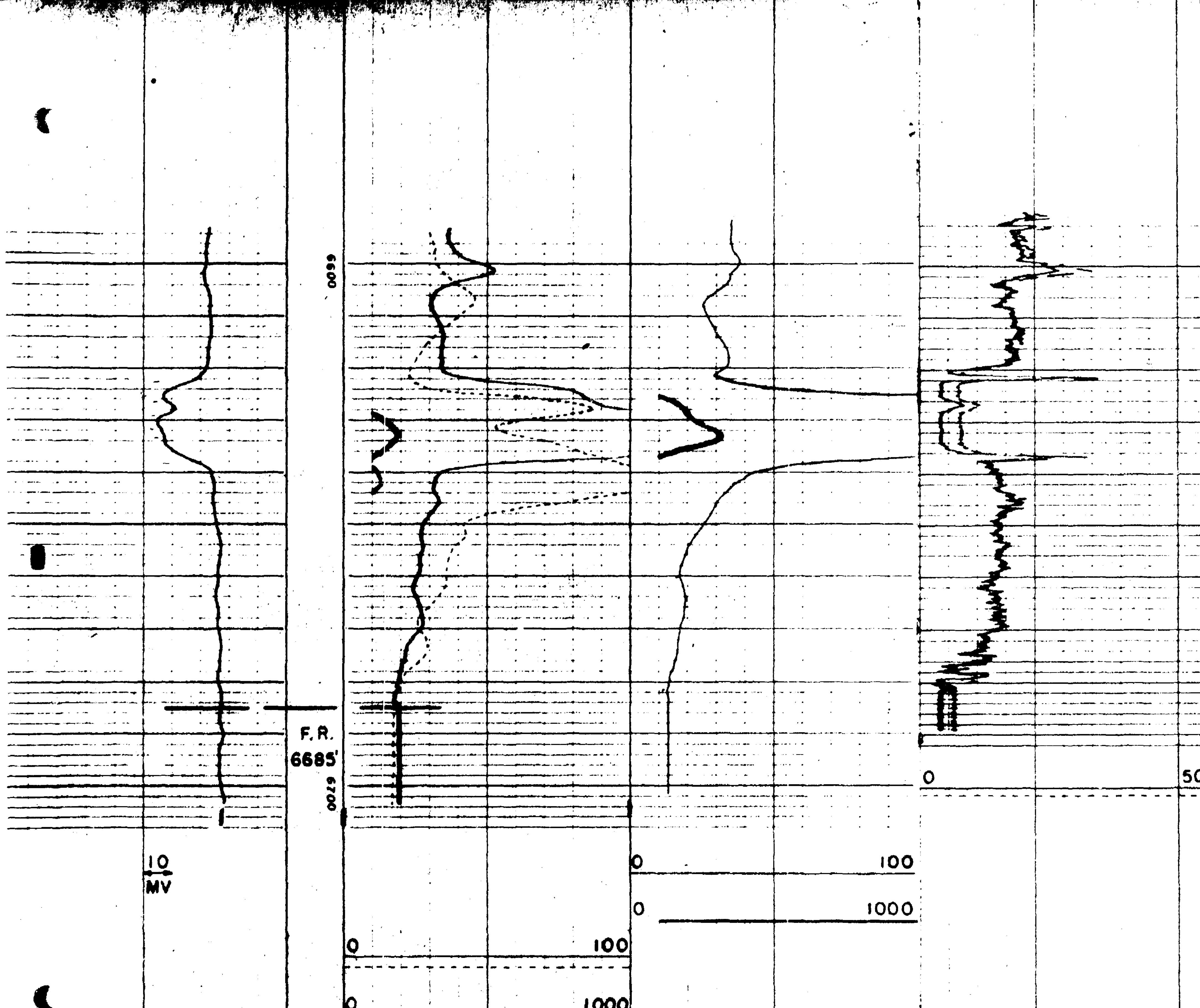


..US. W. DOSWELL

SCOTT - FEDERAL NO. 2 179

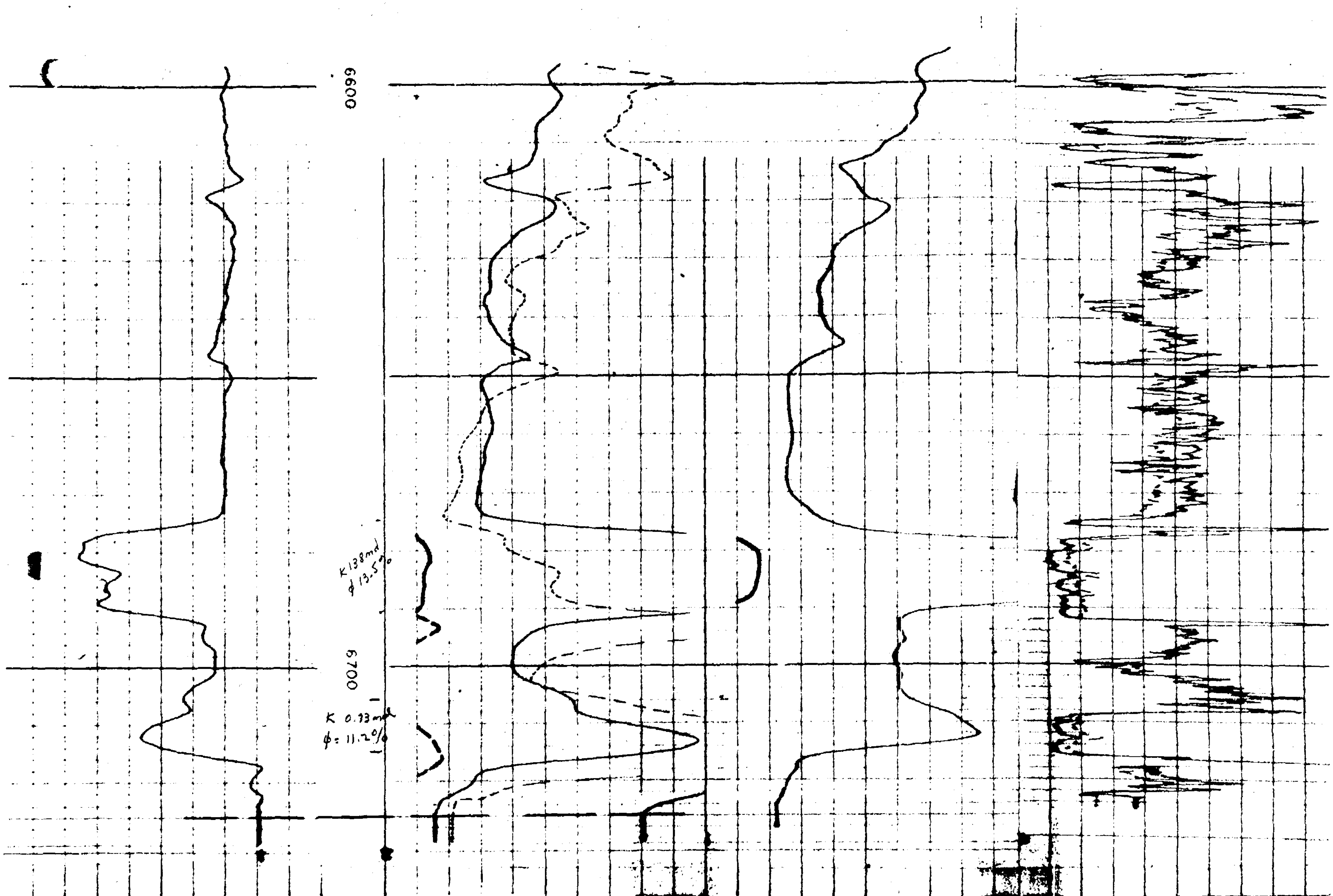
SEC 9 — 26N — 6W

RIO ARRIBA CO., N.M.



THOS. W. DOSWELL
SCOTT - FEDERAL NO. 2
SEC. 9 - 26N - 6W.
RIO ARRIBA CO., N.M.

179



— |10| +

F.R. 6726

NORMAL
0 — 1000
0 — 10000

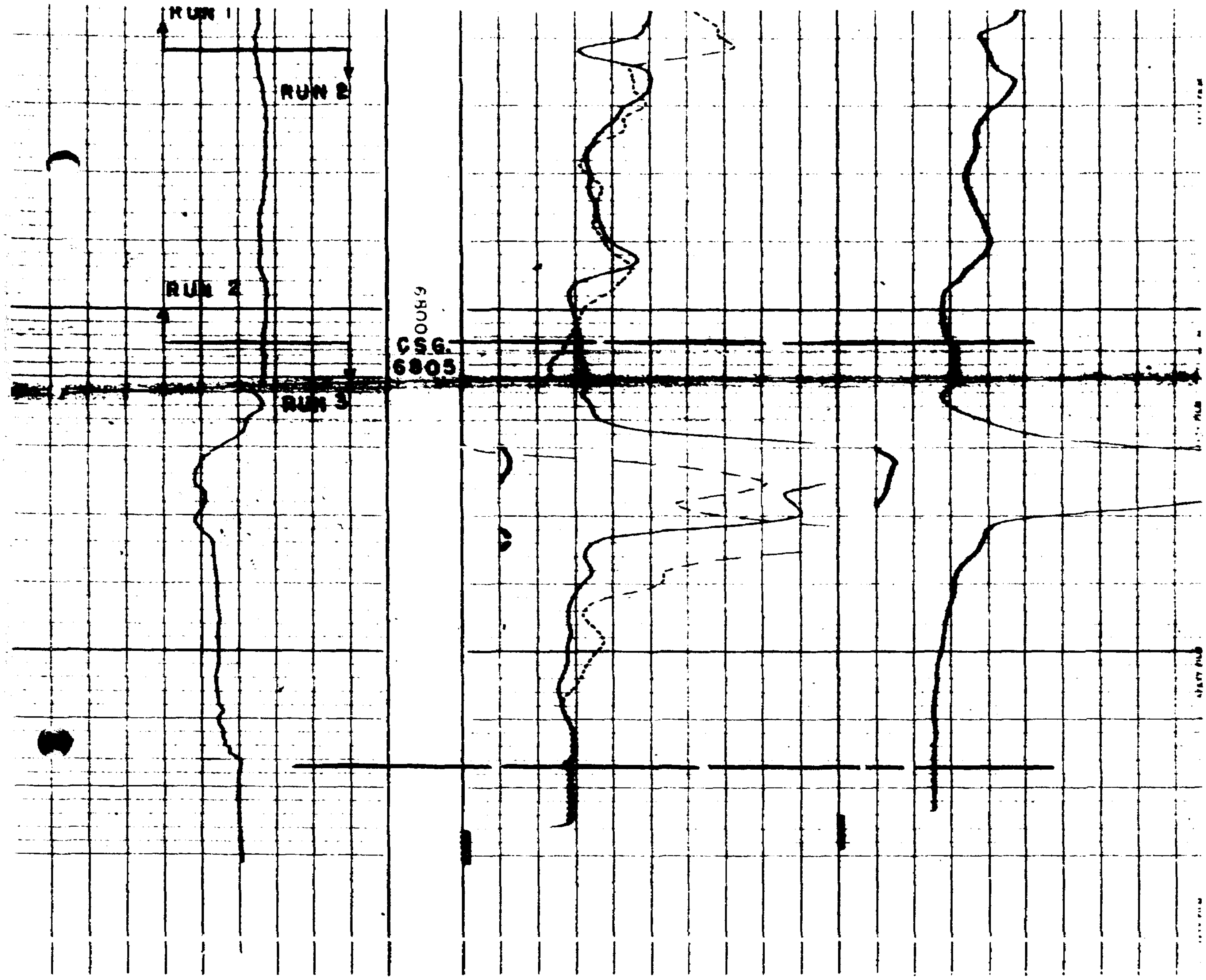
LATERAL
0 — 1000
0 — 1000

AMPLIFIED NORMAL
0 — 20

LONG NORMAL
0 — 1000
0 — 10000
0

MICROLOG
AO = 1.5 — 50
AM = 2" — 50

..Y ET AL
FEDERAL 4-13-132
SEC.9-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6502 G.L.
6515 K.B.

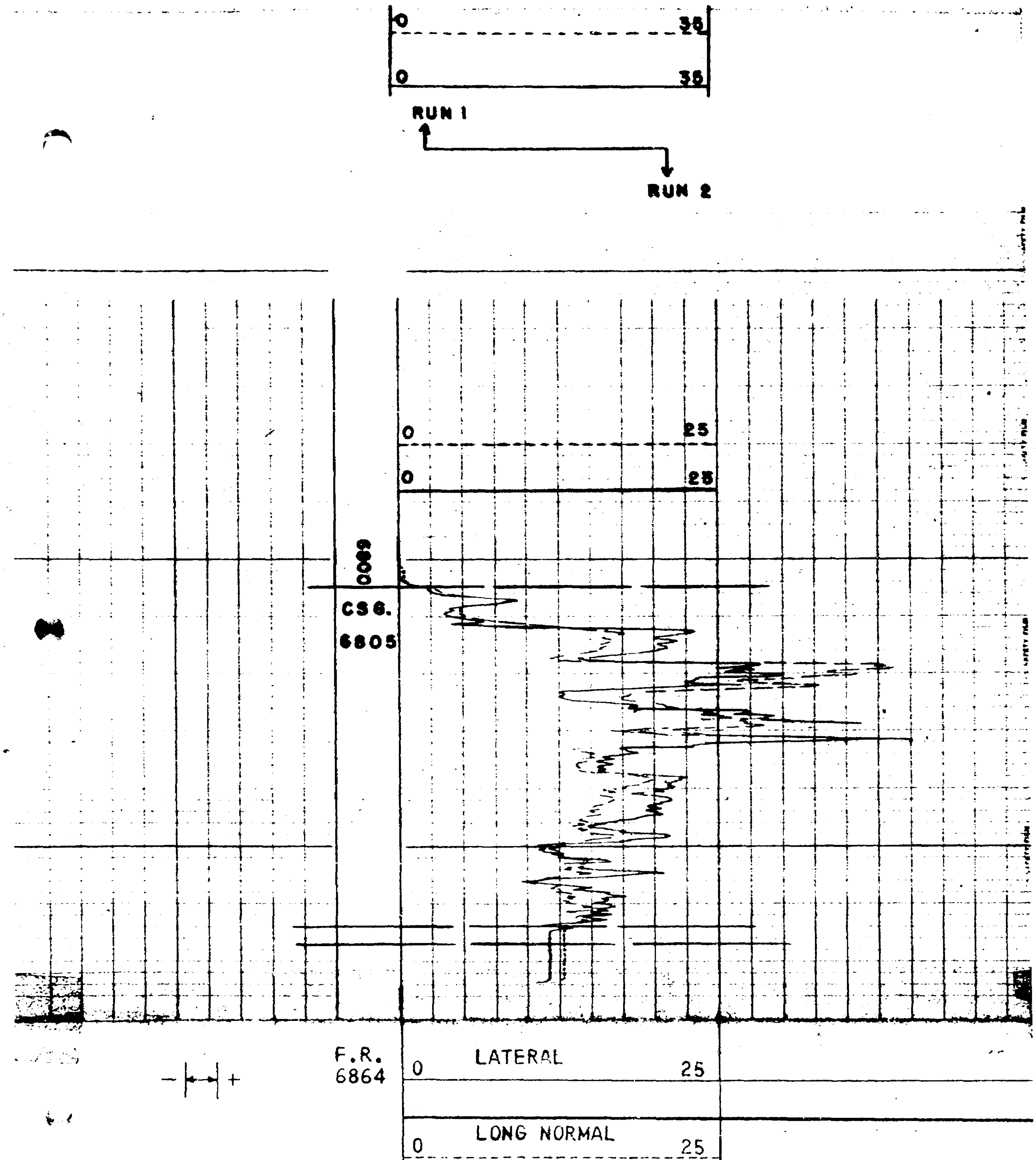


— |10| +

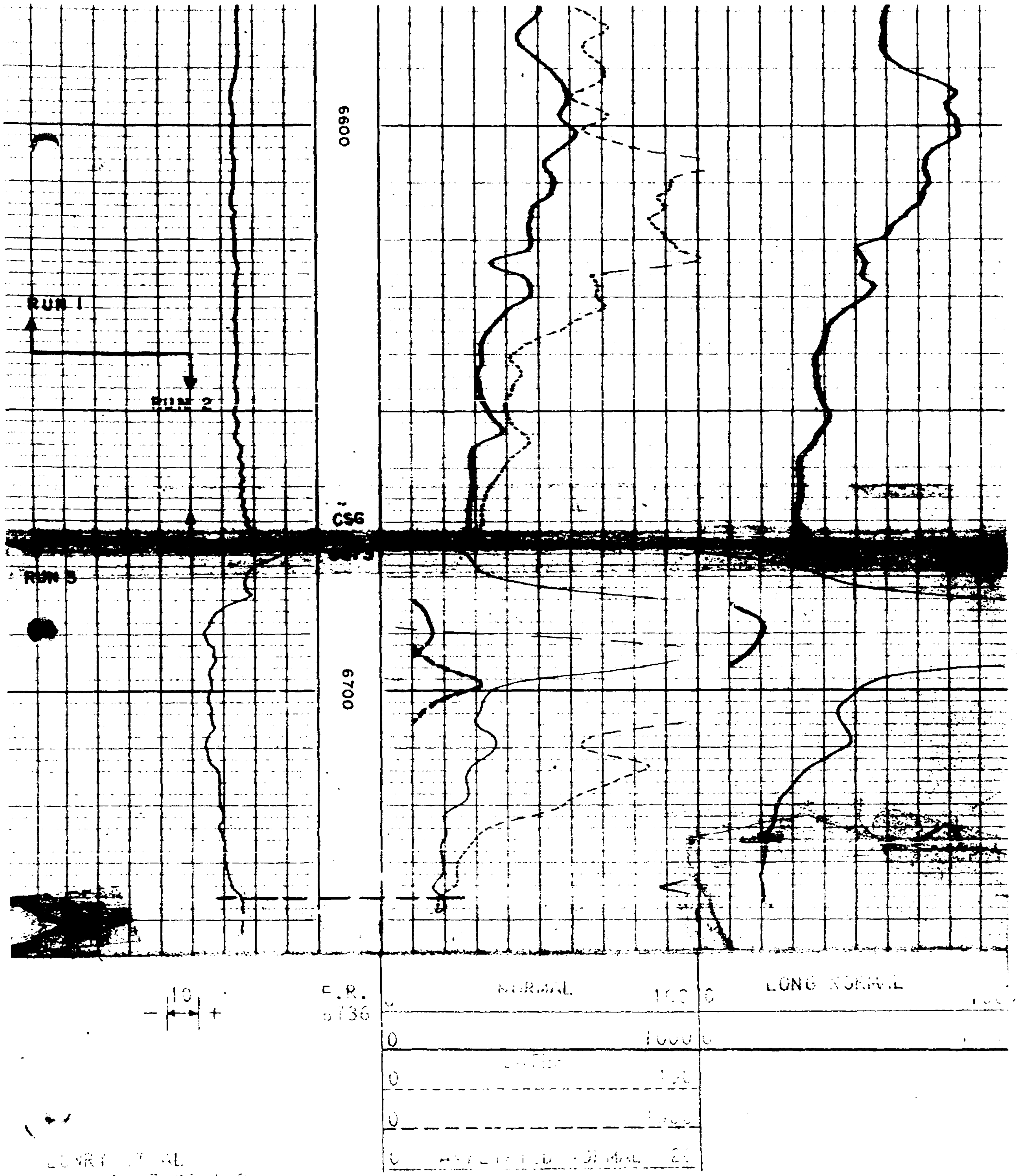
F.R.
6867'

0	NORMAL	100	0	LONG NORMAL	100
0		1000	0		1000
0	LATERAL	100			
0		1000			
0	AMPLIFIED NORMAL	20			

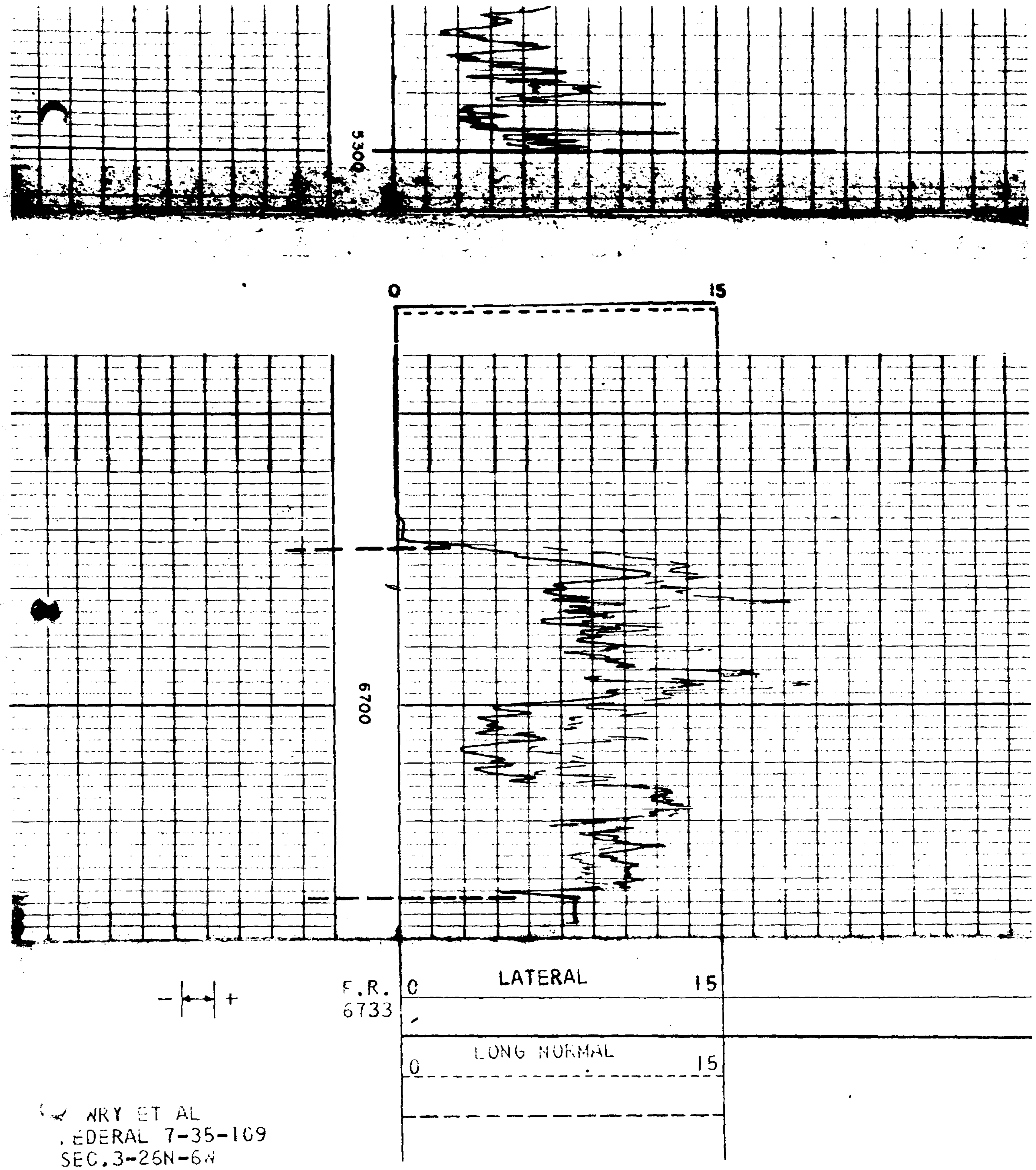
LOWRY ET AL
FEDERAL 19-34-157
SEC. 10-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6638' G.L.



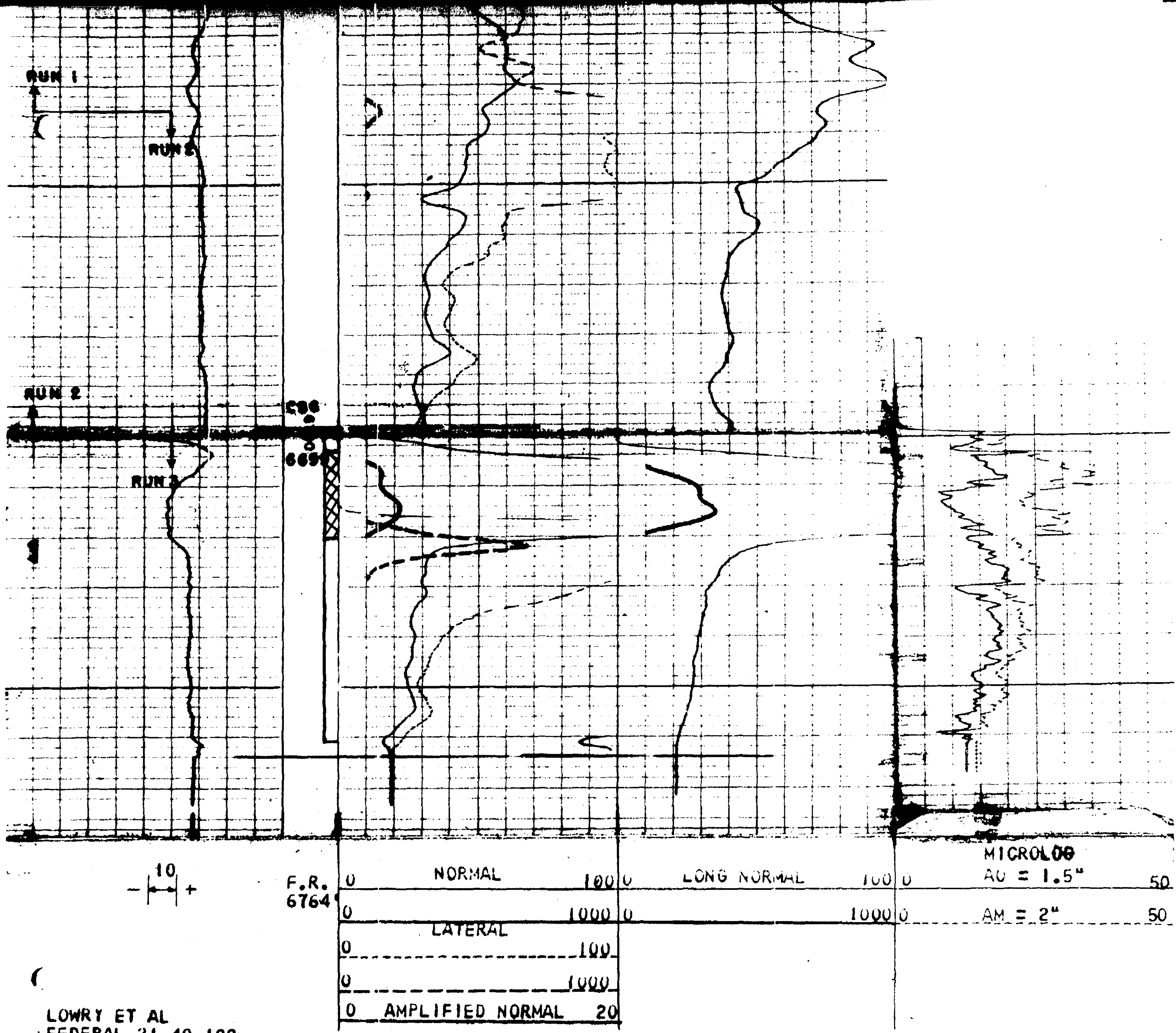
LOWRY ET AL
FEDERAL 19-34-157
SEC. 10-26N-6W
RIO ARRIBA COUNTY, NEW MEXICO
ELEV. 6638' G.L.



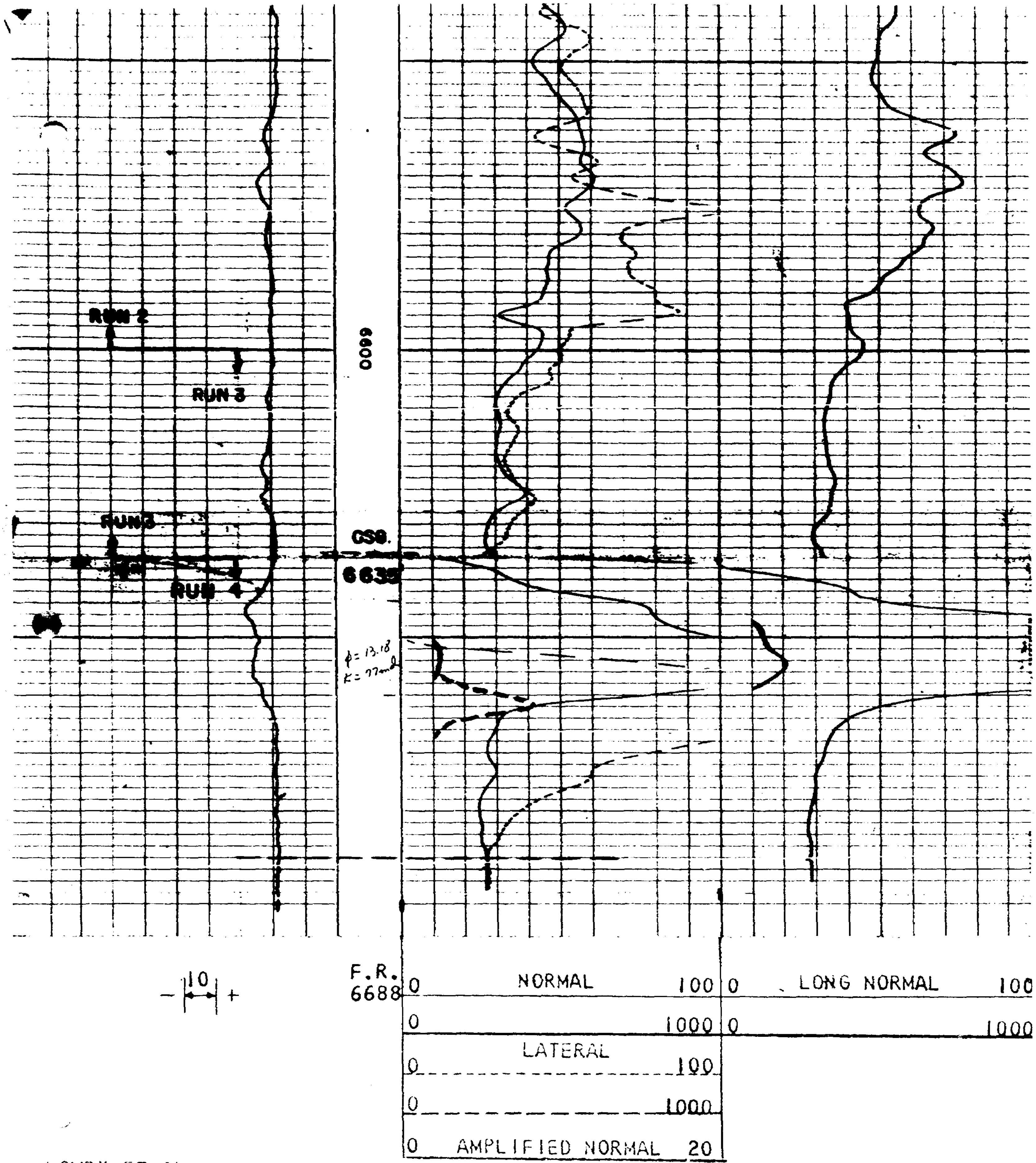
7-35-109



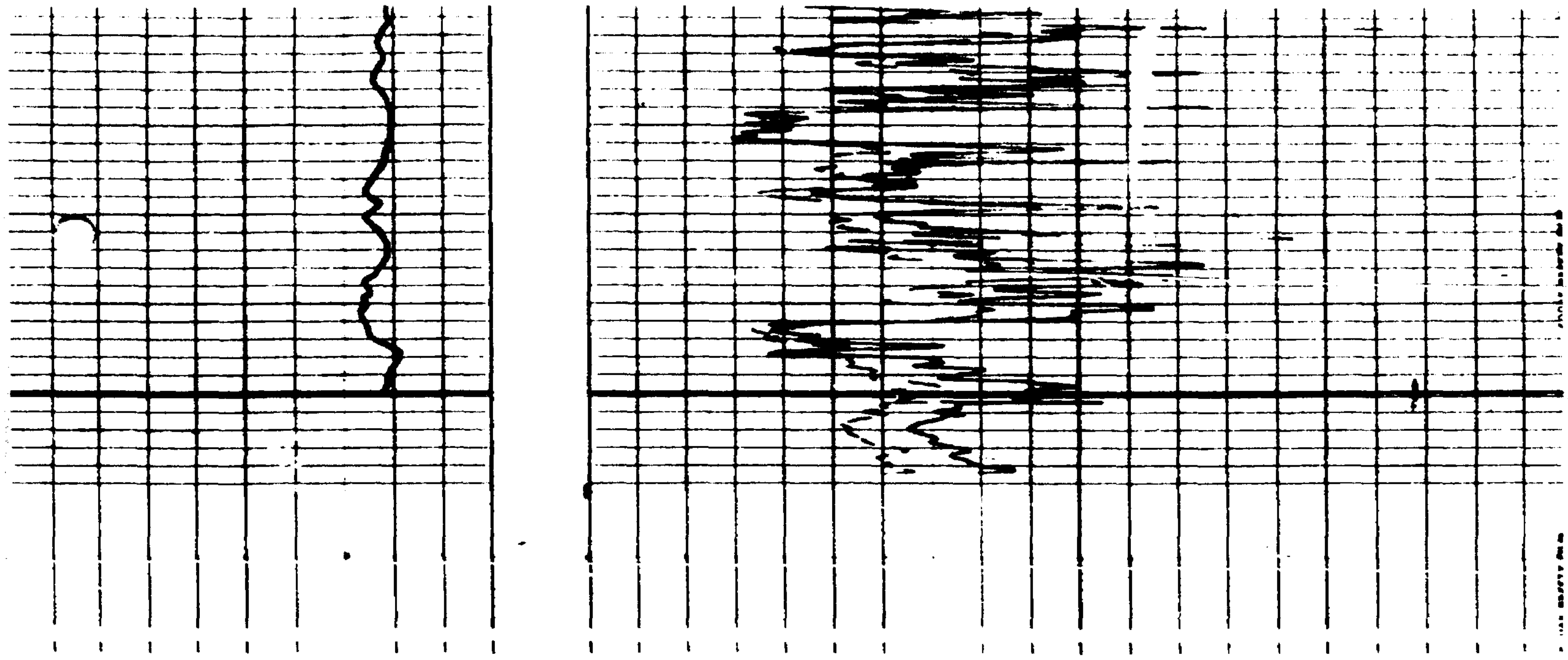
WRY ET AL
EDERAL 7-35-109
SEC.3-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6484' G.L.

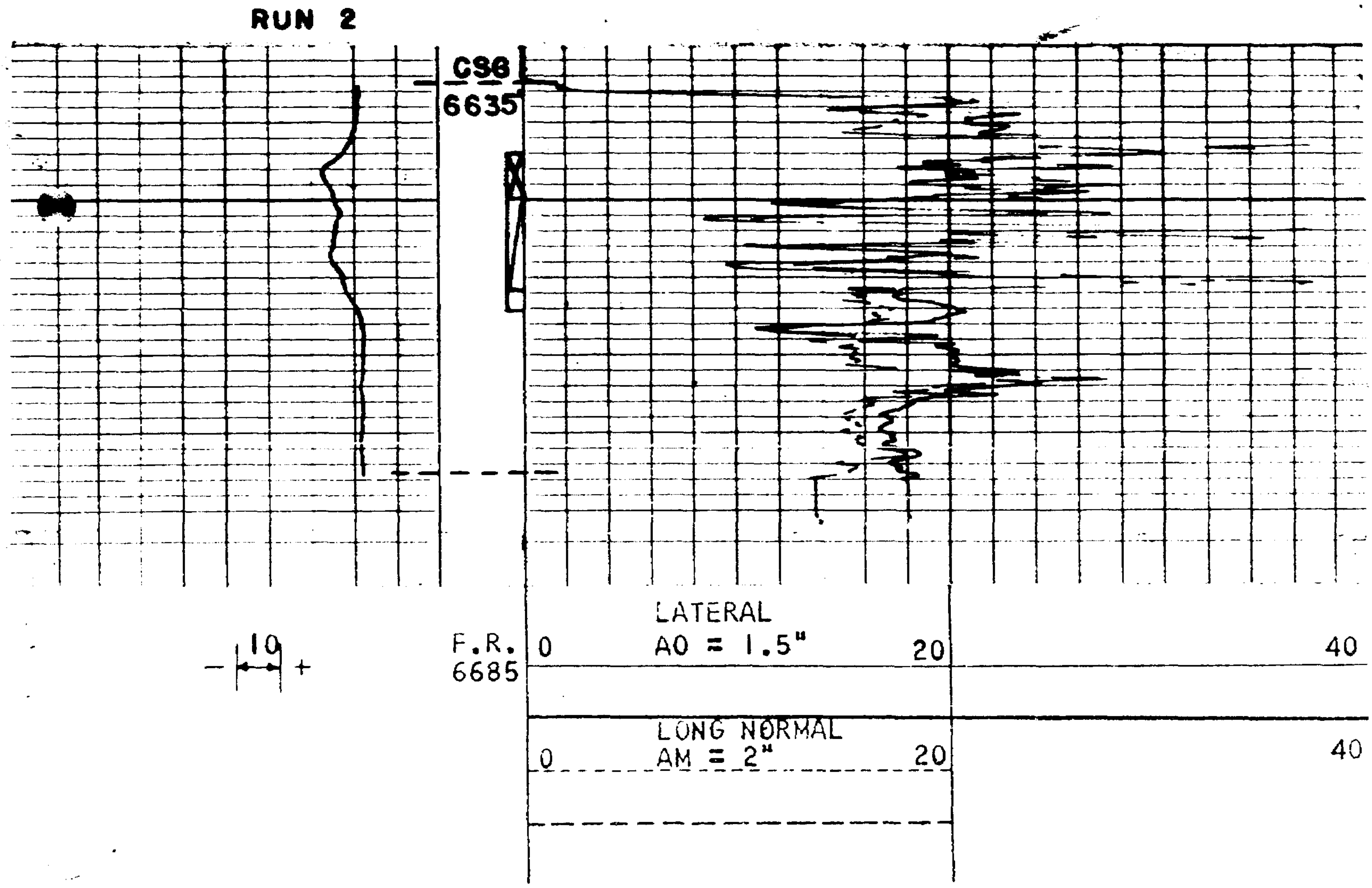


LOWRY ET AL
FEDERAL 21-40-182
SEC. 10-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6552' G.L.



LOWRY ET AL
FEDERAL 22-45-207
SEC. 10-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6506' D.F.





LOWRY ET AL
FEDERAL 22-45-207
SEC. 10-26N-6W
RIO ARRIBA, NEW MEXICO
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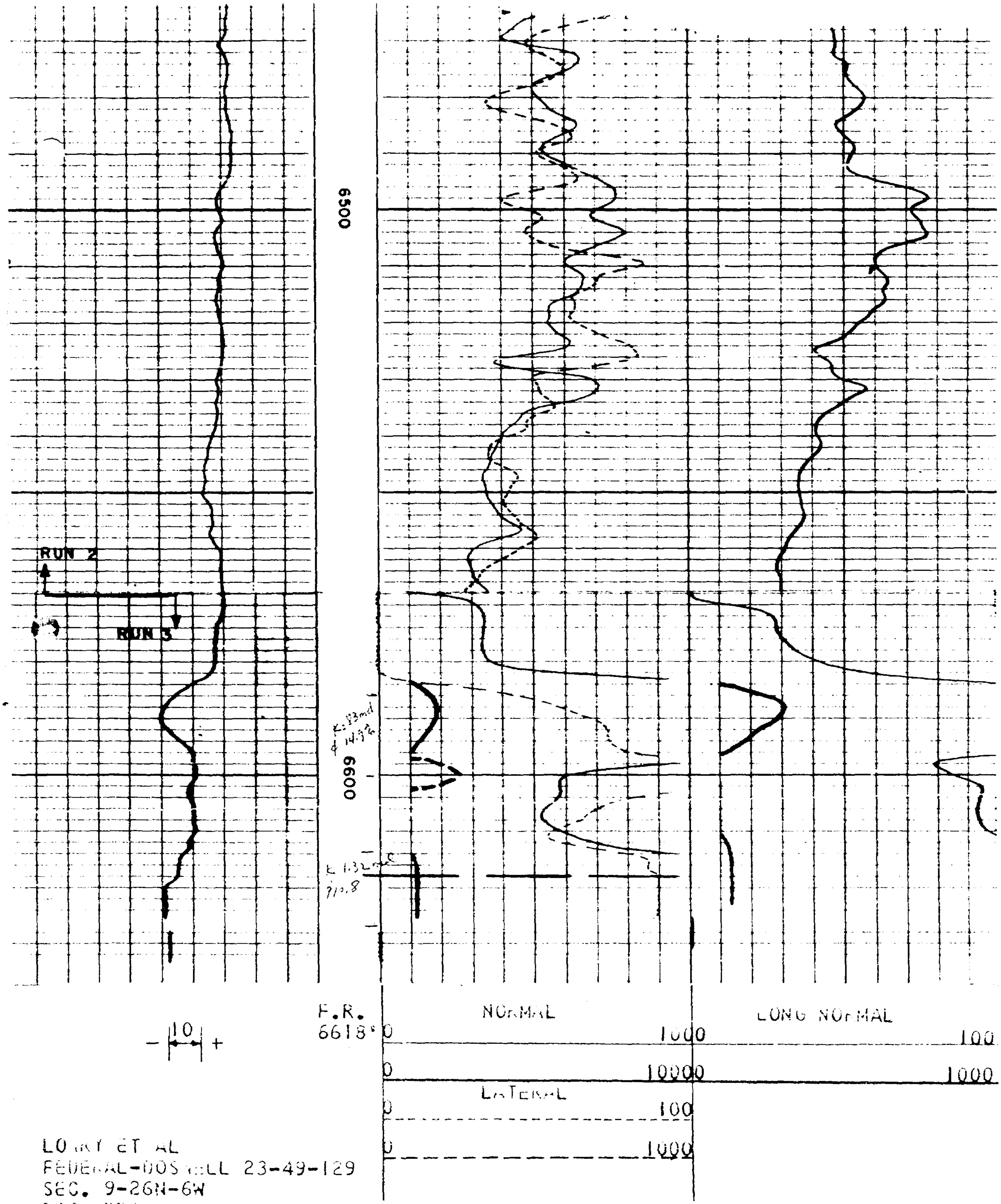


LOWRY ET AL
FEDERAL-DOSWELL 23-49-129
SEC. 9-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6413' G.L.

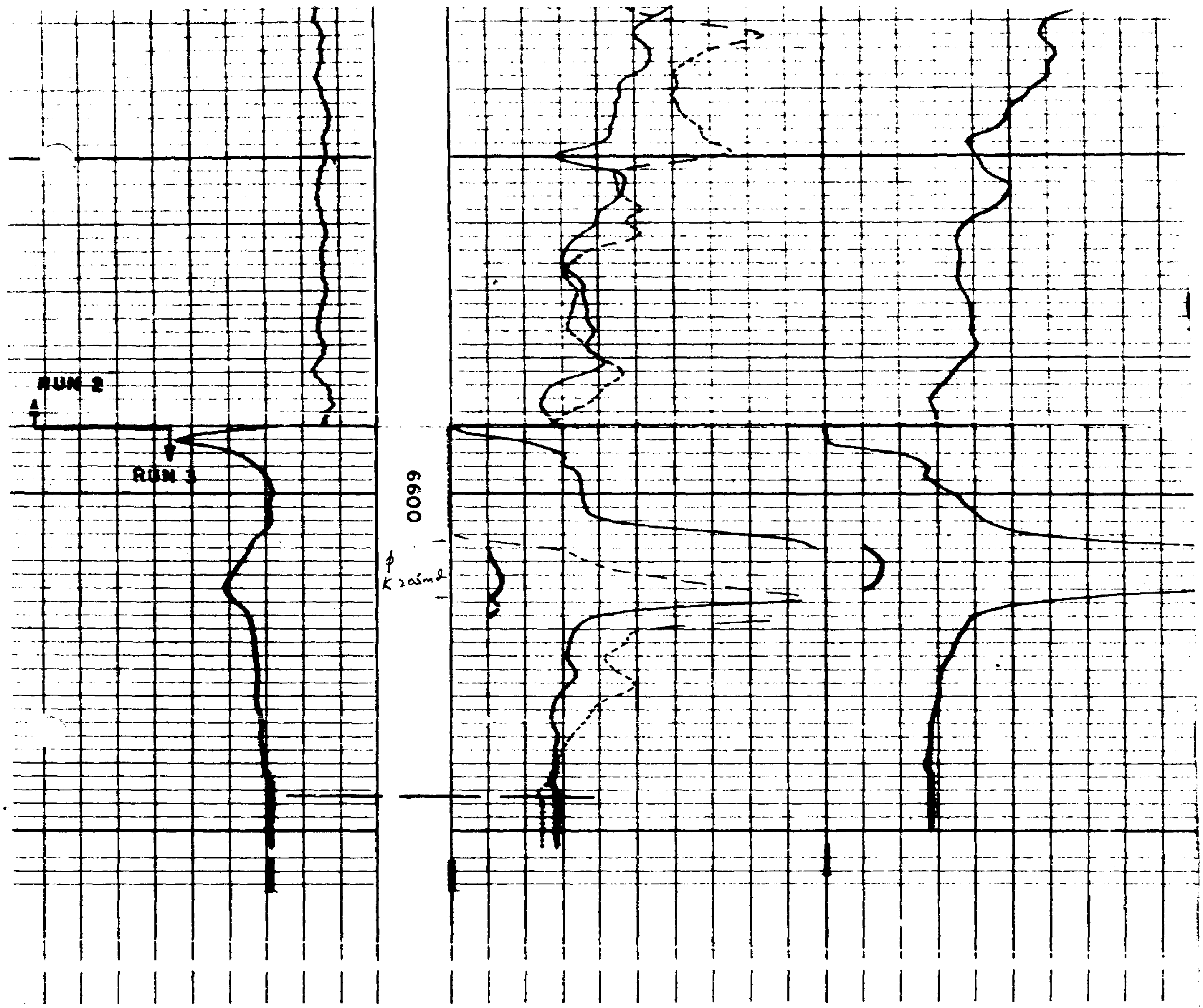
— |10| +

F.R.
6615'

LATERAL AO = 1.5"		
0	50	100

LONG NORMAL AM = 2"		
0	50	100

LOWRY ET AL
FEDERAL-DOSWELL 23-49-129
SEC. 9-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6413' G.L.

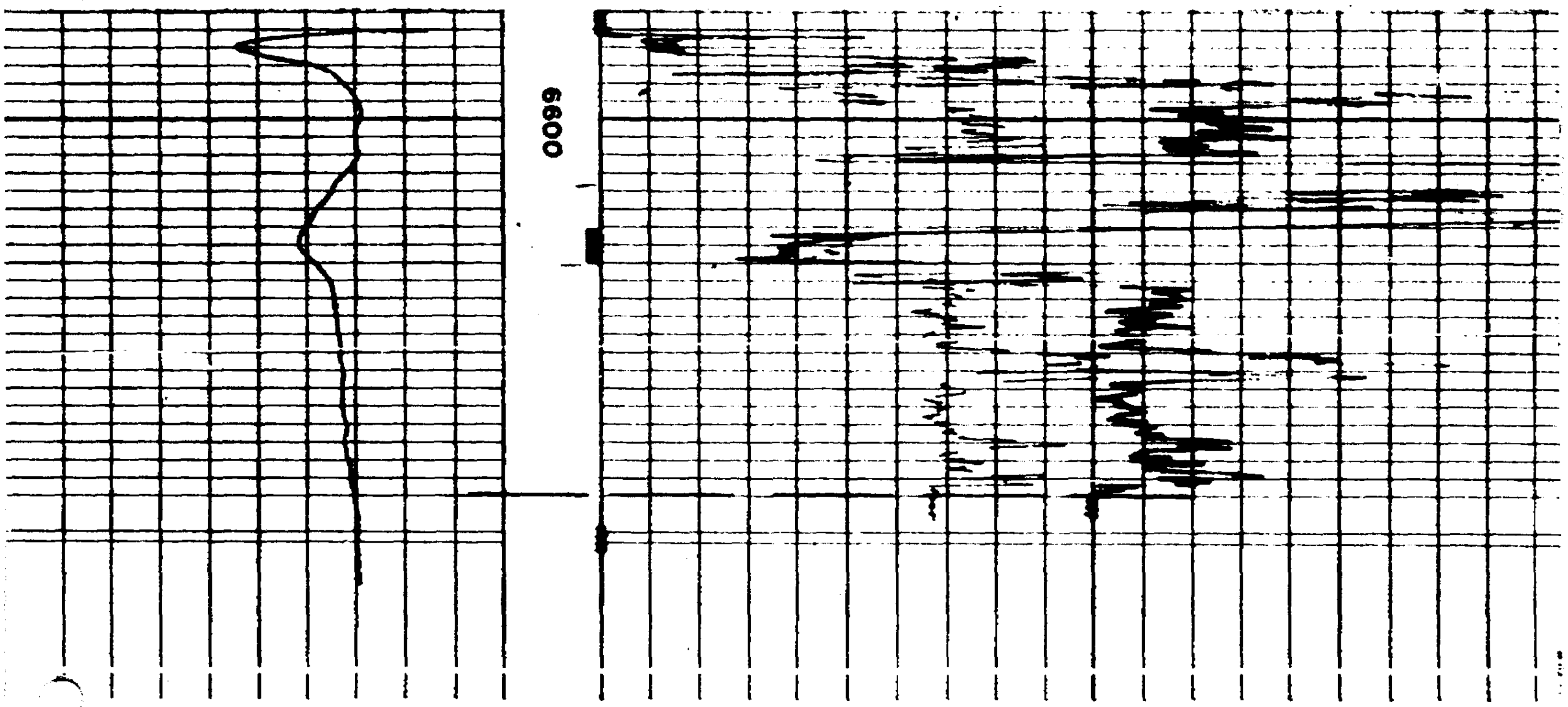


10

F.R.
6645'

NORMAL		LONG NORMAL	
0	100	0	100
0	1000	0	1000
LATERAL			
0	100		
0	1000		

LOWRY ET AL
FEDERAL DOSWELL #24-50-177
SEC. 9-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6466' G.L.



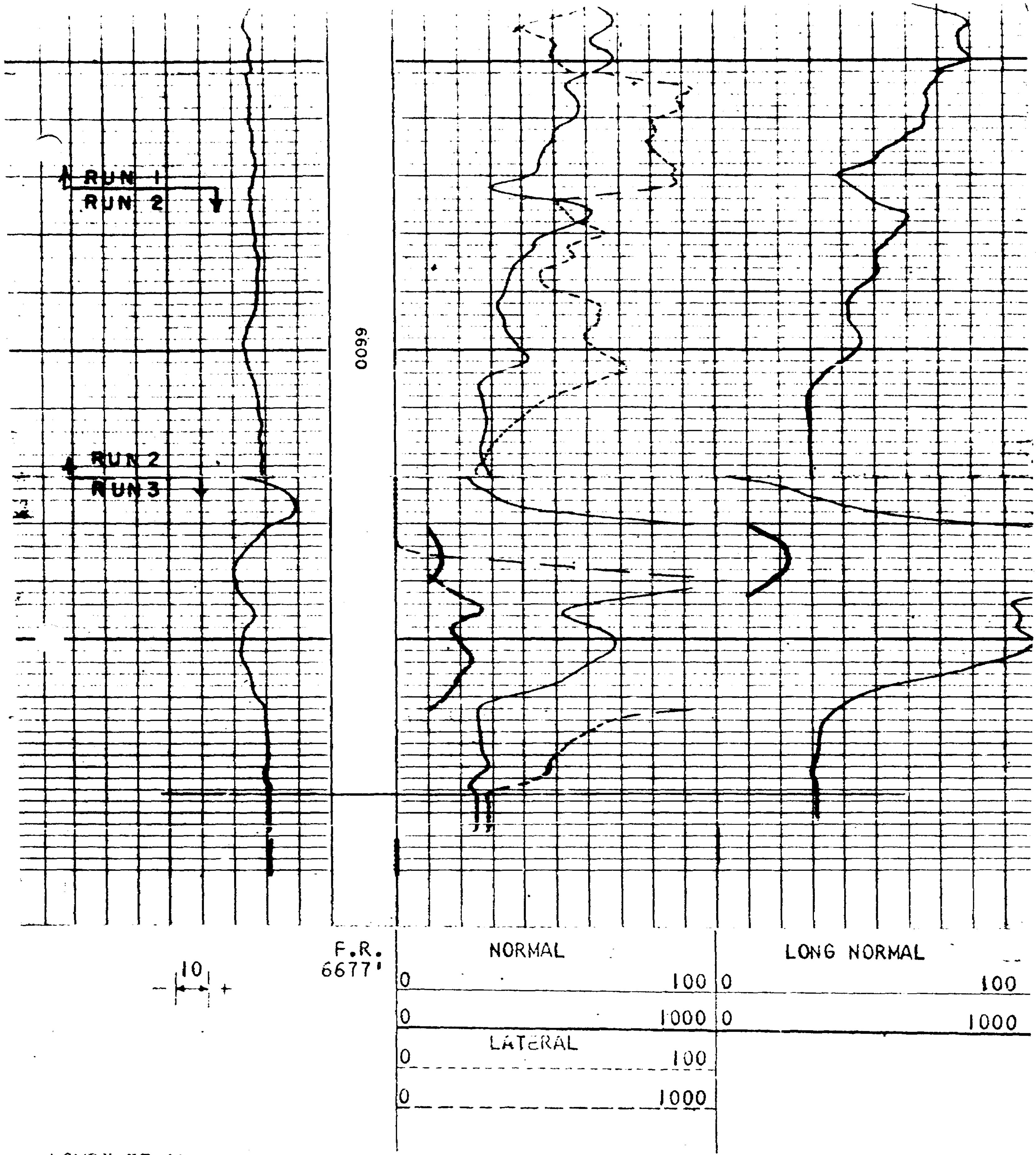
10

F.R.
6645

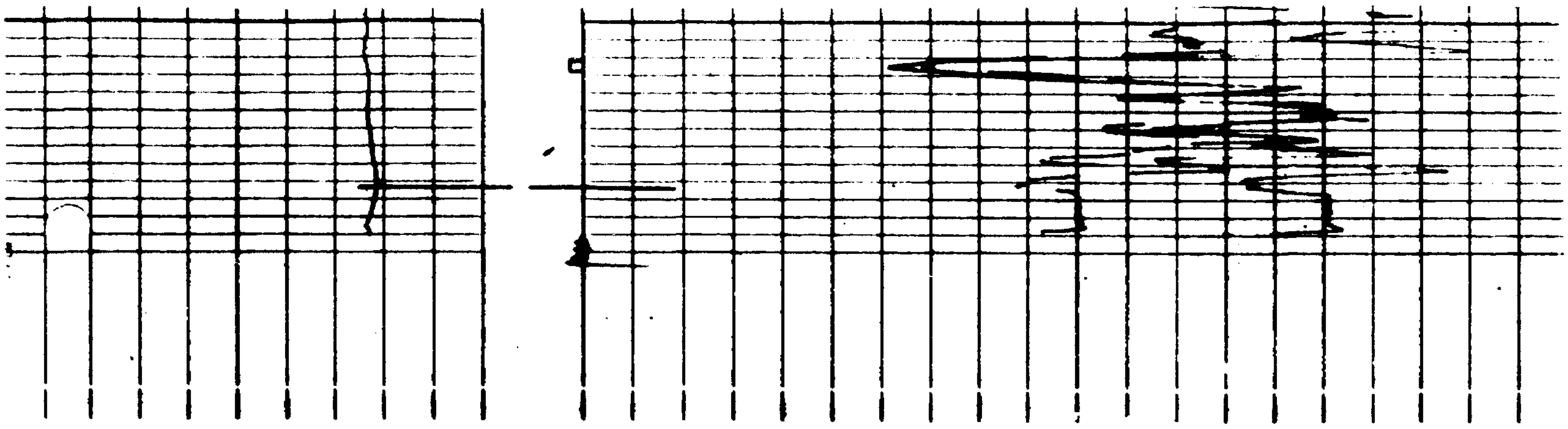
0 Micro Inverse 1"x1" 20 40

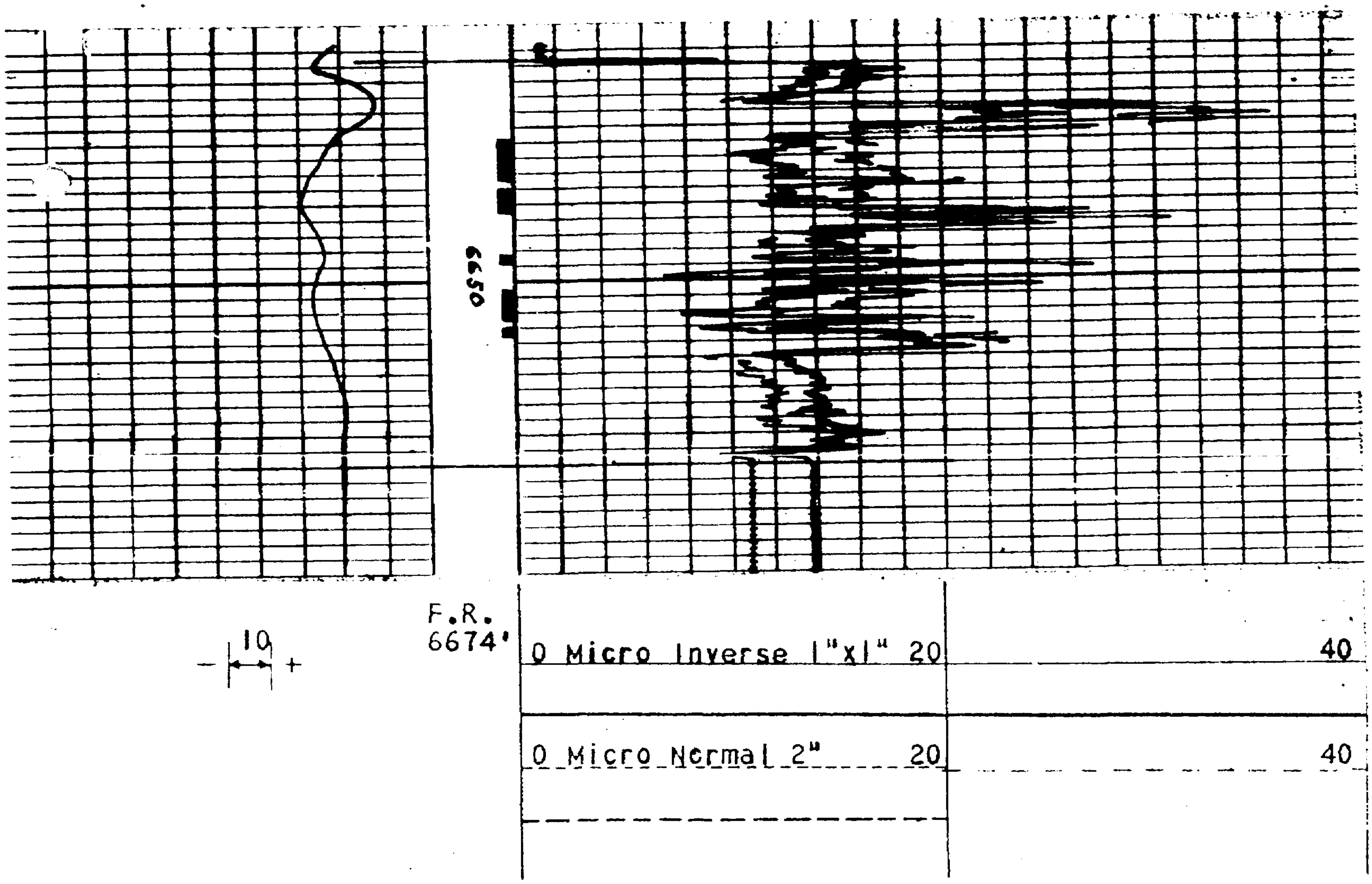
0 Micro Normal 2" 20 40

LOWRY ET AL
FEDERAL DOSWELL #24-50-177
SEC. 9-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6466' G.L.

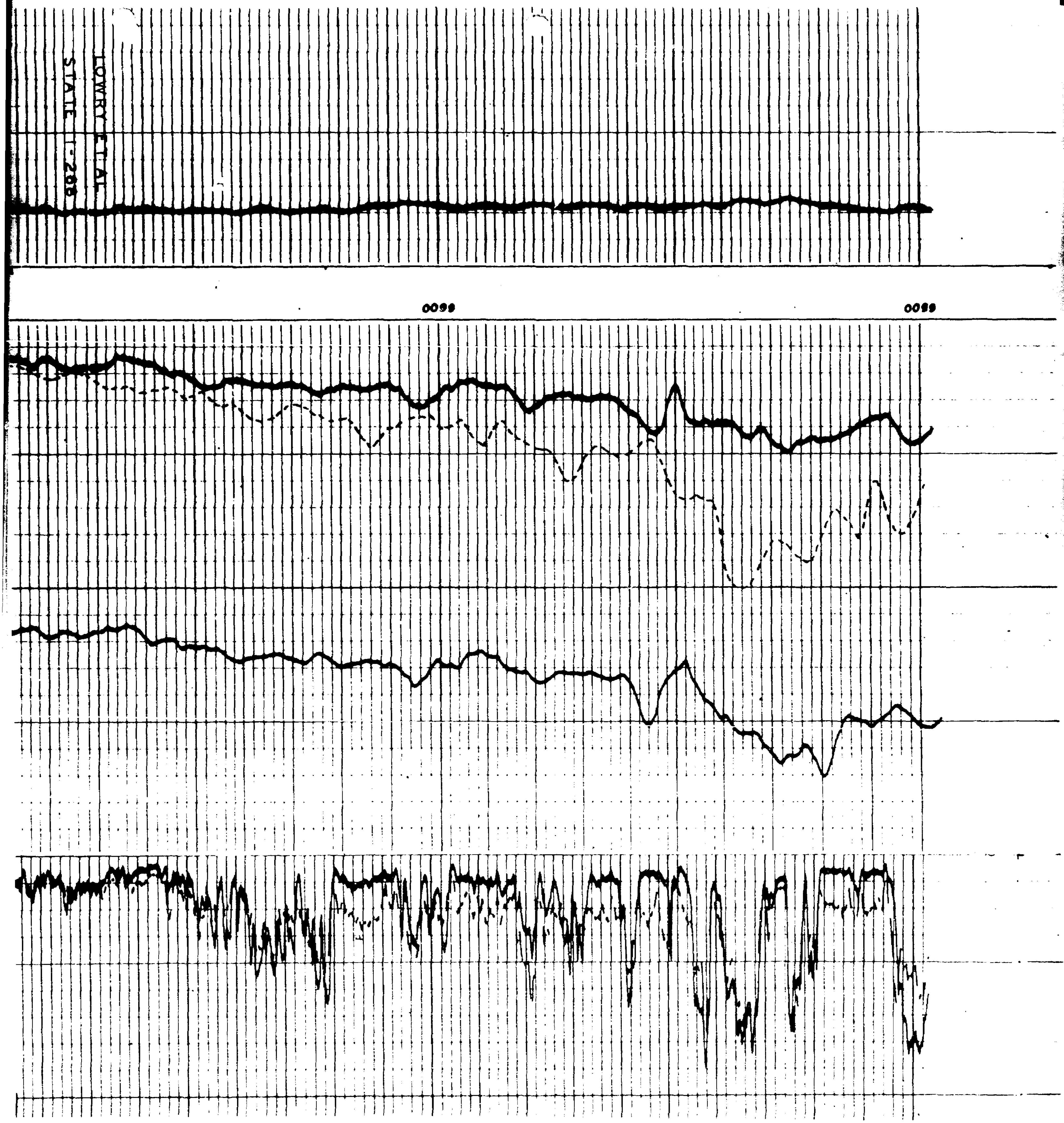


LOWRY ET AL
FEDERAL DOSWELL 25-51-127
SEC. 8-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6482' G.L.





LOWRY ET AL
FEDERAL DOSWELL #25-51-127
SEC. 8-26N-6W
RIC ARRIBA, NEW MEXICO
ELEV. 6482' G.L.



LOWRY ET AL
STATE 1-208

OILFIELD RESEARCH LABORATORIES

August 13, 1952

Lowry et al Operating Account
616 East Central Avenue
Albuquerque, New Mexico

Gentlemen:

Enclosed herewith is the report of the analysis of the 3½" Rotary core samples taken from the Federal Lease, Well No. 82-45-207, Rio Arriba County, New Mexico, and submitted to our laboratory on August 4, 1952.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

Carl L. Pate

CLP:bl
9 c.c.

LOWRY et al OPERATING ACCOUNT

CORE ANALYSIS REPORT

FEDERAL LEASE WELL NO. 22-45-207

RIO ARRIBA COUNTY, NEW MEXICO

OILFIELD RESEARCH LABORATORIES

CHANUTE, KANSAS

AUGUST 13, 1952

Oil Field Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Lowry et al Operating Account Lease Federal Well No. 22-45-207

Location SW¼, SE¼,

Section 10 Twp. 26N Rge. 6W County Rio Arriba State New Mexico

Name of Sand	Tocito
Top of Core	6643.00
Bottom of Core	6662.00
Top of Sand	6643.95
Bottom of Sand	6662.00
Total Feet of Permeable Sand	9.10
Total Feet of Floodable Sand	11.55

Distribution of Permeable Sand:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 1	2.25	2.25
1 - 2	1.00	3.25
2 - 4	3.00	6.25
4 & above	2.85	9.10

Average Permeability Millidarcys	68.27
Average Percent Porosity	11.02
Average Percent Oil Saturation	35.66
Average Percent Water Saturation	22.83
Average Oil Content, Bbls./A. Ft.	305.
Total Oil Content, Bbls./Acre	5,792.
Average Percent Oil Recovery by Laboratory Flooding Tests	8.61
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	95.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	1,103.
Total Calculated Oil Recovery, Bbls./Acre	2,200.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

An oil base mud was used as a circulating fluid in the coring of the sand in this well. This well was drilled in virgin territory.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
6643.00 - 6643.95 -	Sandy limestone.
6643.95 - 6647.75 -	Dark medium grained micaceous calcareous sandstone.
6647.75 - 6649.65 -	Dark fine grained micaceous calcareous sandstone.
6649.65 - 6650.60 -	Dark fine grained micaceous calcareous shaley sandstone.
6650.60 - 6653.45 -	Dark coarse grained micaceous calcareous sandstone containing a vertical fracture.
6653.45 - 6655.35 -	Hard calcareous shaley sandstone.
6655.35 - 6659.15 -	Brown medium grained micaceous calcareous sandstone.
6659.15 - 6662.00 -	Brown to dark medium grained micaceous calcareous sandstone.

Coring was started at a depth of 6643.00 feet in sandy limestone and completed at 6662.00 feet in medium grained micaceous calcareous sandstone. This core shows a total of 19.00 feet of formation containing oil. For the most part, the pay is made up of fine to medium grained micaceous calcareous sandstone.

PERMEABILITY

For the sake of distribution, the core was divided into three sections. The weighted average permeability of the upper, middle and lower sections is 1.10, 214.74 and 1.92 millidarcys respectively; the overall average being 68.27 (See Table II). By observing the data given on the coregraph, it is noticeable that the cored section has a very irregular permeability profile and contains a very loose zone in the middle of the sand section.

The sand in this core shows a fair weighted average percent oil saturation, namely, 35.66. The weighted average percent oil saturation of the upper, middle and lower sections is 35.86, 37.40 and 34.90 respectively. The weighted average percent water saturation of the upper, middle and lower sections is 24.75, 19.30 and 22.29 respectively; the overall average being 22.83 (See Table IV). This gives an overall weighted average total fluid saturation of 58.49 percent. This low total fluid saturation shows that considerable fluid was lost during coring which was no doubt oil.

For the sake of future information, all of the saturation samples were analyzed for chloride content. The results of these tests are given in Tables VII and VIII. From the data given in these tables and on the coregraph, it is noticeable that the sand has a very irregular chloride content.

The weighted average oil content of the upper, middle and lower sections is 266, 511 and 271 barrels per acre foot respectively; the overall average being 305. The total oil content, as shown by this core, is 5,792 barrels per acre (See Table IV).

LABORATORY FLOODING TESTS

The sand in this core responded fairly well to laboratory flooding tests, as a total recovery of 1,103 barrels of oil per acre was obtained from 11.55 feet of sand. The weighted average percent oil saturation was reduced from 32.30 to 23.69, or represents an average recovery of 8.61 percent. The weighted average effective permeability of the samples is 4.65 millidarcys, while the average initial fluid production pressure is 31.3 pounds per square inch (See Table VI).

By observing the data given in Table 7, you will note that of the 20 samples tested, 12 produced oil and water. This indicates that approximately 60 percent of the sand represented by these samples is floodable. The tests also show that the sand has a very wide variation in effective permeability and that the middle part of the cored section is very loose. A synthetic brine of approximately 25,000 parts per million, calculated as common salt or sodium chloride, was used to flood out the sand samples.

CONCLUSION

On the basis of the above data, it is evident that a total recovery of 2,200 barrels of oil per acre, 1800 barrels per acre by primary production and 400 barrels per acre by secondary recovery, can be obtained from the area represented by this core by efficient developing and operating practices. In calculating this recovery, an allowance was made for oil lost during coring.

The principle drawback of this core is the fact that it has a wide variation in permeability and a low percent porosity. The fact that the oil carries so much gas in solution is another factor that greatly reduces the volume of recoverable oil in place. Chances are, pressure maintenance, (the injection of the gas, produced along with the oil, back into the pay zone), will recover almost as much oil as would be expected by a combination of primary production and water-flooding. Furthermore, this method would be less expensive.

Oilfield Research Laboratories

RESULTS OF PERMEABILITY TESTS

TABLE I

Company Lowry et al Operating Acct. Lease Federal Well No. 22-45-207

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	6643.15	Imp.	0.95	0.95	0.00
2	6644.00	Imp.	0.55	1.50	0.00
3	6645.00	0.99	1.00	2.50	0.99
4	6646.00	1.75	1.00	3.50	1.75
5	6647.00	0.66	1.25	4.75	0.82
6	6648.00	Imp.	0.75	5.50	0.00
7	6649.00	Imp.	1.15	6.65	0.00
8	6650.00	Imp.	0.95	7.60	0.00
9	6651.00	229.	0.90	8.50	206.00
10	6652.00	126.	1.00	9.50	126.00
11	6653.00	295.	0.95	10.45	280.00
12	6654.00	Imp.	1.05	11.50	0.00
13	6655.00	Imp.	0.85	12.35	0.00
14	6656.00	Imp.	1.15	13.50	0.00
15	6657.00	2.9	1.00	14.50	2.90
16	6658.00	Imp.	1.00	15.50	0.00
17	6659.00	3.4	0.65	16.15	2.21
18	6660.00	0.49	1.35	17.50	0.66
19	6661.00	Imp.	1.00	18.50	0.00
20	6661.85	Imp.	0.50	19.00	0.00

Oil Field Research Laboratories

SUMMARY OF PERMEABILITY TESTS

TABLE II

Company Lowry, et al Operating Acct. Lease Federal Well No. 22-45-207

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity, Ft. x Md.
6643.00-6650.60	3.25	1.10	3.56
6650.60-6653.45	2.85	214.74	612.00
6653.45-6662.00	3.00	1.92	5.77
6643.00-6662.00	9.10	68.27	621.33

Oil Field Research Laboratories

RESULTS OF SATURATION TESTS

TABLE III

Company Lowry et al Operating Account Lease Federal Well No. 22-45-207

Sat. No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content Bbls./A. Ft.	Feet of Core		Total Oil Content Bbls./Acre
			Oil	Water	Total		Ft.	Cum. Ft.	
1	6643.15	5.6	49.5	22.5	72.0	215	0.95	0.95	204
2	6644.00	8.9	34.4	19.4	53.8	238	0.55	1.50	131
3	6645.00	9.2	29.6	17.1	46.7	211	1.00	2.50	211
4	6646.00	9.3	41.8	28.6	70.4	388	1.00	3.50	388
5	6647.00	10.8	30.8	23.6	54.4	258	1.25	4.75	322
6	6648.00	12.4	47.8	21.3	69.1	461	0.75	5.50	346
7	6649.00	9.7	23.9	33.8	67.7	180	1.15	6.65	207
8	6650.00	8.1	35.2	27.4	62.6	221	0.95	7.60	210
9	6651.00	19.4	25.4	20.9	46.3	383	0.90	8.50	345
10	6652.00	12.9	39.4	17.4	56.8	394	1.00	9.50	394
11	6653.00	20.7	46.8	19.8	66.6	754	0.95	10.45	716
12	6654.00	6.8	51.2	23.2	74.4	271	1.05	11.50	285
13	6655.00	4.9	30.6	37.5	68.1	116	0.85	12.35	99
14	6656.00	13.9	35.0	23.7	58.7	378	1.15	13.50	435
15	6657.00	13.6	32.6	20.7	53.3	344	1.00	14.50	344
16	6658.00	9.8	33.9	22.3	56.2	258	1.00	15.50	258
17	6659.00	17.1	29.3	19.4	48.7	389	0.65	16.15	253
18	6660.00	11.6	31.7	16.9	48.6	286	1.35	17.50	386
19	6661.00	9.3	27.5	18.0	45.5	198	1.00	18.50	198
20	6661.85	3.5	45.0	21.4	66.4	122	0.50	19.00	61
							Total - - -	- - - -	- 5,792

Oil Field Research Laboratories

SUMMARY OF SATURATION TESTS

TABLE IV

Company Lowry et al Operating Account Lease Federal Well No. 22-45-207

Depth Interval, Feet	Feet of Core Analyzed	Average Percent Porosity	Average Percent Oil Saturation	Average Percent Water Saturation	Average Oil Content Bbls./A. Ft.	Total Oil Content Bbls./Acre
6643.00 - 6650.60	7.60	9.32	35.86	24.75	266	2,019
6650.60 - 6653.45	2.85	17.58	37.40	19.30	511	1,455
6653.45 - 6662.00	8.55	10.35	34.90	22.29	271	2,318
6643.00 - 6662.00	19.00	11.02	35.66	22.83	305	5,792

Oilfield Research Laboratories

RESULTS OF LABORATORY FLOODING TESTS

TABLE V

Company: Lowry et al Operating Account   Lease: Federal   Well No. 2

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery		Residual Saturation			Volume of Recovered cc*
			Percent	Bbls./A. Ft.	Percent	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.	
1	6643.15	5.8	47.7	215	0.0	0	47.7	27.3	215	0
2	6644.00	8.9	32.4	224	1.6	11	30.8	53.9	212	1
3	6645.00	9.6	28.4	212	7.0	52	21.4	70.8	160	1
4	6646.00	9.7	39.4	296	11.2	84	28.2	54.0	212	5
5	6647.00	10.7	28.7	238	0.0	0	28.7	45.9	238	0
6	6648.00	12.3	46.4	443	0.0	0	46.4	25.8	443	0
7	6649.00	9.3	26.4	191	0.0	0	26.4	45.4	191	0
8	6650.00	8.4	35.2	230	0.0	0	35.2	40.0	230	0
9	6651.00	19.1	26.8	397	10.0	148	16.8	66.5	249	93
10	6652.00	13.1	36.7	374	16.1	164	20.6	65.5	210	175
11	6653.00	20.7	44.4	714	20.2	325	24.2	65.4	389	72
12	6654.00	6.4	48.9	243	0.0	0	48.9	30.0	243	0
13	6655.00	5.2	29.1	118	0.0	0	29.1	66.2	118	0
14	6656.00	13.9	33.0	356	10.2	110	22.8	60.0	246	42
15	6657.00	15.5	34.0	358	6.5	68	27.5	57.2	268	3
16	6658.00	9.7	31.7	239	2.9	22	28.8	49.3	217	1
17	6659.00	17.4	27.2	367	5.2	70	22.0	53.4	297	65
18	6660.00	11.4	30.3	268	5.1	45	25.2	42.2	223	8
19	6661.00	9.0	26.0	182	4.7	33	21.3	41.5	149	5
20	6661.85	3.8	42.0	124	0.0	0	42.0	35.0	124	0

Notes: cc - cubic centimeter
* - Volume of water recovered at the time of maximum oil recovery.
** - Determined by passing water through sample which still contains residual oil.

[illegible]-207

Water ...d	Effective Permeability, Millidarcys **	Initial Fluid Production Pressure Lbs./Sq. In.
	Imp.	50+
	0.048	50
	[illegible]	50
	0.146	30
	Imp.	50+
	Imp.	50+
	Imp.	50+
	Imp.	50+
	24.50	5
	11.30	15
	17.90	5
	Imp.	50+
	Imp.	50+
	1.19	20
	0.202	50
	0.030	50
	1.75	20
	0.176	30
	0.202	50
	Imp.	50+

Oilfield Research Laboratories

SUMMARY OF LABORATORY FLOODING TESTS

TABLE VI

Company: Lowry et al Operating Account Lease: Federal Well No. 22-35-207

Depth Interval, Feet	6643.95 - 6646.50	6650.60 - 6653.45	6655.35 - 6661.50	66[illegible]3.95 - 6661.50
Feet of Core Analyzed	2.55	2.85	6.15	11.55
Average Percent Porosity	9.49	17.51	12.18	12.90
Average Percent Original Oil Saturation	33.57	36.13	30.02	32.30
Average Percent Oil Recovery	7.49	15.54	5.87	8.61
Average Percent Residual Oil Saturation	26.08	20.59	24.15	23.69
Average Percent Residual Water Saturation	53.14	65.05	50.83	54.76
Average Percent Total Residual Fluid Saturation	79.22	85.64	74.98	78.45
Average Original Oil Content, Bbls./A. Ft.	248.	494.	291.	230.
Average Oil Recovery, Bbls./A. Ft.	56.	212.	58.	95.
Average Residual Oil Content, Bbls./A. Ft.	192.	282.	233.	235.
Total Original Oil Content, Bbls./Acre	631.	1,408.	1,787.	2,[illegible]26.
Total Oil Recovery, Bbls./Acre	142.	605.	356.	1,102.
Total Residual Oil Content, Bbls./Acre	[illegible]	803.	1,431.	2,723.
Average Effective Permeability, Millidarcys	0.083.	17.68	0.517	4.66
Average Initial Fluid Production Pressure, p.s.i.	4[illegible].3	8.3	36.7	31.3

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

Oilfield Research Laboratories

RESULTS OF WATER DIFFERENTIATION TESTS

TABLE VII

Company Lowry et al Operating Acct. Lease Federal Well No. 22-45-207

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation Connate	Drilling & Foreign	Total
1	6643.15	44,000			
2	6644.00	12,800			
3	6645.00	31,000			
4	6646.00	19,700			
5	6647.00	13,500			
6	6648.00	48,500			
7	6649.00	36,800			
8	6650.00	27,800			
9	6651.00	37,500			
10	6652.00	36,800			
11	6653.00	7,430			
12	6654.00	22,900			
13	6655.00	50,100			
14	6656.00	29,600			
15	6657.00	22,300			
16	6658.00	35,900			
17	6659.00	7,000			
18	6660.00	42,000			
19	6661.00	47,000			
20	6661.85	71,500			

Note: ppm - parts per million.

Oil Field Research Laboratories

SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VIII

Company Lowry et al Operating Acct. Lease Federal Well No. 22-45-207

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
6643.00-6650.60	29,147		
6650.60-6653.45	27,231		
6653.45-6662.00	35,423		
6643.00-6662.00	31,684		

Note: ppm - parts per million.

Lowry et al Operating Account

Factual Data Report

Pettigrew-Tocito Pool

EXHIBIT 5

Lowry

So. Blanco

~~PETTIGREW~~-TOCITO POOL

Rio Arriba County, New Mexico

1. History of Pettigrew-Tocito Pool

The discovery well of the Pettigrew-Tocito Oil Pool was the Lowry et al Operating Account Federal 2-179, located in the center of the NW/4, SE/4, Section 9, T26N, R6W, Rio Arriba County, New Mexico. This well was completed in the Tocito formation on July 10, 1951, at a total depth of 6,692 feet. Initial potential was 720 barrels of oil per day through a 3/4" tubing choke.

At present there are 10 producing oil wells completed in this Pool. From inception through April 30, 1953, the total oil production amounted to 522,972 barrels. The crude oil gravity averages 43.8° API. Cumulative oil and gas production from inception, by wells, is as follows:

	Cumulative Production	
	Oil - Barrels	Gas - MCF
Federal 1-134	5,215	15,389
Federal 2-179	182,659	263,827
Federal 4-13-132	69,063	76,047
Federal 19-34-157	89,257	100,834
Federal 7-35-109	25,952	45,404
Federal 21-40-182	64,321	174,981
Federal 22-45-207	58,023	99,349
Federal 23-49-129	19,865	14,730
Federal 24-50-177	7,764	18,773
Federal 25-51-127	853	698
	522,972	810,032

So Blanco

Crude oil from the ~~Pettigrew~~-Tocito Field is purchased by Malco Refineries, Inc. and transported by pipeline to their refinery located at Prewitt, New Mexico. The crude oil is sweet, green color, paraffin type, and is considered very high quality, best suited for topping and cracking to give a high yield of good quality gasoline and heavier burning oils.

2. Physical Properties of Reservoir Rock:

a. Approximate average porosity, percent:

Upper Portion:	13.90 percent
Lower Portion:	11.00 percent

b. Approximate average permeability, millidarcys:

Upper Portion:		
	Horizontal:	121.1 millidarcys
	Vertical:	31.6 millidarcys
Lower Portion:		
	Horizontal:	1.1 millidarcys
	Vertical:	0.4 millidarcys

c. Approximate average interstitial water saturation, percent:

Upper Portion:	23 percent
Lower Portion:	45 percent

3. Structural Features of the Reservoir:

a. General Geological Description of the Reservoir:

The Pettigrew-Tocito Pool is a lenticular sand reservoir of Upper Cretaceous Geologic age. The sand lentil trends in a northwest-southeast direction, with the pool limits not yet defined by drilling. The upper portion of the Tocito Sand is a fairly porous, permeable, medium grain sand, presently considered productive for an approximate 2,535-acre area. The lower portion of the Tocito sand is of limited areal extent, and is a low porosity, low permeability sand, considered productive because of a fracture system of drainage.

b. Original Gas-Oil Contact:

No gas cap is believed present.

c. Original Water-Oil Contact:

Not yet determined, if present.

d. Ratio of Gas-Cap Volume to Oil Zone Volume:

No gas cap.

e. Dip of Producing zone:

Approximately 90 feet per mile toward northeast.

4. Characteristics of Reservoir Fluid:

a. Average Gravity of Stock Tank Oil: 43.8° API

b. Estimated Saturation Pressure: 2,052 P.S.I.

c. Formation Volume Factor:

at original pressure: 1.508 @ 2,197 P.S.I.
at saturation pressure: 1.512 @ 2,052 P.S.I.
at 2,001 P.S.I. : 1.505

d. Viscosity of Reservoir Oil - Centipoise:

at original pressure: 0.40 @ 2,197 P.S.I.
at saturation pressure: 0.39 @ 2,052 P.S.I.
at 2,001 P.S.I.: 0.39

e. Dissolved Gas-Oil Ratio @ 0 P.S.I. Separator Pressure - Cu. Ft. / Barrel Stock Tank Oil:

at original Pressure: 862
at saturation Pressure: 862
at 2,001 P.S.I. 840

5. Pressures and Temperatures:

a. Estimated Original Reservoir Pressure @ -100 feet: 2,197 P.S.I.

b. Estimated Reservoir Temperature @ -100 feet: 175° Fahrenheit

c. Reservoir Pressure History: See attached data and graph.

d. Average Shut-In Time Prior to Pressure Survey: 72 hour minimum

e. Productivity Index - Bbls./Day/P.S.I. Pressure Drop:

Maximum: 1.162 (Federal 2-179)
Minimum: 0.842 (Federal 2-179)
Average: 0.985 (Federal 2-179)

6. Statistical Data

a. Oil Production - barrels per day: See attached data and graph.

b. Average weighted gas-oil ratio: See attached data and graph.

c. Water production - percent of total fluid: Approximately 10 percent

d. Number of producing wells: 10 (as of April 30, 1953)

e. Approximate Developed acreage: 920 acres

f. Volume of Gas Production: See attached data and graph.

g. Stage of Depletion: Primary.

7. Individual Well Problems:

During the completion of the well, care must be exercised to keep the drilling fluid as light as possible to prevent damaging the permeable Tocito sand sections. To assure a successful completion, a 60 percent oil emulsion mud is used, and casing is set above the producing zone to keep the weight of the cement off formation during the cementing operation. Paraffin accumulation in tubing and flow lines necessitates remedial treatment on occasions. The crude oil has a pour point of approximately 25° F., and the oil must be heated in the storage tank to a temperature of approximately 60° F. in order to keep the oil fluid enough to flow through pipelines.

8. General Reservoir Mechanics

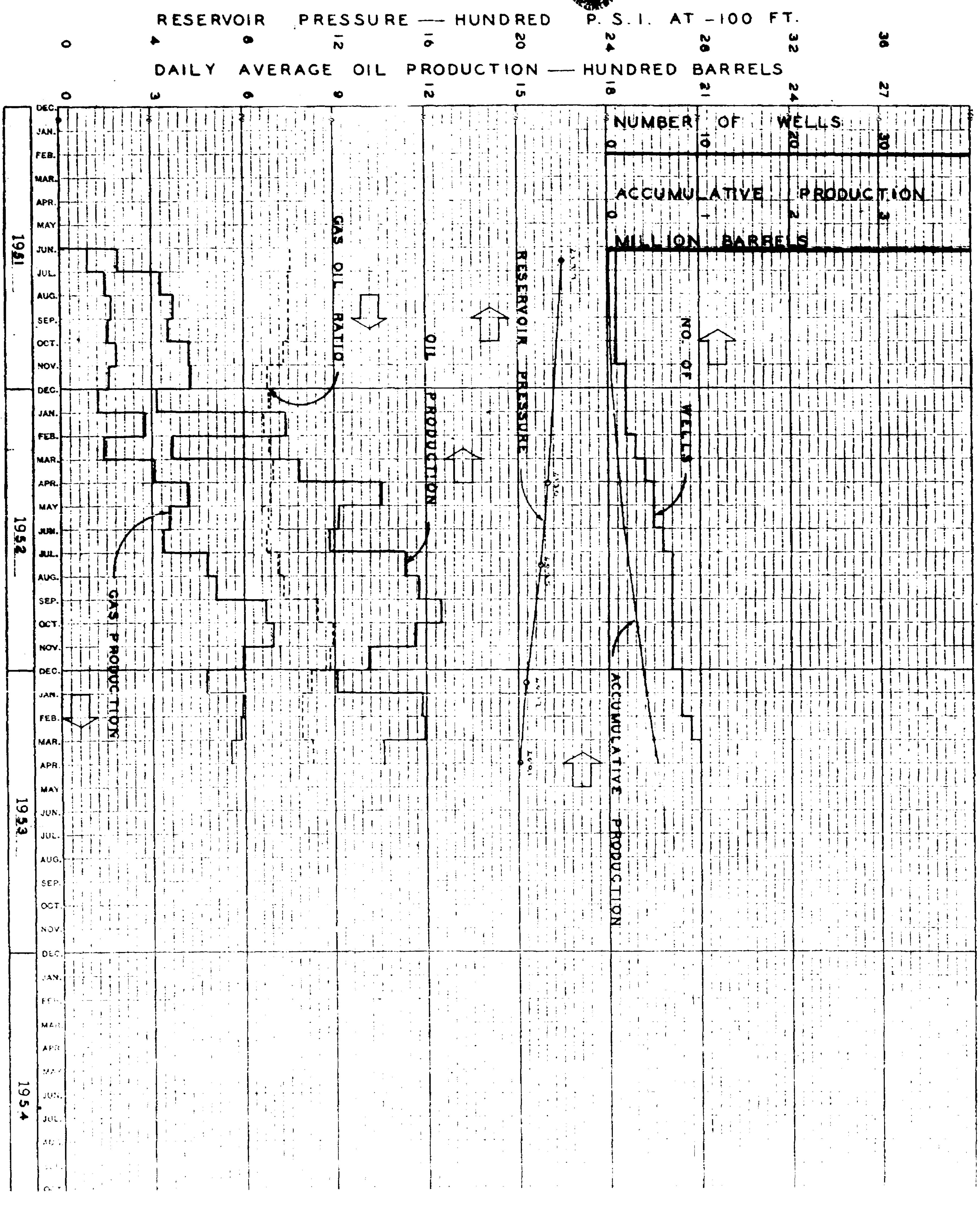
The Pettigrew-Tocito Pool produces from a solution gas drive. To date, there is no evidence of an initial gas cap or any extraneous water influx into the reservoir. Because of the high shrinkage of the reservoir crude and the large solution gas-oil ratio, it can be assumed that the Field will produce with a relatively high gas-oil ratio during its depletion life.

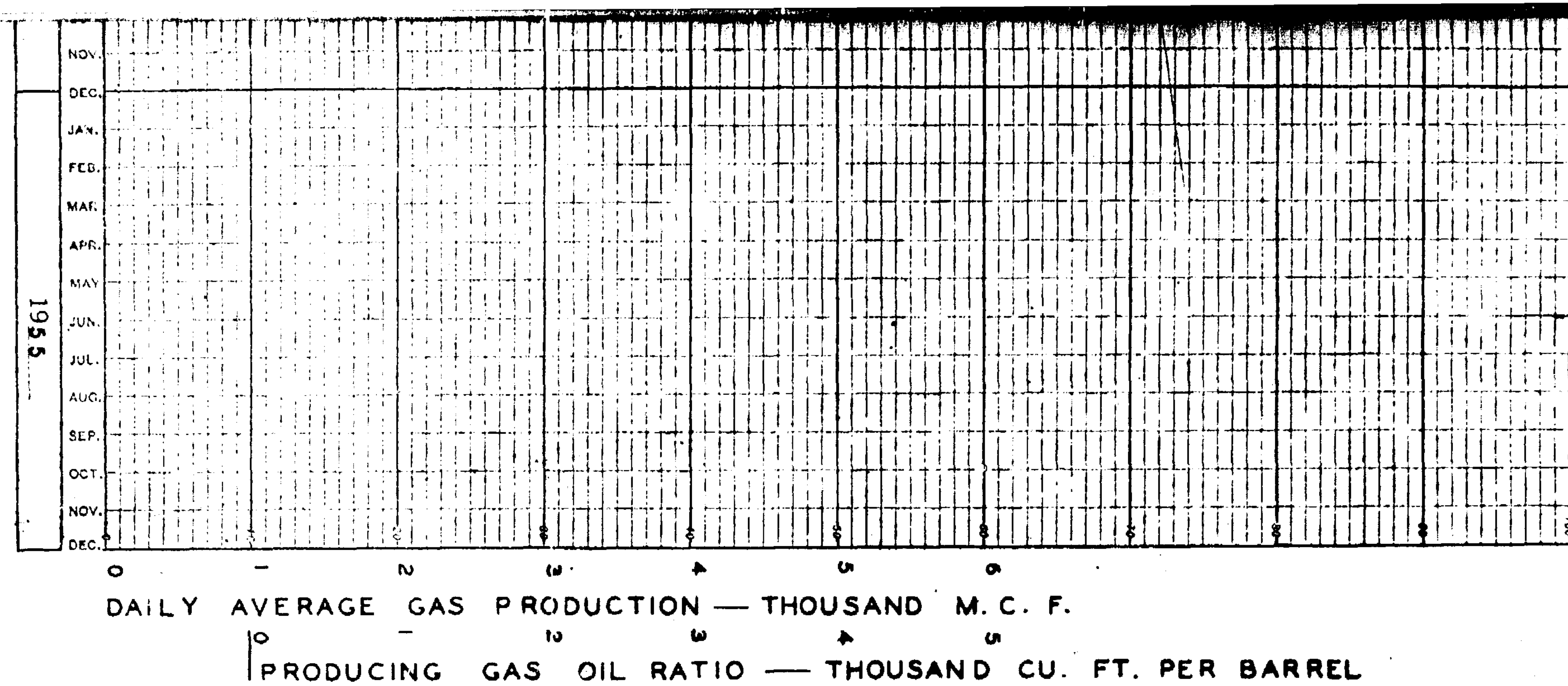
PRODUCTION DATA

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

Month & Year	Monthly Oil Production, Barrels	Monthly Gas Production, M.C.F.	Gas-Oil Ratio Cu.Ft./Bbl.	Daily Average Oil Production, Barrels	Daily Average Gas Production M.C.F.	Cumulative Oil Production, Barrels	Cumulative Gas Production M.C.F.
1951							
July	5,970	8,991	1506	193	290	5,970	8,991
August	10,143	15,215	1500	327	491	16,113	24,206
September	10,973	16,460	1500	366	549	27,086	40,666
October	11,027	16,541	1500	356	533	38,113	57,207
November	12,599	18,233	1447	420	608	50,712	75,440
December	13,215	16,658	1260	425	537	63,927	92,098
1952							
January	9,761	12,474	1278	315	402	73,688	104,572
February	21,540	26,183	1216	743	903	95,228	130,755
March	11,245	14,555	1294	363	470	106,473	145,310
April	23,535	31,129	1323	785	1038	130,008	176,439
May	32,772	42,603	1300	1057	1374	162,780	219,042
June	27,426	35,316	1288	914	1177	190,206	254,358
July	27,425	34,604	1262	885	1116	217,631	288,962
August	35,135	48,866	1391	1133	1576	252,766	337,828
September	35,428	50,642	1429	1181	1688	288,194	388,470
October	38,510	69,510	1805	1242	2242	326,704	457,980
November	34,827	69,030	1982	1161	2301	361,531	527,010
December	31,572	61,770	1956	1018	1993	393,103	588,780
1953							
January	28,199	48,939	1735	910	1579	421,302	637,719
February	33,394	55,459	1661	1193	1981	454,696	693,178
March	36,552	60,788	1663	1179	1961	491,248	753,966
April	31,724	56,066	1767	1057	1869	522,972	810,032
May							

PETTIGREW TOCITO POOL
RIO ARRIBA COUNTY, N.M.

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1955
0 1 2 3 4 5 6
DAILY AVERAGE GAS PRODUCTION — THOUSAND M. C. F.
0 1 2 3 4 5
PRODUCING GAS OIL RATIO — THOUSAND CU. FT. PER BARREL

BOTTOMHOLE PRESSURE TESTS

Pettigrew-Tocito Field

Rio Arriba County, N.M.

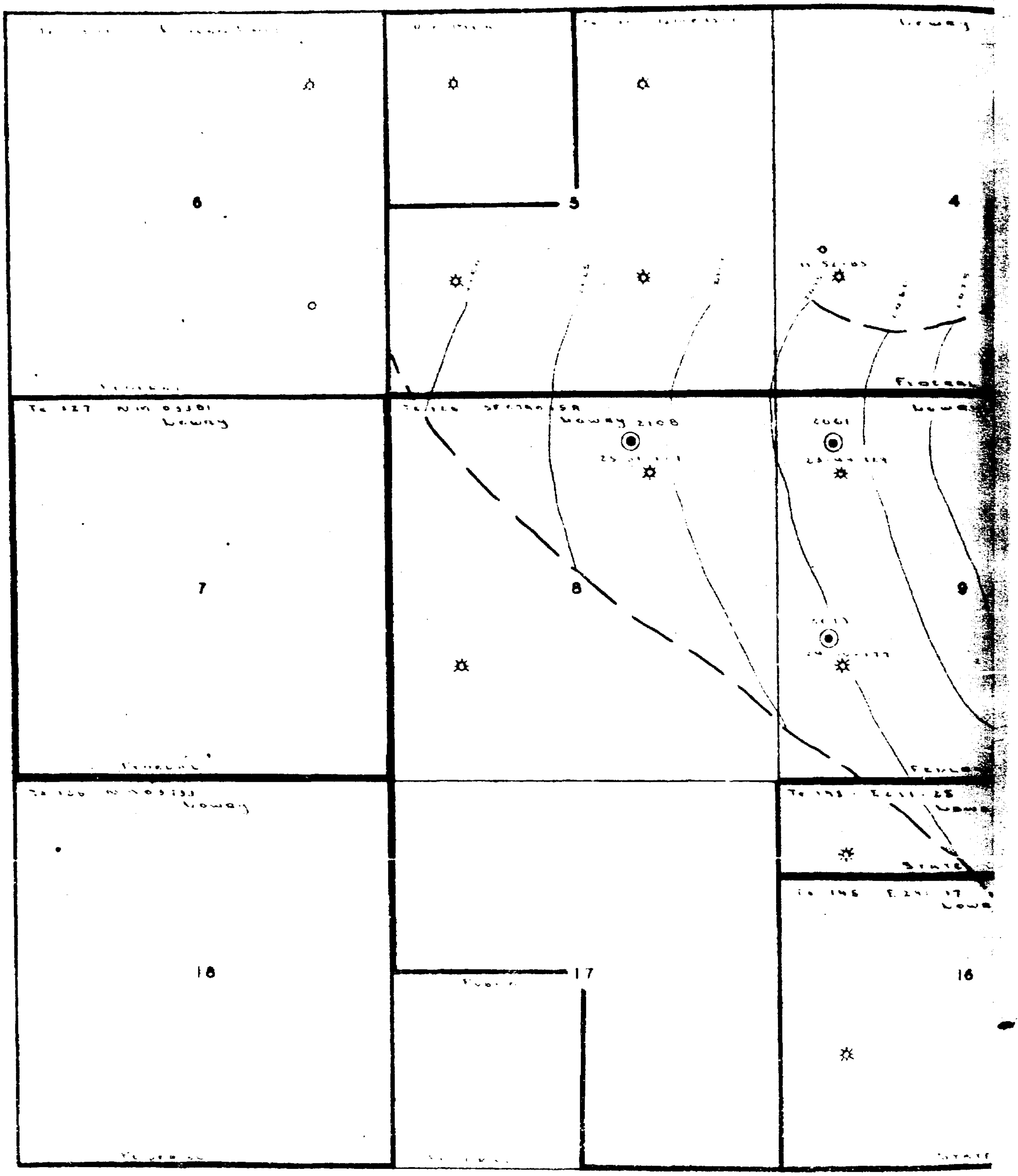
Well No.	Date	Hours Shut In	Bottomhole Pressure
Federal 1-134	8-20-52	120	1904
	1-12-53	99	1759
	4-27-53	94	1721
Federal 2-179	7-26-51	43	2197
	12-17-51	100	2158
	5-1-52	76½	2112
	9-2-52	73	2093
	1-12-53	145	2043
	4-27-53	73	2014
Federal 4-13-132	12-17-51	46	2125
	1-3-52	73	2138
	1-1-52	24	2111
	5-1-52	76½	2069
	8-20-52	123	2045
	1-13-53	97	1996
	4-27-53	72	1959
Federal 19-34-157	3-3 0-52	91	2123
	5-1-52	99	2115
	8-18-52	78	2053
	1-14-53	67	1959
	4-27-53	92	1931
Federal 7-35-109	5-1-52	193	2103
	8-20-52	117	2014
	1-13-53	100	1922
	4-28-53	104	1856
Federal 21-40-182	6-5-52	76	2108
	8-19-52	90	2080
	1-13-53	78	1988
	4-27-53	99	1967

Well No.	Date	Hours Shut In	Bottomhole Pressure
Federal 22-45-207	8-2-52	79	2111
	8-20-52	116	2099
	1-13-53	80	1977
	4-27-53	96	1939
Federal 23-49-129	1-12-53	85	2111
	4-27-53	81	2061
Federal 24-50-177	3-15-53	87	2091
	4-27-53	82	2079
Federal 25-51-127	4-28-53	116	2108

Weighted Average Reservoir Pressure

Datum -100 feet

	Date	Bottomhole Pressure, p.s.i.
Original reservoir pressure:	July 26,1951	2197
1st General survey:	May 1, 1952	2130
2nd General survey:	August 18-20,1952	2095
3rd General survey:	January 12-14,1952	2037
4th General survey:	April 27-28, 1952	2001



LOWRY OIL COMPANY

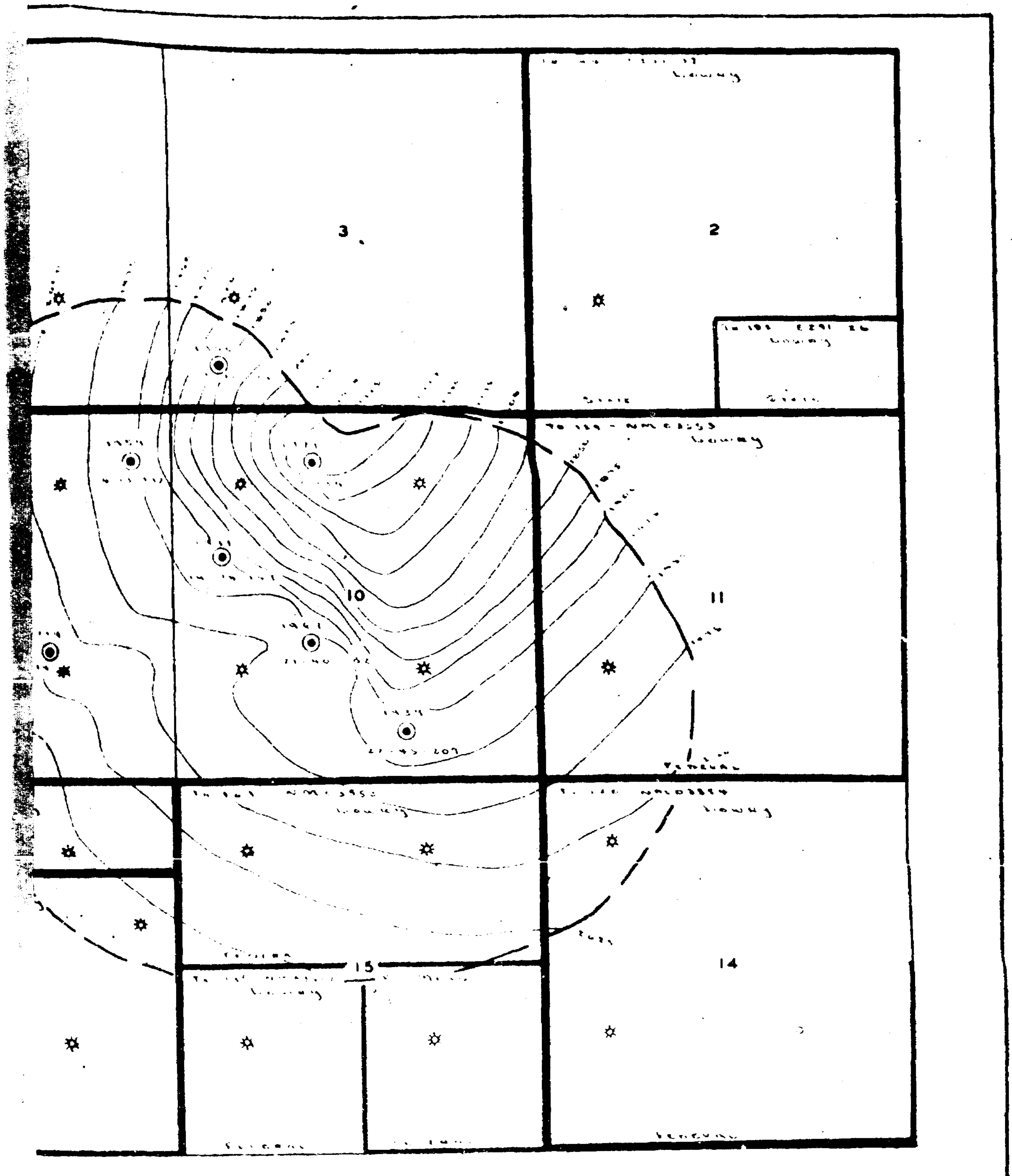
T26N — R6W

RIO ARRIBA COUNTY, N. M.

PETTIGREW TOCITO

ISOBARIC MAP

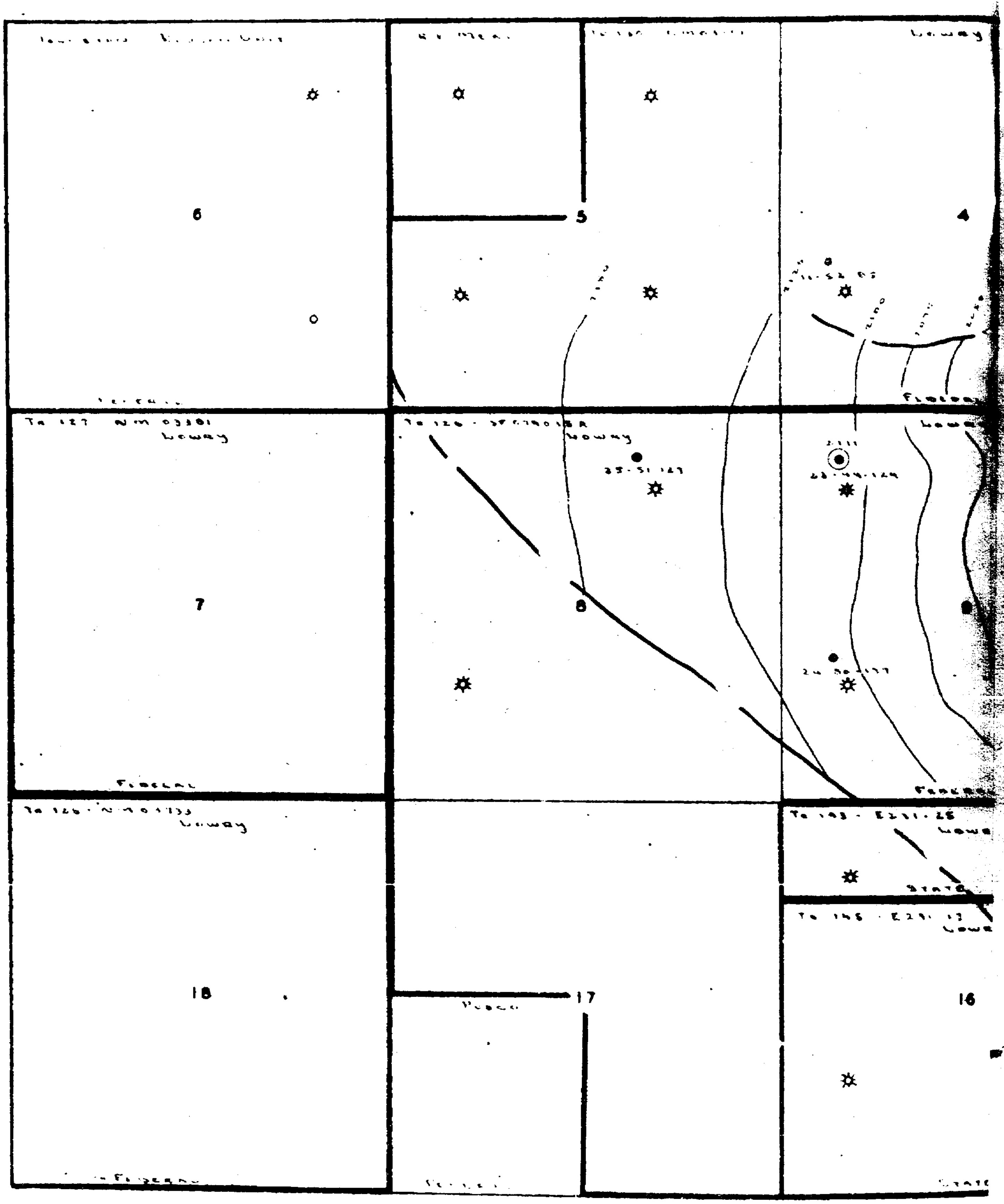
APRIL 27-28, 195



POOL

4 Th GENERAL SURVEY

AVG. RESERVOIR PRESS.
2001 PSI -100 FT.



LOWRY OIL COMPANY

T 26 N — R 6 W

RIO ARRIBA COUNTY, N. M.

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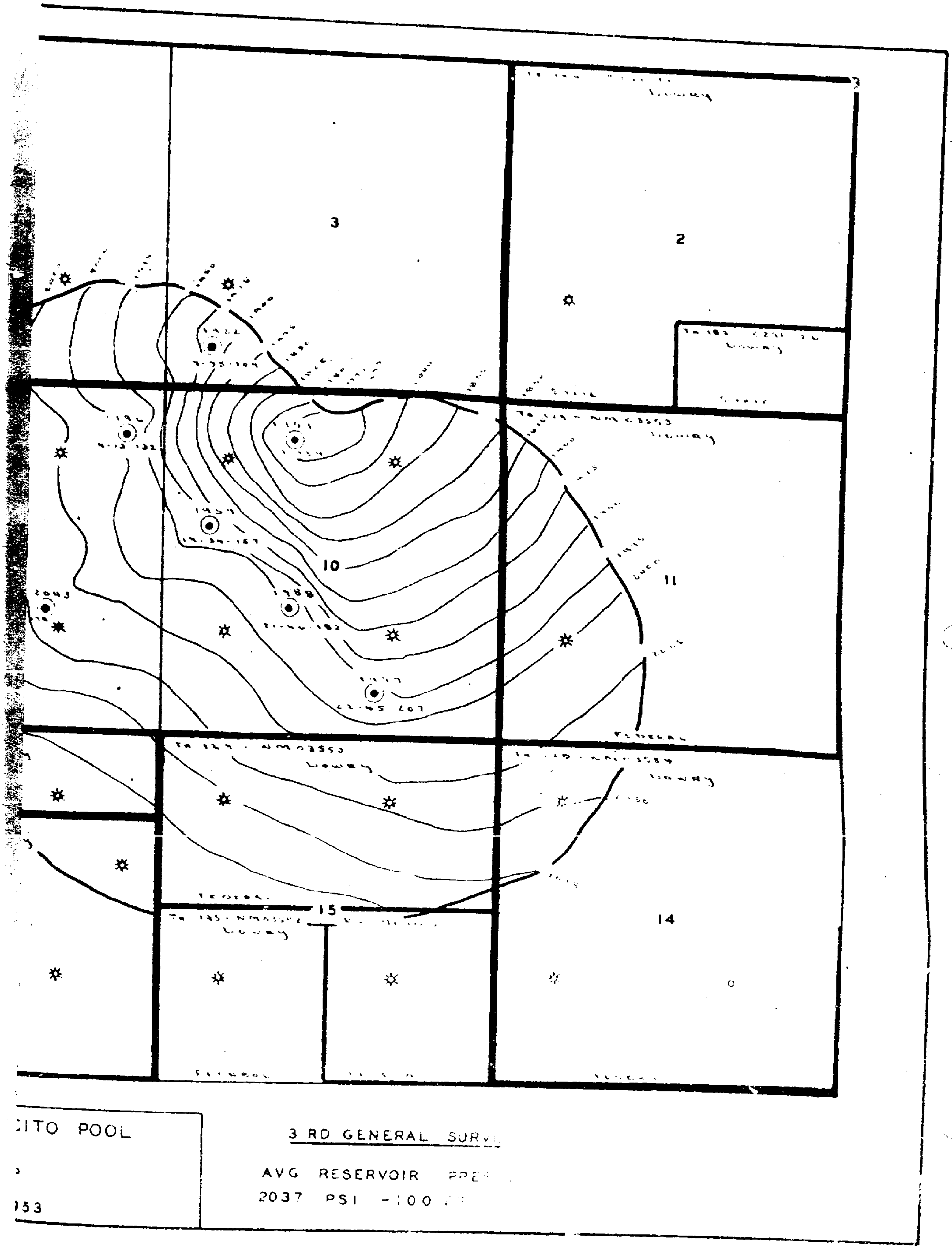
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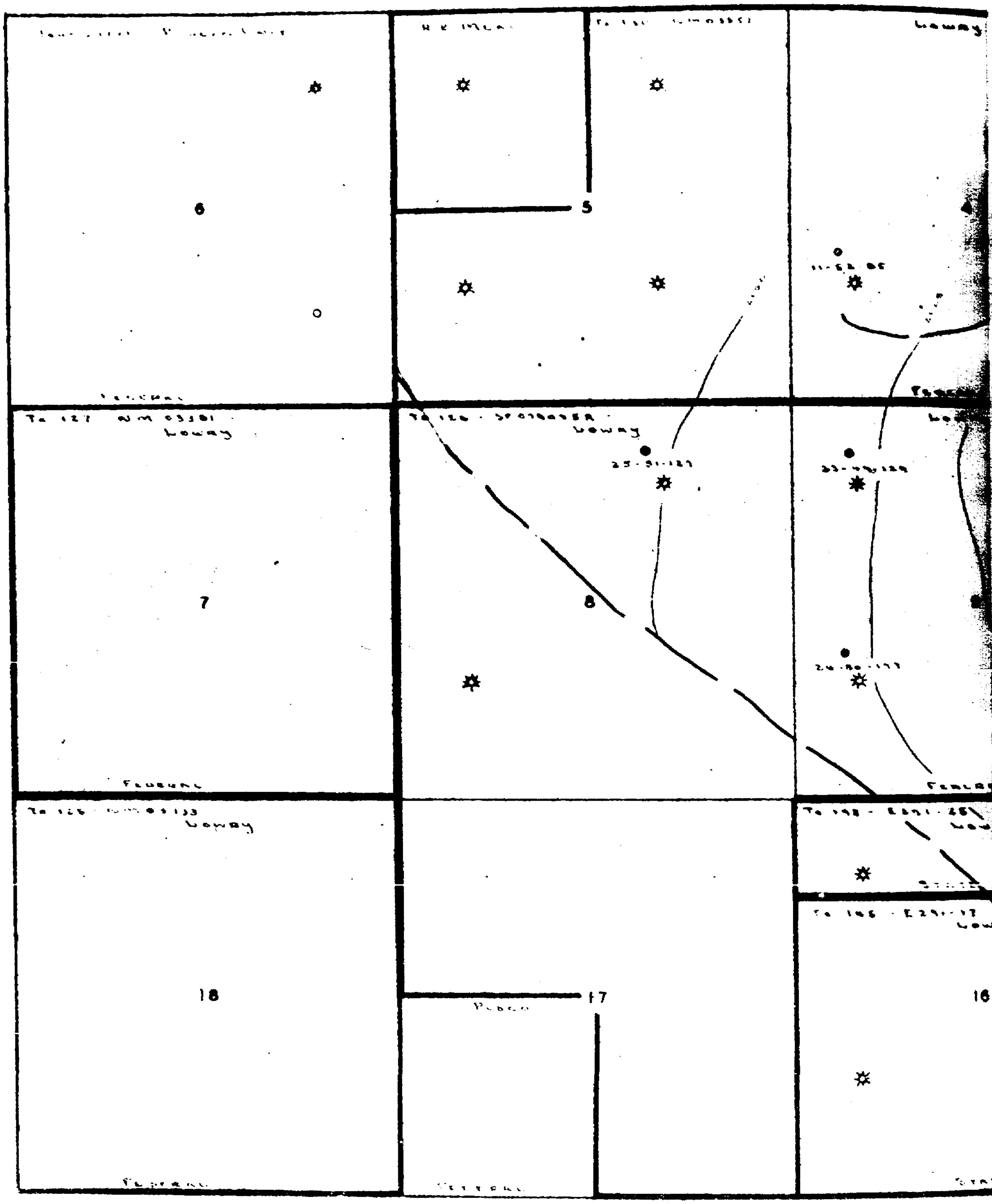

LOWRY OIL COMPANY
T 26 N -- R 6 W
RIO ARRIBA COUNTY, N. M.

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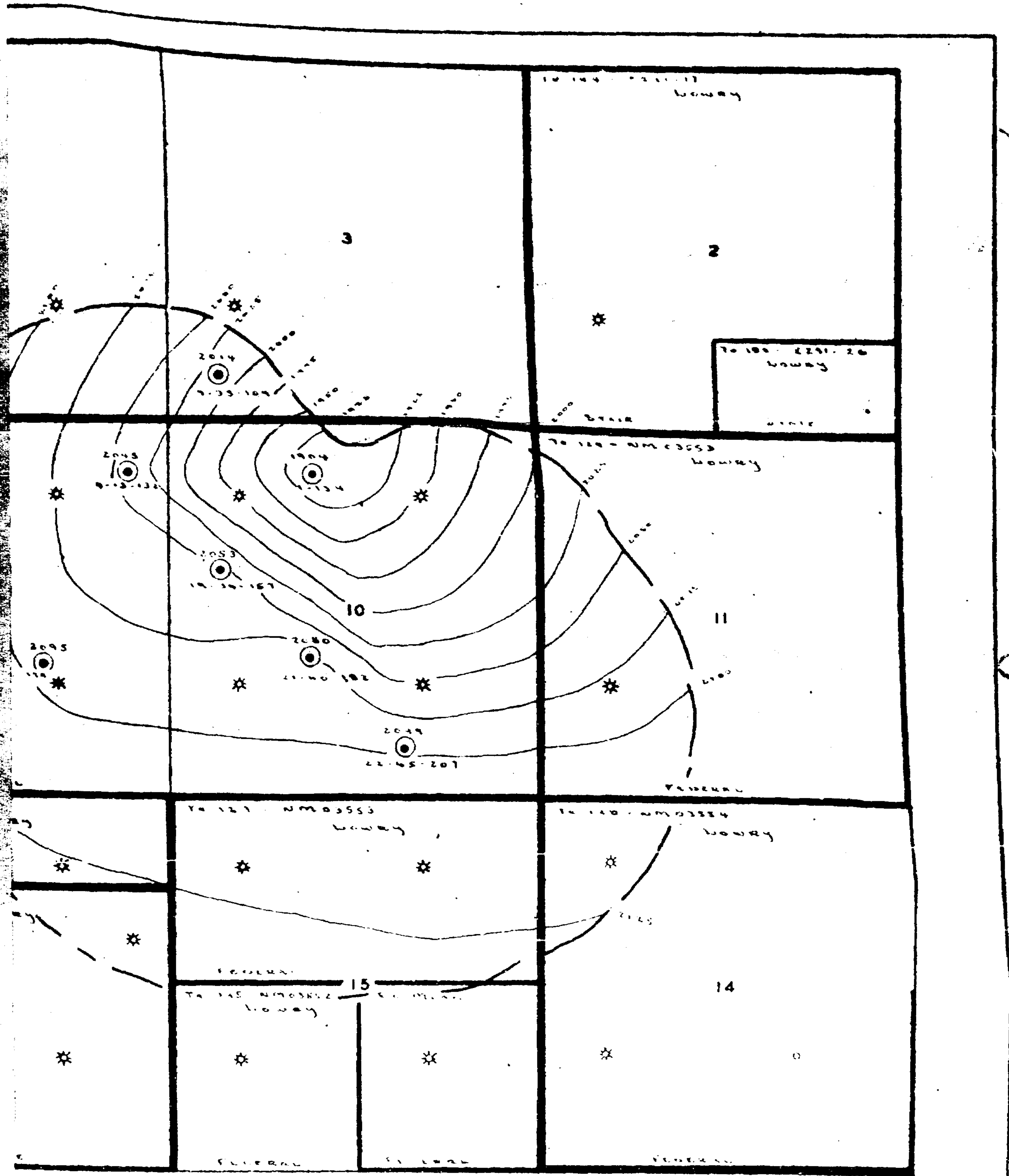
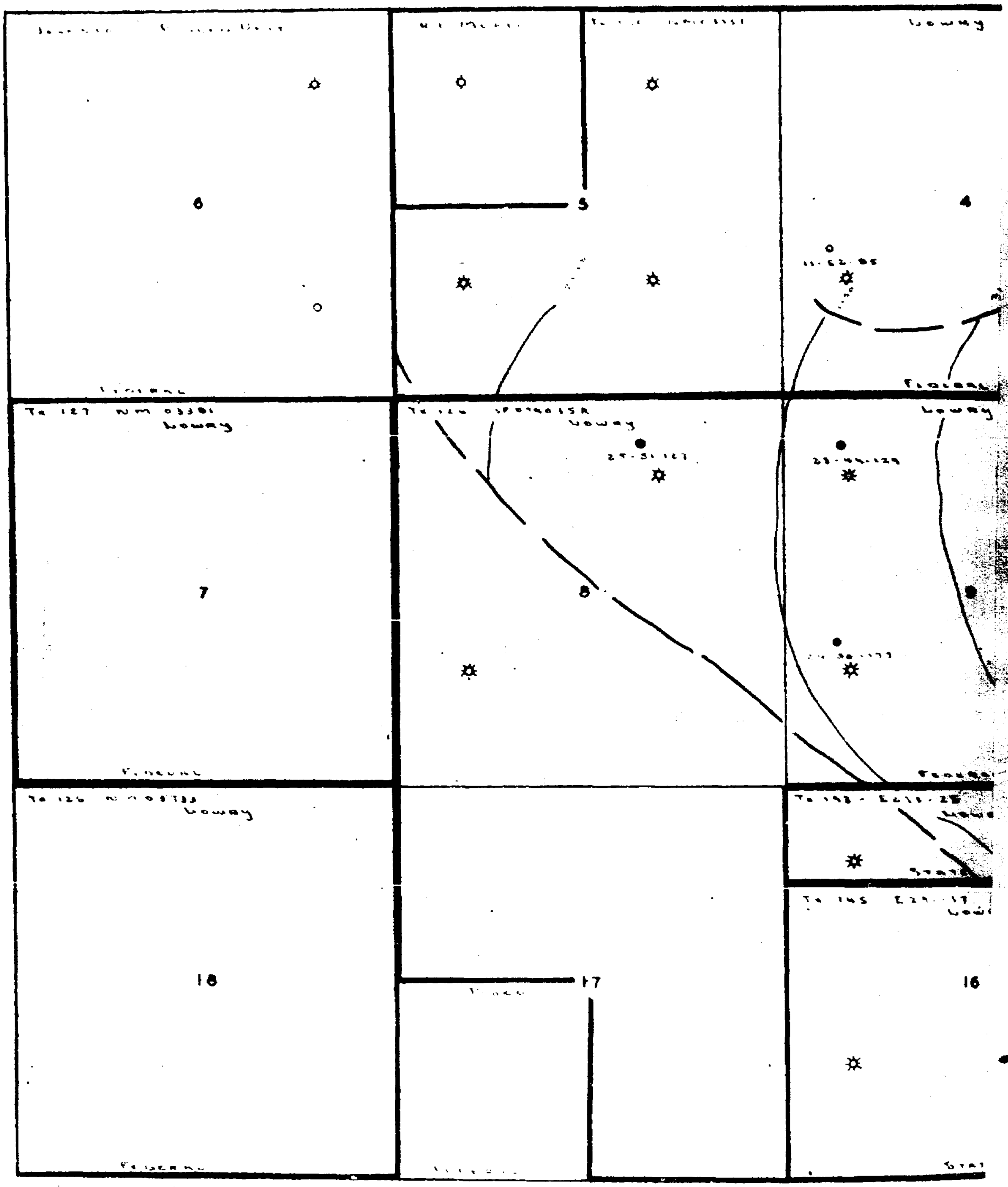


CITO POOL

2 ND GENERAL SURVEY

AVG. RESERVOIR PRESS.
2095 PSI -100 FT.

152



LOWRY OIL COMPANY

T26N — R6W

RIO ARRIBA COUNTY, N. M.

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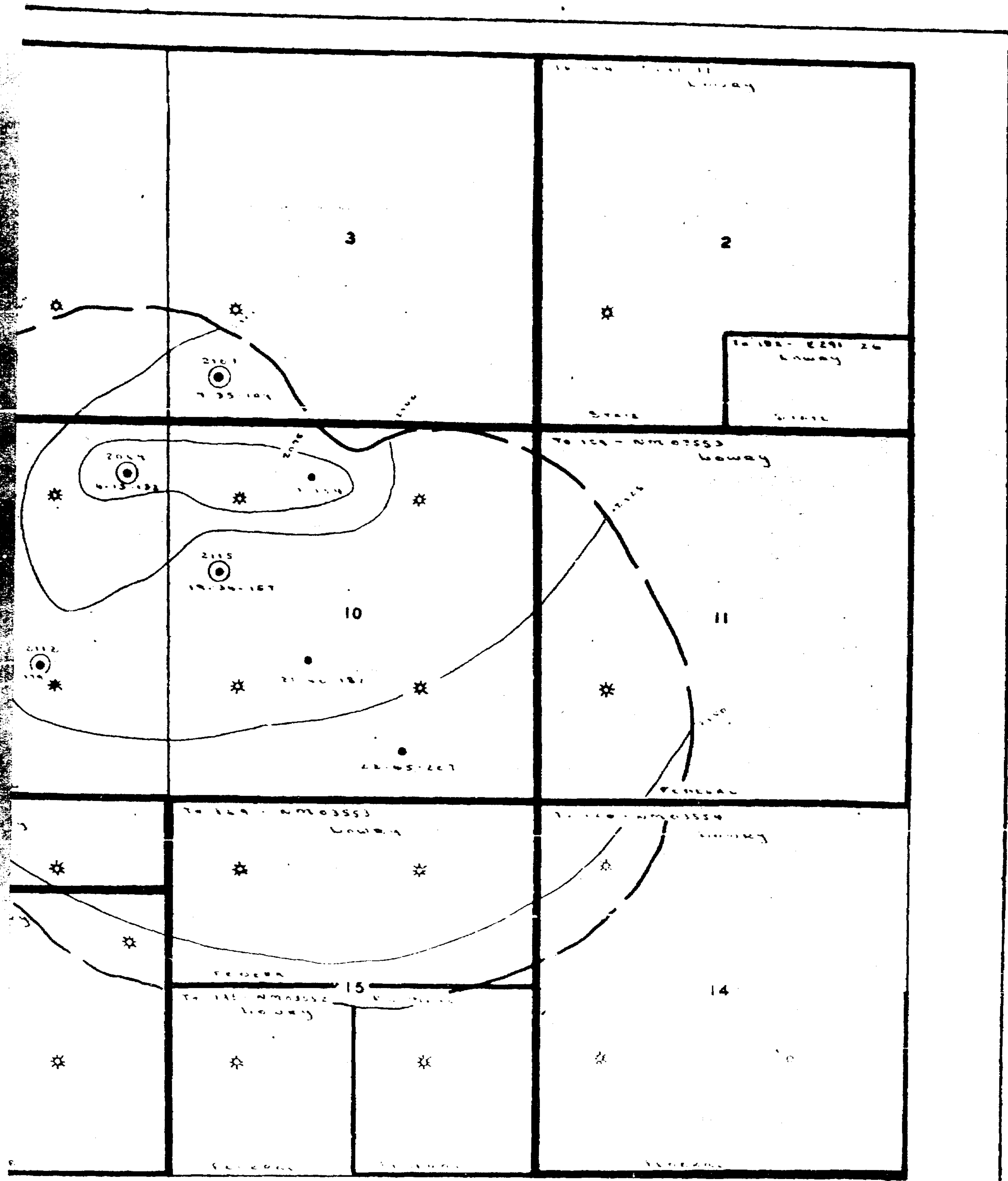


OCITO POOL

AP

1 ST GENERAL SURVEY

AVG. RESERVOIR PRESS.
2130 PSI -100 FT

Gas-Oil Ratio Tests

Well No.	Date	Gas-Oil Ratio	Accumulative Oil Production
Federal 1-134	9-4-52	2127:1	2,271
	1-20-53	3385:1	4,073
	3-2-53	3045:1	4,566
	4-13-53	2805:1	4,905
Federal 2-179	7-28-51	1506:1	4,481
	5-8-52	1498:1	99,822
	8-29-52	1529:1	132,852
	10-12-52	1607:1	144,070
	12-28-52	1231:1	161,611
	2-1-53	852:1	166,396
	2-11-53	878:1	168,388
	4-12-53	1022:1	180,010
Federal 4-13-132	1-4-52	797:1	5,449
	5-21-52	817:1	29,635
	9-12-52	1166:1	44,691
	12-19-52	1648:1	56,011
	1-24-53	1570:1	59,475
	4-14-53	1548:1	67,748
Federal 19-34-157	4-20-52	1080:1	3,867
	5-24-52	1176:1	13,945
	9-6-52	1083:1	39,902
	1-23-53	990:1	71,157
	2-28-53	940:1	78,135
	4-13-53	1519:1	86,883
Federal 7-35-109	4-20-52	1577:1	1,245
	5-17-52	1570:1	3,109
	9-5-52	1213:1	9,762
	1-20-53	2191:1	18,488
	4-14-53	2164:1	25,073
Federal 21-40-182	7-9-52	1194:1	5,700
	9-9-52	1558:1	21,372
	12-23-52	4261:1	45,885
	1-25-53	3606:1	51,606
	2-9-53	3713:1	54,810
	3-26-53	3724:1	61,093
	4-12-53	3923:1	6 2,803

Well No.	Date	Gas Oil Ratio	Accumulative Oil Production
Federal 22-45-207	9-11-52	1632:1	30,134
	1-27-53	1655:1	40,395
	3-3-53	1796:1	47,360
	4-24-53	1998:1	57,465
Federal 23-49-129	1-31-53	790:1	3,768
	2-15-53	736:1	6,541
	4-13-53	723:1	17,816
Federal 24-50-177	4-11-53	2418:1	5,114
Federal 25-51-127	5-4-53	818:1	1,721

WELL DATA

Federal 1-134

Location :	660 FNL, 1980 FWL, Section 10, T26N, R6W
Elevation:	6,550' DF
Drilling Commenced:	April 29, 1950
Drilling Completed:	July 19, 1950
Commenced Producing:	August 21, 1952
Surface Pipe:	13 3/8" OD casing set @ 312', with 350 sks cement
Intermediate Pipe:	9 5/8" OD casing set @ 2,990' with 500 sks cement
Production Pipe:	7" OD casing set @ 7,210' with 300 sks cement. Milled out 7" casing 6,728' - 6,770' to produce from Tocito formation.
Total Depth:	7,562 feet
Plugged back total depth:	6,770 feet
Acid Treatment:	1st treatment: 500 gallons mud acid 2nd treatment: 2,000 gallons acid after shot
Shot record:	120 quarts SNG
Initial Potential:	37.9 barrels of oil per day

Federal 2-179

Location:	1,980' FSL, 1,980' FEL, Section 9, T26N, R6W
Elevation:	KB 6,507'
Drilling Commenced:	May 22, 1951
Drilling Completed:	July 12, 1951
Commenced Producing:	July 11, 1951
Surface Pipe:	1 0 - 3/4" OD casing set @ 500' with 250 sks cement
Production Pipe:	7" OD casing set @ 6,615' with 150 sks cement
Tubing:	2" EUE set @ 6,630'
Total depth:	6,692'
Acid Treatment:	None
Shot Record:	Not shot
Initial Potential:	720 barrels of oil per day

Federal 4-13-132

Location:	660' FNL, 760' FEL, Section 9, T26N, R6W
Elevation:	GL 6,502'
Drilling Commenced:	September 24, 1951
Drilling Completed:	December 13, 1951
Commenced Producing:	December 9, 1951
Surface Pipe:	10 3/4" set @ 522' with 350 sks cement (10 3/4" OD casing)
Production Pipe:	7" OD casing set @ 6,670' with 200 sks cement
Tubing:	2" EUE set at 6,693'
Total Depth:	6,731'
Acid Treatment:	None
Shot Record:	Not shot
Initial Potential:	407 barrels of oil per day

Federal 19-34-157

Location:	1,980' FNL, 660' FWL, Section 10, T26N, R6W
Elevation:	GL 6,643'
Drilling Commenced:	February 2, 1952
Drilling Completed:	March 24, 1952
Commenced Producing:	March 26, 1952
Surface Pipe:	10 3/4" OD casing set @ 610' with 325 sks cement
Production Pipe:	7" OD casing set @ 6,812' with 170 sks cement
Tubing:	2" EUE set @ 6,840'
Total depth:	6,873'
Acid Treatment:	None
Shot Record:	Not shot
Initial Potential:	662 barrels of oil per day

Federal 7-35-109

Location:	660' FSL, 660' FWL, Section 3, T26N, R6W
Elevation:	GL 6,484'
Drilling Commenced:	February 23, 1952
Drilling Completed:	March 30, 1952
Commenced Producing:	May 5, 1952
Surface Pipe:	10 3/4" OD casing set @ 480' with 250 sks cement
Production Pipe:	7 5/8" OD casing set @ 6,674' with 175 sks cement
Tubing:	2" EUE set @ 6,700'
Total depth:	6,735'
Acid Treatment:	None
Shot record:	Not shot
Initial Potential:	135 barrels of oil per day

Federal 21-40-182

Location:	1740' FSL, 1800' FWL, Section 10, T26N, R6W
Elevation:	GL 6,552'
Drilling Commenced:	April 6, 1952
Drilling Completed:	May 26, 1952
Commenced Producing:	May 31, 1952
Surface Pipe:	10 3/4" OD casing set @ 575' with 310 sks cement
Production Pipe:	7 5/8" OD casing set : 6,700' with 175 sks cement
Tubing:	2½" EUE set @ 6,720'
Total depth:	6,761'
Acid Treatment:	None
Shot Record:	Not shot
Initial Potential:	1,743 barrels of oil per day

Federal 22-45-207

Location:	660' FSL, 1980' FEL, Section 10, T26N, R6W
Elevation:	6,506' DF
Drilling Commenced:	June 9, 1952
Drilling Completed:	July 25, 1952
Commenced Producing:	July 29, 1952
Surface Pipe:	10 3/4" OD casing set @ 409' with 175 sks cement
Production Pipe:	7 5/8" OD casing set @ 6,635' with 200 sks cement
Tubing:	2½" EUE set @ 6,661'
Total depth:	6,688'
Acid Treatment:	None
Shot Record:	Not shot
Initial Potential:	570 barrels of oil per day

Federal 23-49-129

Location:	660' FNL, 760' FWL, Section 9, T26N, R6W
Elevation:	6,423' DF
Drilling Commenced:	October 31, 1952
Drilling Completed:	January 5, 1953
Commenced Producing:	January 8, 1953
Surface Pipe:	10 3/4" OD casing set @ 426' with 175 sks cement
Production Pipe:	7" OD casing set @ 6,568' with 200 sks cement
Tubing:	2" EUE set @ 6,618'
Total depth:	6,628'
Acid Treatment:	None
Shot Record:	Not shot
Initial Potential:	870 barrels of oil per day

Federal 24-50-177

Location:	1,980' FSL, 660' FWL, Section 9, T26N, R6W
Elevation:	6,477' DF
Drilling Commenced:	January 29, 1953
Drilling Completed:	March 8, 1953
Commenced Producing:	March 11, 1953
Surface Pipe:	10 3/4" OD casing set @ 406' with 200 sks cement
Production Pipe:	7" OD casing set @ 6,591' with 200 sks cement
Tubing:	2" EUE set at 6,642'
Total depth:	6,645'
Acid Treatment:	None
Shot Record:	Not shot
Initial Potential:	932.98 barrels of oil per day

Federal 25-51-127

Location:	660' FNL, 1,980' FEL, Section 8, T26N, R6W
Elevation:	6,493'
Drilling Commenced:	March 17, 1953
Drilling Completed:	April 17, 1953
Commenced Producing:	April 20, 1953
Surface Pipe:	10 3/4" OD casing set @ 499.5' with 200 sks cement
Production Pipe:	7" OD casing set @ 6,620' with 200 sks cement
Tubing:	2" EUE set @ 6,649'
Total depth:	6,677'
Acid Treatment:	None
Shot Record:	Not shot
Initial Potential:	714.72 barrels of oil per day

CORING RECORD

CORING RECORD

Pettigrew-Tocito Pool

Rio Arriba County, N.M.

- -

Federal 4-13-132

Core No. 1: 6650' - 6673'. Cored 23 feet - recovered 18'; 2" of hard black shale.

Core No. 2: 6673' - 6687'. Recovered 15½'. 9' hard black, macro fossiliferous marine shale. 6½' coarse, angular, highly porous and permeable coaly sandstone, slightly calcareous, strong oil odor and stain, slightly fluorescent.

Core No. 3: 6687' - 6702'. Recovered 18'. 10' coarse angular, highly porous and permeable coaley sandstone, strong oil odor and stain. 1' shaly sand with good odor, vertically-fractured sandy shale with no appreciable odor.

Core No. 4: 6706' - 6722'. Recovered 17'2" of core. 4' hard black medium grained shaley sand. Strong oil odor and stain. All saturated. Fair porosity and permeability. Vertically fractured. 13' hard dark grey medium to coarse grained sandstone with occasional thin shale streaks. Fair to excellent porosity and permeability. Strong oil odor and stain, oil saturated, vertically fractured. Bottom 2" black shale, no odor, no stain.

Federal 22-45-207

Core No. 1: 6638' - 6688'. Cored 50 feet. Recovered 50 feet. 3 3/4 feet dense black shale, 19 1/4 feet sand, and 27 feet dense black Mancos shale.

Federal 23-49-129

Core No. 1: 6571' - 6592'. Recovered 21'. 13½' shale; 1' tight shaley sand with some odor and stain; 3½' permeable oil sand with some shale streaks, good odor and stain; 3' shaley oil sand, some permeable oil sand in streaks, good odor and stain.

Core No. 2: 6592' - 6621'. Recovered 26½'. 2½' fairly porous and permeable saturated sand with thin shale streaks. 1/2' good porous and permeable saturated sand with thin shale streaks. Some vertical fractures; 2½' fairly porous and permeable saturated sand with thin shale streaks; 1/2' shale; 4' good porous and permeable saturated sand with thin shale streaks; 16½' tight shaley sand with odor and saturation.

Core No. 3: 6621' - 6628'. Recovered 7 1/4 feet. 2' fairly light sandstone with odor and saturation; 3' tight shaly sandstone with fair odor and stain; 1' interbedded shale and tight sandstone; 1 1/4' shale with very thin shale streaks.

Federal 24-50-177

Core No. 1: Cored from 6594' to 6645'. Recovered 51' as follows:
10 1/4' black Mancos shale.
12 1/2' Tocito sandstone
28 1/4' black Mancos shale.

DST RECORD

RECORD OF DRILL STEM TESTS

Pettigrew-Tocito Pool

Rio Arriba County, N. M.

Federal 1-134

Drill stem test 6720' - 6956'. Tool open 3 hours. Gas to surface in 10 minutes. Heavy blow 1 hour. Small blow 2 hours. Estimated 50 MCF gas per day. Recovered 250' gas-cut mud. Bottomhole flowing pressure 600 PSI; 20 minute shut in bottomhole pressure 800 PSI.

Federal 2-179

Drill stem test 6605' - 6700'. Tool open 40 minutes. Gas to surface in 5 mintues. Mud to surface 15 minutes. Oil to surface in 18 minutes. Estimated flow 40 barrels per hour. Shut in bottomhole pressure 2250 PSI. Bottomhole flowing pressure 1500 PSI.

Federal 25-51-127

Drill stem test 6648½' - 6676'. Tool open 3 hours, 45 minutes. Good blow of air immediately decreasing to slight blow of air. Recovered 35 feet drilling mud - no oil or gas recovered. Bottomhole flowing pressure 10 PSI. One hour shut in pressure 10 PSI.

State 1-268

Drill stem test 6554' - 6655'. Tool open 1 hour through 1/2" choke. Fair blow of air for 35 minutes. Died at end of 50 minutes. Recovered 390 feet gas-cut mud. Flowing pressure 115 PSI. 20-minute shut in pressure 125 PSI.

Drill stem test 6566' - 6745'. Tool open 1 hour through 1/2" choke. Gas to surface in 20 minutes. Estimated 60 MCF. Recovered 450' of gas-cut mud. Flowing pressure 350 PSI. 20-minute shut in pressure 500 PSI.

Legal Notice OCC Hearing

Publication:

SANTA FE
ESPANOLA

Date: May 19 1953 Hearing

CASE 527:

In the matter of the application of Lowry et al Operating Account for an order calling for the establishment of pool rules for the Pettigrew-Tocito Pool, Rio Arriba County New Mexico, with attention to spacing regulations, the fixing of gas-oil ratios, establishment of a casing program, and related matters.

?

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

August 5, 1952

Lowry, et al. Operating Account
616 East Central Avenue
Room 215
Albuquerque, New Mexico

Attention: Mr. Arthur Holland

Subject: Core Analysis
Federal 22-45-207 Well
Largo Canyon Field
Rio Arriba County, New Mexico

Gentlemen:

Diamond conventional cores from the subject well in the Tocito formation have been sampled and quick-frozen by a representative of Core Laboratories, Inc. and later analyzed in our Farmington, New Mexico laboratory. Results of analysis are presented in tabular and graphical form on the attached Coregraph. Oil emulsion mud was used as the drilling fluid.

Tocito formation analyzed from 6642 to 6644 feet is interpreted to be nonproductive due to low permeability.

Sand analyzed from 6644 to 6661 feet is interpreted to be oil productive where permeable.

Sand analyzed from 6661 to 6663.5 feet is interpreted to be nonproductive due to low permeability.

Recovery estimates for the zone, 6644 to 6661 feet, are given on page one of the report.

We hope these data prove beneficial in the evaluation of this well.

Very truly yours,

Core Laboratories, Inc.

J D Harris (PS)

J. D. Harris,
District Engineer

JDH:ma

FORM F-11A

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS

Page 1 of 1
File FNML-56 FC
Well Federal 22-45-207

CORE SUMMARY AND CALCULATED RECOVERABLE OIL

CORE SUMMARY				
FORMATION NAME	Tocito			
DEPTH, FEET	6644.0-6661.0			
% CORE RECOVERY	100			
FEET OF PERMEABLE, PRODUCTIVE FORMATION RECOVERED	12.0			
AVERAGE PERMEABILITY MILLIDARCYS	78			
CAPACITY — AVERAGE PERMEABILITY X FEET PRODUCTIVE FORMATION	936			
AVERAGE POROSITY, PERCENT	16.8			
AVERAGE RESIDUAL OIL SATURATION, % PORE SPACE	22.2			
GRAVITY OF OIL, °A.P.I.	40			
AVERAGE TOTAL WATER SATURATION, % PORE SPACE	24.5			
AVERAGE CALCULATED CONNATE WATER SATURATION, % PORE SPACE	22			
SOLUTION GAS-OIL RATIO, CUBIC FEET PER BARREL (1)	790			
FORMATION VOLUME FACTOR—VOLUME THAT ONE BARREL OF STOCK TANK OIL OCCUPIES IN RESERVOIR (1)	1.46			
CALCULATED RECOVERABLE OIL	Prediction dependent upon complete isolation of each division. Structural position of well, total permeable thickness of oil zone and drainage area of well should be considered.			
BY NATURAL OR GAS EXPANSION, BBLS. PER ACRE FOOT (2)	154			
INCREASE DUE TO WATER DRIVE, BBLS. PER ACRE FOOT	253			
TOTAL AFTER COMPLETE WATER DRIVE, BBLS. PER ACRE FOOT (3)	407			

Core Laboratories, Inc.
J D Harris (PS)
J. D. Harris

NOTE:
(*) REFER TO ATTACHED LETTER.
(1) REDUCTION IN PRESSURE FROM estimated SATURATION PRESSURE TO ATMOSPHERIC PRESSURE.
(2) AFTER REDUCTION FROM ORIGINAL RESERVOIR PRESSURE TO ZERO POUNDS PER SQUARE INCH.
(3) RESERVOIR PRESSURE MAINTAINED BY WATER DRIVE AT OR ABOVE estimated ORIGINAL SATURATION PRESSURE.
(4) NO ESTIMATE FOR GAS PHASE RESERVOIRS.

Case 831

Lowry et al Operating Account

- -

Summary of

Porosity & Permeability

Data

- -

Pettigrew-Tocito Pool

Rio Arriba County

New Mexico

POROSITY DATA
Pettigrew-Tocito Field

Upper Portion of Tocito Sand

Federal 4-13-132

Depth, Feet	Porosity,%*
6675.5	7.0
6676.5	5.2
6677.5	7.9
6678.5	6.5
6679.5	13.2
6680.5	9.9
6681.5	18.4
6682.5	17.3
6683.5	15.5
6684.5	9.8
6685.5	15.7
6686.5	18.1
6687.5	8.9
6688.5	17.5
6689.5	21.3
6690.5	21.3
6691.5	16.6
Wt. Average:	13.54

Federal 22-45-207

Depth, Ft.	Porosity,%*
6644.5	13.0
6645.5	6.4
6646.5	8.9
6647.5	9.9
6648.5	9.5
6651.5	18.1
6652.5	16.6
6653.5	18.3
6657.5	15.8
6658.5	11.2
6659.5	19.0
6660.5	11.5
Wt.Average:	13.18

Federal 23-49-129

Depth, Ft.	Porosity, %*
6586.9 - 6587.2	12.7
6587.2 - 6587.6	12.7
6587.6 - 6588.1	13.2
6588.1 - 6588.6	11.8
6588.6 - 6589.2	14.2
6589.2 - 6589.8	13.3
6589.8 - 6590.1	18.1
6590.2 - 6590.7	22.3
6590.7 - 6591.3	20.8
6591.3 - 6591.8	20.9
6592.0 - 6592.6	20.5
6592.6 - 6593.1	19.0
6593.1 - 6593.7	17.6
6593.7 - 6594.3	17.1
6594.4 - 6595.0	18.6
6595.1 - 6595.7	13.7
6595.7 - 6596.3	9.5
6596.3 - 6596.7	13.3
6596.8 - 6597.2	14.9
6597.2 - 6598.0	10.1
6598.2 - 6599.0	12.1
6599.0 - 6599.6	12.7
6599.6 - 6600.2	11.6
6600.2 - 6600.7	10.3
Wt.Average:	14.90

Federal 24-50-177

Depth, Ft.	Porosity, %*
6607.2 - 6607.6	9.8
6607.6 - 6608.0	10.3
6608.0 - 6608.3	11.1
6608.3 - 6608.5	12.7
6608.5 - 6609.0	10.5
6609.0 - 6609.5	10.4
6609.5 - 6610.5	11.9
6610.5 - 6610.8	10.2
6610.8 - 6611.0	6.3
6611.0 - 6611.5	7.0
6611.5 - 6611.9	7.3
6611.9 - 6612.2	5.5
6612.2 - 6612.7	18.2
6612.7 - 6613.0	19.8
6613.0 - 6613.3	23.2
6613.3 - 6613.9	21.0
6613.9 - 6614.2	22.0
6614.2 - 6614.5	21.5
6614.5 - 6615.0	20.2
6615.0 - 6615.4	18.6
6615.4 - 6615.8	18.3
Wt.Average:	14.03

FIELD WEIGHTED AVERAGE POROSITY

	Ft. of Net Sand	Wt. Average Porosity,%
Federal 4-13-132	17	13.54
Federal 22-45-207	12	13.18
Federal 23-49-129	14	14.90
Federal 24-50-177	9	14.03
Field Weighted Average:		13.90

* Petroleum Production Laboratories

POROSITY DATA

Pettigrew-Tocito Field

- - - - - - - - - - - - - - -

Lower Portion of Tocito Sand

Federal 4-13-132		Federal 23-49-129	
Depth, Ft.	Porosity % *	Depth, Ft.	Porosity %**
6706.5	11.7	6614.5 - 6614.9	10.1
6707.5	11.9	6615.1 - 6615.7	9.4
6708.5	10.8	6615.7 - 6616.2	9.9
6709.7	5.1	6616.2 - 6616.7	9.5
6710.5	12.2	6616.7 - 6617.0	8.0
6711.5	13.3	6617.0 - 6617.4	8.3
6712.5	13.8	6617.4 - 6618.0	12.4
6713.5	13.1	6621.1 - 6621.7	15.2
6714.5	12.1	6621.7 - 6622.5	12.7
6715.5	7.9	6622.5 - 6623.1	11.1
		6623.4 - 6624.0	7.9
		6624.4 - 6625.1	9.9
Wt. average:	11.19	6625.1 - 6625.6	13.0
		6626.8 - 6627.2	10.6
		Wt. average:	10.79

Field Weighted Average Porosity

	Feet of Net Sand	Wt. Average Porosity %
Federal 4-13-132	10	11.19
Federal 23-49-129	13	10.79
Field weighted average:		10.96

* Core Laboratories
** Petroleum Production Laboratories

HORIZONTAL PERMEABILITY DATA

Pettigrew-Tocito Field

Upper Portion of Tocito Sand

Federal 4-13-132

Depth, Ft.	Permeability Millidarcys*
6675.5	0.1
6676.5	0.4
6677.5	0.6
6678.5	132.0
6679.5	2.8
6680.5	80.0
6681.5	345.0
6682.5	133.0
6683.5	1.6
6684.5	1.3
6685.5	101.0
6686.5	44.0
6687.5	2.2
6688.5	219.0
6689.5	622.0
6690.5	564.0
6691.5	97.0
Wt. Average:	138.0

Federal 22-45-207

Depth, Ft.	Permeability Millidarcys*
6644.5	0.3
6645.5	0.1
6646.5	0.1
6647.5	0.2
6648.5	1.0
6651.5	413.0
6652.5	36.0
6653.5	205.0
6657.5	4.1
6658.5	1.4
6659.5	272.0
6660.5	1.9
Wt. Average:	77.93

Federal 23-49-129

Depth, Ft.	Permeability Millidarcys**
6586.9 - 6587.2	1.1
6587.2 - 6587.6	2.1
6587.6 - 6588.1	2.5
6588.1 - 6588.6	7.0
6588.6 - 6589.2	5.0
6589.2 - 6589.8	10.5
6589.8 - 6590.1	0.1
6590.2 - 6590.7	425.0
6590.7 - 6591.3	192.0
6591.3 - 6591.8	341.0
6592.0 - 6592.6	415.0
6592.6 - 6593.1	203.0
6593.1 - 6593.7	144.0
6593.7 - 6594.3	4.6
6594.4 - 6595.0	221.0
6591.1 - 6595.7	2.3
6595.7 - 6596.3	0.4
6596.3 - 6596.7	1.4
6596.8 - 6597.2	18.0
6597.2 - 6598.0	3.7
6598.2 - 6599.0	3.6
6599.0 - 6599.6	1.8
6599.6 - 6600.2	4.7
6600.2 - 6600.7	1.8
Wt. Average:	83.17

Federal 24-50-177

Depth, Ft.	Permeability Millidarcys **
6607.2 - 6607.6	0.43
6607.6 - 6608.0	0.78
6608.0 - 6608.3	0.35
6608.3 - 6608.5	0.41
6608.5 - 6609.0	0.42
6609.0 - 6609.5	0.24
6609.5 - 6610.5	0.38
6610.5 - 6610.8	0.20
6610.8 - 6611.0	0.07
6611.0 - 6611.5	0.23
6611.5 - 6611.9	0.17
6611.9 - 6612.2	0.17
6612.2 - 6612.7	46.0
6612.7 - 6613.0	10.0
6613.0 - 6613.3	442.0
6613.3 - 6613.9	760.0
6613.9 - 6614.2	778.0
6614.2 - 6614.5	981.0
6614.5 - 6615.0	821.0
6615.0 - 6615.4	247.0
6615.4 - 6615.8	289.0
Wt. Average:	205.68

Field weighted average: 121.09 millidarcys

* Permeability to liquid - Core Laboratories

** Permeability to air - Petroleum Production Laboratories

VERTICAL PERMEABILITY DATA

Pettigrew-Tocito Field

Upper Portion of Tocito Sand

Federal 23-49-129

Depth, Feet	Permeability* Millidarcys
6586.9 - 6587.2	1.0
6587.2 - 6587.6	1.4
6587.6 - 6588.1	0.4
6588.1 - 6588.6	0.4
6588.6 - 6589.2	2.9
6589.2 - 6589.8	4.3
6589.8 - 6590.1	78.0
6590.2 - 6590.7	59.0
6590.7 - 6591.3	90.0
6591.3 - 6591.8	22.0
6592.0 - 6592.6	5.4
6592.6 - 6593.1	48.0
6593.1 - 6593.7	3.3
6593.7 - 6594.3	62.0
6594.4 - 6595.0	40.0
6595.1 - 6595.7	0.5
6595.7 - 6596.3	82.0
6596.3 - 6596.7	3.3
6596.8 - 6597.2	4.0
6597.2 - 6598.0	0.4
6598.2 - 6599.0	2.1
6599.0 - 6599.6	76.0
6599.6 - 6600.2	3.1
6600.2 - 6600.7	0.3
Wt. Average:	20.43

Federal 24-50-177

Depth, Feet	Permeability* Millidarcys
6607.2 - 6607.6	0.04
6607.6 - 6608.0	0.22
6608.0 - 6608.3	0.19
6608.3 - 6608.5	0.06
6608.5 - 6609.0	0.08
6609.0 - 6609.5	0.05
6609.5 - 6610.5	8.10
6610.5 - 6610.8	0.07
6610.8 - 6611.0	0.04
6611.0 - 6611.5	0.43
6611.5 - 6611.9	0.12
6611.9 - 6612.2	0.89
6612.2 - 6612.7	14.00
6612.7 - 6613.0	0.71
6613.0 - 6613.3	183.00
6613.3 - 6613.9	12.00
6613.9 - 6614.2	418.00
6614.2 - 6614.5	335.00
6614.5 - 6615.0	221.00
6615.0 - 6615.4	9.20
6615.4 - 6615.8	8.10
Wt. Average:	48.99

Field Weighted Average: 31.61 millidarcys

* Permeability to air - Petroleum Production Laboratories

HORIZONTAL AND VERTICAL PERMEABILITY DATA

Pettigrew-Tocito Field

Lower Portion of Tocito Sand

- -

Horizontal Permeabilities

Federal 4-13-132

Depth Feet	Permeability Millidarcys *
6706.5	0.2
6707.5	0.5
6708.5	0.3
6709.5	0.0
6710.5	0.7
6711.5	0.7
6712.5	2.1
6713.5	2.5
6714.5	0.2
6715.5	0.1
Wt average:	.73

Federal 23-49-129

Depth Feet	Permeability Millidarcys
6614.5 - 6614.9	1.4
6615.1 - 6615.7	1.6
6615.7 - 6616.2	1.2
6616.2 - 6616.7	1.0
6616.7 - 6617.0	0.8
6617.0 - 6617.4	1.0
6617.4 - 6618.0	2.8
6621.1 - 6621.7	2.2
6621.7 - 6622.5	1.5
6622.5 - 6623.1	0.3
6623.4 - 6624.0	0.2
6624.4 - 6625.1	0.8
6625.1 - 6625.6	2.9
6626.8 - 6627.2	0.4
Wt.average:	1.32

Vertical Permeabilities

Federal 23-49-129

Depth Feet	Permeability Millidarcys
6614.5 - 6614.9	0.4
6615.1 - 6615.7	0.4
6615.7 - 6616.2	0.2
6616.2 - 6616.7	0.3
6616.7 - 6617.0	0.2
6617.0 - 6617.4	0.3
6617.4 - 6618.0	0.4
6621.1 - 6621.7	0.4
6621.7 - 6622.5	0.5
6622.5 - 6623.1	0.6
6623.4 - 6624.0	0.3
6624.4 - 6625.1	0.5
6625.1 - 6625.6	0.5
6626.8 - 6627.2	0.5
Wt. average:	0.41

Field weighted average:

Horizontal: 1.06 millidarcys

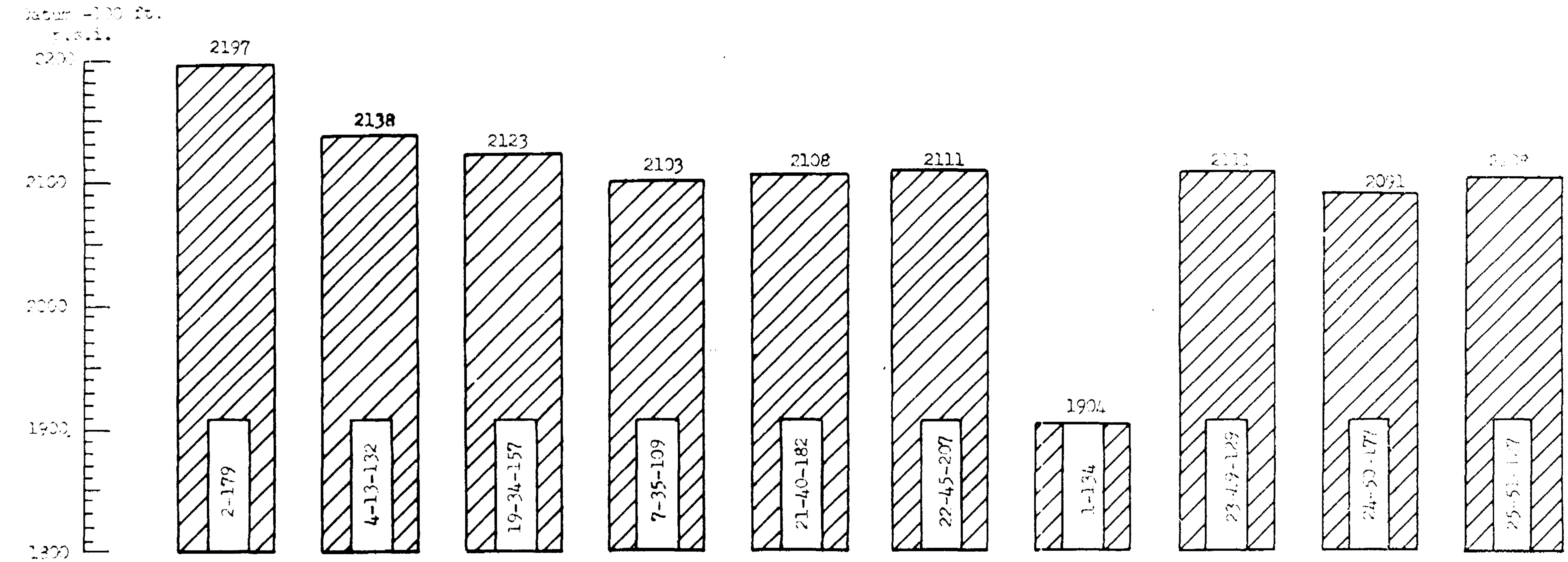
Vertical: 0.41 millidarcys

* Permeability to liquid - Core Laboratories
** Permeability to air - Petroleum Production Laboratories

INITIAL BOTTOMHOLE PRESSURE TESTS

PETTIGREW-TOCITO FIELD

RIO ARRIBA COUNTY, N. M.



Date of completion:	7-3-51	11-2-51	3-25-52	4-18-52	5-26-52	7-29-52	8-20-52	1-4-53	3-11-53	[illegible]
Date of initial Bottomhole Pressure test:	7-26-51	1-3-52	3-30-52	5-1-52	6-5-52	8-2-52	8-20-52	1-12-53	3-15-53	[illegible]
Distance to nearest producing well:		2,908 ft.	1,939 ft.	1,939 ft.	1,932 ft.	1,848 ft.	1,867 ft.	3,663 ft.	2,640 ft.	[illegible]
Pressure drop below initial reservoir pressure:		59 p.s.i.	74 p.s.i.	94 p.s.i.	89 p.s.i.	86 p.s.i.	293 p.s.i.	86 p.s.i.	106 p.s.i.	89 p.s.i.

Chse 537

14

RESERVOIR FLUID STUDY

for

LOWRY et al OPERATING ACCOUNT

Federal 4-13-132

\- - - - -

January 11, 1952

WEST TEXAS ENGINEERING SERVICE, INC.
Midland, Texas

WEST TEXAS ENGINEERING SERVICE, INC.

Midland, Texas

January 24, 1952

Lowry, et al
Room 213-215
616 East Central [illegible]e.
Albuquerque, [illegible] [illegible]xico

Attention: M[illegible] [illegible]

Gentlemen:

Under separate cover, we have submitted a report on the analysis of a reservoir fluid sample taken by our field engineers Messrs. Cates and Black, on your Federal Doswell #4-13, Rio Arriba County, New Mexico.

The bubble point pressure was measured at 2054 pounds per square inch gauge at 175° F. Since the reservoir pressure is 2137 p.s.i.g. this indicates that the oil in the reservoir is slightly undersaturated with gas, but that gas will begin to be liberated as the pressure is reduced by withdrawal. There fore it may be concluded that unless some pressure maintenance effect (water drive, for example) is observed your operating gas-oil ratio will start to rise fairly soon.

By differential liberation the reservoir oil at 175° F. (reservoir temperature) yielded 862 cubic feet of gas (measured at 60° F. and atmospheric pressure) per barrel of stock tank oil. During this process 1.526 barrels of saturated reservoir oil shrank to one barrel of stock tank oil. This means that the reservoir oil will shrink by about 35% of its volume before reaching the stock tank. It is my understanding that you already maintain a relatively high separator pressure. Bearing in mind the above figure of 35% shrinkage, it might be well to maintain a slight pressure on the tanks and keep the oil as low in temperature as practicable. While there is not much to be gained by raising the gravity, since this figure is already in the 40's, this maintenance of high pressure and low temperature will keep weathering to a minimum and enable the retention of the greatest liquid volumes possible.

So much for my suggestions on the physical application of these data. Further use can be made in connection with your core analysis on this reservoir. A theoretical calculation can be made of your reserves by use of the formula:

$$\frac{7758 \times P \times (1-C) \times RF}{1.526} = \text{Bbl. Stock Tank Oil per Acre Foot}$$

where 7758 = 1 Acre foot in Bbl. (Known)
P = % Porosity (From core analysis)
C = % Connate water (From core analysis)
RF = % Recovery factor*
1.526 = Relative liquid volume (From sample data)
Then take B.S.T.O./Ac. Ft. x sand thickness x no. of acres of estimated drainage to bore hole = ultimate recovery.

*Just an additional word regarding "RF" above. This relation can be assumed from the data at hand to be around 20 to 25 percent.

I trust that this answers your question in regard to the use of the bottomhole sample analysis. While normally the analysis is used in connection with core analysis, decline curves, subsequent tests, etc. by the operators own engineers or consultants, I am happy if this is of some use to you. It is good information to have if only to "hang on the wrench" for near future use and like virgin reservoir pressures cannot be had or estimated in the later life of the field.

Thank you for this opportunity of serving you and we are looking forward to moving in up there as soon as the volume warrents our doing so.

Very truly yours,

WEST TEXAS ENGINEERING SERVICE, Inc.

/s/ W. T. Hagler

W. T. Hagler

WTH:ech

COPY

Bottom Hole Sample Analysis

Federal Doswell # 4-13

Wildcat Field

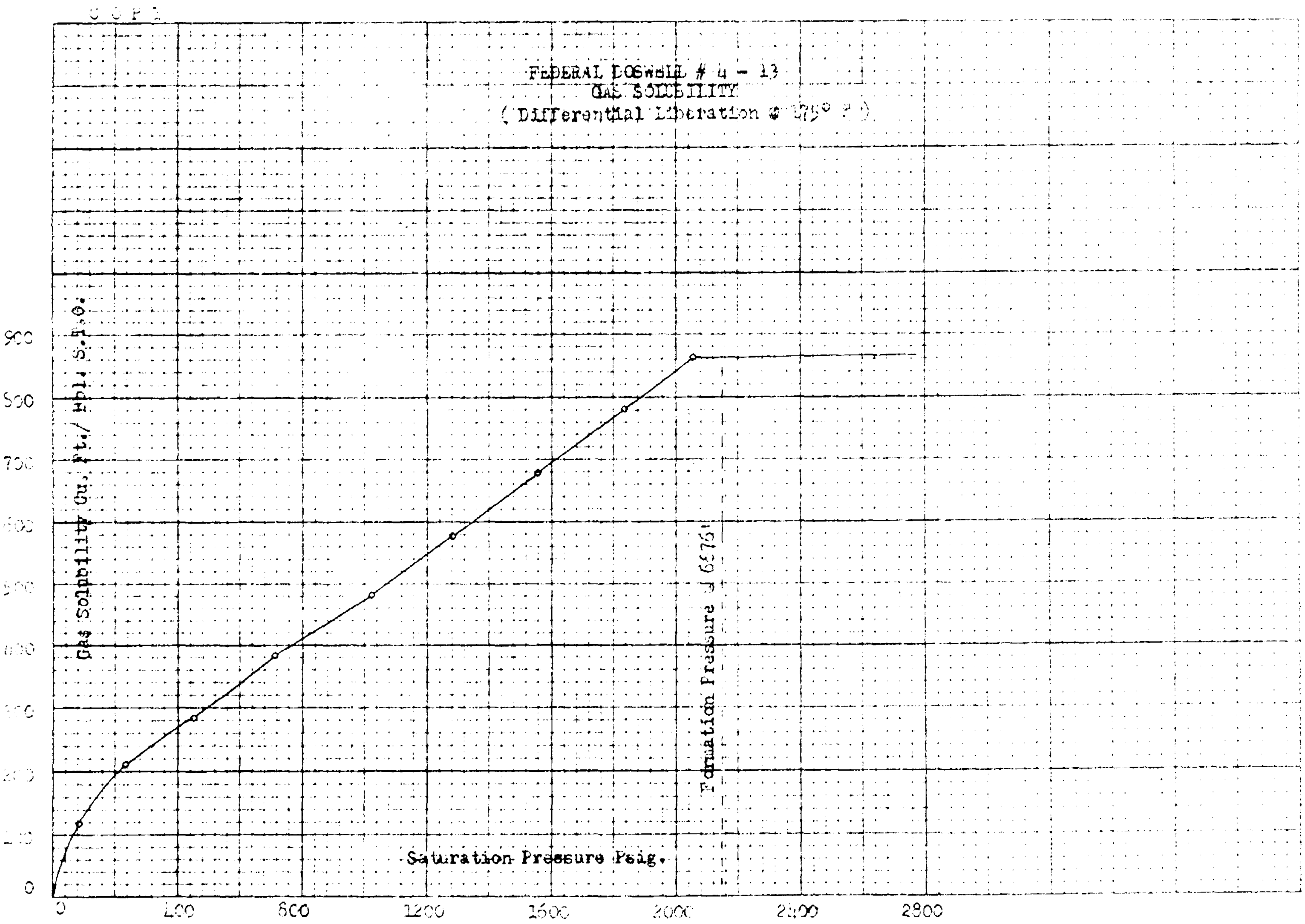
Rio Arriba County, New Mexico

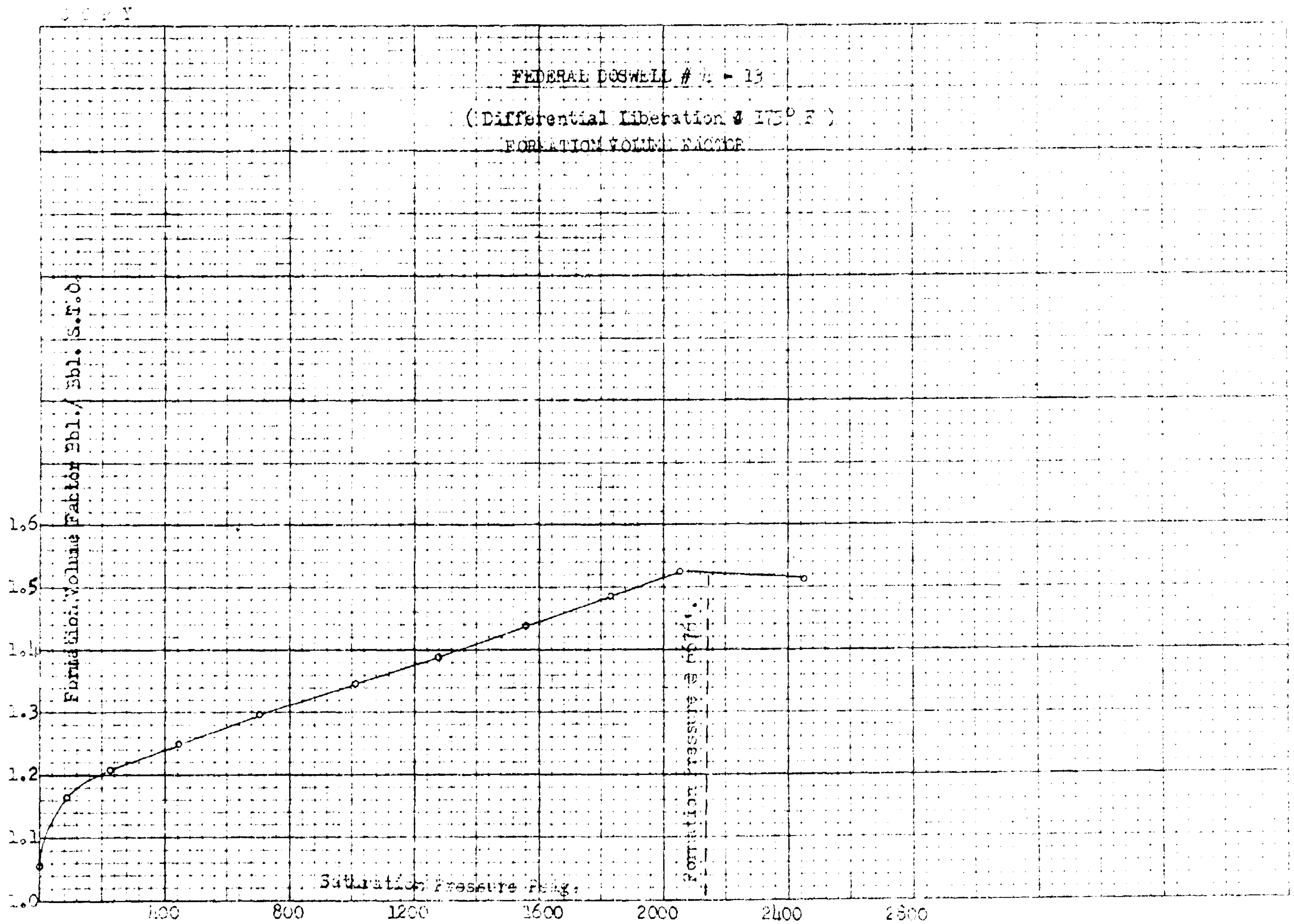
Date Sample Taken	**January 2 & 3, 1952**
Date Analyzed	**January 11, 1952**
Shut-In Prior to Sampling	**24 Hours**
Sampling Depth	**6676'**
Pressure at 6676'	**2137 psi**
Tubing Depth	**6697'**
Top of Tocito Formation	**6676'**
Temperature @ 6676'	**175° F**

TEST SUMMARY

Saturation Pressure	**2054 psig**
Gas in Solution @ 2054 (Differential Lib.) **Gas corrected to 14.7 psi & 60° F**	862 Cu. Ft./Bbl.
Relative Liquid Volume **(2054 psi and 175° F)**	**1526 Bbl./Bbl. S. T. O.**
Thermal Coefficient of Expansion **(Sat. Oil & 3000 spig 73° to 150° F)**	**6.4 x 10^{-4} Cuft/Cuft/° F.**
From 73° F to 175° F	**6.55 x 10^{-4} Cuft/Cuft/psig**
Compressibility Coefficient **(Saturated Oil @ 175° F)**	
From 2054 psi to 2180 psi	13.95 x 10^{-6} Cuft/cuft/psi
From 2054 psi to 2434 psi	15.40 x 10^{-6} Cuft/Cuft/psi
From 2054 psi to 2723 psi	15.90 x 10^{-6} Cuft/Cuft/psi

C O P Y


FEDERAL DOSWELL # 4 - 13
GAS SOLUBILITY
(Differential Liberation
Gas Solubility Cu. Ft./ Bbl. S.T.O.
Saturation Pressure Psig.
Formation Pressure
0
100
200
300
400
500
600
700
800
900
0
400
800
1200
1600
2000
2400
2800


FEDERAL DOSWELL # - 13
(Differential Liberation @ F)
FORMATION VOLUME FACTOR
Formation Volume Factor Bbl./ Bbl. S.T.O.
1.0
1.1
1.2
1.3
1.4
1.5
1.6
400
800
1200
1600
2000
2400
2800
Saturation Pressure Psig.
Formation Pressure @

LOWRY et al OPERATING ACCOUNT

- - - - - - - - - - - - - - -

PRODUCTIVITY INDEX TESTS

Federal 2-179

March 26, 1951 to March 29, 1951

WEST TEXAS ENGINEERING SERVICE, INC.
Midland, Texas

W. T. Hagler
H. L. Hagler
W. M. Cates
C. H. Pickens
R. W. Harrington
D. R. Watson, Jr.
B. E. Black
Field Petroleum Engineers

WEST TEXAS Engineering SERVICE INC.

P. O. Box 1637
Telephone 4-4451
Freetag Building
223 S. Big Spring St.
Midland, Texas

Full Insurance Coverage

INDIVIDUAL WELL DATA SHEET

Company Doswell & Pettigrew Lease Federal Scott Well No. 2

Field Wildcat County Rio Arriba State New Mexico

Test Date 7-26-51 Time 11:05 AM Status of Well S. I.

Top of Pay 6622' Total Depth ____ Producing Formation ____

Tubing 2"EUE Depth 6618' B.H.C. ____ Packer ____ Pressure Datum ____

Casing ____ Depth ____ Perf. ____ Liner ____ Packer ____

Depth Feet	Δ Depth	Pressure Lbs. Sq. In.	Δ Pressure	Gradient Lbs./Ft.		
Surface		1257			Casing Press.	1675
	4910		417	.084	Tubing Press.	1257
4910		1674			Top of Fluid	4900'
	1000		302	.302	Top of Water	No
5910		1976			Hrs.- Shut In	43 Flowing
	715		224	.313	Temp. @	6615' = 174° F.
6615		2200			Elev.-D.F.	6507.5 Gr. 6498
					Last Test Date	Initial
					Press. Last Test	
					B.H.P. Change	
					Gain - Loss/Day	
					Choke Size	
					Oils Bbls/day	
					Water Bbls/day	
					Total Bbls/day	
					Orifice & Line	
					Static & Differential	
					Gas Sp. Gr.	
					Cu. Ft./day	
					GOR	
					GFR	

PRODUCTIVITY INDEX-BBLS./DAY LBS. DROP

Last Cumulative Production ____ Present Cumulative Production ____ Production Between Tests ____

Instrument Amerada Number RPG 9186 BR Recovery Factor Bbls/pound Loss ____

Run By W. M. Cates Calibration No. 731 @ 174° Calculated By W. M. Cates

Calculations and Remarks:

Stapleton Ptg. Co., Midland

W. T. HAGLER
H. L. HAGLER
W. M. CATES
C. H. PICKENS
R. W. HARRINGTON
D. R. WATSON, JR.
B. E. BLACK
FIELD PETROLEUM ENGINEERS

WEST TEXAS Engineering SERVICE INC.

P. O. BOX 1637
TELEPHONE 4-4451
FREETAG BUILDING
223 S. BIG SPRING ST.
MIDLAND, TEXAS

FULL INSURANCE COVERAGE

INDIVIDUAL WELL DATA SHEET

Company Doswell & Pettigrew Lease Federal Scott Well No. 2

Field Wildcat County Rio Arriba State New Mexico

Test Date 7-28-51 Time 5:02PM Status of Well Flowing

Top of Pay 6622' Total Depth ____ Producing Formation ____

Tubing 2" Depth 6618' B.H.C. ____ Packer ____ Pressure Datum ____

Casing ____ Depth ____ Perf. ____ Liner ____ Packer ____

Depth Feet	Δ Depth	Pressure Lbs. Sq. In.	Δ Pressure	Gradient Lbs./Ft.		
Surface		677			Casing Press.	700
	4915		635	.129	Tubing Press.	677
4915		1312			Top of Fluid	—
	1000		163	.163	Top of Water	No
5915		1475			Hrs.- Shut In	Flowing 9
	500		88	.175	Temp. @	6615' = 174° F.
6415		1563			Elev.-D.F.	6507.5 Gr. 6498
	200		39	.196	Last Test Date	
6615		1602			[illegible]s. Last Test	2200 Static
					B.H.P. Change	598
					Gain - Loss/Day	
6615 Stabilized		1593			Choke Size	22/64"
					Oils Bbls/day	580
					Water Bbls/day	No
					Total Bbls/day	580
					Orifice & Line	2" X 1½ O.P.
					Static & Differential	
					Gas Sp. Gr.	.784
					Cu. Ft./day	900.5 MCF
					GOR	1552
					GFR	

PRODUCTIVITY INDEX-BBLS./DAY LBS. DROP

Last Cumulative Production ____ Present Cumulative Production ____ Production Between Tests ____

Instrument Amerada Number RPG 9186 BR Recovery Factor Bbls/pound Loss ____

Run By W. M. Cates Calibration No 731 @ 174° Calculated By W. M. Cates

Calculations and Remarks:

STAPLETON PTG. CO., MIDLAND

W. T. HAGLER
H. L. HAGLER
W. M. CATES
C. H. PICKENS
R. W. HARRINGTON
D. R. WATSON, JR.
B. E. BLACK
FIELD PETROLEUM ENGINEERS

WEST TEXAS Engineering SERVICE INC.

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TELEPHONE 4-4451
FREETAG BUILDING
223 S. BIG SPRING ST.
MIDLAND, TEXAS

FULL INSURANCE COVERAGE

INDIVIDUAL WELL DATA SHEET

Company Doswell & Pettigrew Lease Federal Scott Well No. 2

Field Wildcat County Rio Arriba State New Mexico

Test Date 7-28-51 Time 10:56 PM Status of Well Flowing

Top of Pay 6622' Total Depth ___ Producing Formation ___

Tubing 2" Depth 6618' B.H.C. ___ Packer ___ Pressure Datum ___

Casing ___ Depth ___ Perf. ___ Liner ___ Packer ___

Depth Feet	Δ Depth	Pressure Lbs. Sq. In.	Δ Pressure	Gradient Lbs./Ft.		
Surface		738			Casing Press.	750
	4915		701	.142	Tubing Press.	738
4915		1439			Top of Fluid	
	1000		184	.184	Top of Water	
5915		1623			Hrs.- Shut In	Flowing
	500		79	.157	Temp. @	6615' = 172° F.
6415		1702			Elev.-D.F.	6507.5 Gr. 6498
	200		39	.196	Last Test Date	
6615		1741			~~XXXXXXXX~~ Test	2200 Static
					B.H.P. Change	
					Gain - Loss/Day	
6615 Stabilized		1801			Choke Size	18/64"
					Oils Bbls/day	
					Water Bbls/day	
					Total Bbls/day	161
					Orifice & Line	
					Static & Differential	
					Gas Sp. Gr.	
					Cu. Ft./day	
					GOR	
					GFR	

PRODUCTIVITY INDEX-BBLS./DAY LBS. DROP

Last Cumulative Production	Present Cumulative Production	Production Between Tests
Instrument Amerada	Number RPG 9186 BR	Recovery Factor Bbls/pound Loss
Run By W. M. Cates	Calibration No 731 @ 174°	Calculated By W. M. Cates

Calculations and Remarks:

STAPLETON PTG. CO., MIDLAND

W. T. HAGLER
H. L. HAGLER
W. M. CATES
C. H. PICKENS
R. W. HARRINGTON
D. R. WATSON, JR.
B. E. BLACK
FIELD PETROLEUM ENGINEERS

WEST TEXAS Engineering SERVICE INC.

P. O. BOX 1637
TELEPHONE 4-4451
FREETAG BUILDING
223 S. BIG SPRING ST.
MIDLAND, TEXAS

FULL INSURANCE COVERAGE

INDIVIDUAL WELL DATA SHEET

Company Dowell & Pettigrew Lease Federal Scott Well No. 2

Field Wildcat County Rio Arriba State New Mexico

Test Date 7-29-51 Time [illegible] Status of Well Flowing

Top of Pay 6422' Total Depth ____ Producing Formation ____

Tubing 2" Depth 6415' B.H.C. ____ Packer ____ Pressure Datum ____

Casing ____ Depth ____ Perf. ____ Liner ____ Packer ____

Depth Feet	Δ Depth	Pressure Lbs. Sq. In.	Δ Pressure	Gradient Lbs./Ft.		
Surface		632			Casing Press.	[illegible]
	4915		888	.179	Tubing Press.	632
4915		1520			Top of Fluid	—
	1000		163	.163	Top of Water	No
5915		1683			Hrs.- Shut In	Flowing
	500		87	.174	Temp. @	6415' = 172°F.
6415		1770			Elev.-D.F.	6397, Gr. 6403
	200		37	.185	Last Test Date	
6615 Calculated		1807			Press. Last Test	
					B.H.P. Change	
					Gain - Loss/Day	
					Choke Size	16/64"
					Oils Bbls/day	331
					Water Bbls/day	
					Total Bbls/day	
					Orifice & Line	
					Static & Differential	
					Gas Sp. Gr.	
					Cu. Ft/day	
					GOR	
					GFR	

PRODUCTIVITY INDEX-BBLS./DAY/LBS. DROP

Last Cumulative Production ____ Present Cumulative Production ____ Production Between Tests ____

Instrument ____ Number ____ Recovery Factor Bbls/pound Loss ____

Run By ____ Calibration No ____ Calculated By ____

Calculations and Remarks:

STAPLETON PTG. CO., MIDLAND

W. T. HAGLER
H. L. HAGLER
W. M. CATES
C. H. PICKENS
R. W. HARRINGTON
D. R. WATSON, JR.
B. E. BLACK
FIELD PETROLEUM ENGINEERS

WEST TEXAS Engineering SERVICE INC.

P. O. BOX 1637
TELEPHONE 4-4451
FREETAG BUILDING
223 S. BIG SPRING ST.
MIDLAND, TEXAS

FULL INSURANCE
COVERAGE

INDIVIDUAL WELL DATA SHEET

Company Doswell & Pettigrew Lease Federal Scott Well No. 2

Field Wildcat County Rio Arriba State New Mexico

Test Date 7-29-51 Time 7:58 AM Status of Well Flowing

Top of Pay 6622' Total Depth ______ Producing Formation ______

Tubing 2" Depth 6618' B.H.C. ______ Packer ______ Pressure Datum ______

Casing ______ Depth ______ Perf. ______ Liner ______ Packer ______

Depth Feet	Δ Depth	Pressure Lbs. Sq. In.	Δ Pressure	Gradient Lbs./Ft.		
Surface		912			Casing Press.	850
	4915		713	.145	Tubing Press.	912
4915		1625			Top of Fluid	
	1000		206	.206	Top of Water	No
5915		1831			Hrs.- Shut In	Flowing
	500		94	.189	Temp. @	6615' = 172° F.
6415		1925			Elev.-D.F.	6507, Gr. 6498
	200		30	.150	Last Test Date	
6615		1955			Press. Last Test	
					B.H.P. Change	
					Gain - Loss/Day	
6615 Stabilized		1977			Choke Size	12/64"
					Oils Bbls/day	219
					Water Bbls/day	
					Total Bbls/day	
					Orifice & Line	
					Static & Differential	
					Gas Sp. Gr.	
					Cu. Ft./day	
					GOR	
					GFR	

PRODUCTIVITY INDEX-BBLS./DAY LBS. DROP

Last Cumulative Production ______ Present Cumulative Production ______ Production Between Tests ______

Instrument Amerada Number RPG 9186 BR Recovery Factor Bbls/pound Loss ______

Run By W. M. Cates Calibration No 731 @ 174° Calculated By W. M. Cates

Calculations and Remarks:

STAPLETON PTG. CO., MIDLAND

LOWRY et al OPERATING ACCOUNT

- - - - - - - - - - - - - - - -

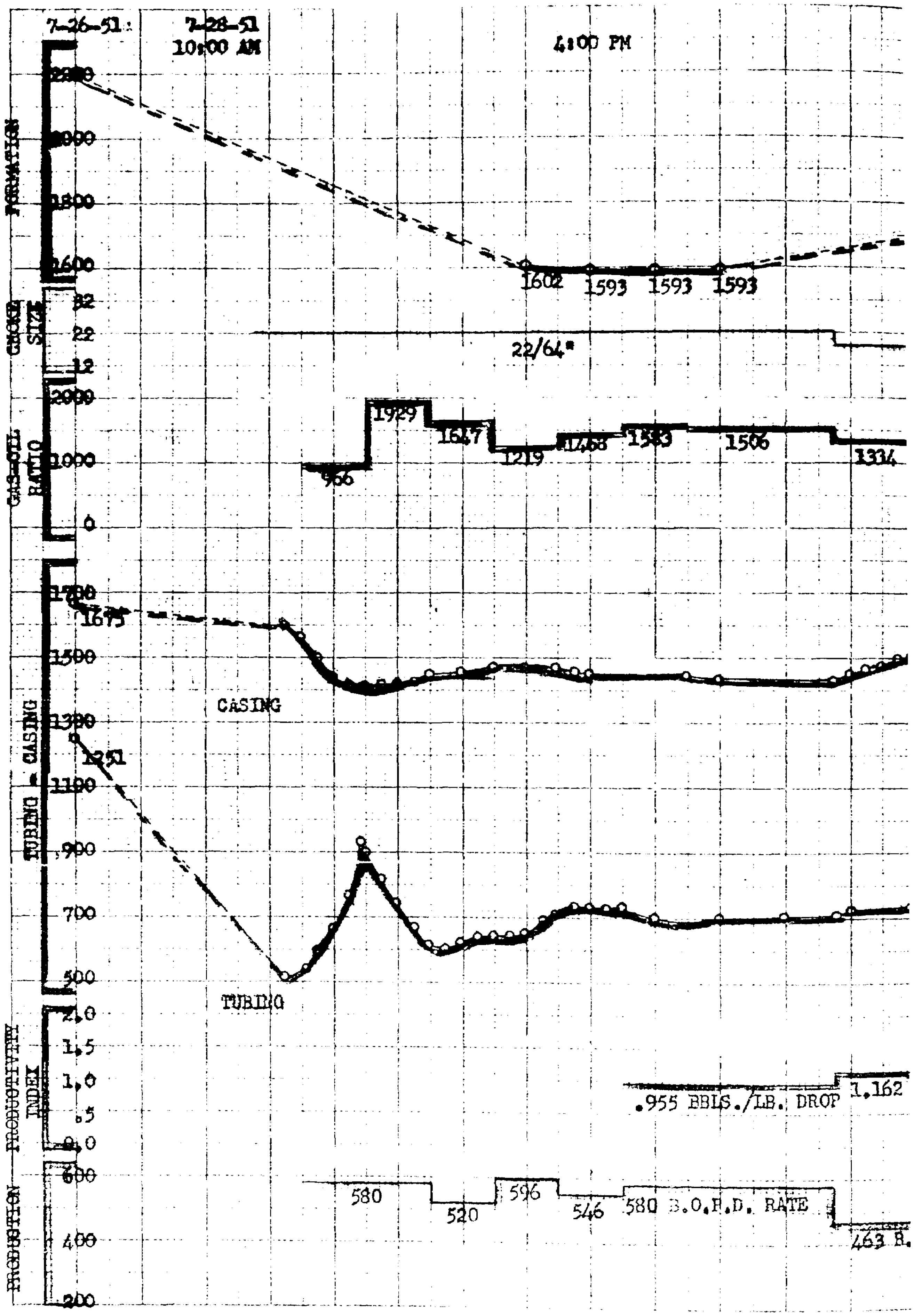
PRODUCTIVITY INDEX TESTS

Federal 4-13-132

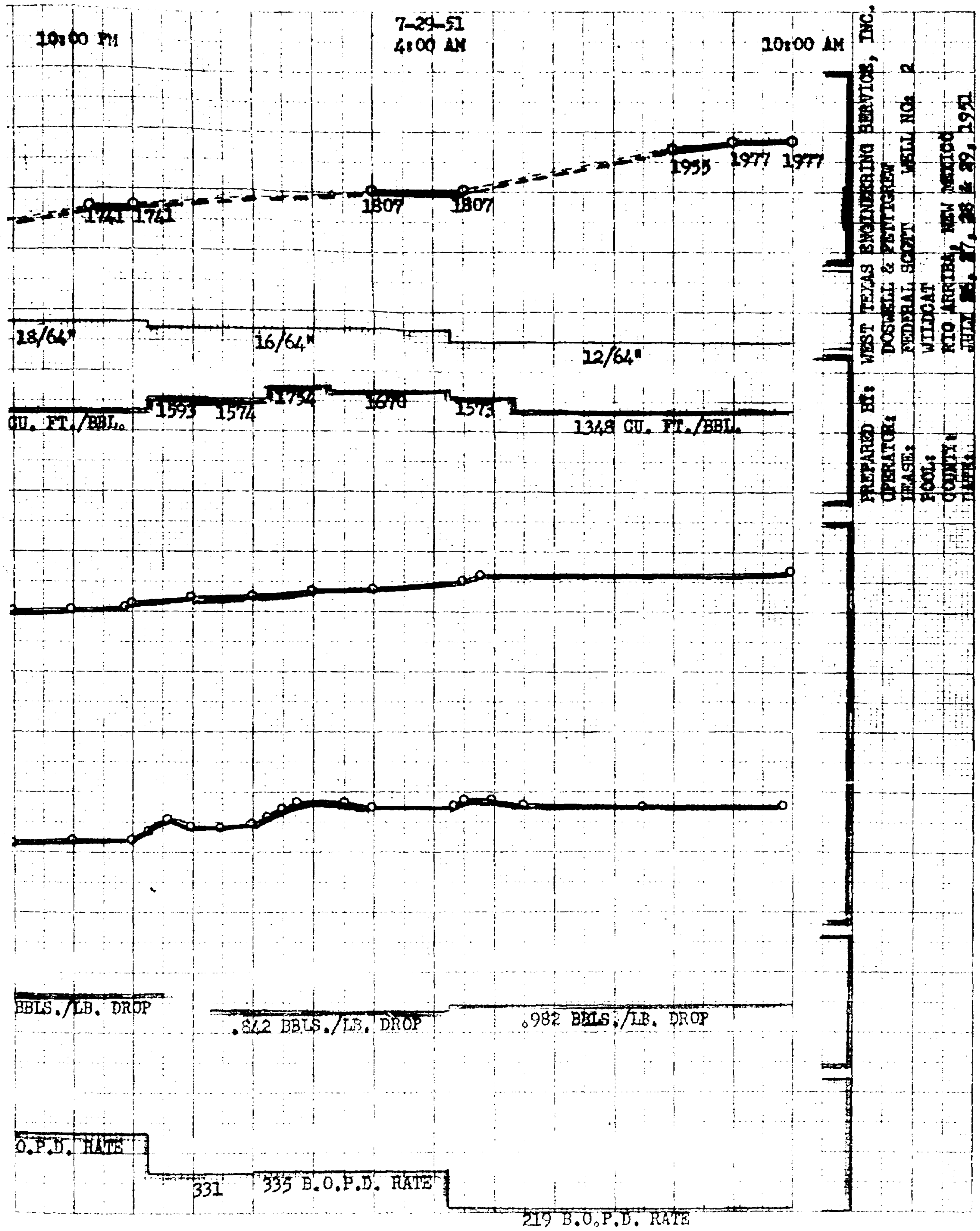
- - - - -

January 1, 1952 to January 4, 1952

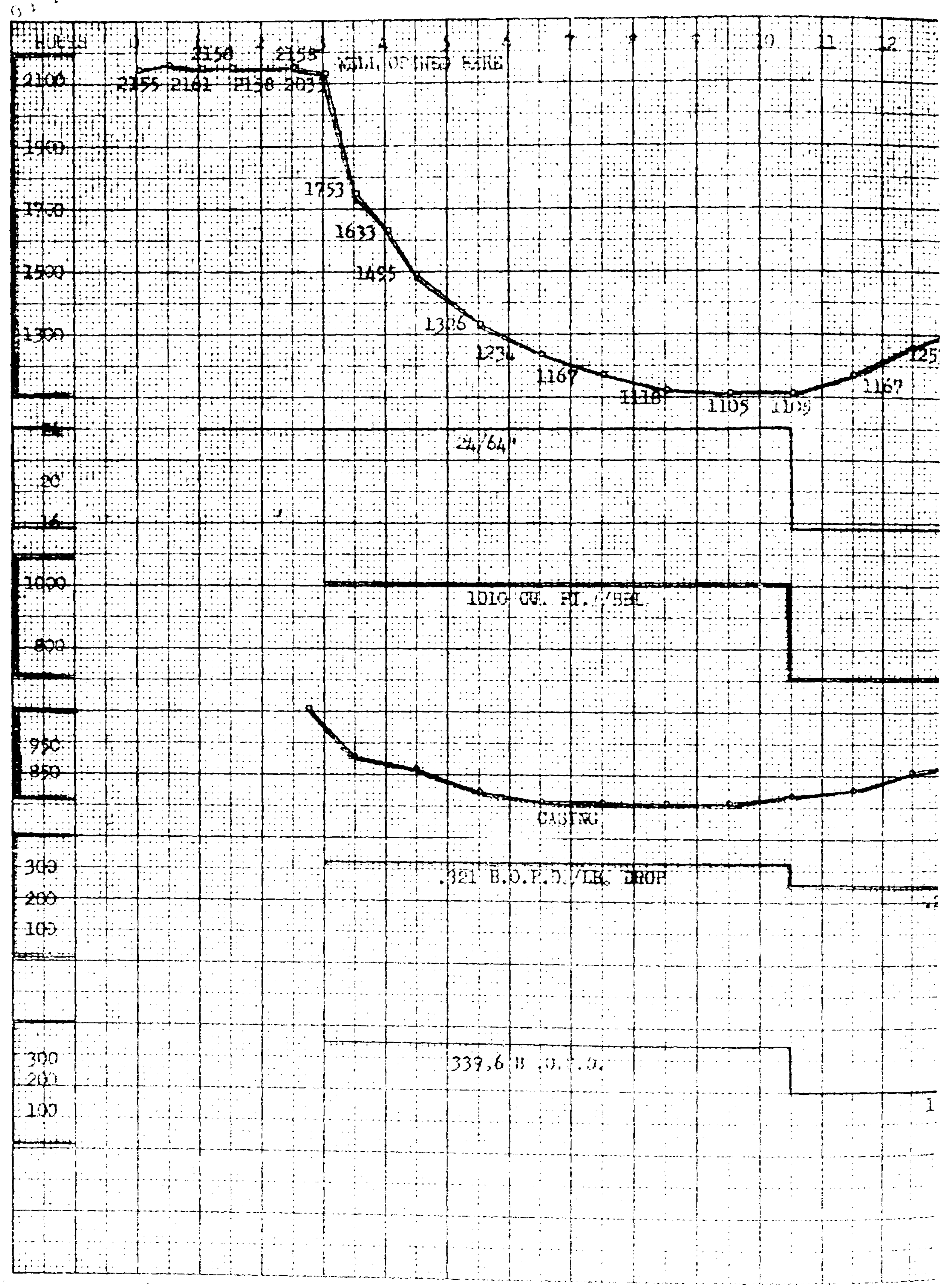
WEST TEXAS ENGINEERING SERVICE, INC.
Midland, Texas



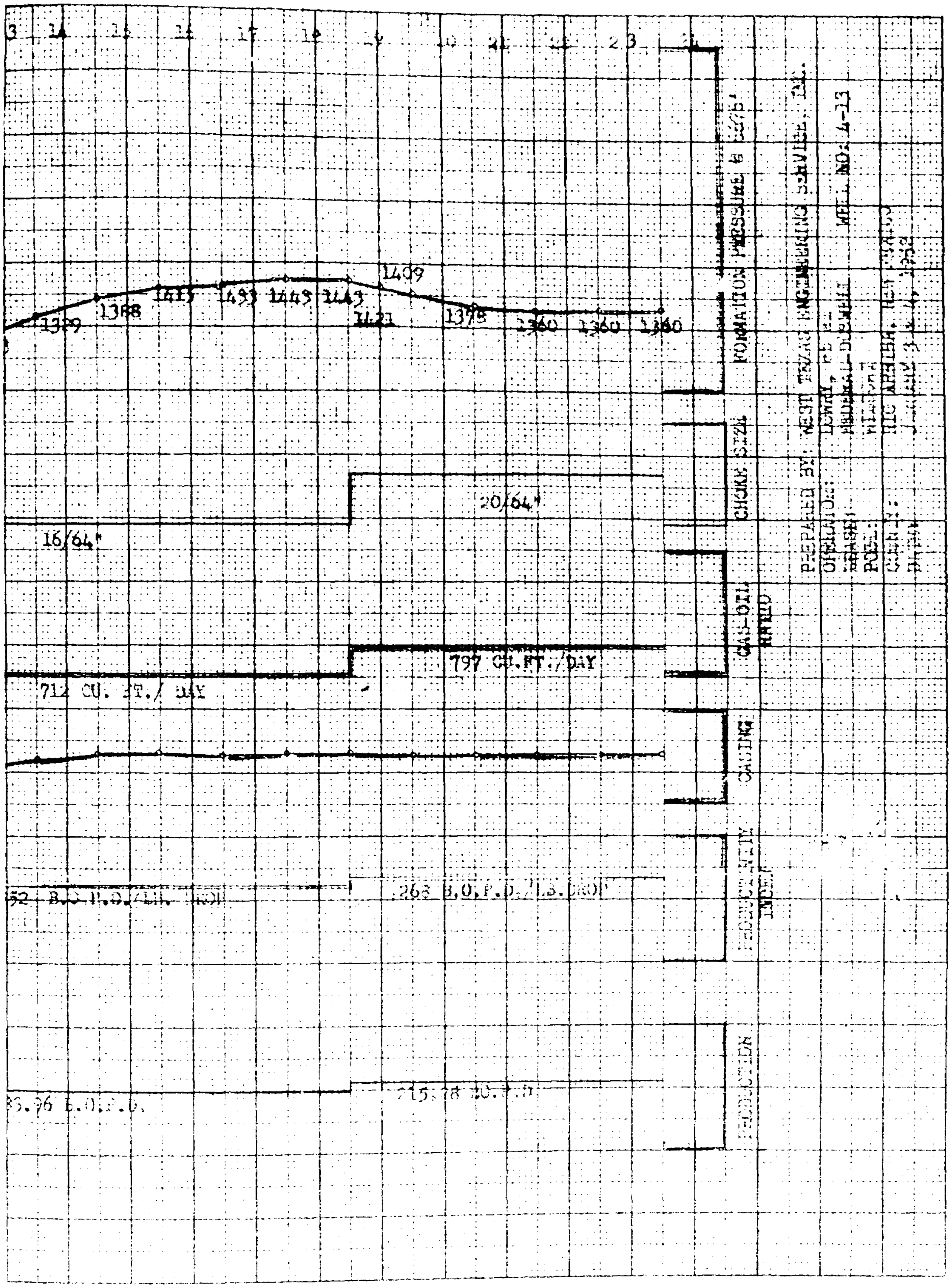
7-26-51
7-28-51
10:00 AM
4:00 PM
FORMATION
2200
2000
1800
1600
1602
1593
1593
1593
CHOKE SIZE
32
22
12
22/64"
GAS-OIL RATIO
2000
1000
0
966
1929
1647
1219
1468
1583
1506
1334
TUBING - CASING
1700
1675
1500
CASING
1300
1251
1100
900
700
500
TUBING
PRODUCTIVITY INDEX
2.0
1.5
1.0
.5
0.0
.955 BBLS./LB. DROP
1.162
PRODUCTION
600
400
200
580
520
596
546
580 B.O.P.D. RATE
463 B.



10:00 PM
7-29-51
4:00 AM
10:00 AM
1741
1741
1807
1807
1955
1977
1977
18/64"
16/64"
12/64"
1593
1574
1734
1670
1573
CU. FT./BBL.
1348 CU. FT./BBL.
BBLS./LB. DROP
.842 BBLS./LB. DROP
.982 BBLS./LB. DROP
O.P.D. RATE
331
335 B.O.P.D. RATE
219 B.O.P.D. RATE
PREPARED BY: WEST TEXAS ENGINEERING SERVICE, INC.
OPERATOR: DOSWELL & PETTIGREW
LEASE: FEDERAL SCOTT WELL NO. 2
POOL: WILDCAT
COUNTY: RIO ARRIBA, NEW MEXICO
DATE: JULY



HOURS
0
4
10
11
12
2150
2155
2100
2155
2161
2150
2033
1900
1753
1633
1500
1495
1326
1300
1234
1167
1118
1105
1167
24/64"
20
16
1000
1010 CU. FT./BBL
800
950
850
CASING
300
200
100
.321 B.O.P.D./LB. DROP
300
200
100
339.6



FORMATION PRESSURE
CHOKE SIZE
GAS-OIL RATIO
CASING
PRODUCTIVITY INDEX
PRODUCTION
PREPARED BY: WEST TEXAS ENGINEERING SERVICE, INC.
WELL NO. 4-13
1379
1388
1409
1421
1378
1360
1360
1360
16/64"
20/64"
712 CU. FT./DAY
797 CU.FT./DAY

W. T. HAGLER
H. L. HAGLER
W. M. CATES
C. H. PICKENS
R. W. HARRINGTON
D. R. WATSON, JR.
B. E. BLACK
J. I. LOWMAN
FIELD PETROLEUM ENGINEERS

WEST TEXAS Engineering SERVICE INC.

P. O. BOX 1637
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FREETAG BUILDING
223 S. BIG SPRING ST.
MIDLAND, TEXAS

FULL INSURANCE COVERAGE

INDIVIDUAL WELL DATA SHEET

Company Lowry, et al   Lease Federal - Doswell   Well No. 4-13

Field Wildcat   County Rio Arriba   State New Mexico

Test Date 1-1-52   Time 11:57 A.M.   Status of Well S. I.

Top of Pay 6676'   Total Depth ____   Producing Formation Tocito

Tubing 2"   Depth 6693' B.H.C. ____   Packer ____   Pressure Datum Top of Pay

Casing 7"   Depth 6670'   Perf. ____   Liner ____   Packer ____

Depth Feet	Δ Depth	Pressure Lbs. Sq. In.	Δ Pressure	Gradient Lbs./Ft.		
Surface		1023			Casing Press.	1025
	3976		261	.065	Tubing Press.	1023
3976		1284			Top of Fluid	3900'
	1000		313	.313	Top of Water	No
4976		1597			Hrs.- Shut In	24 Flowing
	1000		313	.313	Temp. @	6676' = 175°F.
5976		1910			Elev.-D.F.	6502 Gr.
	500		156	.312	Last Test Date	Initial
6476		2066			Press. Last Test	
	200		71	.355	B.H.P. Change	
6676 Top of Pay		2137			Gain - Loss/Day	
					Choke Size	
					Oils Bbls/day	
					Water Bbls/day	
					Total Bbls/day	
					Orifice & Line	
					Static & Differential	
					Gas Sp. Gr.	
					Cu. Ft/day	
					GOR	
					GFR	

PRODUCTIVITY INDEX-BBLS./DAY /LBS. DROP

Last Cumulative Production   Present Cumulative Production   Production Between Tests

Instrument Amerada   Number RPG 3709 BR   Recovery Factor Bbls/pound Loss

Run By W. M. Cates & B. E. Black   Calibration No. 1720 @ 175°   Calculated By B. E. Black

Calculations and Remarks:

STAPLETON PTG. CO., MIDLAND

W. T. HAGLER
H. L. HAGLER
W. M. CATES
C. H. PICKENS
R. W. HARRINGTON
D. R. WATSON, JR.
B. E. BLACK
J. I. LOWMAN
FIELD PETROLEUM ENGINEERS

WEST TEXAS Engineering SERVICE INC.

P. O. BOX 1637
TELEPHONE 4-4451
FREETAG BUILDING
223 S. BIG SPRING ST.
MIDLAND, TEXAS

FULL INSURANCE COVERAGE

INDIVIDUAL WELL DATA SHEET

Company [illegible], et al Lease Federal - [illegible] Well No. 4-13

Field Wildcat County Rio Arriba State New Mexico

Test Date 1-3-52 Time [illegible] Status of Well [illegible]

Top of Pay 6676' Total Depth ____ Producing Formation [illegible]

Tubing ____ Depth 6693' B.H.C. ____ Packer ____ Pressure Datum Top of Pay

Casing ____ Depth 6570' Perf. ____ Liner ____ Packer ____

Depth Feet	Δ Depth	Pressure Lbs. Sq. In.	Δ Pressure	Gradient Lbs./Ft.		
Surface		995			Casing Press.	800
	3976		337	.0[illegible]4	Tubing Press.	995
3976		1332			Top of Fluid	3180'
	1000		307	.307	Top of Water	No
4976		1639			Hrs.- Shut In	72 Flowing
	1000		307	.307	Temp. @	6670' = 175°F.
5976		1946			Elev.-D.F.	6502 Gr.
	500		154	.307	Last Test Date	
6476		2100			Press. Last Test	
	200		61	.307	B.H.P. Change	
6676 Top of Pay		2161			Gain - Loss/Day	
					Choke Size	
					Oils Bbls/day	
					Water Bbls/day	
					Total Bbls/day	
					Orifice & Line	
					Static & Differential	
					Gas Sp. Gr.	
					Cu. Ft./day	
					GOR	
					GFR	

PRODUCTIVITY INDEX-BBLS./DAY /LBS. DROP

Last Cumulative Production	Present Cumulative Production	Production Between Tests
Instrument	Number	Recovery Factor Bbls/pound Loss
Run By [illegible]	Calibration No. [illegible]	Calculated By [illegible]

Calculations and Remarks:

STAPLETON PTG. CO., MIDLAND

Case 231

INTERFERENCE TEST

May 1 - 3, 1952

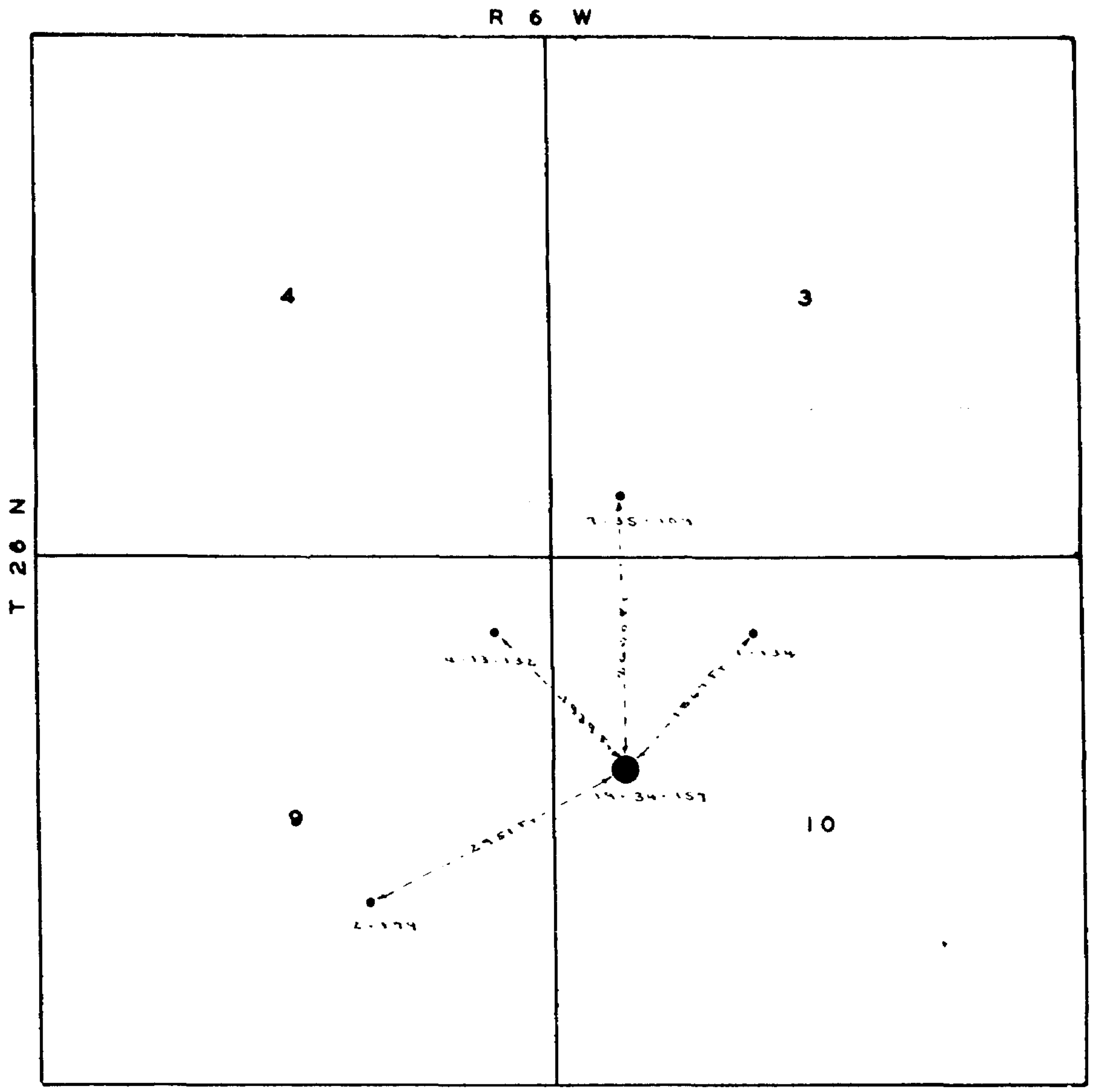
Pettigrew-Tocito Field

Rio Arriba County, N.M.

- - - - - - - - - - - - - - - -

LOWRY et al OPERATING ACCOUNT

WEST TEXAS ENGINEERING SERVICE, INC.
Midland, Texas

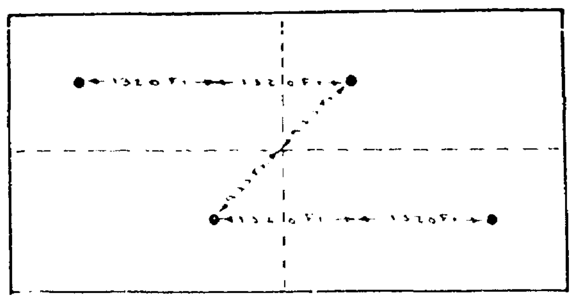


Interference Test

[illegible] 1952

[illegible]

[illegible]



80-acre typical spacing pattern

[illegible]

[illegible]

[illegible]

P[illegible]

DESCRIPTION OF INTERFERENCE TEST

Federal 19-34-157

May 1, 1952 to May 3, 1952

An interference test was conducted during the period 4:45 P.M. May 1, 1952 to 8:45 A.M. May 3, 1952 for Lowry et al Operating Account well no. 19-34-157 of the Pettigrew-Tocito Pool, Rio Arriba County, New Mexico. This test was conducted by the West Texas Engineering Service of Midland, Texas, to determine if communication in the reservoir could be detected between wells, thereby furnishing evidence as to the effective drainage area for wells of this Pool.

At the time the test was conducted, there were four wells completed, and one well, Federal 1-134, was in the process of being completed in the Tocito formation. All wells, with the exception of Federal 1-134 were shut in prior to the test for bottomhole pressure measurements. Results of this bottomhole pressure survey were as follows:

Well No.	Shut In Time - Hours	Bottomhole pressure Datum -100 feet
Federal 2-179	76¼	2,112
Federal 4-13-132	76½	2,069
Federal 19-34-157	99	2,115
Federal 7-35-109	193	2,103

Volumetric average reservoir pressure 2,150 p.s.i.

After completion of the bottomhole pressure tests, the bottomhole pressure gauge was lowered to the top of the Tocito zone for Well Federal 19-34-157, and the gauge remained in the well for a period of forty hours with the well shut in. The remaining wells were placed on production and produced the following amounts of oil:

	Oil Production - Barrels		
Well No.	First 24 hours	Next 16 hours	Total - 40 hours
Federal 1-134	90.19	48.95	139.14
Federal 2-179	490.64	362.50	853.14
Federal 4-13-132	254.21	171.50	425.71
Federal 7-35-109	18.67	0	18.67
	853.71	582.95	1436.66

At the start of the interference test the bottomhole pressure at the top of the Tocito zone (6,319 ft. or -168 feet datum) was 2137 p.s.i., and at the conclusion of the 40-hour test, the bottomhole pressure measured 2130 p.s.i.

It is concluded that this 7 p.s.i. decrease in bottomhole pressure was occasioned by oil being produced from the reservoir by other wells.

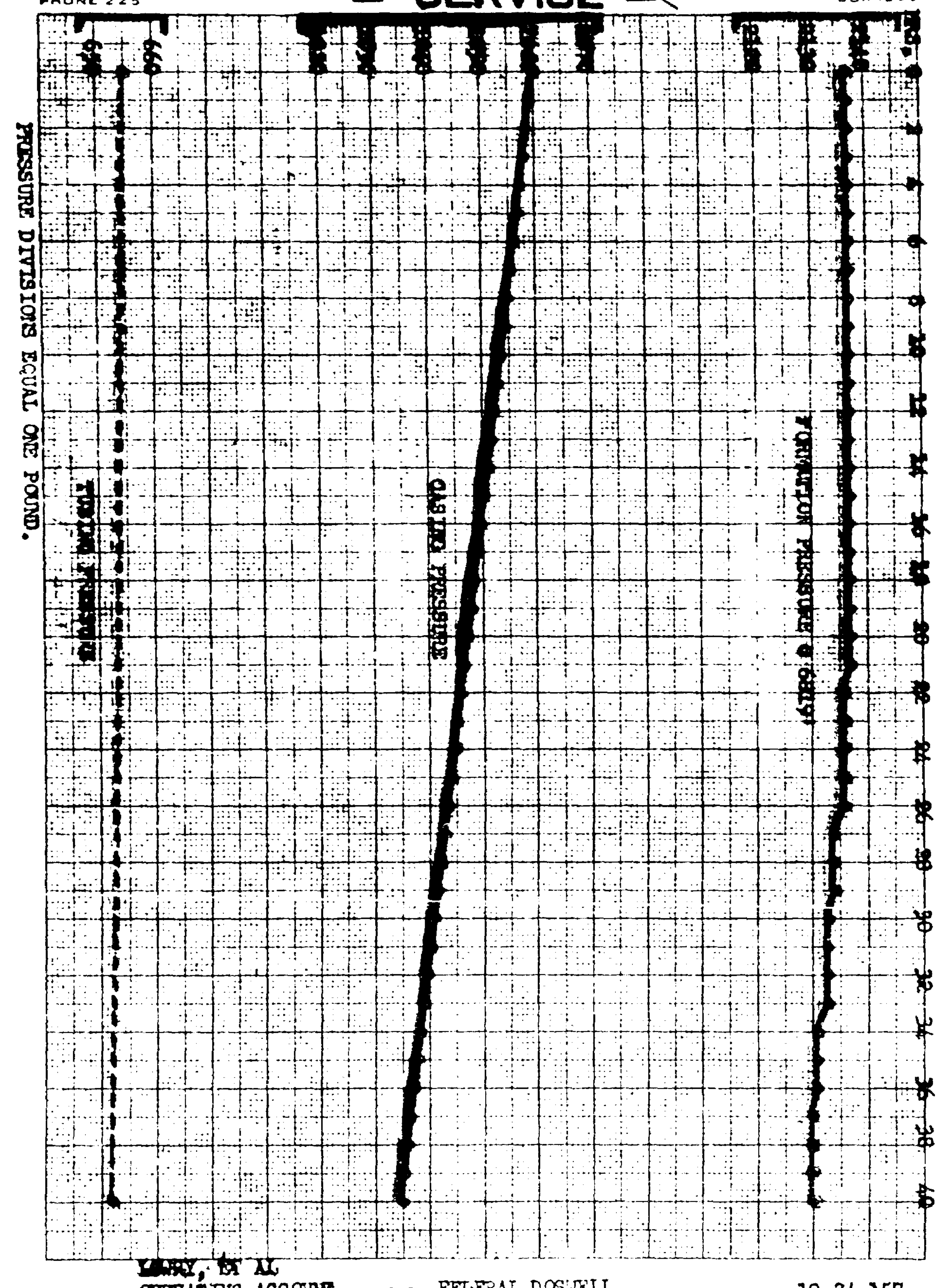
The distance of well Federal 19-34-157 from other wells producing from the same reservoir is as follows:

Federal 1-134	1,867 feet
Federal 2-179	2,951 feet
Federal 4-13-132	1,939 feet
Federal 7-35-109	2,640 feet

From a review of the factual data of the test, it is concluded that oil drainage occurs for a distance of at least 1,867 feet for wells of the Pettigrew-Tocito reservoir. It is concluded that one well will readily drain economically and efficiently an 80-acre proration unit since the maximum drainage area for wells of this proration pattern is 1,320 feet.

WEST TEXAS Engineering SERVICE

PHONE 225 | BOX 1299



OPERATOR LOWRY, ET AL OPERATING ACCOUNT LEASE FEDERAL DOSWELL WELL NO. 19-34-157

POOL PETTIGREW TOCITO COUNTY RIO ARRIBA DATE 5-1-52 to 5-3-52

W. T. Hagler
H. L. Hagler
D. R. Watson, Jr.
C. H. Pickens
R. W. Harrington
B. E. Black
J. I. Lowman

West Texas Engineering Services Inc.

P. O. Box 1687
Telephone 4-4461
Freetas Building
223 S. Big Spring St.
Midland, Texas

Midland, Texas

CONTINUOUS RECORDING OF BOTTOM HOLE PRESSURE
AT A DEPTH OF 6819'.

Hours	Pressure	Hours	Pressure
Arrival @ Bottom	2137	21	2137
1	2137	22	2136
2	2137	23	2136
3	2137	24	2136
4	2137	25	2136
5	2137	26	2136
6	2137	27	2134
7	2137	28	2134
8	2137	29	2134
9	2137	30	2133
10	2137	31	2133
11	2137	32	2133
12	2137	33	2133
13	2137	34	2131
14	2137	35	2131
15	2137	36	2131
16	2137	37	2130
17	2137	38	2130
18	2137	39	2130
19	2137	40	2130
20	2137		

Lowry et al Operating Account

- - - - - - - - - - - - - - - - - -

Economics of Development

Pettigrew-Tocito Pool

Rio Arriba County, New Mexico

- - - - - - - - - - - - - - - - - -

23

ECONOMICS OF DEVELOPMENT 40 - acre PRORATION UNITS

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

- -

Crude Oil Price	$ 2.4500 /bbl.
Less Royalty (1/8 - .3063/bbl.)	2.1437
Less Severance Tax (.025% - .0536/bbl)	2.0901
Less Conservation tax (.00125% - .0027/bbl)	2.0874
Less Production tax (.020896% of 50% Value -) ($.0224/bbl.)	2.0650

Number of Productive Acres	2,535
Average Sand Thickness - Feet	
Upper Portion	9.4
Lower Portion	11.0
Ultimate Oil Recovery, Barrels	3,330,230
Ultimate Oil Recovery - Barrels per acre	1,314
Ultimate Oil Recovery - 40 acre, Barrels	52,560
Operating Income - 40 acre tract (52,560 barrels @ $2.07/bbl)	$108,799.20
Total Cost of Drilling and Completing Tocito wells	$110,609.34

Note: No Operating Costs considered in computing Operating Income

COST OF DRILLING AND COMPLETING TOCITO OIL WELLS

Pettigrew-Tocito Field

Rio Arriba County, New Mexico

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

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

Note: No overhead charges included in above completion costs.

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

- -

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

TOTAL TO COMPLETE WELL (less tank battery) $102,505.29

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

- -

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

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

TANK BATTERY FOR WELL NOS:	Federal Doswell 21-40-182 Federal Doswell 22-45-207
FIELD:	Pettigrew-Tocito
LOCATION:	Section 10, 26N-6W Rio Arriba County, New Mexico

- -

EQUIPMENT & MATERIAL		$17,418.70
5 - 400 bbl Stell tanks w/walkways & stairways	$8,589.67	
1 - Separator	1,096.53	
1 - Steam generator	1,543.00	
Flow & Gathering Lines		
2" Line pipe, 3,142 ft.	1,503.45	
2 3/8" line pipe, 64'	36.48	
3" Line pipe, 428'	404.20	
4" Line pipe, 56'	80.06	
Valves & Misc. Fittings	2,694.13	
Steam Coils, 200' each tank	470.00	
Fencing	99.83	
Miscellaneous Material	901.35	
SERVICES		1,684.76
Bulldozer	100.00	
Road Grader	80.00	
Trucking	558.70	
Labor	761.64	
Welding	174.42	

TOTAL FOR TANK BATTERY $19,103.46

Lowry et al Operating Account

Core Analysis and

Water Permeability Report

Federal Lease

Wells 4-13-132 and 22-45-207

Rio Arriba County, New Mexico

Oilfield Research Laboratories

1028 South Santa Fe

Chanute, Kansas

August 30, 1952

Lowry et al Operating Account
616 East Central Avenue
Albuquerque, New Mexico

Gentlemen:

Attached hereto are the results of tests made on core samples taken from the Federal Lease, Well No. 4-13-132, and submitted to our laboratory on August 26, 1952.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

Carl L. Pate

CLP:mm

9 c.c.

Oil Field Research Laboratories

RESULTS OF PERMEABILITY AND POROSITY TESTS

TABLE I A

Company Lowry Oil Company Lease Federal Well No. 4-13-132

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.	Percent Porosity
			Ft.	Cum. Ft.		
1		182.				14.5
2		178.				17.8
3		282.				14.8
4		178.				15.7

Company Lowry Oil Company Lease Federal Well No. 4-13-132

Results Effective Permeability Tests

Sample No.	Effective Permeability Millidarcys
	Salt Water
1	39.00
2	69.30
3	51.20
4	65.30
5	Imp.
	Fresh Water
1	21.40
2	34.80
3	38.20
4	61.10
5	Imp.

August 30, 1952

Lowry et al Operating Account
616 East Central Avenue
Albuquerque, New Mexico

Gentlemen:

Attached hereto are the results of tests made on core samples taken from the Federal Lease, Well No. 22-45-207, and submitted to our laboratory on August 26, 1952.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

Carl L. Pate

CLP:mm

9 c.c.

Oil Field Research Laboratories

RESULTS OF PERMEABILITY AND POROSITY TESTS

TABLE I A

Company Lowry Oil Company Lease Federal Well No. 22-45-207

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.	Percent Porosity
			Ft.	Cum. Ft.		
1		0.75				10.7
2		Imp.				-
3		151.				17.3
4		Imp.				-
5		110.				14.4
6		12.				16.3
7		37.				16.3
8		Imp.				-

Company Lowry Oil Company Lease Federal Well No. 22-45-207

Results of Effective Permeability Tests

Sample No.	Effective Permeability Millidarcys
Salt Water	
1	Imp.
2	Imp.
3	46.80
4	Imp.
5	26.35
6	5.14
7	13.23
8	Imp.
Fresh Water	
1	Imp.
2	Imp.
3	61.0
4	Imp.
5	22.50
6	4.58
7	13.42
8	Imp.

CORE ANALYSIS REPORT

For

Lowry et al Operating Account

Federal 4-13-132 Well

Wildcat

Rio Arriba County, New Mexico

Core Laboratories, Inc.
Dallas, Texas

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS
November 21, 1951

Lowry, et al.
Box 967
Farmington, New Mexico

Attention: Mr. Frank O. Grey

Subject: Core Analysis
Federal 4-13-132 Well
Wildcat
Rio Arriba County, New Mexico

Gentlemen:

Diamond conventional cores from the subject well in the Tocito formation have been sampled and quick-frozen by a representative of Lowry, et al. and analysed in our Farmington, New Mexico laboratory. Results of analysis are presented in tabular and graphical form on the attached Coregraph. Water base mud was used as the drilling fluid.

Shale and sandy shale analyzed from 6649 to 6675 feet are interpreted to be nonproductive due to low permeability.

Sand analyzed from 6675 to 6692 feet is interpreted to be essentially oil productive. The productive capacity, average permeability times thickness, is 2346 millidarcy-feet and the average permeability is 138 millidarcys, sufficient for a satisfactory oil rate upon completion. The average residual oil saturation and calculated connate water saturation are 15.1 and 25 per cent of pore space, respectively, within the range of water-free, oil productive sands.

Sandy shale analyzed from 6692 to 6695 feet is interpreted to be essentially nonproductive due to low permeability; however, these three feet show an increase in per cent water saturation and when a pressure differential is applied across the formation they might possibly show some water-cut. It is recommended that completion be limited to the sand from 6675 to 6692 feet.

The points indicated by an asterisk between the depths of 6699 and 6705 feet are interpreted to be essentially nonproductive due to low permeability.

Sand analyzed from 6706 to 6716 feet is interpreted to be very low capacity, oil productive; however, due to the low capacity, it is doubtful if any appreciable volumes of oil will be produced from this zone.

Recovery figures for the zone, 6675 to 6692 feet, are given on page one.

We hope these data prove beneficial in the evaluation of this well.

Very truly yours,

CORE LABORATORIES, INC.

J D Harris (PS)

J. D. Harris,
District Engineer

JDH:jr

FORM ?...A

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS

File FRML-36 FC
Well FEDERAL 4-13-132

CORE SUMMARY AND CALCULATED RECOVERABLE OIL

CORE SUMMARY				
FORMATION NAME	TOCITO			
DEPTH, FEET	6675.0-6692.0			
% CORE RECOVERY	100			
FEET OF PERMEABLE, PRODUCTIVE FORMATION RECOVERED	17.0			
AVERAGE PERMEABILITY MILLIDARCYS	138			
CAPACITY — AVERAGE PERMEABILITY X FEET PRODUCTIVE FORMATION	2346			
AVERAGE POROSITY, PERCENT	15.1			
AVERAGE RESIDUAL OIL SATURATION, % PORE SPACE	15.1			
GRAVITY OF OIL, °A.P.I.	OVER 42			
AVERAGE TOTAL WATER SATURATION, % PORE SPACE	27.3			
AVERAGE CALCULATED CONNATE WATER SATURATION, % PORE SPACE	25			
SOLUTION GAS-OIL RATIO, CUBIC FEET PER BARREL (1)	800			
FORMATION VOLUME FACTOR—VOLUME THAT ONE BARREL OF STOCK TANK OIL OCCUPIES IN RESERVOIR (1)	1.46			
CALCULATED RECOVERABLE OIL { Prediction dependent upon complete isolation of each division. Structural position of well, total permeable thickness of oil zone and drainage area of well should be considered.				
BY NATURAL OR GAS EXPANSION, BBLS. PER ACRE FOOT (2)	148			
INCREASE DUE TO WATER DRIVE, BBLS. PER ACRE FOOT	277			
TOTAL AFTER COMPLETE WATER DRIVE, BBLS. PER ACRE FOOT (3)	425			

CORE LABORATORIES, INC.

J D Harris (PB)

J. D. Harris

NOTE:

(*) REFER TO ATTACHED LETTER.

(1) REDUCTION IN PRESSURE FROM estimated SATURATION PRESSURE TO ATMOSPHERIC PRESSURE.

(2) AFTER REDUCTION FROM ORIGINAL RESERVOIR PRESSURE TO ZERO POUNDS PER SQUARE INCH.

(3) RESERVOIR PRESSURE MAINTAINED BY WATER DRIVE AT OR ABOVE estimated ORIGINAL SATURATION PRESSURE.

(4) NO ESTIMATE FOR GAS PHASE RESERVOIRS.

ILLEGIBLE

CORE LABORATORIES, INC. CORE LAB Petroleum Reservoir Engineering

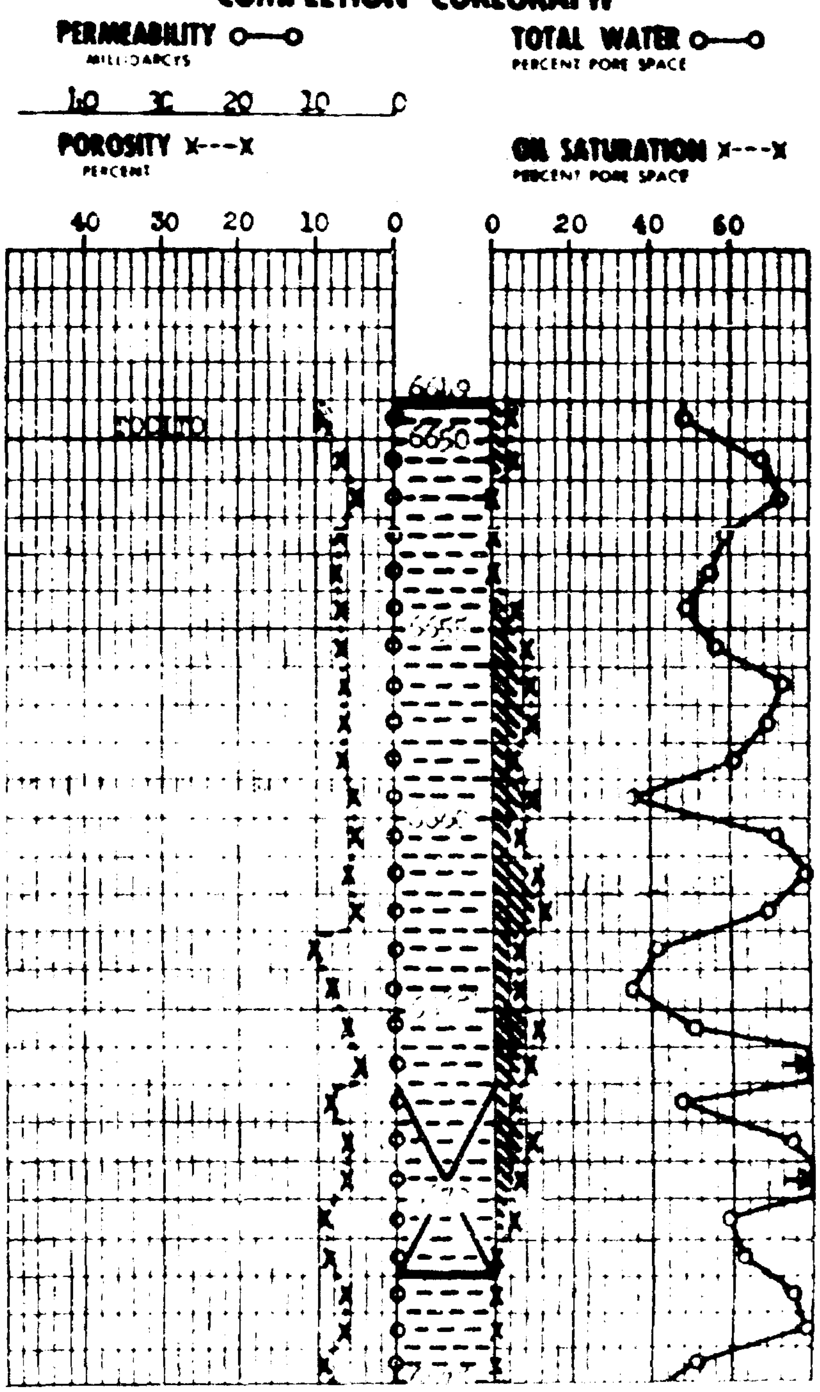
COMPANY	LOWRY, ET AL.	DATE	11/6 - 11/15/51	FILE	[illegible] - 36 [illegible]
WELL	FEDERAL 4-13-132	CORES	DIAMOND	ANALYSTS	[illegible]
FIELD	WILDCAT	FORMATION	TOCITO	ELEVATION	6615' [illegible]
COUNTY	RIO ARRIBA	DRLG. FLUID	WATER BASED MUD	LOCATION	SEC.?-2[illegible]-5[illegible]
STATE	NEW MEXICO	REMARKS	SERVICE # 5		

[illegible]

CORE ANALYSIS AND INTERPRETATION

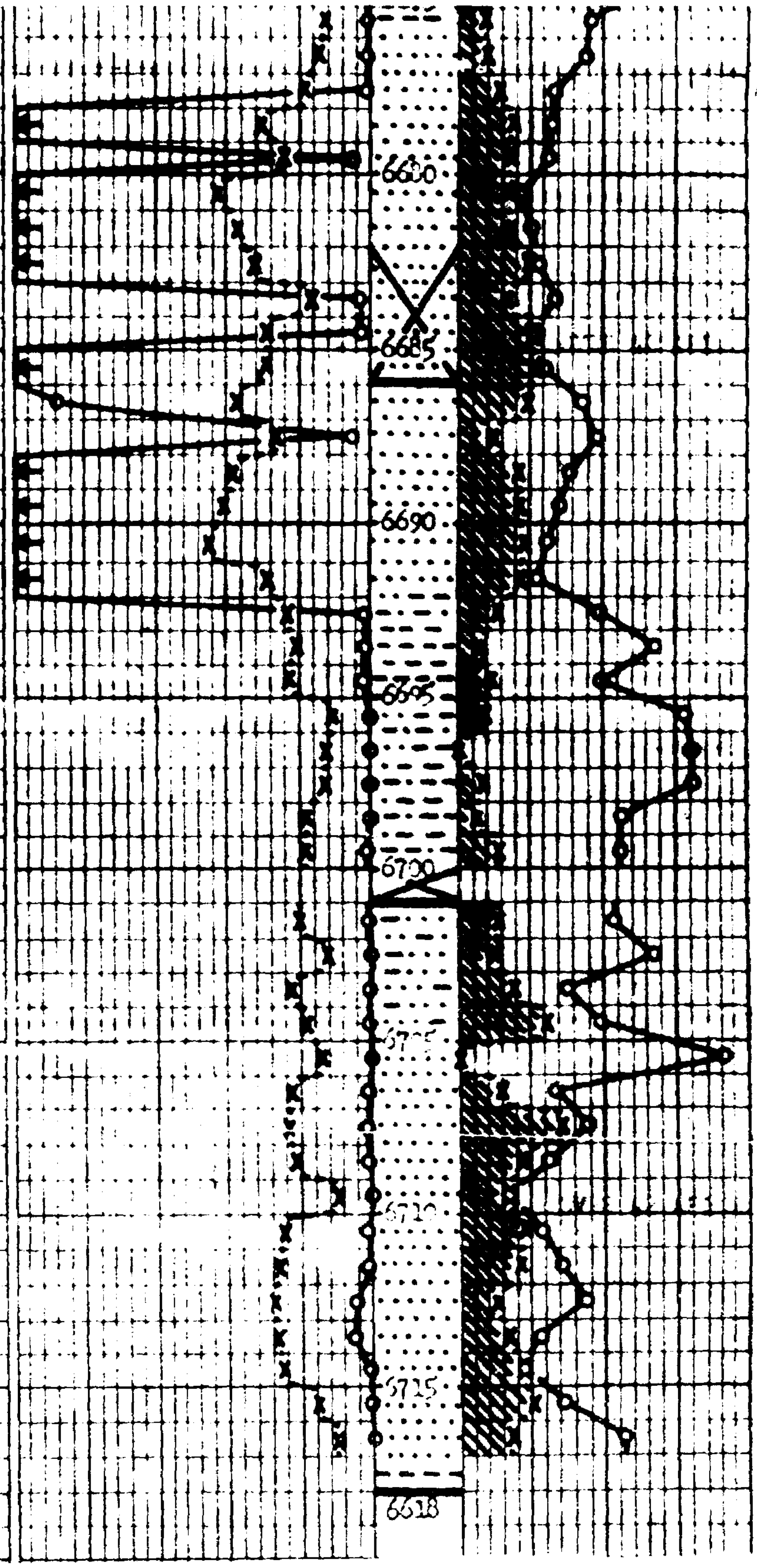
SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS	POROSITY %	RESIDUAL LIQUID SATURATION % PORE SPACE: OIL	RESIDUAL LIQUID SATURATION % PORE SPACE: TOTAL WATER	PROBABLE PROD.
1	6649.5	0.0	9.1	4.4	18.3	
2	50.5	0.0	6.8	5.9	67.7	
3	51.5	0.0	5.0	0.0	72.0	
4	52.5	0.0	5.7	0.0	59.8	
5	53.5	0.0	7.4	0.0	55.4	
6	54.5	0.0	6.7	6.0	59.3	
7	55.5	0.0	6.9	[illegible]	[illegible]	
8	56.5	0.0	6.3	[illegible]	73.0	
9	57.5	0.0	5.1	[illegible]	[illegible]	
10	58.5	0.0	[illegible]	5.9	[illegible]	
11	59.5	0.0	[illegible]	1.7	[illegible]	
12	[illegible]	0.0	5.3	7.5	71.7	
13	61.5	0.0	6.2	[illegible]	[illegible]	
14	62.5	0.0	5.4	13.0	[illegible]	
15	63.5	0.0	10.5	6.7	[illegible]	
16	64.5	0.0	[illegible]	[illegible]	[illegible]	
17	65.5	0.0	[illegible]	[illegible]	[illegible]	
18	66.5	0.0	[illegible]	[illegible]	22.2	
19	67.5	0.0	[illegible]	[illegible]	47.7	
20	68.5	0.0	[illegible]	[illegible]	[illegible]	
21	69.5	0.0	[illegible]	[illegible]	[illegible]	
22	70.5	0.0	9.3	[illegible]	[illegible]	
23	71.5	0.0	[illegible]	0.0	63.2	
24	72.5	0.0	6.9	0.0	[illegible]	
25	73.5	0.0	7.0	0.0	[illegible]	
26	74.5	0.0	9.3	0.0	[illegible]	

COMPLETION COREGRAPH



ILLEGIBLE

27	75.5	0.1	6.3	7.[illegible]	36.5	OIL
28	76.5	0.4	7.6	7.9	35.5	OIL
29	77.5	0.6	9.9	11.1	27.3	OIL
30	78.5	132	15.7	25.9	26.1	OIL
31	79.5	2.8	12.9	14.0	25.6	OIL
32	80.5	80	21.5	13.5	17.2	OIL
33	81.5	345	18.9	14.3	20.1	OIL
34	82.5	133	16.2	19.7	22.8	OIL
35	83.5	1.6	8.4	13.1	27.4	OIL
36	84.5	1.3	14.8	20.9	20.9	OIL
37	85.5	101	14.9	22.1	24.1	OIL
38	86.5	44	18.3	29.7	34.4	OIL
39	87.5	2.2	13.7	8.8	38.7	OIL
40	88.5	219	19.3	16.1	31.6	OIL
41	89.5	622	20.3	16.2	28.5	OIL
42	90.5	564	22.5	18.7	25.3	OIL
43	91.5	97	24.8	16.9	22.3	OIL
44	92.5	0.7	11.9	10.1	39.5	*
45	93.5	0.4	10.3	5.8	54.3	*
46	94.5	0.6	11.6	9.5	39.7	*
47	95.5	0.0	5.3	7.5	62.3	
48	96.5	0.0	6.1	0.0	64.0	
49	97.5	0.0	6.2	6.5	64.6	
50	98.5	0.0	9.3	4.3	45.2	
51	99.5	0.3	2.4	11.7	44.7	*
52	6701.5	0.1	10.0	11.0	43.0	*
53	02.5	0.0	6.1	9.8	54.1	
54	03.5	0.1	11.3	15.9	30.1	*
55	04.5	0.1	9.3	21.7	22.4	*
56	05.5	0.0	7.[illegible]	0.0	72.[illegible]	
57	06.5	0.2	11.7	12.0	27.4	OIL
58	07.5	0.5	11.9	22.6	35.3	OIL
59	08.5	0.3	10.9	17.6	25.0	OIL
60	09.5	0.0	5.1	13.7	13.7	
61	10.5	0.7	12.2	16.0	23.0	OIL
62	11.5	0.7	13.3	26.5	28.6	OIL
63	12.5	2.1	13.8	10.1	34.8	OIL
64	13.5	2.5	13.1	13.7	22.9	OIL
65	14.5	0.2	12.1	17.4	17.4	OIL
66	15.5	0.1	7.9	22.2	22.1	OIL
67	6716.5	0.0	1.8	11.6	45.8	



Lowry et al Operating Account

Core Analysis Report

Federal Lease

Well Number 4-13-132

Rio Arriba County, New Mexico

OILFIELD RESEARCH LABORATORIES

August 13, 1952

Lowry et al Operating Account
616 East Central Avenue
Albuquerque, New Mexico

Gentlemen:

Attached hereto are the results of tests made on the four 3½" Rotary core samples taken from the Federal Lease, Well No. 4-13-132, Rio Arriba County, New Mexico, and submitted to our laboratory on August 4, 1952.

The reason why the samples have such a low total fluid saturation is the fact that they have been exposed to the weather for approximately a year and that the cans were not properly sealed.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

Carl L. Pate

CLP:bl
9 c.c.

Company Lowry et al Operating Account Lease Federal Well No. 4-13-132

LOG

Sample No.	Description
1	Brown coarse grained micaceous slightly carbonaceous sandstone.
2	Brown coarse grained micaceous slightly carbonaceous calcareous sandstone.
3	Brown coarse grained micaceous slightly carbonaceous sandstone.
4	Brown coarse grained micaceous sandstone.

Oilfield Research Laboratories

RESULTS OF PERMEABILITY TESTS

TABLE I

Company Lowry et al Operating Account Lease Federal Well No. 4-13-132

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1		87.			
2		5.6			
3		56.			
4		687.			

Oil Field Research Laboratories

RESULTS OF SATURATION TESTS

TABLE III

Company **Lowry et al Operating Account** Lease **Federal** Well No. [illegible]-13-132

Sat. No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content Bbls./A. Ft.	Feet of Core		Total Oil Content Bbls./Acre
			Oil	Water	Total		Ft.	Cum. Ft.	
1		17.8	14.1	2.3	16.4	195			
2		16.8	9.5	5.5	14.0	124			
3		16.3	12.9	2.8	15.7	163			
4		21.8	11.1	1.5	12.6	168			

Oilfield Research Laboratories

RESULTS OF LABORATORY FLOODING TESTS

TABLE V

Company **Lowry et al Operating Account** Lease **Federal** Well No.

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery		Residual Saturation			Volume o Recov cc
			Percent	Bbls./A. Ft.	Percent	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.	
1		17.4	15.1	204	0.0	0	15.1	50.0	204	104
2		17.0	7.8	105	0.0	0	7.8	56.8	105	207
3		16.5	11.6	148	0.0	0	11.6	53.0	148	144
4		21.5	8.4	140	0.0	0	8.4	58.1	140	547

Notes: cc - cubic centimeter
*Volume of water recovered at the time of maximum oil re
**Determined by passing water through sample which contai

4-13-122

Water ered	Effective Permeability, Millidarcys **	Initial Fluid Production Pressure Lbs./Sq. In.
	40.30	5
	4.60	15
	30.70	5
	552.00	5

covery.
ns residual oil.

Oilfield Research Laboratories

RESULTS OF WATER DIFFERENTIATION TESTS

TABLE VII

Company Lowry et al Operating Account Lease Federal Well No. 4-13-132

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation Connate	Drilling & Foreign	Total
1		52,500			
2		14,900			
3		24,400			
4		22,400			

Note: ppm - parts per million.

ROBERT MEAD
504 Employers Insurance Building
Dallas, Texas

OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO
MAY 19 1953

May 18, 1953

Oil Conservation Commission
P. O. Box 871
Santa Fe, New Mexico

Dear Sirs:

This is to advise you that I am in agreement with the field rules proposed by the Lowry Oil Company for the Pettigrew-Tocito Field, Rio Arriba County, New Mexico.

Sincerely,

Robert E Mead

Robert E. Mead

mw

Case 537

NEW MEXICO OIL CONSERVATION COMMISSION

SANTA FE, NEW MEXICO

IN THE MATTER OF THE APPLICATION OF LOWRY, ET AL OPERATING ACCOUNT FOR THE ESTABLISHMENT OF POOL RULES FOR THE PETTIGREW-TOCITO (ERKAN-TOCITO) POOL, RIO ARRIBA COUNTY, NEW MEXICO; FIXING THE SPACING OF WELLS; FIXING GAS-OIL RATIOS; ESTABLISHING A CASING PROGRAM; AND RELATED MATTERS.

CASE NO. 537

TO THE NEW MEXICO OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO.

Comes the undersigned, Lowry et al Operating Account, with offices at 616 Central Avenue, East, Albuquerque, New Mexico, by its attorney, Jason W. Kellahin, P. O. Box 361, Santa Fe, New Mexico, and petitions this honorable commission for an order, fixing by appropriate rules and regulations, rules for the development and operation of the Pettigrew-Tocito (Erkan-Tocito) Pool, Rio Arriba County, New Mexico, as now defined by Commission order or orders, and as the same may hereafter be extended, as follows:

1. The fixing by appropriate rules and regulations, of spacing requirements applicable to wells hereafter drilled in the Pettigrew-Tocito (Erkan-Tocito) Pool, Rio Arriba County, New Mexico, on the basis of one well on each 80-acres and setting a spacing pattern therefore with provisions for related matters, including special approval, after notice and hearing, of unorthodox well locations necessitated by the size and shape of available units or by the nature of the terrain, or for other causes.

2. The fixing, by appropriate order, of gas-oil ratios in such amount as the commission may determine may be produced without waste.

3. The establishment of a casing and cementing program for the protection of shallow potable water strata or stratum from pollution.

In support of which Petitioner would show the Commission as follows:

I.

The Pettigrew-Tocito (Erkan-Tocito) Pool is located in Rio Arriba County, New Mexico, its boundaries being defined by order of this Commission, as more fully described in Exhibit A, which is attached hereto and made a part hereof. The Pool is productive of oil in commercial quantities from the Tocito sand, encountered at a depth of approximately 6,600 feet.

II.

There are now a total of nine wells which are productive of oil from the Tocito sand within the boundaries of the Pettigrew-Tocito (Erkan-Tocito) Pool, all of which are operated by Petitioner. These wells have been drilled, for the most part, to conform to an 80-acre spacing pattern, as proposed in this petition, as more fully shown by Exhibit A, attached hereto, and made a part hereof.

III.

Petitioner has been actively engaged in the drilling and operation of wells within the Pettigrew-Tocito (Erkan-Tocito) Pool. It has accumulated statistics and information bearing upon the permeability, porosity and producing characteristics of the Tocito sand and from such information and statistics it believes that one well completed in the Tocito sand will efficiently and economically drain not less than 80 acres of that formation, and that the drilling of more wells is unnecessary, would result in economic loss without increasing the ultimate recovery of oil from the reservoir, and would constitute waste, as defined by New Mexico Statutes and the rules and regulations of this Commission.

IV.

Petitioner is prepared to submit evidence pertinent to a proper spacing program which will economically and efficiently permit, without unnecessary drilling costs or operating expenses, and without impairment of the rights of others, the recovery of oil reasonably producible from the Pettigrew-Tocito (Erkan-Tocito) Pool. From information available to it, Petitioner believes, and would show, that a uniform spacing unit of not less than 80 acres should be provided with respect to wells hereafter drilled in the Pool, with such wells to be located on said drilling units to conform to present development in the Pool.

V.

Petitioner has accumulated statistics and information bearing upon the production of associated gas, or casinghead gas, in connection with the production of oil from the Tocito sand within the boundaries of the Pettigrew-Tocito (Erkan-Tocito) Pool, and from such information and statistics, believes and would show that the limiting gas-oil ratio within the Pool should reasonably be set at 2,000 cubic feet of gas for each barrel of oil produced, in accordance with Commission Rule 506 (a).

VI.

Petitioner has accumulated statistics and information bearing upon the location, depth and thickness of potable water-bearing strata within the boundaries of the Pettigrew-Tocito (Erkan-Tocito) Pool, and from such information and statistics, believes and would show that a proper casing and cementing program should be established for the protection of such strata against pollution, by requiring that the surface pipe be set through the shallow potable water-bearing beds and not with a sufficient amount of cement to circulate the cement behind the pipe to the bottom of the cellar.

WHEREFORE, Petitioner requests the Commission, after notice and hearing as required by law and the rules and regulations of the Commission, to enter its order or orders fixing the spacing of wells hereafter drilled in the Pettigrew-Tocito (Erkan-Tocito) Pool, Rio Arriba County, New Mexico, as it now exists or may hereafter be extended, on the basis of one well located on a drilling unit of approximately 80 acres substantially in the shape of a rectangle, such drilling unit to lie wholly within the same quarter section, according to the governmental survey thereof, and to consist of adjoining quarter quarter sections which have contiguous boundaries, either South or East, North or West, with wells to be located on said drilling units substantially in the center of the NW¼ and SE¼ of each quarter section, as shown by the governmental survey thereof, with an allowable tolerance of 100 feet from such location, with suitable provisions for any related matters, including special provisions, after notice and hearing, of unorthodox well locations for good cause shown; and providing for a gas-oil ratio limitation of 2,000 cubic feet of gas to each barrel of oil produced, said gas-oil ratio limitation to be enforced by the Commission by suitable order or orders as may become necessary; and providing for a casing and cementing program which would require that the surface pipe be set through the shallow potable water-bearing beds and set with a sufficient amount of cement to circulate the cement behind the pipe to the bottom of the cellar; and providing that in the event the Commission determines to institute orders prorating production of oil at some future date, that each 80-acre drilling unit shall be treated as a proration unit for such purpose.

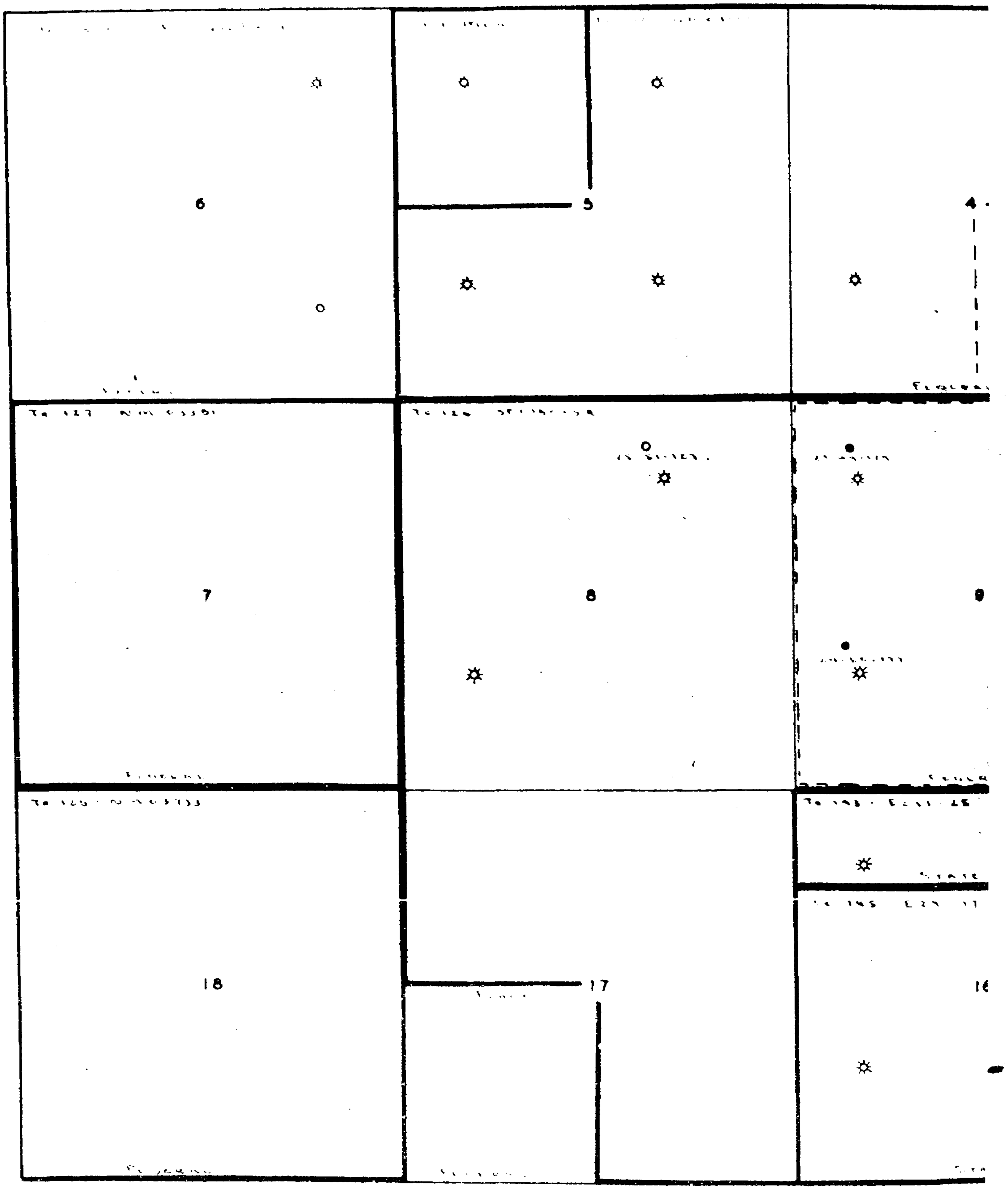
Respectfully submitted

LOWRY et al OPERATING ACCOUNT

By Jason W. Kellahin
Attorney

Jason W. Kellahin
P. O. Box 361
Santa Fe, New Mexico

Attorney for Petitioner

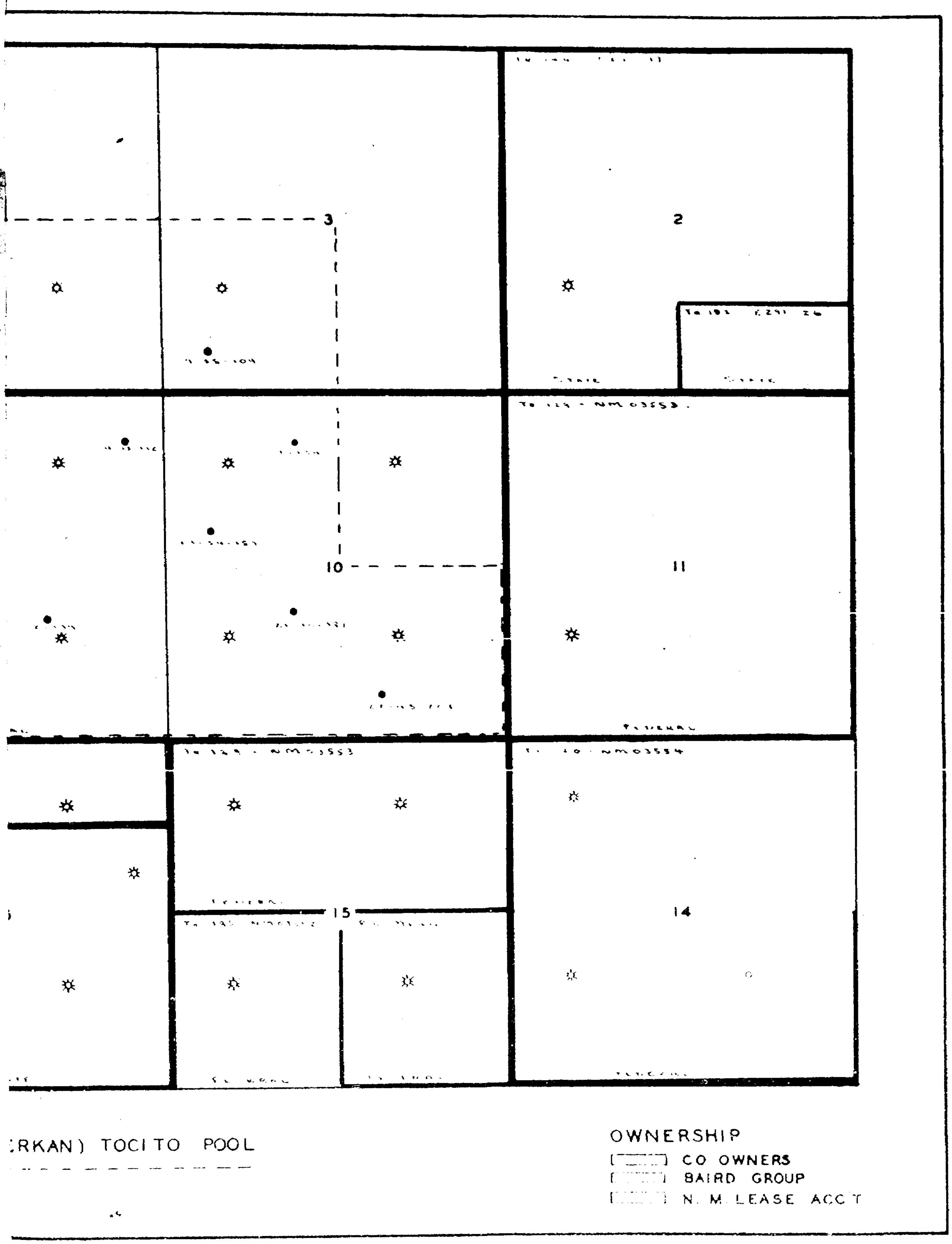


LOWRY OIL COMPANY

T26N—R6W

RIO ARRIBA COUNTY, N. M.

PETTIGREW (E



3
2
10
11
15
14
:RKAN) TOCITO POOL
OWNERSHIP
CO OWNERS
BAIRD GROUP
N. M. LEASE ACC'T

August 30, 1952

Lowry et al Operating Account
616 East Central Avenue
Albuquerque, New Mexico

Gentlemen:

Attached hereto are the results of tests made on core samples taken from the Federal Lease, Well No. 4-13-132, and submitted to our laboratory on August 26, 1952.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

Carl L. Pate

CLP:mm

9 c.c.

Oil Field Research Laboratories

RESULTS OF PERMEABILITY AND POROSITY TESTS

TABLE I A

Company Lowry Oil Company Lease Federal Well No. 4-13-132

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.	Percent Porosity
			Ft.	Cum. Ft.		
1		182.				14.5
2		178.				17.8
3		282.				14.8
4		178.				15.7

Company Lowry Oil Company Lease Federal Well No. 4-13-132

Results Effective Permeability Tests

Sample No.	Effective Permeability Millidarcys
Salt Water	
1	39.00
2	69.30
3	51.20
4	65.30
5	Imp.
Fresh Water	
1	21.40
2	34.80
3	38.20
4	61.10
5	Imp.

[illegible]

August 30, 1952

Lowry et al Operating Account
616 East Central Avenue
Albuquerque, New Mexico

Gentlemen:

Attached hereto are the results of tests made on core samples taken from the Federal Lease, Well No. 22-45-207, and submitted to our laboratory on August 26, 1952.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

Carl L. Pate

CLP:mm

9 c.c.

Oil Field Research Laboratories

RESULTS OF PERMEABILITY AND POROSITY TESTS

TABLE I A

Company Lowry Oil Company Lease Federal Well No. 22-45-207

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core Ft.	Feet of Core Cum. Ft.	Permeability Capacity Ft. x Md.	Percent Porosity
1		0.75				10.7
2		Imp.				-
3		151.				17.3
4		Imp.				-
5		110.				14.4
6		12.				16.3
7		37.				16.3
8		Imp.				-

Company Lowry Oil Company Lease Federal Well No. 22-45-207

Results of Effective Permeability Tests

Sample No.	Effective Permeability Millidarcys
Salt Water	
1	Imp.
2	Imp.
3	46.80
4	Imp.
5	26.35
6	5.14
7	13.23
8	Imp.
Fresh Water	
1	Imp.
2	Imp.
3	61.0
4	Imp.
5	22.50
6	4.58
7	13.42
8	Imp.

ILLEgible

Petroleum Production Laboratories, Inc.

TELEPHONE Victor-[illegible]

Dallas, Texas

ADDRESS ALL CORRESPONDENCE TO P. O. BOX [illegible]

ADDRESS ALL SHIPMENTS TO [illegible] SOUTH HASKELL

October 7, 1952

File No. LO-790

Lowry Oil Company
616 East Central Avenue
Albuquerque, New Mexico

Attention: Mr. A. F. Holland

Subject: Porosity Determinations
Tocito Sandstone Reservoir
Federal 22-45-207
Federal 4-13-132
Pettigrew Tocito Field
Rio Arriba County, New Mexico

Gentlemen:

You will find enclosed the results of the porosity determinations on 39 samples of cores from the Tocito Sandstone Reservoir in the Federal 22-45-207 and the Federal 4-13-132 Wells in the Pettigrew Tocito Field. The samples used for the measurements were drilled samples of approximately 3/4 of an inch in diameter and of varying lengths.

The results are arranged on two tabular data sheets in the order of increasing depth. Table I lists the results for the 19 samples from the Federal 22-45-207 Well and Table II lists the results for the 20 samples from the Federal 4-13-132 Well. A discussion of the tabular data follows:

1. The first column of figures indicates the sample numbers.

2. The second column indicates the depths from which the samples were taken.

3. The last column lists the effective porosities (expressed as a percent of the bulk volume) as determined using an air expansion type porosimeter.

Arithmetic averages of the results of the analyses are shown below. An average is shown for the combined results of the samples from both wells and also for the separate results from each individual well.

Well	Number of Samples	Porosity (% bulk volume)
Federal 22-45-207	19	11.4
Federal 4-13-132	20	13.0
Combined	39	12.2

ILLEgible

Petroleum Production Laboratories, Inc.

DALLAS, TEXAS

File No. LO-790

We sincerely appreciate this opportunity to be of service to you and hope that we may have the opportunity to serve you again in the future.

Yours very truly,

Harold S. Deyo

Laboratory Manager

HSDeyo:gad
Enclosures

ILLEgibLE

Petroleum Production Laboratories, Inc.

DALLAS, TEXAS

POROSITY DETERMINATIONS

Company: Lowry Oil Company | Date: October 7, 1952

Well: Federal 4-13-132 | File No: LO-790

Reservoir: Tocito Sandstone | County: Rio Arriba

Field: Pettigrew Tocito | State: New Mexico

Sample Number	Depth (Ft.)	Porosity (%)
27	6675.5	7.0
28	6676.5	5.2
29	6677.5	7.9
30	6678.5	6.5
31	6679.5	13.2
32	6680.5	9.9
33	6681.5	18.4
34	6682.5	17.3
35	6683.5	15.5
36	6684.5	9.8
37	6685.5	15.7
38	6686.5	18.1
39	6687.5	8.9
40	6688.5	17.5
41	6689.5	21.3
42	6690.5	21.3
43	6691.5	16.6
44	6692.5	8.0
45	6693.5	13.4
46	6694.5	7.7
Arithmetic Average		13.0

Table II

ILLEgible

Petroleum Production Laboratories, Inc.

DALLAS, TEXAS

POROSITY DETERMINATIONS

Company: Lowry Oil Company Date: October 7, 1952

Well: Federal 22-45-207 File No: LO-790

Reservoir: Tocito Sandstone County: Rio Arriba

Field: Pettigrew Tocito State: New Mexico

Sample Number	Depth (Ft.)	Porosity (%)
2	6643.5	6.1
3	6644.5	13.0
4	6645.5	6.4
5	6646.5	8.9
6	6647.5	9.9
7	6648.5	9.5
8	6649.5	10.9
9	6650.5	10.7
10	6651.5	18.1
11	6652.5	16.6
12	6653.5	18.3
13	6654.5	7.0
14	6655.5	5.5
15	6656.5	9.0
16	6657.5	15.8
17	6658.5	11.2
18	6659.5	19.0
19	6660.5	11.5
20	6661.5	9.1
Arithmetic Average		11.4

Table I

ILLEGIBLE

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS
November 21, 1951

Lowry, et al.
Box 967
Farmington, New Mexico

Attention: Mr. Frank O. Grey

Subject: Core Analysis
Federal 4-13-132 Well
Wildcat
Rio Arriba County, New Mexico

Gentlemen:

Diamond conventional cores from the subject well in the Tocito formation have been sampled and quick-frozen by a representative of Lowry, et al. and analyzed in our Farmington, New Mexico laboratory. Results of analysis are presented in tabular and graphical form on the attached Coregraph. Water base mud was used as the drilling fluid.

Shale and sandy shale analyzed from 6649 to 6675 feet are interpreted to be nonproductive due to low permeability.

Sand analyzed from 6675 to 6692 feet is interpreted to be essentially oil productive. The productive capacity, average permeability times thickness, is 2346 millidarcy-feet and the average permeability is 138 millidarcys, sufficient for a satisfactory oil rate upon completion. The average residual oil saturation and calculated connate water saturation are 15.1 and 25 per cent of pore space, respectively, within the range of water-free, oil productive sands.

Sandy shale analyzed from 6692 to 6695 feet is interpreted to be essentially nonproductive due to low permeability; however, these three feet show an increase in per cent water saturation and when a pressure differential is applied across the formation they might possibly show

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some water-cut. It is recommended that completion be limited to the sand from 6675 to 6692 feet.

The points indicated by an asterisk between the depths of 6699 and 6705 feet are interpreted to be essentially nonproductive due to low permeability.

Sand analyzed from 6706 to 6716 feet is interpreted to be very low capacity, oil productive; however, due to the low capacity, it is doubtful if any appreciable volumes of oil will be produced from this zone.

Recovery figures for the zone, 6675 to 6692 feet, are given on page one.

We hope these data prove beneficial in the evaluation of this well.

Very truly yours,

CORE LABORATORIES, INC.

J D Harris (PS)

J. D. Harris,
District Engineer

JDH:jr

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FORM P. A

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS

File FDML-36 FC
Well FEDERAL 4-13-132

CORE SUMMARY AND CALCULATED RECOVERABLE OIL

CORE SUMMARY				
FORMATION NAME	TOCITO			
DEPTH FEET	6675.0-6692.0			
% CORE RECOVERY	100			
FEET OF PERMEABLE PRODUCTIVE FORMATION RECOVERED	17.0			
AVERAGE PERMEABILITY MILLIDARCYS	138			
CAPACITY — AVERAGE PERMEABILITY × FEET PRODUCTIVE FORMATION	2346			
AVERAGE POROSITY, PERCENT	15.1			
AVERAGE RESIDUAL OIL SATURATION, % PORE SPACE	15.1			
GRAVITY OF OIL, °A.P.I.	OVER 42			
AVERAGE TOTAL WATER SATURATION, % PORE SPACE	27.3			
AVERAGE CALCULATED CONNATE WATER SATURATION, % PORE SPACE	25			
SOLUTION GAS OIL RATIO, CUBIC FEET PER BARREL (1)	800			
FORMATION VOLUME FACTOR—VOLUME THAT ONE BARREL OF STOCK TANK OIL OCCUPIES IN RESERVOIR (1)	1.46			
CALCULATED RECOVERABLE OIL	Prediction dependent upon complete isolation of each division. Structural position of well, total permeable thickness of oil zone and drainage area of well should be considered.			
BY NATURAL OR GAS EXPANSION BBLS. PER ACRE FOOT (2)	148			
INCREASE DUE TO WATER DRIVE BBLS. PER ACRE FOOT	277			
TOTAL AFTER COMPLETE WATER DRIVE BBLS. PER ACRE FOOT (3)	425			

CORE LABORATORIES, INC.

J. D. Harris (PS)

J. D. Harris

NOTE

(*) REFER TO ATTACHED LETTER

(1) REDUCTION IN PRESSURE FROM estimated SATURATION PRESSURE TO ATMOSPHERIC PRESSURE

(2) AFTER REDUCTION FROM ORIGINAL RESERVOIR PRESSURE TO ZERO POUNDS PER SQUARE INCH

(3) RESERVOIR PRESSURE MAINTAINED BY WATER DRIVE AT OR ABOVE estimated ORIGINAL SATURATION PRESSURE

(4) NO ESTIMATE FOR GAS PHASE RESERVOIRS

ILLEgible

OILFIELD RESEARCH LABORATORIES

August 13, 1952

Lowry et al Operating Account
616 East Central Avenue
Albuquerque, New Mexico

Gentlemen:

Attached hereto are the results of tests made on the four [illegible]" Rotary core samples taken from the Federal Lease, Well No. [illegible]-132, Rio Arriba County, New Mexico, and submitted to our laboratory on August 4, 1952.

The reason why the samples have such a low total fluid saturation is the fact that they have been exposed to the weather for approximately a year and that the [illegible] were not properly sealed.

Very truly yours,

ILLEGIBLE

ILLEgibLE

OILFIELD RESEARCH LABORATORIES

Company Lowry et al Operating Account Lease Federal Well No. 4-13-132

LOG

Sample No.	Description
1	Brown coarse grained micaceous slightly carbonaceous sandstone.
2	Brown coarse grained micaceous slightly carbonaceous calcareous sandstone.
3	Brown coarse grained micaceous slightly carbonaceous sandstone.
4	Brown coarse grained micaceous sandstone.

Oilfield Research Laboratories

RESULTS OF PERMEABILITY TESTS

TABLE I

Company Lowry et al Operating Account Lease Federal Well No. 4-13-132

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1		87.			
2		5.6			
3		56.			
4		687.			

Oil Field Research Laboratories

RESULTS OF SATURATION TESTS

TABLE III

Company: Lowry et al Operating Account Lease: Federal Well No. [illegible]-13-132

Sat. No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content Bbls./A. Ft.	Feet of Core		Total Oil Content Bbls./Acre
			Oil	Water	Total		Ft.	Cum. Ft.	
1		17.8	14.1	2.3	16.4	195			
2		16.8	9.5	5.5	14.0	124			
3		16.3	12.9	2.8	15.7	163			
4		21.8	11.1	1.5	12.6	168			

Oilfield Research Laboratories

RESULTS OF LABORATORY FLOODING TESTS

TABLE V

Company Lowry et al Operating Account Lease Federal Well No.

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery		Residual Saturation			Volume o[f] Recov[ered] cc*
			Percent	Bbls./A. Ft.	Percent	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.	
1		17.4	15.1	204	0.0	)	15.1	50.0	204	104
2		17.0	7.8	103	0.0	)	7.8	56.8	103	207
3		16.5	11.6	148	0.0	)	11.6	33.0	148	144
4		21.5	8.4	140	0.0	)	8.4	56.1	140	547

Notes: cc - cubic centimeter
*Volume of water recovered at the time of maximum oil re
**Determined by passing water through sample which contai

4-13-132

[illegible] Water [illegible]ered	Effective Permeability, Millidarcys **	Initial Fluid Production Pressure Lbs./Sq. In.
	40.30	5
	4.60	15
	30.70	5
	552.00	5

covery.
ns residual oil.

Oilfield Research Laboratories

RESULTS OF WATER DIFFERENTIATION TESTS

TABLE VII

Company Lowry et al Operating Account Lease Federal Well No. 4-13-132

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation Connate	Drilling & Foreign	Total
1		52,500			
2		14,900			
3		24,400			
4		22,400			

Note: ppm - parts per million.

August 13, 1952

Lowry et al Operating Account
616 East Central Avenue
Albuquerque, New Mexico

Gentlemen:

Enclosed herewith is the report of the analysis of the $3\frac{1}{2}$" Rotary core samples taken from the Federal Lease, Well No. 22-45-207, Rio Arriba County, New Mexico, and submitted to our laboratory on August 4, 1952.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

Carl L. Pate

CLP:bl
9 c.c.

LOWRY et al OPERATING ACCOUNT

CORE ANALYSIS REPORT

FEDERAL LEASE WELL NO. 22-45-207

RIO ARRIBA COUNTY, NEW MEXICO

OILFIELD RESEARCH LABORATORIES

CHANUTE, KANSAS

AUGUST 13, 1952

LOWRY et al OPERATING ACCOUNT

CORE ANALYSIS REPORT

FEDERAL LEASE WELL NO. 22-45-207

RIO ARRIBA COUNTY, NEW MEXICO

OILFIELD RESEARCH LABORATORIES

CHANUTE, KANSAS

AUGUST 13, 1952

Oil Field Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Lowry et al Operating Account Lease Federal Well No. 22-45-207

Location SW¼, SE¼,

Section 10 Twp 26N Rge. 6W County Rio Arriba State New Mexico

Name of Sand	Tocito
Top of Core	6643.00
Bottom of Core	6662.00
Top of Sand	6643.95
Bottom of Sand	6662.00
Total Feet of Permeable Sand	9.10
Total Feet of Floodable Sand	11.55

Distribution of Permeable Sand:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 1	2.25	2.25
1 - 2	1.00	3.25
2 - 4	3.00	6.25
4 & above	2.85	9.10

Average Permeability Millidarcys	68.27
Average Percent Porosity	11.02
Average Percent Oil Saturation	35.66
Average Percent Water Saturation	22.83
Average Oil Content, Bbls./A. Ft.	305.
Total Oil Content, Bbls./Acre	5,792.
Average Percent Oil Recovery by Laboratory Flooding Tests	8.61
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	95.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	1,103.
Total Calculated Oil Recovery, Bbls./Acre	2,200.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

An oil base mud was used as a circulating fluid in the coring of the sand in this well. This well was drilled in virgin territory.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
6643.00 - 6643.95	- Sandy limestone.
6643.95 - 6647.75	- Dark medium grained micaceous calcareous sandstone.
6647.75 - 6649.65	- Dark fine grained micaceous calcareous sandstone.
6649.65 - 6650.60	- Dark fine grained micaceous calcareous shaley sandstone.
6650.60 - 6653.45	- Dark coarse grained micaceous calcareous sandstone containing a vertical fracture.
6653.45 - 6655.35	- Hard calcareous shaley sandstone.
6655.35 - 6659.15	- Brown medium grained micaceous calcareous sandstone.
6659.15 - 6662.00	- Brown to dark medium grained micaceous calcareous sandstone.

Coring was started at a depth of 6643.00 feet in sandy limestone and completed at 6662.00 feet in medium grained micaceous calcareous sandstone. This core shows a total of 19.00 feet of formation containing oil. For the most part, the pay is made up of fine to medium grained micaceous calcareous sandstone.

PERMEABILITY

For the sake of distribution, the core was divided into three sections. The weighted average permeability of the upper, middle and lower sections is 1.10, 214.74 and 1.92 millidarcys respectively; the overall average being 68.27 (See Table II). By observing the data given on the coregraph, it is noticeable that the cored section has a very irregular permeability profile and contains a very loose zone in the middle of the sand section.

The sand in this core shows a fair weighted average percent oil saturation, namely, 35.66. The weighted average percent oil saturation of the upper, middle and lower sections is 35.86, 37.40 and 34.90 respectively. The weighted average percent water saturation of the upper, middle and lower sections is 24.75, 19.30 and 22.29 respectively; the overall average being 22.83 (See Table IV). This gives an overall weighted average total fluid saturation of 58.49 percent. This low total fluid saturation shows that considerable fluid was lost during coring which was no doubt oil.

For the sake of future information, all of the saturation samples were analyzed for chloride content. The results of these tests are given in Tables VII and VIII. From the data given in these tables and on the coregraph, it is noticeable that the sand has a very irregular chloride content.

The weighted average oil content of the upper, middle and lower sections is 266, 511 and 271 barrels per acre foot respectively; the overall average being 305. The total oil content, as shown by this core, is 5,792 barrels per acre (See Table IV).

LABORATORY FLOODING TESTS

The sand in this core responded fairly well to laboratory flooding tests, as a total recovery of 1,103 barrels of oil per acre was obtained from 11.55 feet of sand. The weighted average percent oil saturation was reduced from 32.30 to 23.69, or represents an average recovery of 8.61 percent. The weighted average effective permeability of the samples is 4.65 millidarcys, while the average initial fluid production pressure is 31.3 pounds per square inch (See Table VI).

By observing the data given in Table V, you will note that of the 20 samples tested, 12 produced oil and water. This indicates that approximately 60 percent of the sand represented by these samples is floodable. The tests also show that the sand has a very wide variation in effective permeability and that the middle part of the cored section is very loose. A synthetic brine of approximately 25,000 parts per million, calculated as common salt or sodium chloride, was used to flood out the sand samples.

CONCLUSION

On the basis of the above data, it is evident that a total recovery of 2,200 barrels of oil per acre, 1,800 barrels per acre by primary production and 400 barrels per acre by secondary recovery, can be obtained from the area represented by this core by efficient developing and operating practices. In calculating this recovery, an allowance was made for oil lost during coring.

The principle drawback of this core is the fact that it has a wide variation in permeability and a low percent porosity. The fact that the oil carries so much gas in solution is another factor that greatly reduces the volume of recoverable oil in place. Chances are, pressure maintenance, (the injection of the gas, produced along with the oil, back into the pay zone), will recover almost as much oil as would be expected by a combination of primary production and water-flooding. Furthermore, this method would be less expensive.

Oilfield Research Laboratories

RESULTS OF PERMEABILITY TESTS

TABLE I

Company Lowry et al Operating Acct. Lease Federal Well No. 22-45-207

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	6643.15	Imp.	0.95	0.95	0.00
2	6644.00	Imp.	0.55	1.50	0.00
3	6645.00	0.99	1.00	2.50	0.99
4	6646.00	1.75	1.00	3.50	1.75
5	6647.00	0.66	1.25	4.75	0.82
6	6648.00	Imp.	0.75	5.50	0.00
7	6649.00	Imp.	1.15	6.65	0.00
8	6650.00	Imp.	0.95	7.60	0.00
9	6651.00	229.	0.90	8.50	206.00
10	6652.00	126.	1.00	9.50	126.00
11	6653.00	295.	0.95	10.45	280.00
12	6654.00	Imp.	1.05	11.50	0.00
13	6655.00	Imp.	0.85	12.35	0.00
14	6656.00	Imp.	1.15	13.50	0.00
15	6657.00	2.9	1.00	14.50	2.90
16	6658.00	Imp.	1.00	15.50	0.00
17	6659.00	3.4	0.65	16.15	2.21
18	6660.00	0.49	1.35	17.50	0.66
19	6661.00	Imp.	1.00	18.50	0.00
20	6661.85	Imp.	0.50	19.00	0.00

Oil Field Research Laboratories

SUMMARY OF PERMEABILITY TESTS

TABLE II

Company Lowry et al Operating Acct. Lease Federal Well No. 22-45-207

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity, Ft. x Md.
6643.00-6650.60	3.25	1.10	3.56
6650.60-6653.45	2.85	214.74	612.00
6653.45-6662.00	3.00	1.92	5.77
6643.00-6662.00	9.10	68.27	621.33

Oil Field Research Laboratories

RESULTS OF SATURATION TESTS

TABLE III

Company: Lowry et al Operating Account   Lease: Federal   Well No. 22-45-207

Sat. No.	Depth, Feet	Effective Porosity Percent	Percent Saturation Oil	Percent Saturation Water	Percent Saturation Total	Oil Content, Bbls./A. Ft.	Feet of Core Ft.	Feet of Core Cum. Ft.	Total Oil Content Bbls./Acre
1	6643.15	5.6	49.5	22.5	72.0	215	0.95	0.95	204
2	6644.00	8.9	34.4	19.4	53.8	238	0.55	1.50	131
3	6645.00	9.2	29.6	17.1	46.7	211	1.00	2.50	211
4	6646.00	9.3	41.8	28.6	70.4	388	1.00	3.50	388
5	6647.00	10.8	30.8	23.6	54.4	258	1.25	4.75	322
6	6648.00	12.4	47.8	21.3	69.1	461	0.75	5.50	346
7	6649.00	9.7	23.9	33.8	67.7	180	1.15	6.65	207
8	6650.00	8.1	35.2	27.4	62.6	221	0.95	7.60	210
9	6651.00	19.4	25.4	20.9	46.3	383	0.90	8.50	345
10	6652.00	12.9	39.4	17.4	56.8	394	1.00	9.50	394
11	6653.00	20.7	46.8	19.8	66.6	754	0.95	10.45	716
12	6654.00	6.8	51.2	23.2	74.4	271	1.05	11.50	285
13	6655.00	4.9	30.6	37.5	68.1	116	0.85	12.35	98
14	6656.00	13.9	35.0	23.7	58.7	378	1.15	13.50	435
15	6657.00	13.6	32.6	20.7	53.3	344	1.00	14.50	344
16	6658.00	9.8	33.9	22.3	56.2	258	1.00	15.50	258
17	6659.00	17.1	29.3	19.4	48.7	3[illegible]9	0.65	16.15	253
18	6660.00	11.6	31.7	16.9	48.6	286	1.35	17.50	386
19	6661.00	9.3	27.5	18.0	45.5	198	1.00	18.50	198
20	6661.85	3.5	45.0	21.4	66.4	122	0.50	19.00	61
							Total		5,792

Oil Field Research Laboratories

SUMMARY OF SATURATION TESTS

TABLE IV

Company Lowry et al Operating Account Lease Federal Well No. 22-45-207

Depth Interval, Feet	Feet of Core Analyzed	Average Percent Porosity	Average Percent Oil Saturation	Average Percent Water Saturation	Average Oil Content Bbls./A. Ft.	Total Oil Content Bbls./Acre
6643.00-6650.60	7.60	9.32	35.86	24.75	266	2,019
6650.60-6653.45	2.85	17.58	37.40	19.30	511	1,455
6653.45-6662.00	8.55	10.35	34.90	22.29	271	2,318
6643.00-6662.00	19.00	11.02	35.66	22.83	305	5,792

Oilfield Research Laboratories

RESULTS OF LABORATORY FLOODING TESTS

TABLE V

Company Lowry et al Operating Account. Lease Federal Well No.

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation Percent	Original Oil Saturation Bbls./A. Ft.	Oil Recovery Percent	Oil Recovery Bbls./A. Ft.	Residual Saturation % Oil	Residual Saturation % Water	Residual Saturation Bbls./A. Ft.	Volume of Water Recovered cc*
1	6643.15	5.8	47.7	215	0.0	0	47.7	27.3	215	0
2	6644.00	8.9	32.4	224	1.6	11	30.8	55.9	213	1
3	6645.00	9.6	28.4	212	7.0	52	21.4	50.8	160	1
4	6646.00	9.7	39.4	296	11.2	84	28.2	54.0	212	5
5	6647.00	10.7	28.7	238	0.0	0	28.7	45.9	238	0
6	6648.00	12.3	46.4	443	0.0	0	46.4	23.8	443	0
7	6649.00	9.3	26.4	191	0.0	0	26.4	45.4	191	0
8	6650.00	8.4	35.2	230	0.0	0	35.2	40.0	230	0
9	6651.00	19.1	26.8	397	10.0	148	16.8	66.5	249	99
10	6652.00	13.1	36.7	374	16.1	164	20.6	65.5	210	175
11	6653.00	20.7	44.4	714	20.2	325	24.2	63.4	389	72
12	6654.00	6.4	48.9	243	0.0	0	48.9	30.0	243	0
13	6655.00	5.2	29.1	118	0.0	0	29.1	68.2	118	0
14	6656.00	13.9	33.0	356	10.2	110	22.8	60.0	246	42
15	6657.00	13.5	34.0	356	6.5	68	27.5	57.2	288	3
16	6658.00	9.7	31.7	239	2.9	22	28.8	49.3	217	1
17	6659.00	17.4	27.2	367	5.2	70	22.0	59.4	297	83
18	6660.00	11.4	30.3	268	5.1	45	25.2	42.2	223	8
19	6661.00	9.0	26.0	182	4.7	33	21.3	41.5	149	5
20	6661.85	3.8	42.0	124	0.0	0	42.0	25.0	124	0

Notes: cc - cubic centimeter
* - Volume of water recovered at the time of maximum oil recovery.
** - Determined by passing water through sample which still contains residual oil.

22-45-207

Water d	Effective Permeability, Millidarcys **	Initial Fluid Production Pressure Lbs./Sq. In.
	Imp.	50+
	0.048	50
	0.039	50
	0.146	30
	Imp.	50+
	Imp.	50+
	Imp.	50+
	Imp.	50+
	24.50	5
	11.30	15
	17.90	5
	Imp.	50+
	Imp.	50+
	1.19	20
	0.202	50
	0.[illegible]30	50
	1.75	20
	0.176	50
	0.202	50
	Imp.	50+

Oilfield Research Laboratories

SUMMARY OF LABORATORY FLOODING TESTS

TABLE VI

Company Lowry et al Operating Account Lease Federal Well No. 22-45- 207

Depth Interval, Feet	6643.95 - 6646.50	6650.60 - 6653.45	6655.35 - 6661.50	6643.95 - 6661.50
Feet of Core Analyzed	2.55	2.85	6.15	11.55
Average Percent Porosity	9.49	17.51	12.18	12.90
Average Percent Original Oil Saturation	33.57	36.13	30.02	32.30
Average Percent Oil Recovery	7.49	15.54	5.87	8.61
Average Percent Residual Oil Saturation	26.08	20.59	24.15	23.69
Average Percent Residual Water Saturation	53.14	65.05	50.83	54.76
Average Percent Total Residual Fluid Saturation	79.22	85.64	74.98	78.45
Average Original Oil Content, Bbls./A. Ft.	248.	494.	291.	330.
Average Oil Recovery, Bbls./A. Ft.	56.	212.	58.	95.
Average Residual Oil Content, Bbls./A. Ft.	192.	282.	233.	235.
Total Original Oil Content, Bbls./Acre	631.	1,408.	1,787.	3,826.
Total Oil Recovery, Bbls./Acre	142.	605.	356.	1,103.
Total Residual Oil Content, Bbls./Acre	4[illegible]9.	803.	1,431.	2,723.
Average Effective Permeability, Millidarcys	0.083	17.68	0.517	4.65
Average Initial Fluid Production Pressure, p.s.i.	43.3	8.3	36.7	31.3

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

Oilfield Research Laboratories

RESULTS OF WATER DIFFERENTIATION TESTS

TABLE VII

Company Lowry et al Operating Acct. Lease Federal Well No. 22-45-207

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation Connate	Drilling & Foreign	Total
1	6643.15	44,000			
2	6644.00	12,800			
3	6645.00	31,000			
4	6646.00	19,700			
5	6647.00	13,500			
6	6648.00	48,500			
7	6649.00	36,800			
8	6650.00	27,800			
9	6651.00	37,500			
10	6652.00	36,800			
11	6653.00	7,430			
12	6654.00	22,900			
13	6655.00	50,100			
14	6656.00	29,600			
15	6657.00	22,300			
16	6658.00	35,900			
17	6659.00	7,000			
18	6660.00	42,000			
19	6661.00	47,000			
20	6661.85	71,500			

Note: ppm - parts per million.

Oil Field Research Laboratories

SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VIII

Company Lowry et al Operating Acct. Lease Federal Well No 22-45-207

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
6643.00-6650.60	29,147		
6650.60-6653.45	27,231		
6653.45-6662.00	35,423		
6643.00-6662.00	31,684		

Note: ppm - parts per million.

Core Analysis Report
for
LOWRY OIL COMPANY

Tocito Sandstone Reservoir

Federal 23-49-129

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

Petroleum Production Engineering Co.

Reservoir and Engineering Analyses

P. O. BOX 4111
TULSA, OKLAHOMA

February 20, 1953

FILE NO.
LO-834

Lowry Oil Company
616 East Central Avenue
Albuquerque, New Mexico

Attention: Mr. A. F. Holland

Subject: Routine Core Analysis
Tocito Sandstone Reservoir
Federal 23-49-129
Pettigrew Tocito Field
Rio Arriba County, New Mexico

Gentlemen:

You will find enclosed the results of the routine analysis of core samples from the Tocito Sandstone Reservoir in the Federal 23-49-129 Well in the Pettigrew Tocito Field. Both tabular and graphical presentations of the data will be found.

The core was taken between the depths of 6584.9 feet and 6627.2 feet using rotary coring tools. Samples of the recovered core, selected in the field by a representative of the Lowry Oil Company, were placed in airtight plastic bags, sealed in cans, and shipped to us for routine plug type core analysis.

In addition to the routine core analysis, gas-oil relative permeability measurements are to be effected on the four samples considered most representative of the formation. The delay in submitting the written report of the routine analysis was caused by the delay in obtaining the horizontal permeability measurements due to the special handling that was necessary to preserve the horizontal permeability plugs for the relative permeability measurements. Appropriate precautions were taken at all times to protect the plugs from exposure to air and the resulting oxidation of the residual oil.

All of the horizontal permeability measurements, with the exception of the measurements made on samples number 10, 22, 29, and 30 were made on large plugs which were drilled with a 1½ inch diameter core bit in order to obtain the maximum volume of sample for the relative permeability determinations. The horizontal permeability measurements reported for the above numbered exceptions were made on 3/4 inch diameter permeability plugs. All of the vertical permeability measurements were made on 3/4 inch diameter plugs.

Petroleum Production Engineering Co.

File No. LO-834

Arithmetic averages of the results of the analysis of the 48 samples reported herein are as follows:

Horizontal Permeability to Air (md.)	42
Vertical Permeability to Air (md.)	12
Porosity (% bulk volume)	12
Residual Oil (% pore space).	21
Total Water (% pore space)	37

This opportunity to be of service to you is sincerely appreciated.

Yours very truly,

Harold S. Deyo

HSDeyo:gad
Enclosures

Petroleum Production Laboratories, Inc.

TELEPHONE Victor-[illegible]

Dallas, Texas

ADDRESS ALL CORRESPONDENCE TO P. O. BOX [illegible]

ADDRESS ALL SHIPMENTS TO [illegible] SOUTH HASKELL

February 19, 1953

File No. LO-834

Petroleum Production Engineering Co.
P. O. Box 4111
Tulsa, Oklahoma

Gentlemen:

Transmitted herewith are the tabular and graphical presentations of the results of the routine analysis of core samples taken from the Tocito Sandstone Reservoir in the Federal 23-49-129 Well in the Pettigrew Tocito Field, Rio Arriba County, New Mexico.

Respectfully yours,

Tom Haliburton

Enclosures

Petroleum Production Laboratories, Inc.

DALLAS, TEXAS

CORE ANALYSIS REPORT

Company: Lawry Oil Company — Date: February 19, 1953

Well: Federal 23-49-129 — File No.: 10-834

Reservoir: Tocito Sandstone — Elevation:

Field: Pettigrew Tocito — Core Diameter (Inches): 3½

County: Rio Arriba — Coring Fluid:

State: New Mexico — Remarks:

NOTE: Permeability results which are less than md. are reported as zero.

Sample Number	Actual Depth, Feet	Description of Formation	Permeability Millidarcies Horizontal	Permeability Millidarcies Vertical	Porosity %	Liquid Saturation % Pore Space Residual Oil	Liquid Saturation % Pore Space Total Water	REMARKS
1	6584.9-85.5	ls	0.1	0.1	4.3	9.3	60.5	w/sh strks
2	6585.5-86.0	ls	0.2	0.3	5.2	23.1	44.2	w/sh strks
3	6586.0-86.6	vy shy ls	0.3	0.2	8.7	29.9	48.3	
	6586.6-86.9	*						
4	6586.9-87.2	vy shy ls	1.1	1.0	12.7	18.9	26.0	
5	6587.2-87.6	vy shy sl cal ss	2.1	1.4	12.7	17.3	28.3	
6	6587.6-88.1	vy shy sl cal ss	2.5	0.4	13.2	18.9	24.2	
7	6588.1-88.6	vy sdy ls	7.0	0.4	11.8	20.3	28.8	
8	6588.6-89.2	cal ss	5.0	2.9	14.2	17.6	27.5	
9	6589.2-89.8	vy shy fg ss	10.5	4.3	13.3	19.5	32.3	
10	6589.8-90.1	vy shy fg ss	0.1	78	18.1	19.3	28.2	w/sh lam
	6590.1-90.2	*						
11	6590.2-90.7	vy cal fg ss	425	59	22.3	22.4	32.7	w/sh lam
12	6590.7-91.3	fg ss	192	90	20.8	26.4	33.7	
13	6591.3-91.8	fg ss	341	22	20.9	17.7	35.9	
	6591.8-92.0	*						
14	6592.0-92.6	fg ss	415	5.4	20.5	22.9	43.4	
15	6592.6-93.1	fg ss	203	48	19.0	22.1	37.9	w/sh lam
16	6593.1-93.7	fg ss	144	3.3	17.6	14.2	35.2	w/sh lam
17	6593.7-94.3	fg ss	4.6	62	17.1	13.5	35.7	w/sh lam
	6594.3-94.4	*						
18	6594.4-95.0	fg ss	221	40	18.6	19.9	32.3	
	6595.0-95.1	*						
19	6595.1-95.7	fg ss	2.3	0.5	13.7	23.4	34.3	w/sh lam
20	6595.7-96.3	ls	0.4	82	9.5	17.9	31.6	
21	6596.3-96.7	vy cal fg ss	1.4	3.3	13.3	25.6	33.8	
	6596.7-96.8	*						
22	6596.8-97.2	fg ss	18	4.0	14.9	20.1	31.5	
23	6597.2-98.0	vy shy fg ss	3.7	0.4	10.1	12.9	46.5	
	6598.0-98.2	*						
24	6598.2-99.0	vy shy fg ss	3.6	2.1	12.1	20.7	30.6	
25	6599.0-99.6	ls	1.8	76	12.7	25.2	22.0	
26	6599.6-00.2	cal fg ss	4.7	3.1	11.6	14.7	26.7	w/sh lam
	ARITHMETIC AVERAGES							

Petroleum Production Laboratories, Inc.

DALLAS, TEXAS

CORE ANALYSIS REPORT

Company: Lowry Oil Company Date: February 19, 1953

Well: Federal 23-49-129 File No.: LO-834

Reservoir: Tocito Sandstone Elevation:

Field: Pettigrew Tocito Core Diameter (Inches): 3½

County: Rio Arriba Coring Fluid:

State: New Mexico Remarks:

NOTE: Permeability results which are less than md. are reported as zero.

Sample Number	Actual Depth, Feet	Description of Formation	Permeability Millidarcies		Porosity %	Liquid Saturation % Pore Space		Remarks
			Horizontal	Vertical		Residual Oil	Total Water	
27	6600.2-00.7	cal fg ss	1.8	0.3	10.3	15.5	47.6	
28	6600.7-01.3	cal fg ss	1.1	0.4	8.0	21.3	18.8	
	6601.3-01.4	*						
29	6601.4-01.8	cal fg ss	0.1	0.4	7.3	21.9	20.5	
30	6601.8-02.4	vy shy fg ss	0.8	0.1	9.7	12.4	54.6	
	6602.4-03.2	*						
31	6603.2-03.8	sl cal vy fg ss	1.0	0.2	8.4	13.1	56.0	
	6603.8-07.4	*						
32	6607.4-08.0	shy ls	0.5	0.2	7.7	22.1	62.3	
	6608.0-08.6	*						
33	6608.6-09.1	shy ls	0.3	0.3	6.2	6.5	69.4	
	6609.1-09.7	*						
34	6609.7-10.0	shy cal fg ss	0.6	0.2	6.6	6.1	74.2	
	6610.0-14.5	*						
35	6614.5-14.9	vy shy cal fg ss	1.4	0.4	10.1	30.7	34.7	
	6614.9-15.1	*						
36	6615.1-15.7	vy shy cal fg ss	1.6	0.4	9.4	26.6	34.0	
37	6615.7-16.2	shy cal fg ss	1.2	0.2	9.9	23.2	39.4	
38	6616.2-16.7	shy vy fg ss	1.0	0.3	9.5	27.4	35.8	
39	6616.7-17.0	shy fg ss	0.8	0.2	8.0	21.3	45.0	
40	6617.0-17.4	shy fg ss	1.0	0.3	8.3	22.9	36.1	
41	6617.4-18.0	cal fg ss	2.8	0.4	12.4	25.8	40.3	w/sh lam
	6618.0-21.1	**						
42	6621.1-21.7	cal fg ss	2.2	0.4	15.2	33.6	36.8	w/sh lam
43	6621.7-22.5	cal fg ss	1.5	0.5	12.7	16.5	24.4	w/sh lam
44	6622.5-23.1	cal fg ss	0.3	0.6	11.1	21.6	23.4	w/sh lam
	6623.1-23.4	*						
45	6623.4-24.0	ls	0.2	0.3	7.9	30.4	36.7	
	6624.0-24.4	*						
46	6624.4-25.1	ls	0.8	0.5	9.9	19.2	32.3	
47	6625.1-25.6	fg ss	2.9	0.5	13.0	31.5	33.1	w/sh lam
	ARITHMETIC AVERAGES							

Petroleum Production Laboratories, Inc.

DALLAS, TEXAS

CORE ANALYSIS REPORT

Company: Lowry Oil Company
Date: February 19, 1953

Well: Federal 23-49-129
File No.: LO-834

Reservoir: Tocito Sandstone
Elevation:

Field: Pettigrew Tocito
Core Diameter (Inches): 3½

County: Rio Arriba
Coring Fluid:

State: New Mexico
Remarks:

NOTE: Permeability results which are less than md. are reported as zero.

Sample Number	Actual Depth, Feet	Description of Formation	Permeability Millidarcies		Porosity %	Liquid Saturation % Pore Space		Remarks
			Horizontal	Vertical		Residual Oil	Total Water	
	6625.6-26.8	*						
48	6626.8-27.2	ls	0.4	0.5	10.6	22.6	25.5	
Arithmetic Averages			42	1[illegible]	12	21	37	

* The core from this depth interval was not received.

** The core from this depth interval was reported to have been lost.

Petroleum Production Laboratories, Inc.

LABORATORY AND RESERVOIR ENGINEERING ANALYSES

DALLAS, TEXAS

COREGRAPH

Company: Lowry Oil Company

Elev:

Well: Federal 23-49-129

File: LO-834

Field: Pettigrew Tocito

Date: February 19, 1953

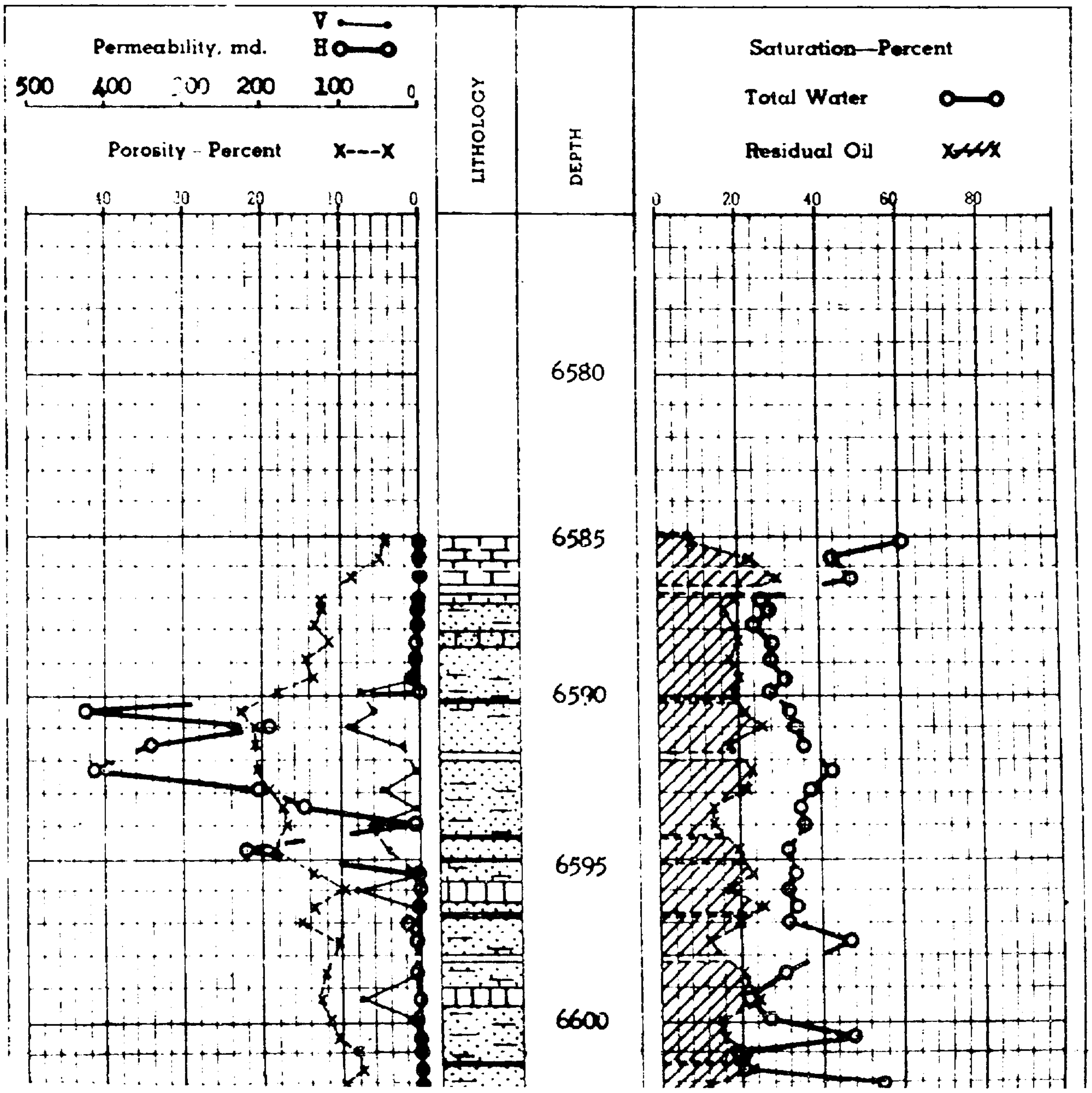
Reservoir: Tocito Sandstone

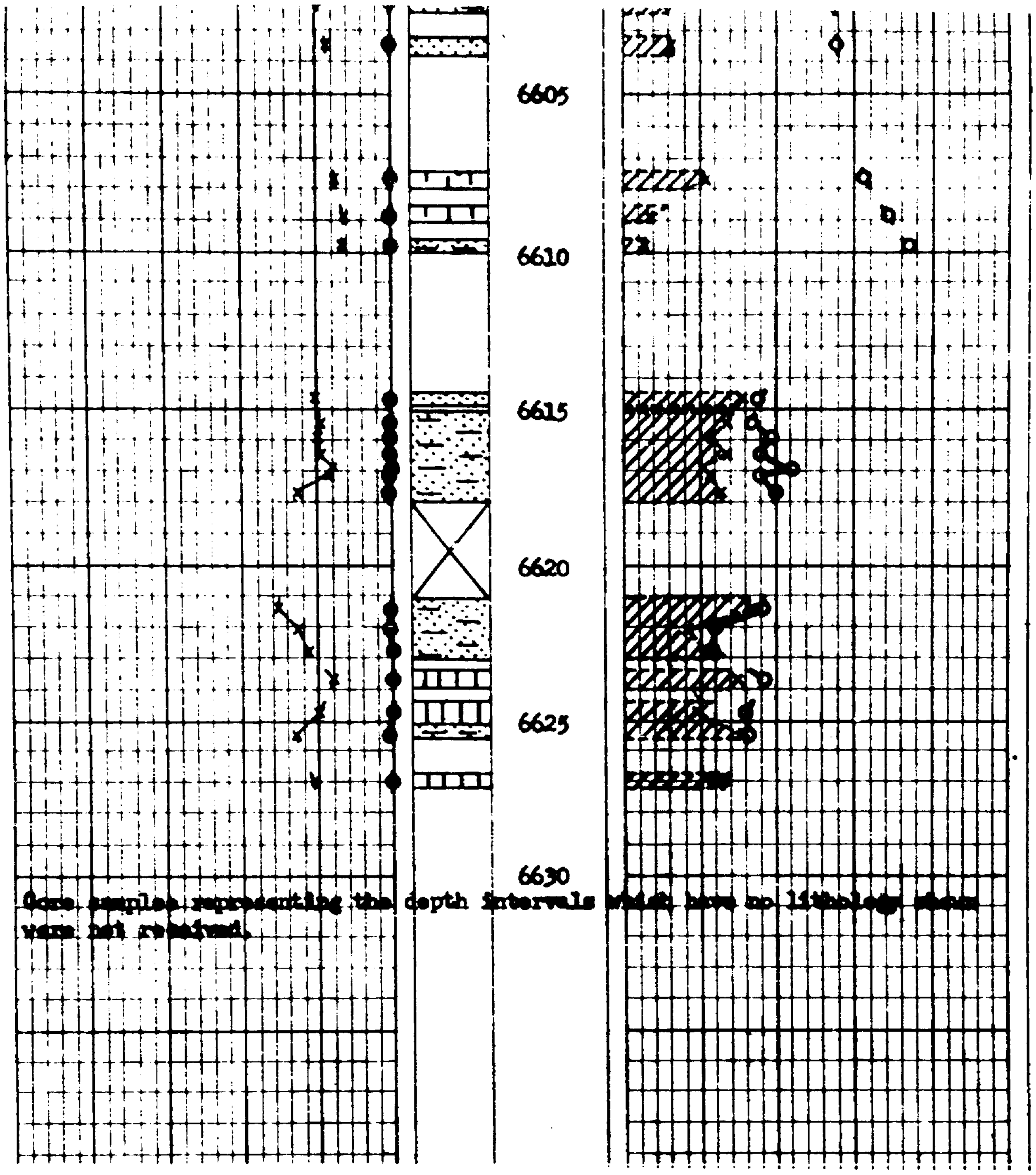
Drilling Fluid:

County: Rio Arriba

Remarks:

State: New Mexico





Core samples representing the depth intervals which have no lithology shown were not received.

Petroleum Production Engineering Co.

Reservoir and Engineering Analyses

P. O. BOX 4111
TULSA, OKLAHOMA

April 22, 1953

FILE NO.
LO-853

Lowry Oil Company
616 East Central Avenue
Albuquerque, New Mexico

Attention: Mr. A. F. Holland

Subject: Routine Permeability and
Porosity Determinations
Tocito Sandstone Reservoir
Federal 24-50-177
Pettigrew Tocito Field
Rio Arriba County, New Mexico

Gentlemen:

The following pages present the results of the routine permeability and porosity determinations made on samples of cores from the Tocito Sandstone Reservoir in the Federal 24-50-177 Well in the Pettigrew Tocito Field. Both tabular and graphical presentations of the data will be found.

The core was taken between the depths of 6604.2 feet and 6616.4 feet using rotary coring tools. Samples of the recovered core were selected in the field by a representative of the Lowry Oil Company, sealed in cans, and submitted for combination special and routine analysis.

As was requested, an analysis was performed on each section of core received. The following measurements were made:

1. Vertical permeability measurement on a full size section of core.

2. Porosity measurement on the full size section of core used in Test 1 above.

3. Horizontal permeability measurement on a $1\frac{1}{2}$ inch diameter plug drilled from the original full size section of core.

4. Porosity measurement on a plug drilled from the original full size section of core.

The results are arranged on the tabular data sheets in the order of increasing depth. A summary of the results follows:

1. The first column of figures lists the sample numbers.

2. The second column indicates the depths from which the samples were taken.

3. The next column gives the lithology of the samples.

4. The fourth column of figures lists the vertical permeabilities to air as measured on the full size core section. These values range from a minimum of 0.01 md. to a maximum of 418 md. and average 40 md.

5. The fifth column lists the porosities as measured on the full size core section. These values vary from 4.3% to 23.2% and average 11.7%.

6. Permeabilities to air as measured on the 1½ inch diameter horizontal plug drilled from the full size core section appear in the next column. These values vary from a minimum of 0.06 md. to a maximum of 981 md. and average 146 md.

7. The last column lists the porosities as measured on a plug taken from the original full size core section. These values vary from 4.6% to 23.8% and average 12.6%.

The graphical presentations of the results will be found following the tabular data. The first graph depicts the results determined from the full size core analysis and the second graph depicts the results determined from the plug analysis.

We sincerely appreciate this opportunity to be of service to you and hope that we may have the opportunity to serve you again in the future.

Yours very truly,

Harold S. Deyo

HSDeyo:gad
Enclosures

Petroleum Production Laboratories, Inc.

TELEPHONE Victor-0871

Dallas, Texas

ADDRESS ALL CORRESPONDENCE TO P. O. BOX 2836

ADDRESS ALL SHIPMENTS TO 407 SOUTH HASKELL

April 21, 1953

File No. LO-853

Petroleum Production Engineering Co.
P. O. Box 4111
Tulsa, Oklahoma

Gentlemen:

You will find enclosed the tabular data and graphs showing the results of the combination special and routine core analysis made on samples of cores from the Tocito Sandstone Reservoir in the Federal 24-30-177 Well, Pettigrew Tocito Field, Rio Arriba County, New Mexico.

Yours very truly,

Tom Swinburton

Enclosures

Petroleum Production Laboratories, Inc.

DALLAS, TEXAS

ROUTINE PERMEABILITY AND POROSITY DETERMINATIONS

Company: Lowry Oil Company — Date: April 22, 1953

Well: Federal 24-50-177 — File No.: LO-853

Reservoir: Tocito Sandstone — County: Rio Arriba

Field: Pettigrew Tocito — State: New Mexico

Sample Number	Depth (Ft.)	Description of Formation	Full Size Core Analysis		Plug Analysis	
			Vertical Air Permeability (md.)	Porosity (%)	Horizontal Air Permeability (md.)	Porosity (%)
1	6604.2-04.7	vy fg cal ss	0.01	5.7	0.10	7.2
2	6604.7-05.2	shy ls - dense	0.04	4.3	0.25	4.7
3	6605.2-05.7	shy ls - dense	0.05	6.2	0.22	5.6
4	6605.7-06.2	shy ls - dense	0.05	8.7	0.26	7.3
5	6606.2-06.5	sdy shy ls - dense	0.03	5.4	0.11	7.8
6	6606.5-06.7	sdy shy ls - dense	*0.04	*6.1	***0.06	6.0
7	6606.7-07.2	shy ls - dense	0.03	8.0	0.10	6.5
8	6607.2-07.6	vy fg shy cal ss	0.04	9.8	0.43	12.0
9	6607.6-08.0	vy fg silty ss	0.22	10.3	0.78	11.3
10	6608.0-08.3	vy fg shy ss	*0.19	*11.1	***0.35	12.5
11	6608.3-08.5	vy fg shy ss	0.06	12.7	0.41	11.0
12	6608.5-09.0	fg shy ss	0.08	10.5	0.42	11.0
13	6609.0-09.5	vy fg shy ss	0.05	10.4	0.24	11.5
14	6609.5-10.5	vy fg shy ss-fractured	**8.1	11.9	0.38	13.5
15	6610.5-10.8	fy shy ss	0.07	10.2	0.20	13.0
16	6610.8-11.0	vy fg shy cal ss	*0.04	*6.3	***0.07	6.2
17	6611.0-11.5	vy fg shy cal ss	0.43	7.0	0.23	9.3
18	6611.5-11.9	fg shy ss	*0.12	*7.3	0.17	7.7

Petroleum Production Laboratories, Inc.

DALLAS, TEXAS File No. LO-853

ROUTINE PERMEABILITY AND POROSITY DETERMINATIONS

Sample Number	Depth (Ft.)	Description of Formation	Full Size Core Analysis		Plug Analysis	
			Vertical Air Permeability (md.)	Porosity (%)	Horizontal Air Permeability (md.)	Porosity (%)
19	6611.9-12.2	fg shy ss	*0.09	*5.5	0.17	4.6
20	6612.2-12.7	fg ss	*14	*18.2	46	19.0
21	6612.7-13.0	fg ss	0.71	19.8	10	21.8
22	6613.0-13.3	fg ss	183	23.2	442	23.8
23	6613.3-13.9	fg ss	12	21.0	760	22.8
24	6613.9-14.2	fg ss	418	22.0	778	23.1
25	6614.2-14.5	fg ss	335	21.5	981	22.1
26	6614.5-15.0	fg sl shy ss	221	20.2	821	23.8
27	6615.0-15.4	fg ss	9.2	18.6	247	21.6
28	6615.4-15.8	fg ss	8.1	18.3	289	18.1
29	6615.8-16.1	shy ls - dense	0.04	6.9	0.24	8.4
30	6616.1-16.4	ls - dense	0.07	5.1	0.13	5.2
Arithmetic Averages			40	11.7	146	12.6

Note: In the two columns falling under the heading of "Full Size Analysis", several of the results are preceded by the symbol *. This indicates that it was not possible to perform an analysis on the full size core section and 1½ inch diameter vertical permeability plugs were drilled and analyzed. The sample preceded by the symbol ** had a vertical fracture extending through the entire length of the section which caused the permeability to be high in comparison with the other samples of similar structure.

In the "Air Permeability" column under "Plug Analysis" the symbol ***, indicates that 3/4 inch diameter horizontal permeability plugs were drilled and analyzed instead of 1½ inch diameter plugs.

Petroleum Production Laboratories, Inc.

DALLAS, TEXAS

COREGRAPH

Company: Lowry Oil Company

Well: Federal 24-50-177

Field: Pettigrew Tocito

Reservoir: Tocito Sandstone

County: Rio Arriba

State: New Mexico

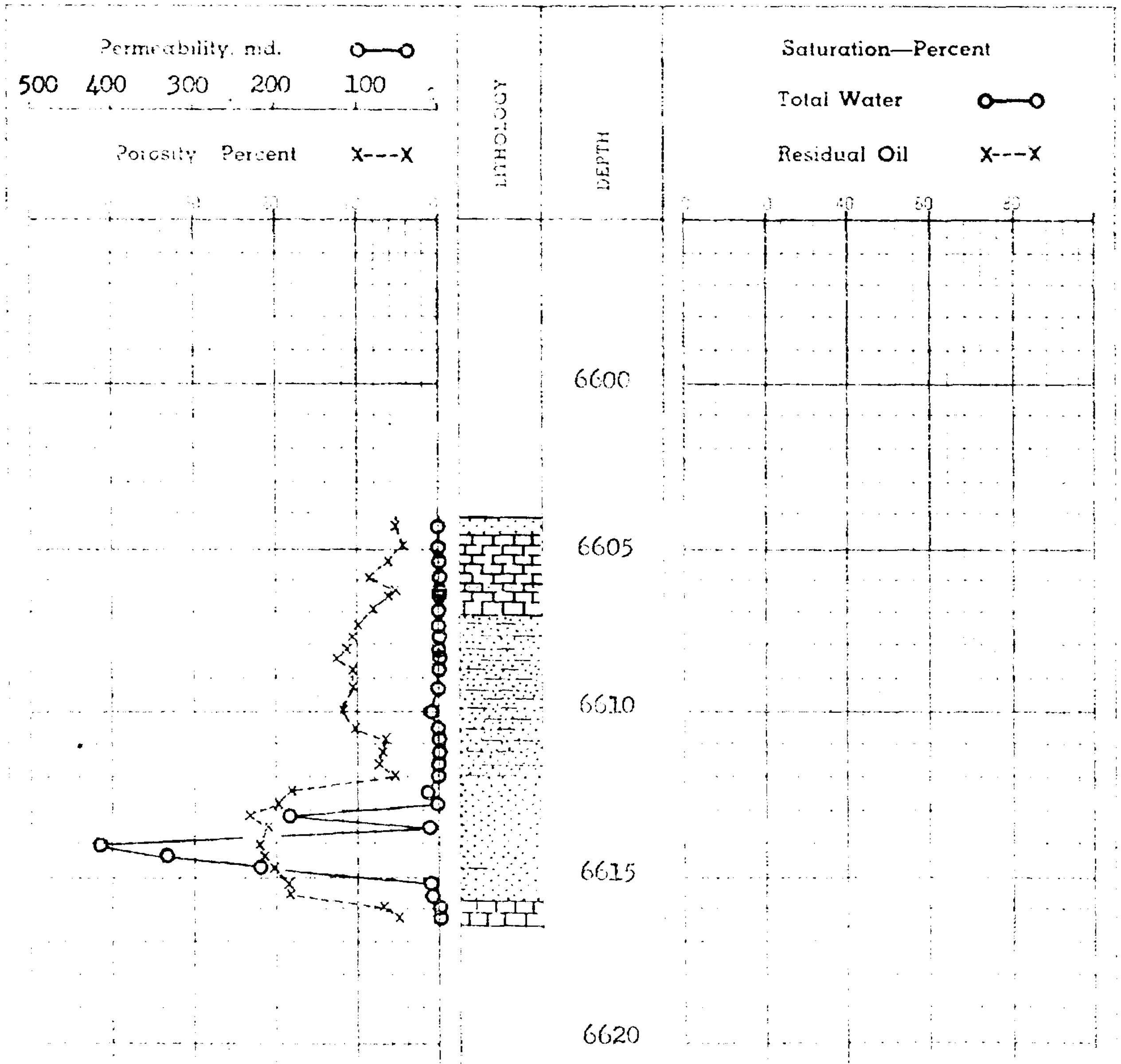
Elev:

File: LO-853

Date: April 21, 1953

Drilling Fluid:

Remarks: Results obtained from full size core analysis



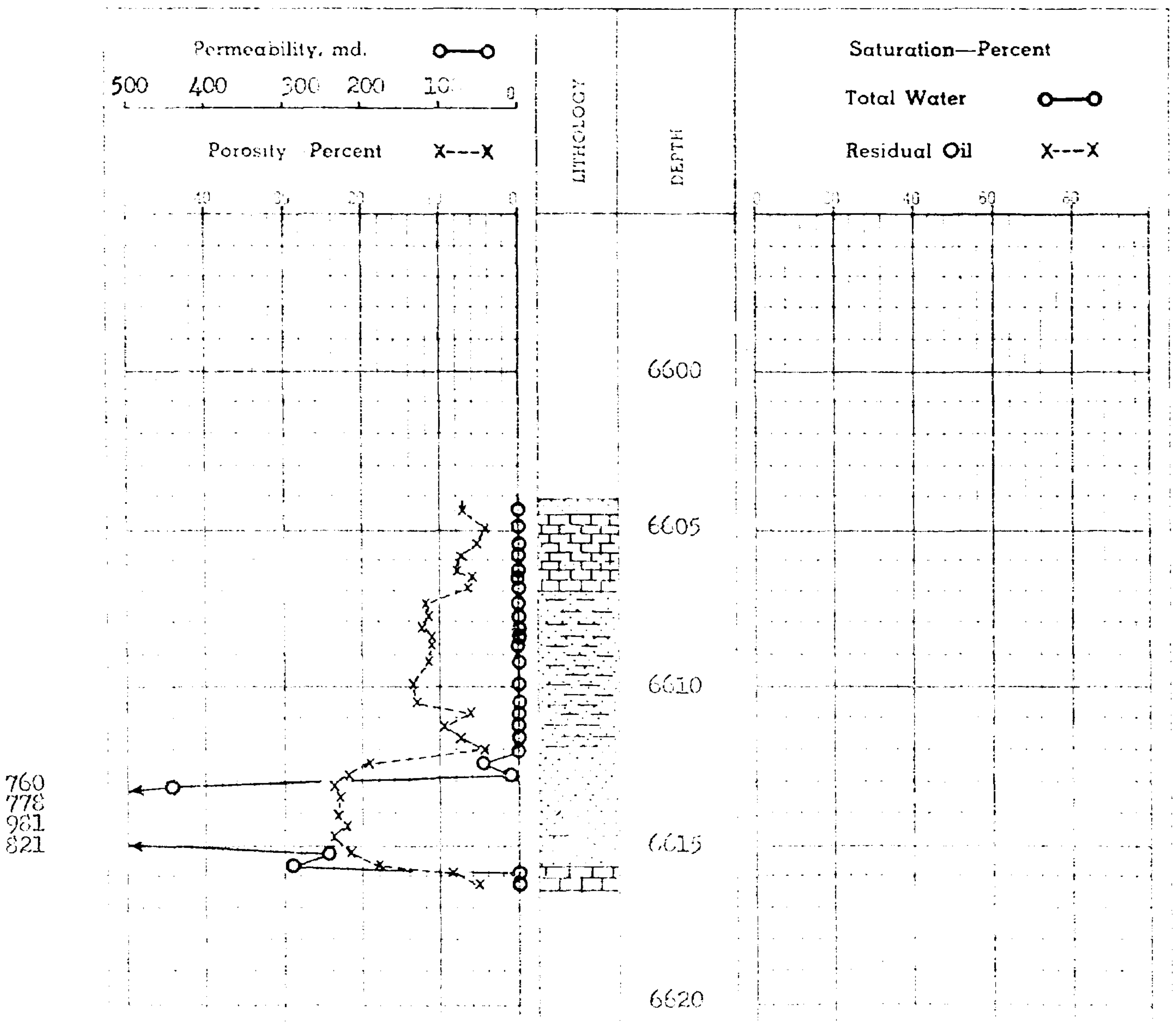
Petroleum Production Laboratories, Inc.

DALLAS, TEXAS

COREGRAPH

Company: Lowry Oil Company
Well: Federal 24-50-177
Field: Pettigrew Tocito
Reservoir: Tocito Sandstone
County: Rio Arriba
State: New Mexico

Elev:
File: LO-853
Date: April 21, 1953
Drilling Fluid:
Remarks: Results obtained from plug analysis



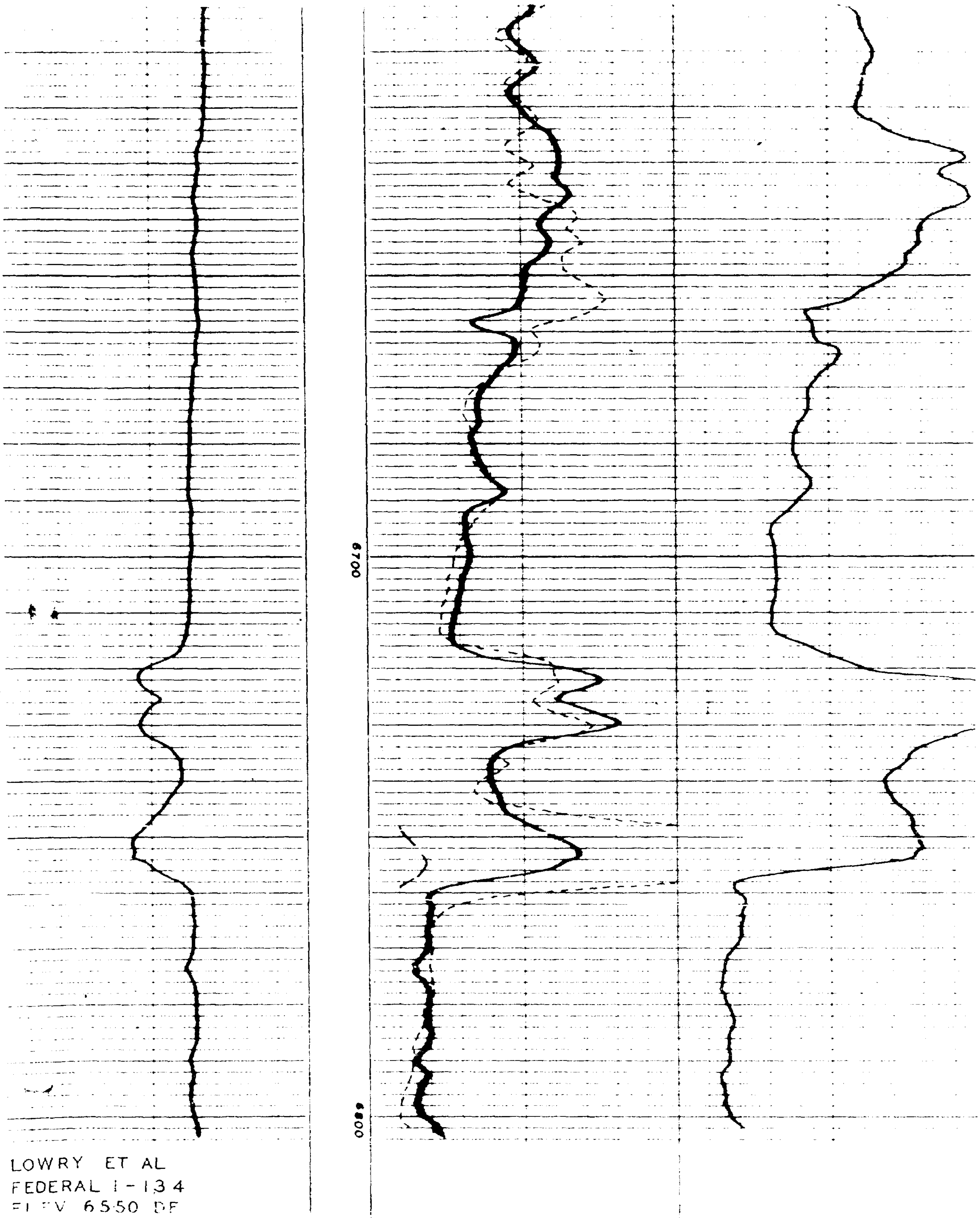
Lowry et al Operating Account

Schlumberger Electric Logs Surveys
and
Schlumberger Microlog Surveys
of
Tocito Sand

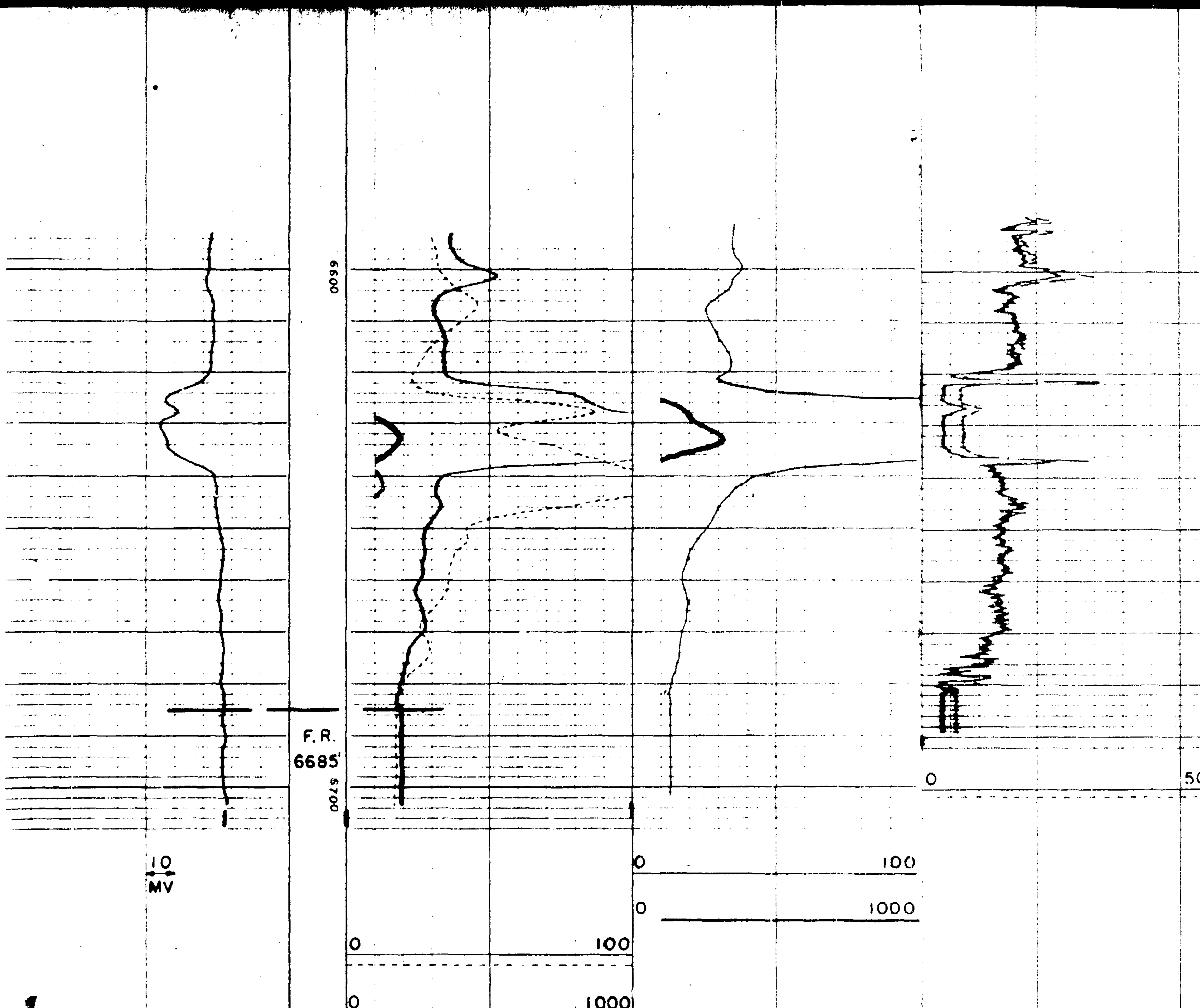
\- - - - - - - - - - - -

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

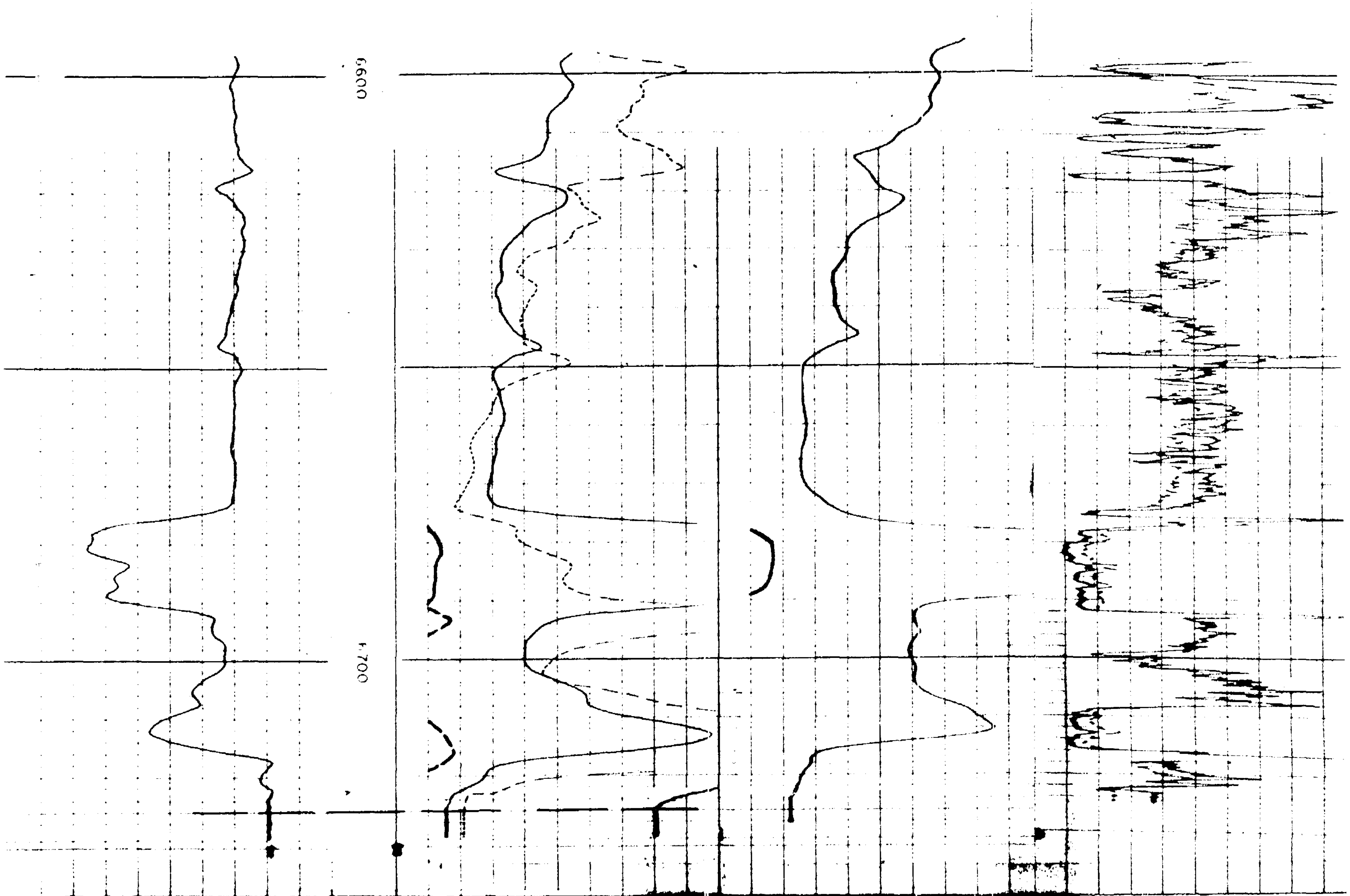
Well No.	Top of Tocito Sand	Elevation	Subsea Datum Top of Tocito Sand
Federal 1-134	6,718	6,550	-168
Federal 2-179	6,622	6,507	-115
Federal 4-13-132	6,676	6,515	-161
Federal 19-34-157	6,819	6,654	-165
Federal 7-35-109	6,682	6,494	-188
Federal 21-40-182	6,705	6,561	-144
Federal 22-45-207	6,643	6,506	-137
Federal 23-49-129	6,583	6,423	-160
Federal 24-50-177	6,605	6,477	-128
Federal 25-51-127	6,629	6,493	-136
State 1-268	6,602	6,514	-88



LOWRY ET AL
FEDERAL 1-134
ELEV 6550 DF



THOS. W. DOSWELL
SCOTT - FEDERAL NO. 2
SEC 9 — 26N — 6W
RIO ARRIBA CO., N.M.



– 10 +

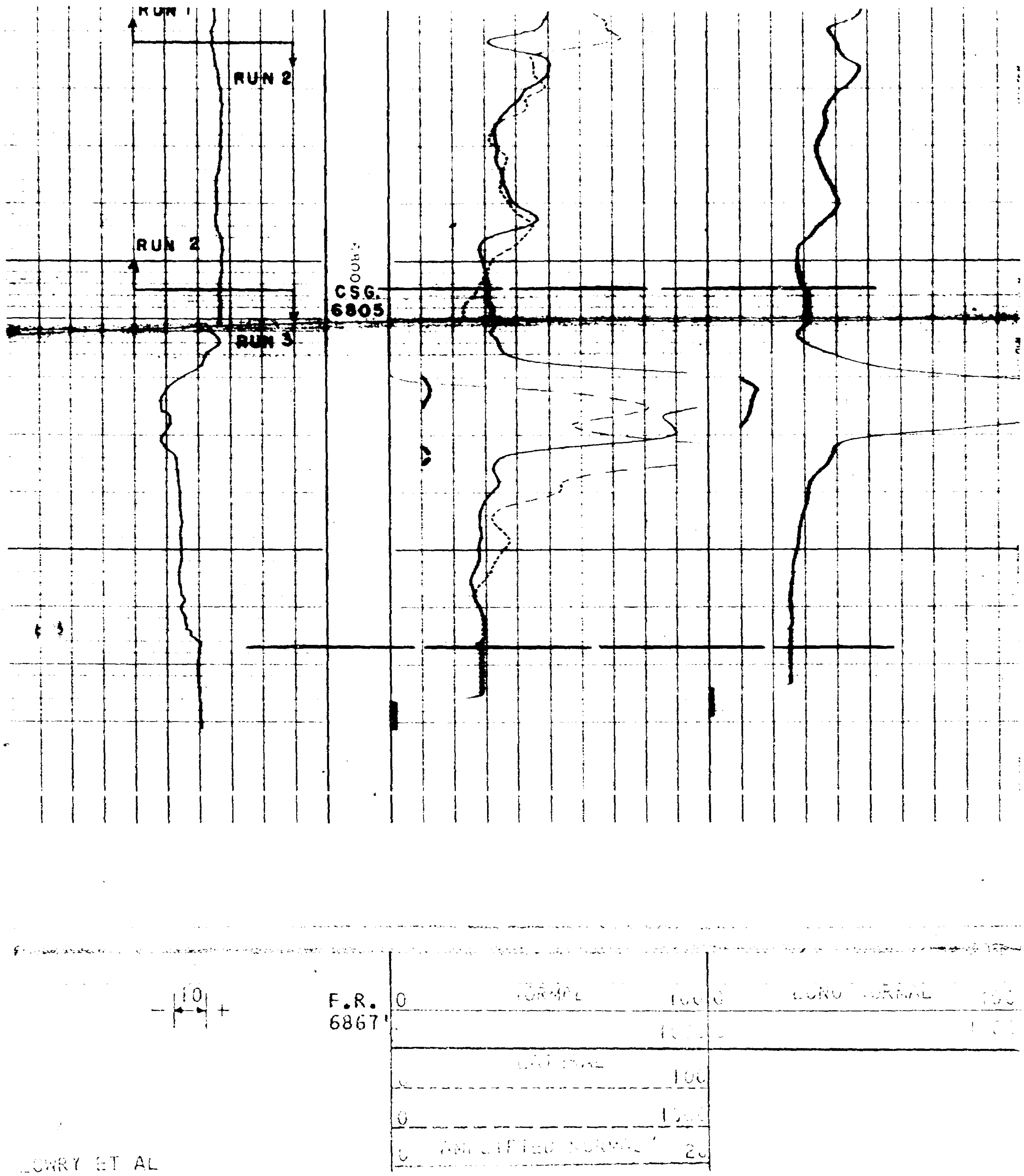
F.R. 6726

NORMAL
0 — 100
0 — 1000
LATERAL
0 — 100
0 — 1000
AMPLIFIED NORMAL
0 — 20

LONG NORMAL
0 — 1000
0 — 10000
0

MICROLOG
AO = 1.5 — 50
AM = 2" — 50

[illegible]RY ET AL
FEDERAL 4-13-132
SEC. 9-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6502 G.L.
6515 K.B.



LOWRY ET AL
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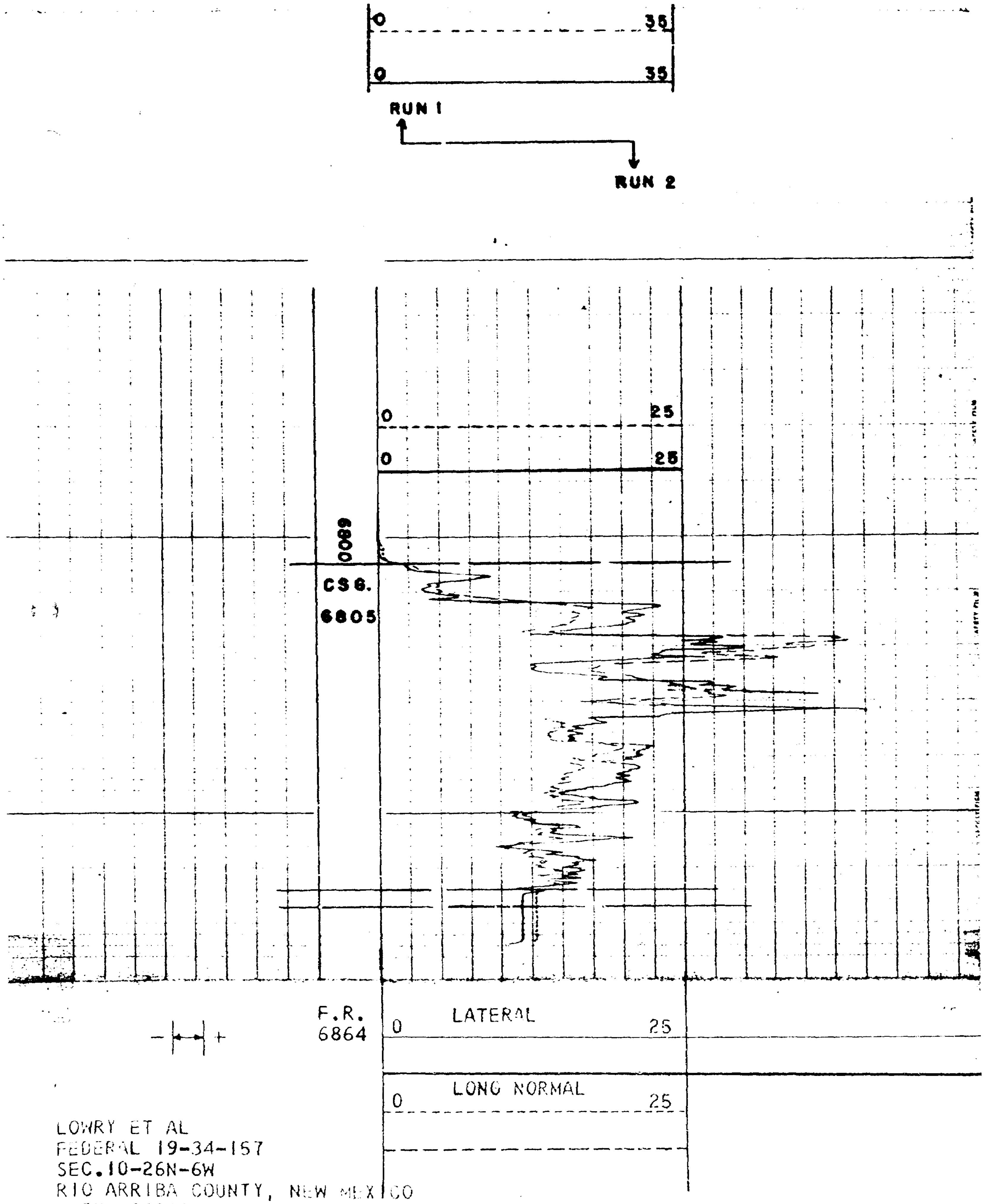
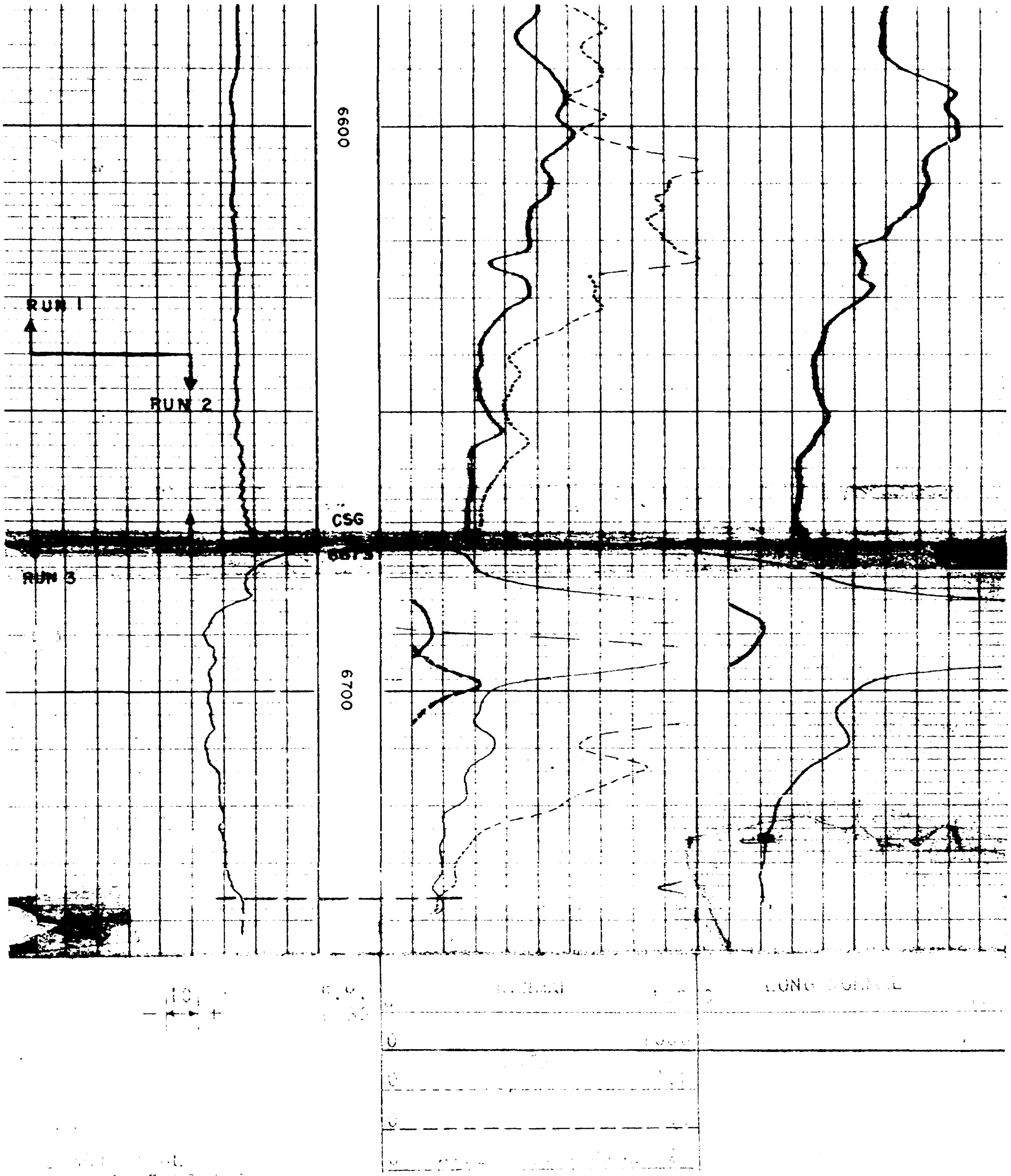
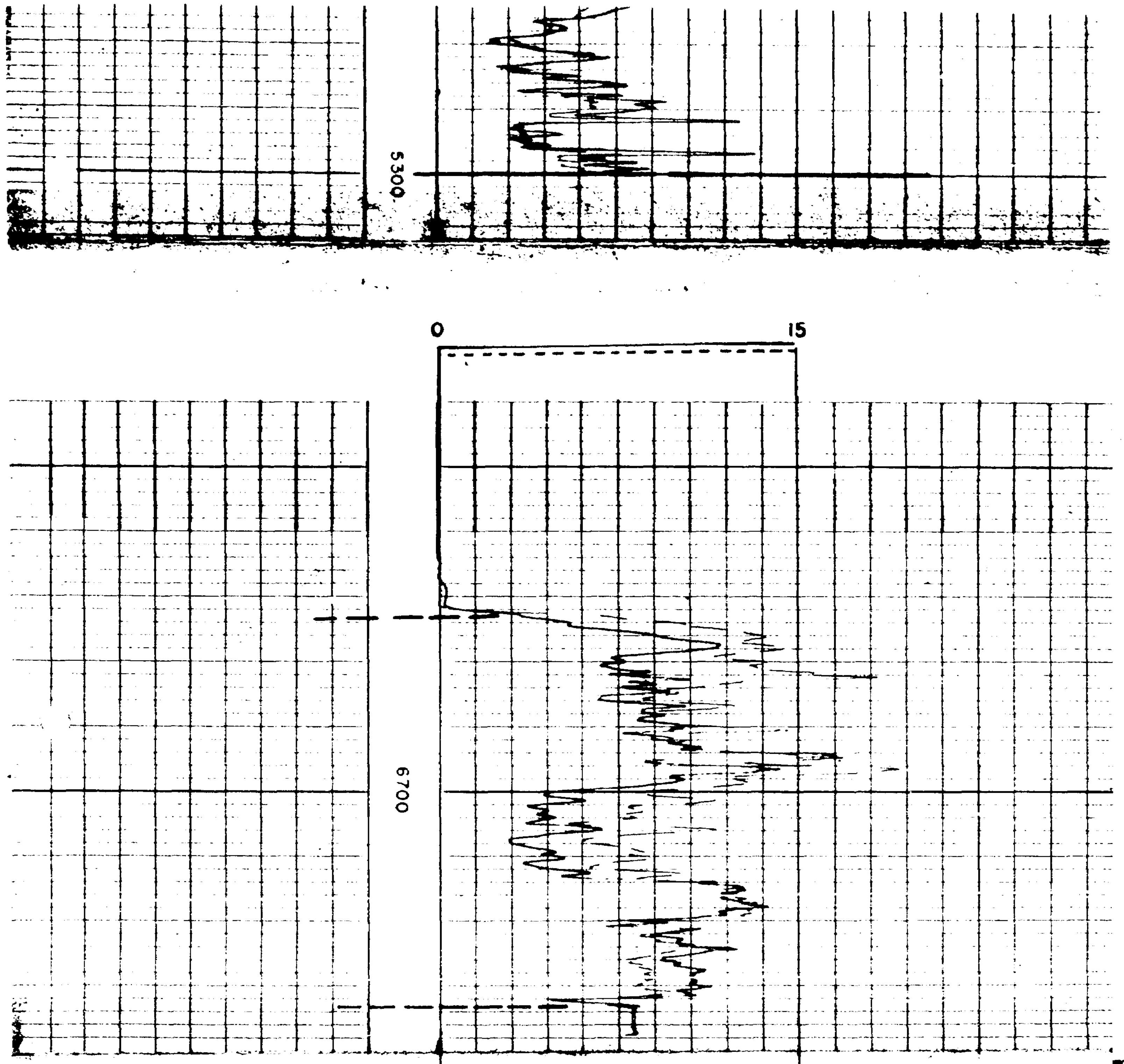
SEC.10-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6633' G.L.



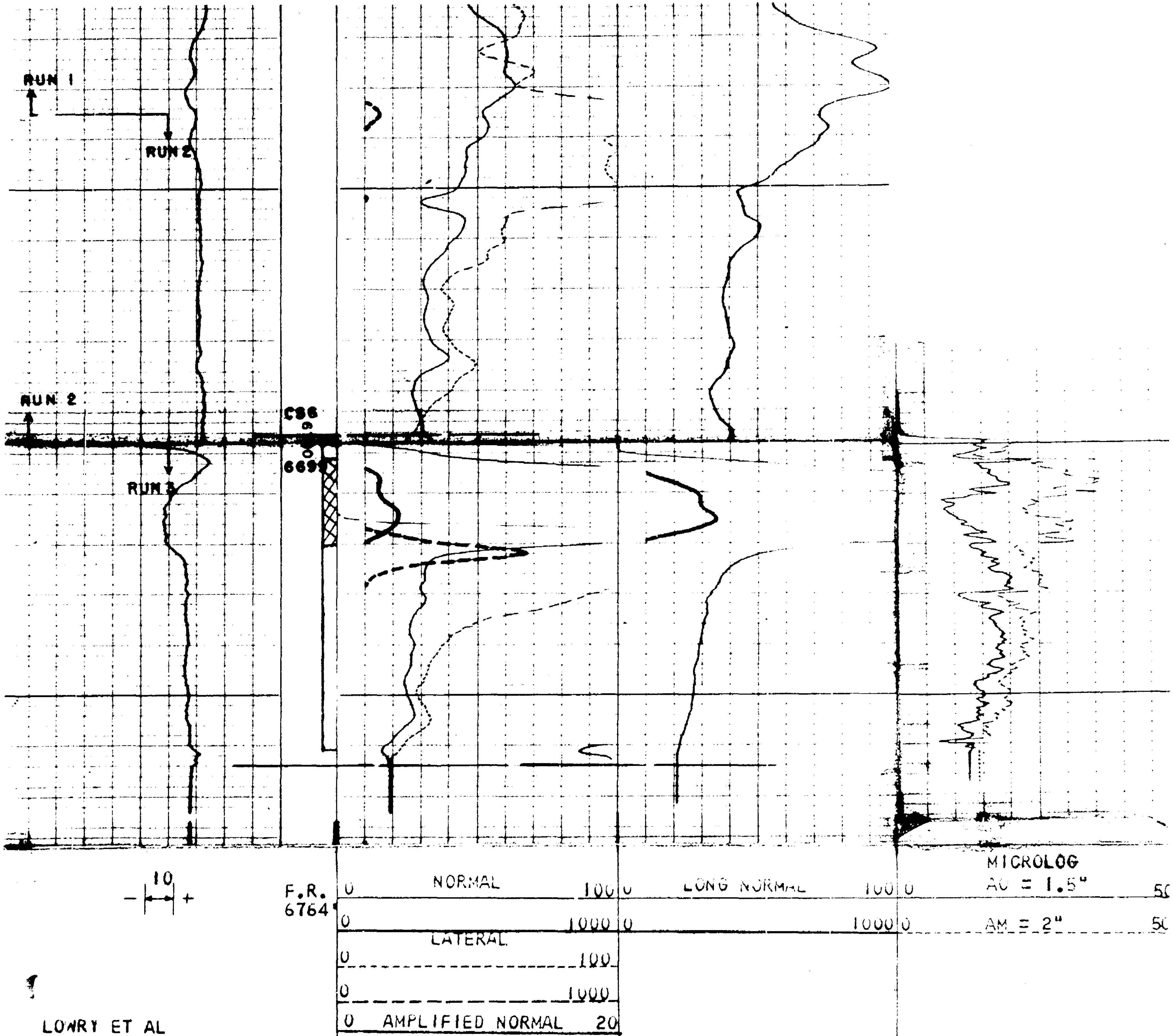
LOWRY ET AL
FEDERAL 19-34-157
SEC.10-26N-6W
RIO ARRIBA COUNTY, NEW MEXICO
ELEV. 6638' G.L.


RUN 1
RUN 2
RUN 3
6600
CSG
6700

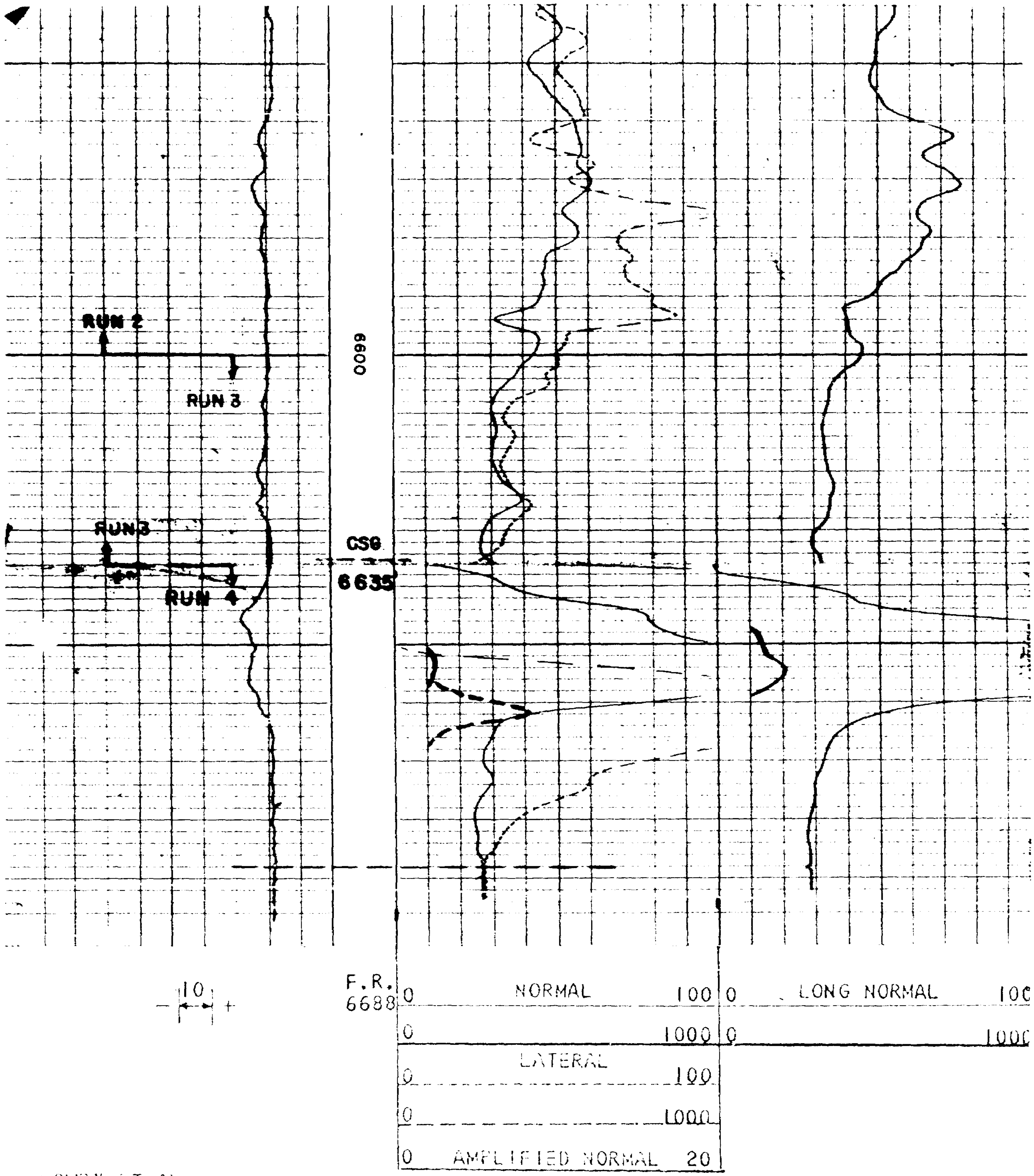


K.R. 6733	0 LATERAL	15
	0 LONG NORMAL	15

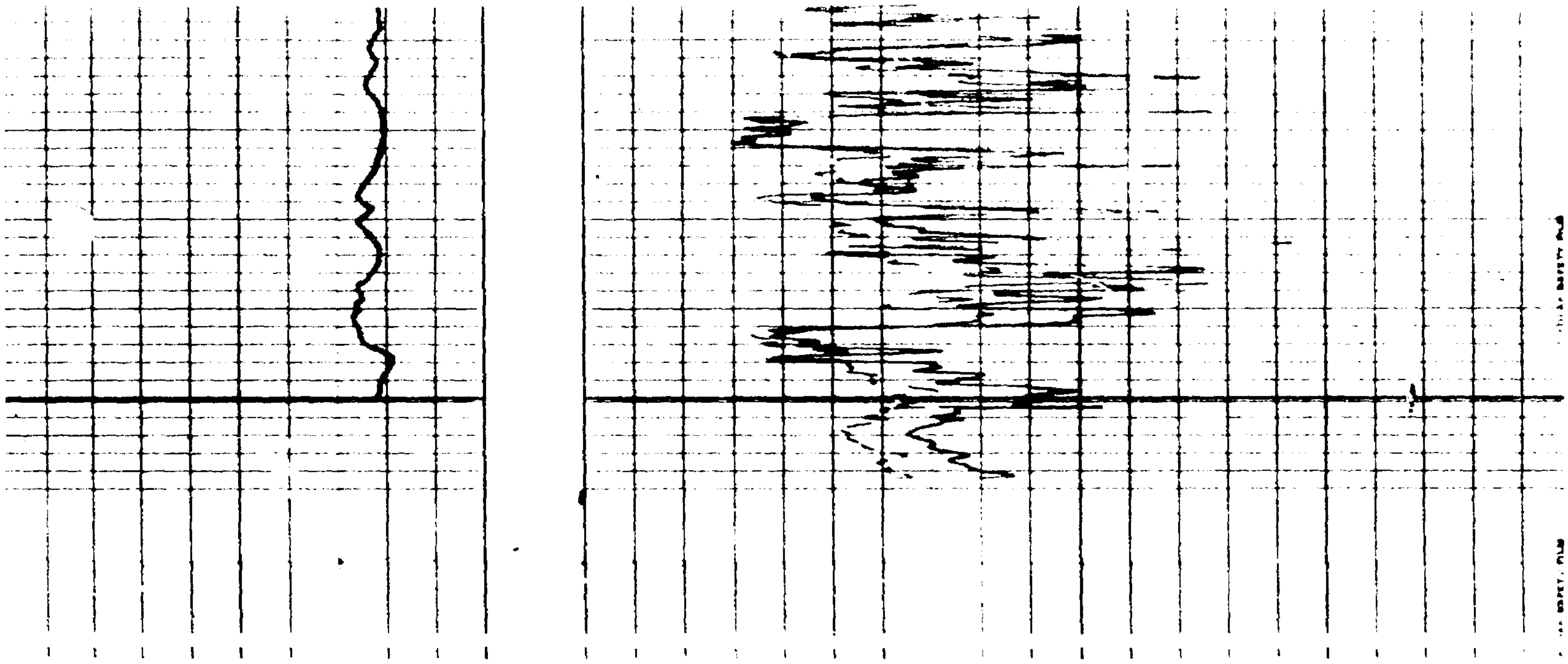
LOWRY ET AL
FEDERAL 7-35-109
SEC.3-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6484' G.L.



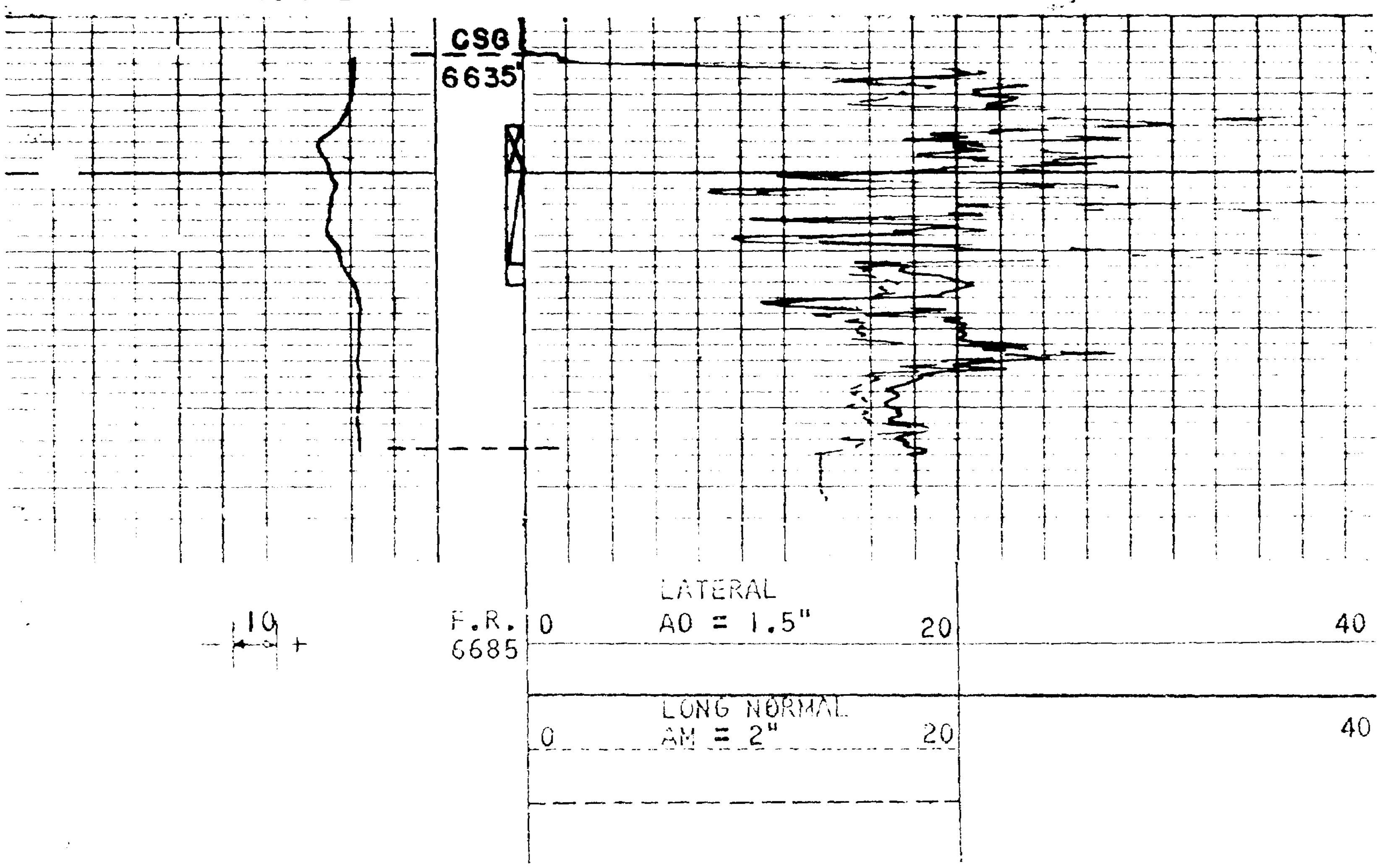
LOWRY ET AL
FEDERAL 21-40-182
SEC. 10-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6552' G.L.



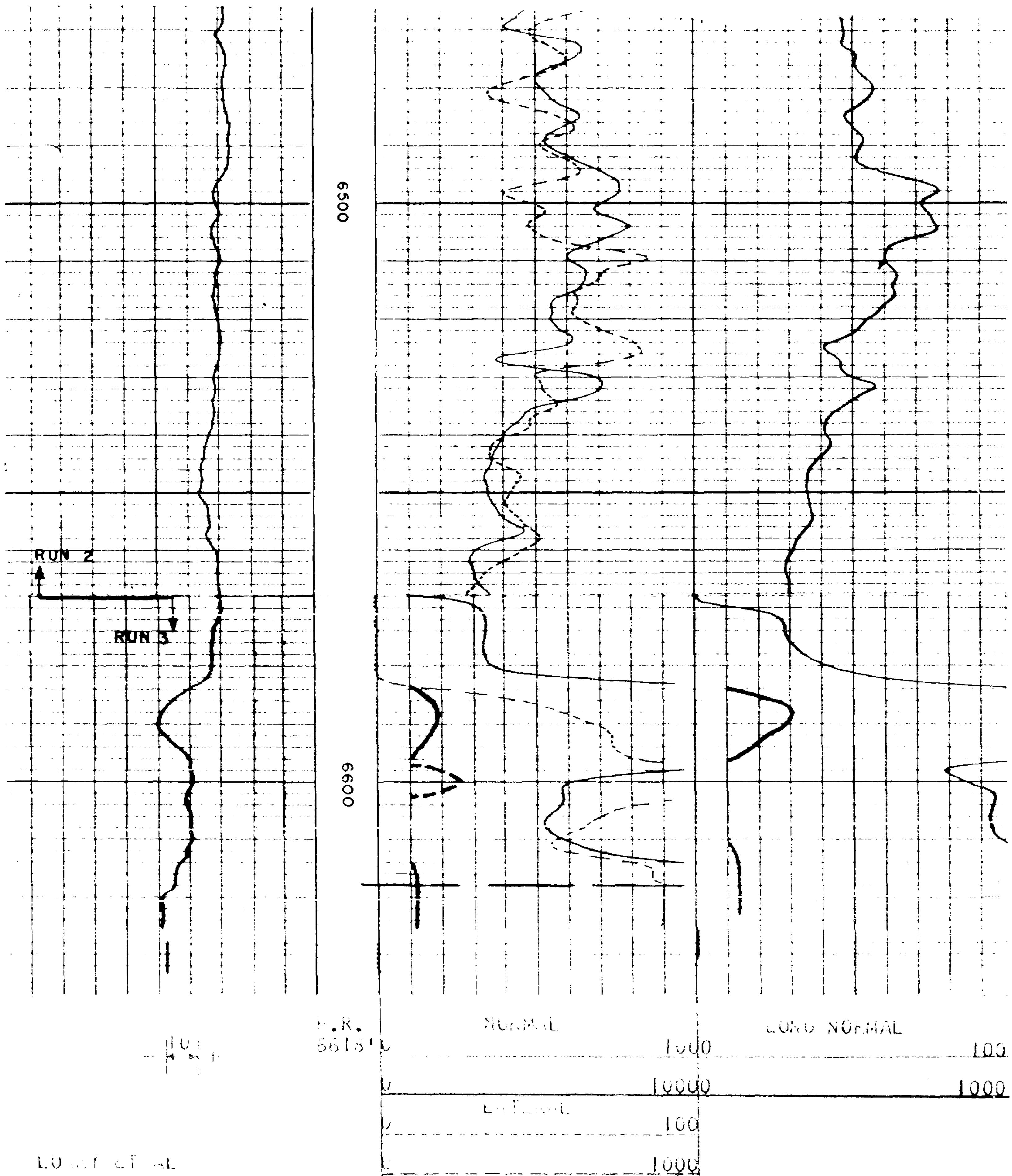
LOWRY ET AL
FEDERAL 22-45-207
SEC.10-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6506' D.F.



RUN 2



LOWRY ET AL
FEDERAL 22-45-207
SEC. 10-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6506' D.F.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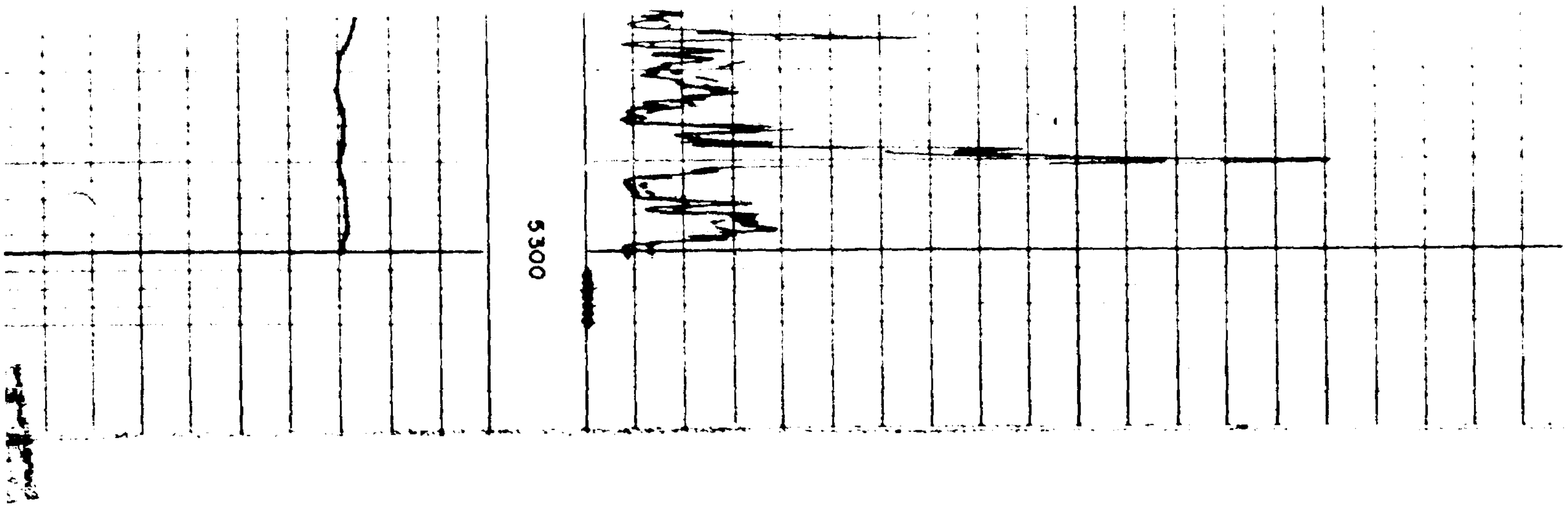
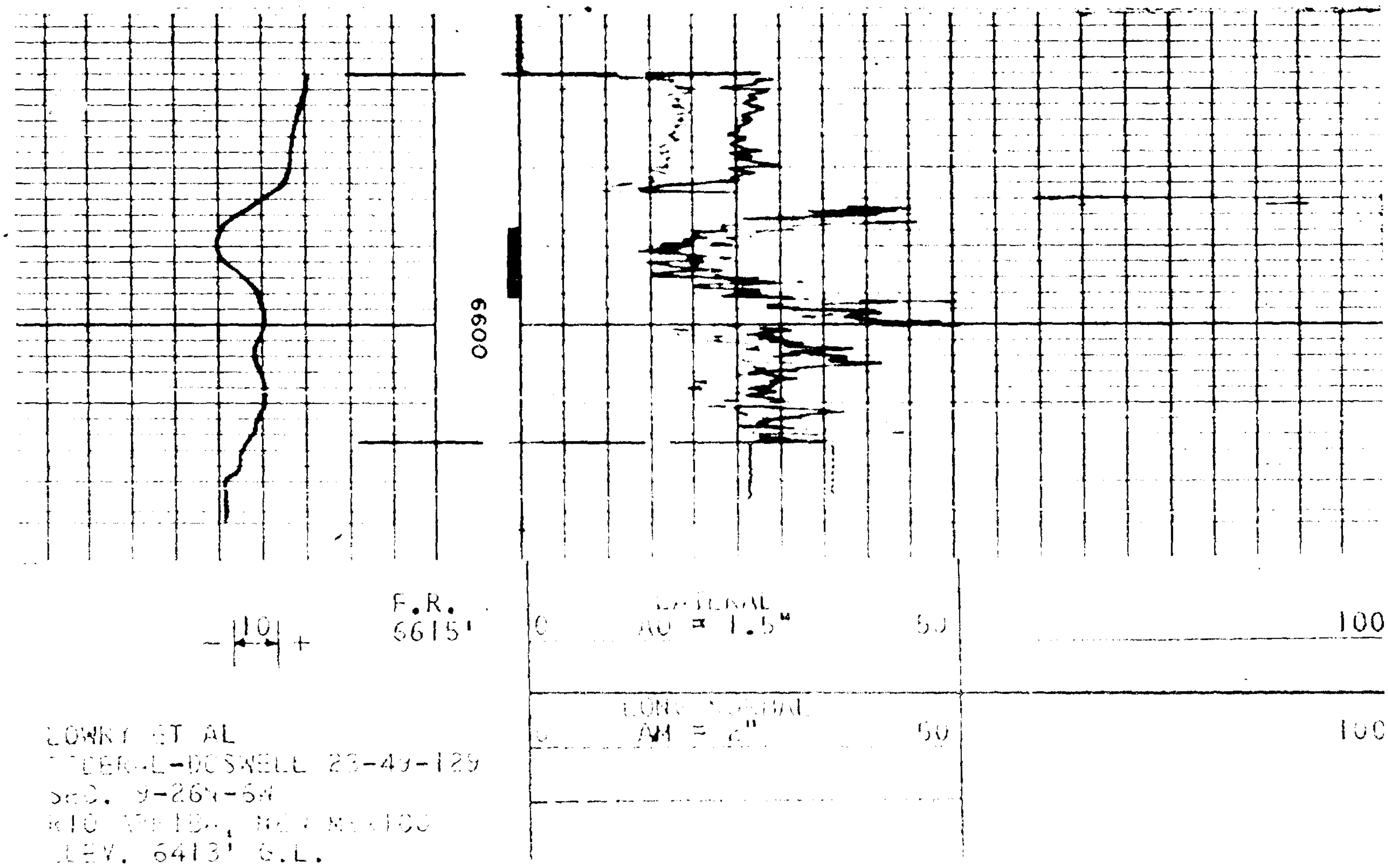
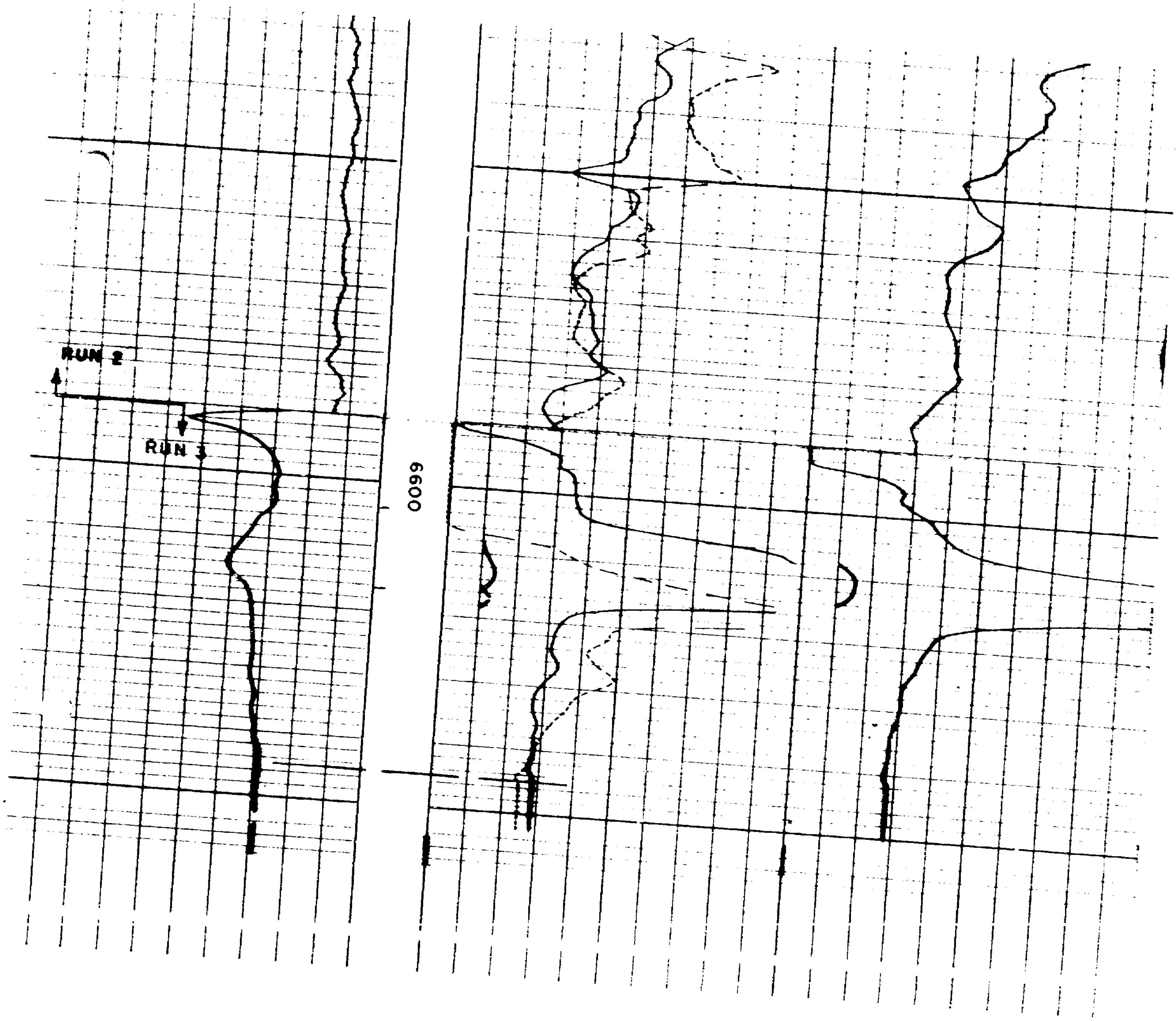
6600
RUN 2
RUN 3
NORMAL
LONG NORMAL
1000
100
10000
1000
100
1000





LOWRY ET AL
FEDERAL-BOSWELL 23-49-129
SEC. 9-26N-5W
RIO ARRIBA, NEW MEXICO
ELEV. 6413' G.L.



10

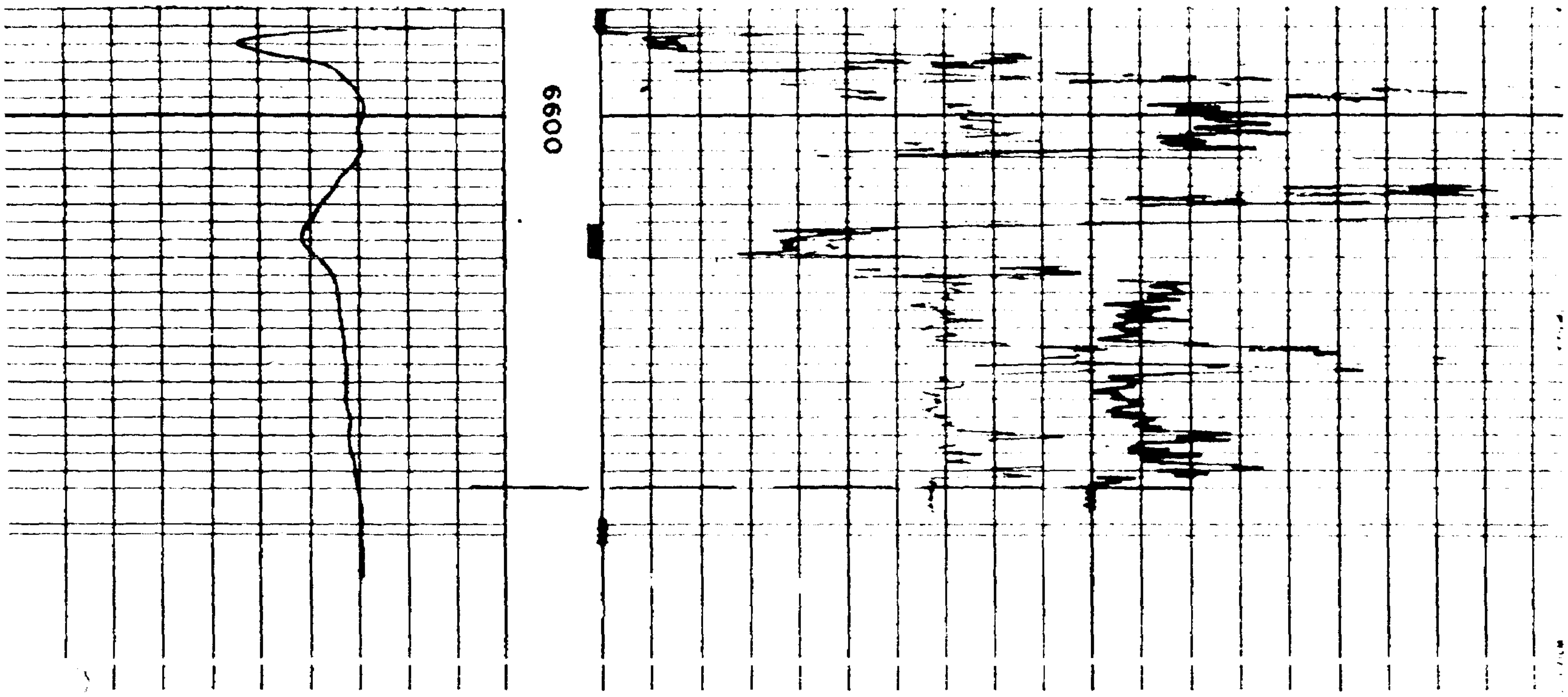
F.R. 6645

NORMAL
0 — 100
0 — 1000

LATERAL
0 — 100
0 — 1000

LONG NORMAL
0 — 100
0 — 1000

L[illegible]RY ET AL
FEDERAL DOSWELL #24-50-177
SEC. 9-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6466' G.L.



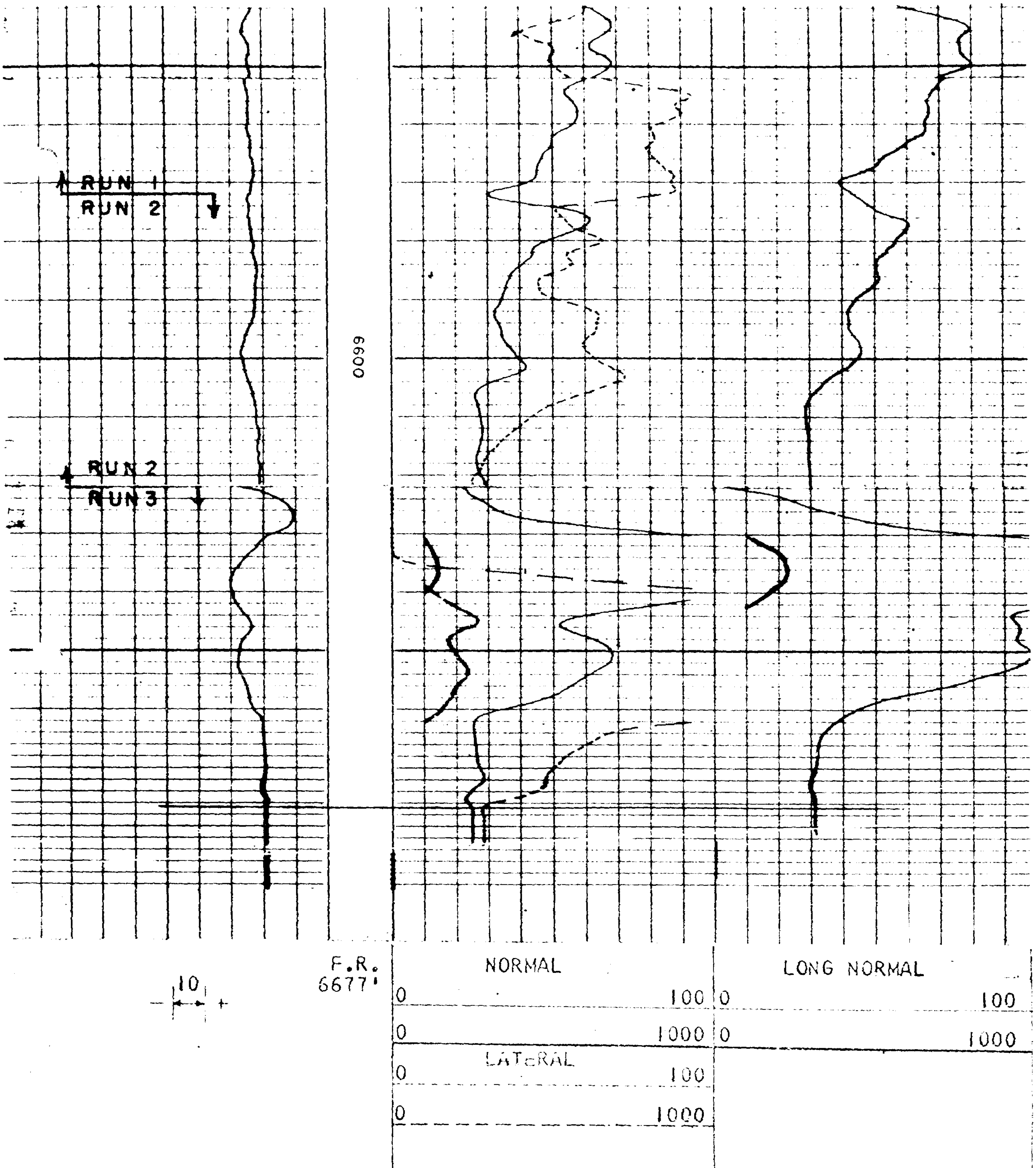
10

F.R.
6645'

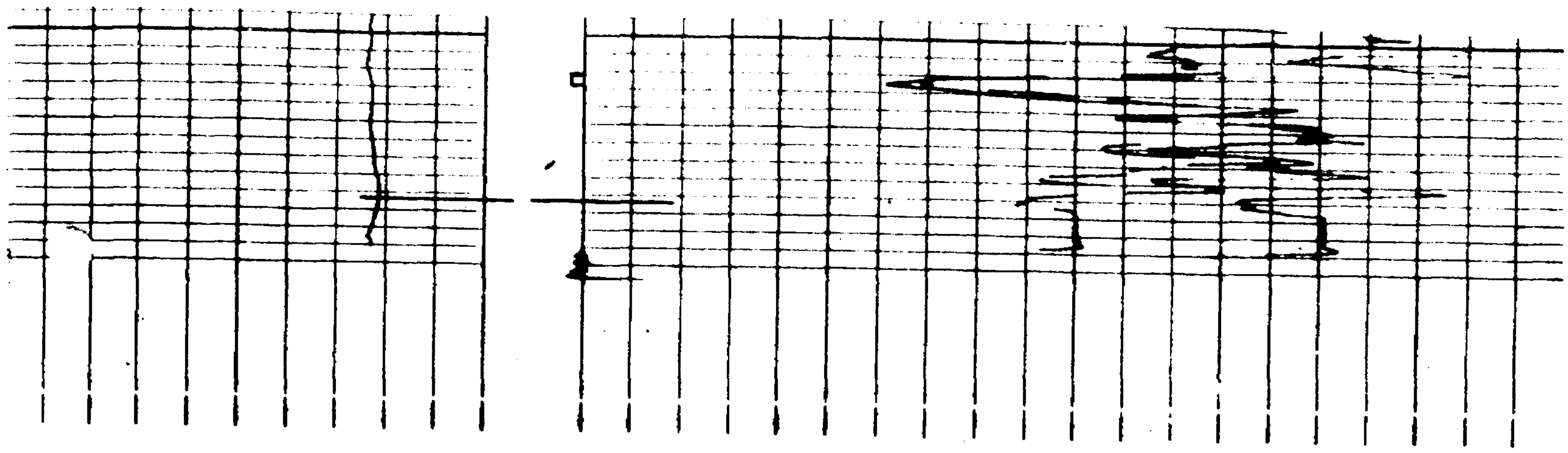
0 Micro Inverse 1"x1" 20 40

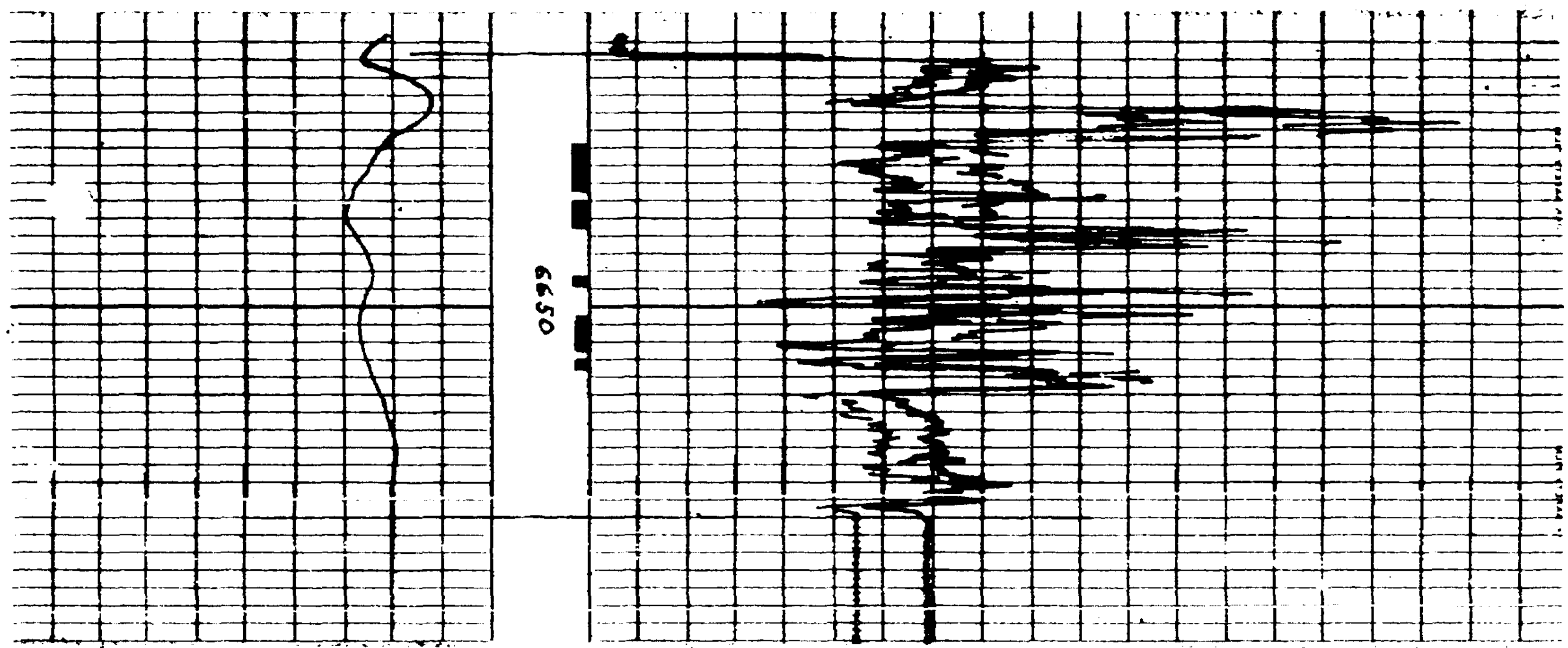
0 Micro Normal 2" 20 40

LOWRY ET AL
FEDERAL DOSWELL #24-50-177
SEC. 9-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6466' G.L.



LOWRY ET AL
FEDERAL DOSWELL 25-51-127
SEC. 8-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6482' G.L.



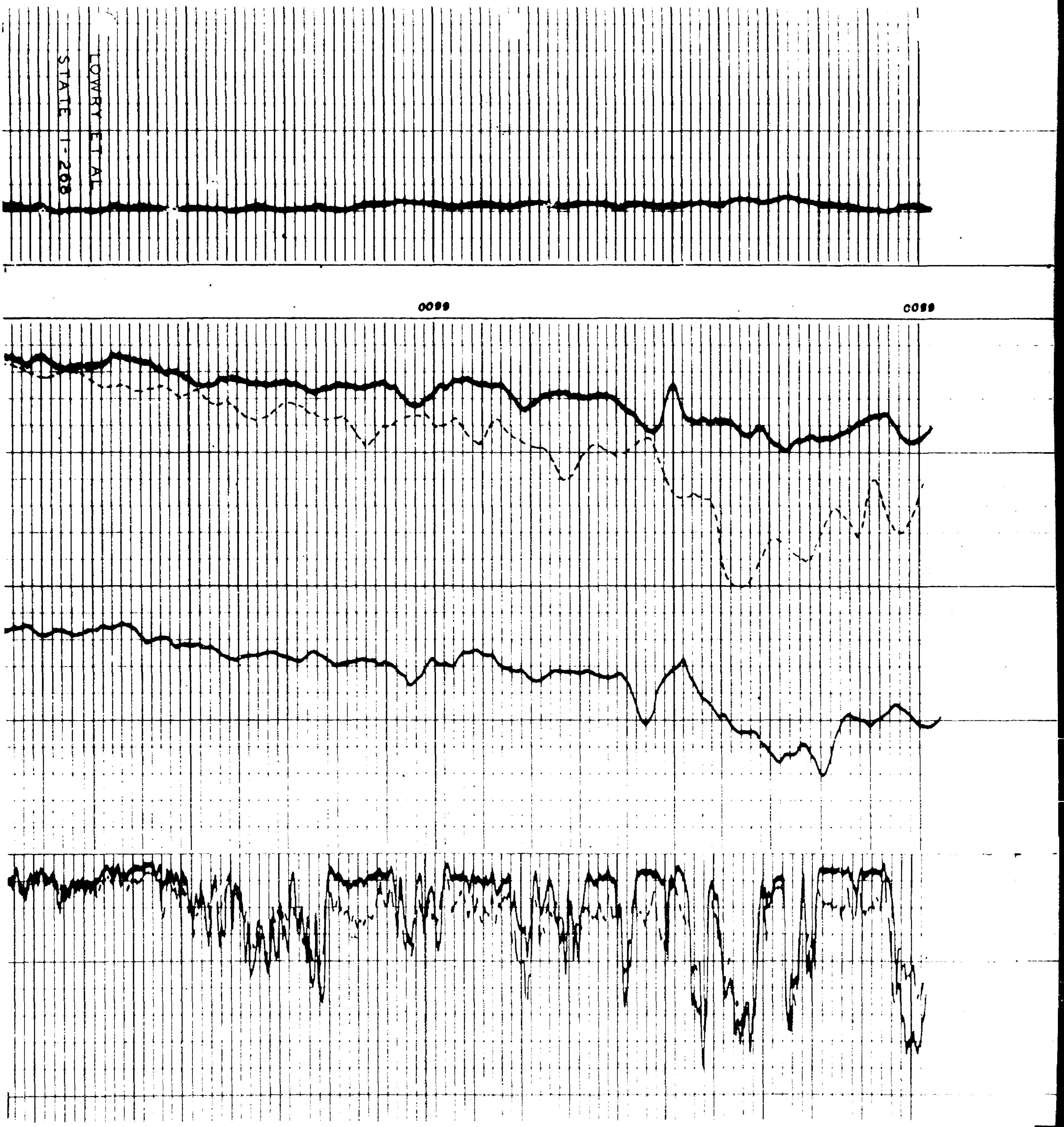


F.R.
6674'

10

0 Micro Inverse 1"x1"	20	40
0 Micro Normal 2"	20	40

LOWRY ET AL
FEDERAL DOSWELL #25-51-127
SEC. 8-26N-6W
RIO ARRIBA, NEW MEXICO
ELEV. 6432' G.L.


LOWRY ET AL
STATE 1-268
6600
6600

WEST TEXAS ENGINEERING SERVICE, INC.

Midland, Texas

January 24, 1952

Lowry, et al
Room 213-215
616 East Central Ave.
Albuquerque, New Mexico

Attention: Mr. Hunt

Gentlemen:

Under separate cover, we have submitted a report on the analysis of a reservoir fluid sample taken by our field engineers Messrs. Cates and Black, on your Federal Doswell #4-13, Rio Arriba County, New Mexico.

The bubble point pressure was measured at 2054 pounds per square inch gauge at 175° F. Since the reservoir pressure is 2137 p.s.i.g. this indicates that the oil in the reservoir is slightly undersaturated with gas, but that gas will begin to be liberated as the pressure is reduced by withdrawal. There fore it may be concluded that unless some pressure maintenance effect (water drive, for example) is observed your operating gas-oil ratio will start to rise fairly soon.

By differential liberation the reservoir oil at 175° F. (reservoir temperature) yielded 862 cubic feet of gas (measured at 60° F. and atmospheric pressure) per barrel of stock tank oil. During this process 1.526 barrels of saturated reservoir oil shrank to one barrel of stock tank oil. This means that the reservoir oil will shrink by about 35% of its volume before reaching the stock tank. It is my understanding that you already maintain a relatively high separator pressure. Bearing in mind the above figure of 35% shrinkage, it might be well to maintain a slight pressure on the tanks and keep the oil as low in tempera-ture as practicable. While there is not much to be gained by raising the gravity, since this figure is already in the 40's, this maintenance of high pressure and low temperature will keep weathering to a minimum and enable the retention of the greatest liquid volumes possible.

So much for my suggestions on the physical application of these data. Further use can be made in connection with your core analysis on this reservoir. A theoretical calculation can be made of your reserves by use of the formula:

$$\frac{7758 \times P \times (1-C) \times RF}{1.526} = \text{Bbl. Stock Tank Oil per Acre Foot}$$

where 7758 = 1 Acre foot in Bbl. (Known)
P = % Porosity (From core analysis)
C = % Connate water (From core analysis)
RF = % Recovery factor*
1.526 = Relative liquid volume (From sample data)

Then take B.S.T.O./Ac. Ft. x sand thickness x no. of acres of estimated drainage to bore hole = ultimate recovery.

*Just an additional word regarding "RF" above. This relation can be assumed from the data at hand to be around 20 to 25 percent.

I trust that this answers your question in regard to the use of the bottomhole sample analysis. While normally the analysis is used in connection with core analysis, decline curves, subsequent tests, etc. by the operators own engineers or consultants, I am happy if this is of some use to you. It is good information to have if only to "hang on the wrench" for near future use and like virgin reservoir pressures cannot be had or estimated in the later life of the field.

Thank you for this opportunity of serving you and we are looking forward to moving in up there as soon as the volume warrants our doing so.

Very truly yours,

[illegible], Inc.

/s/ [illegible] Nagler

[illegible] Nagler

[illegible]

Bottom Hole Sample Analysis

Federal Doswell # 4-13

Wildcat Field

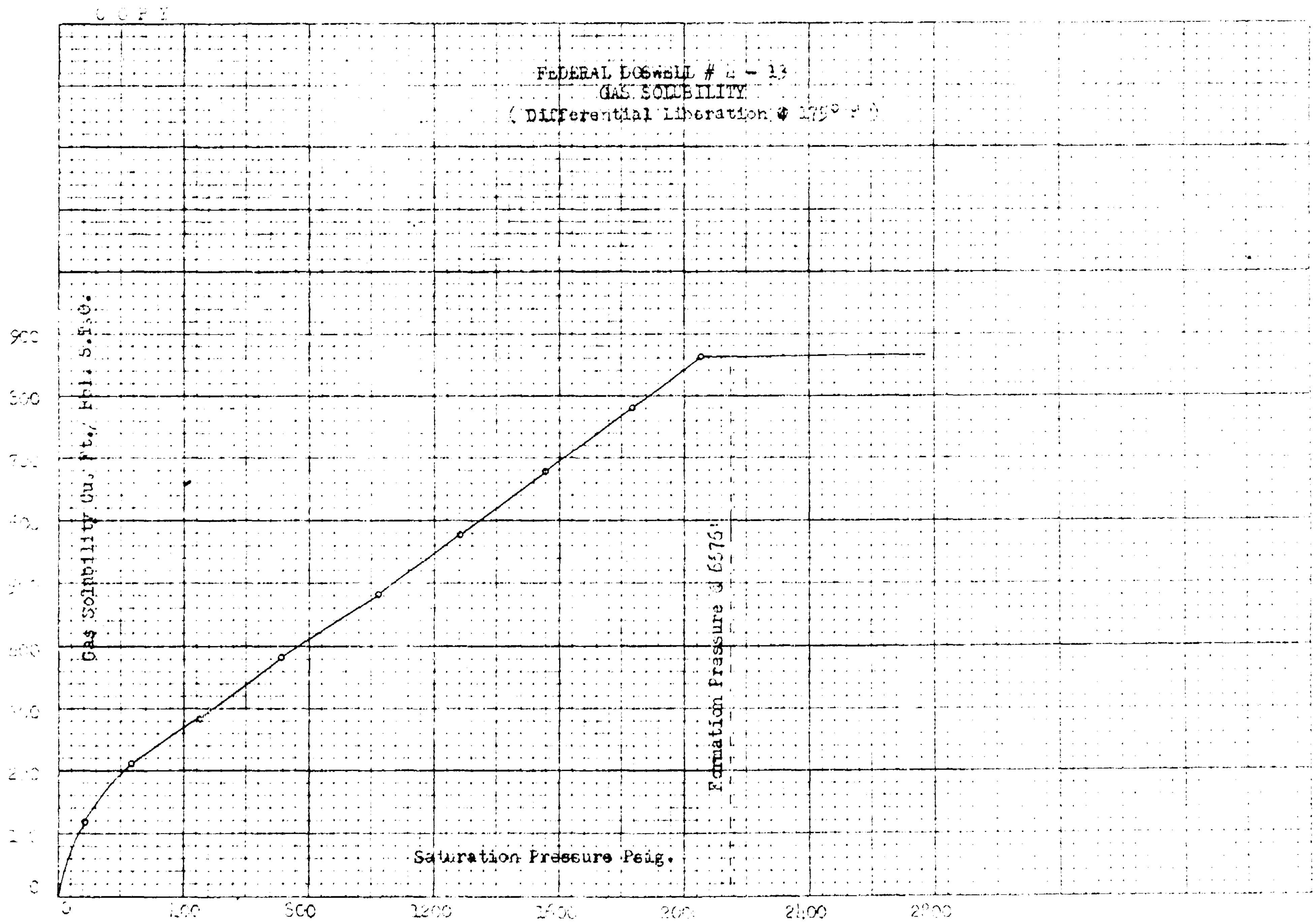
Rio Arriba County, New Mexico

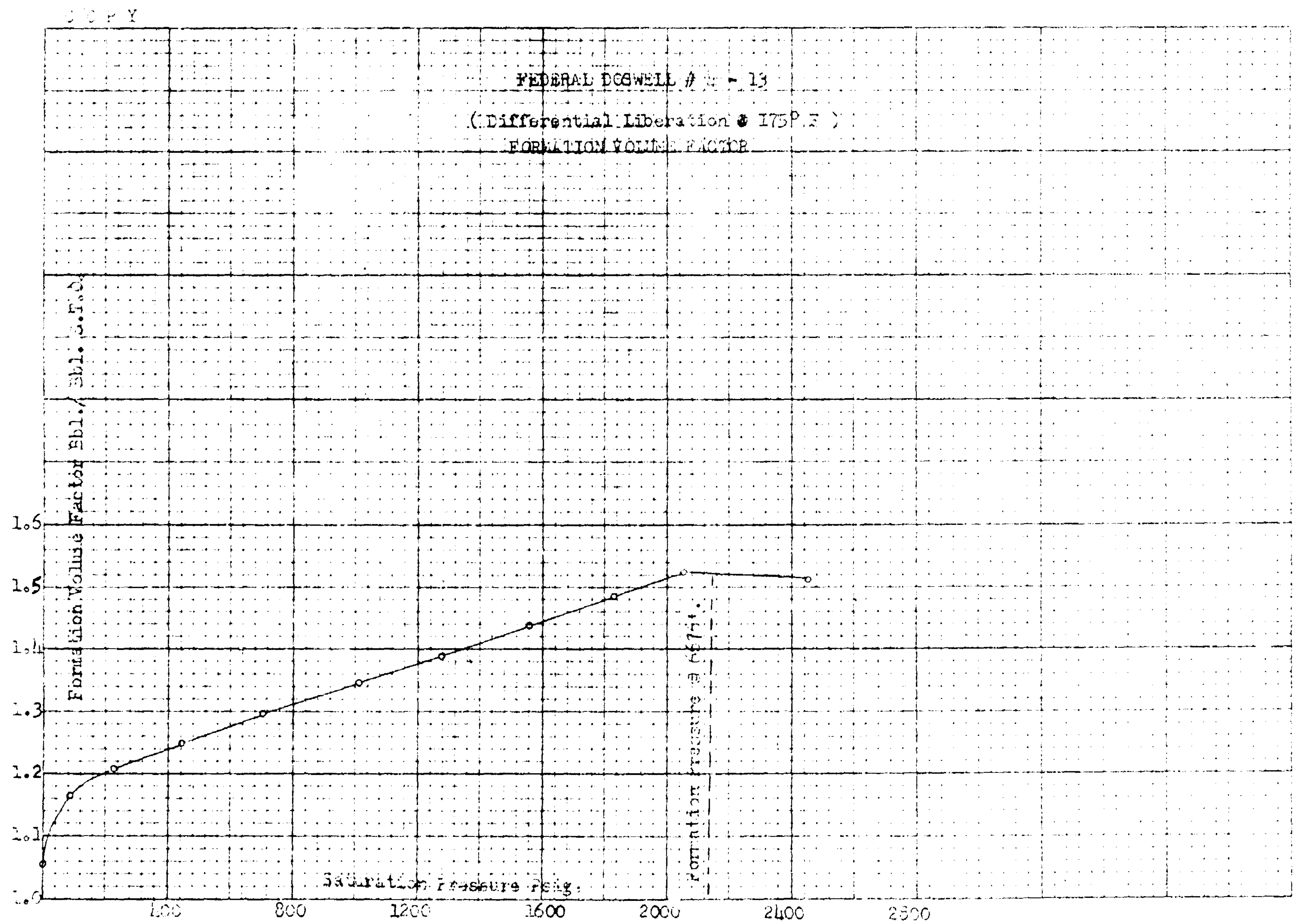
Date Sample Taken	January 2 & 3, 1952
Date Analyzed	January 11, 1952
Shut-In Prior to Sampling	24 Hours
Sampling Depth	6676'
Pressure at 6676'	2137 psi
Tubing Depth	6697'
Top of Tocito Formation	6676'
Temperature @ 6676'	175° F

TEST SUMMARY

Saturation Pressure	2054 psig
Gas in Solution @ 2054 (Differential Lib.) Gas corrected to 14.7 psi & 60° F	862 Cu. Ft./Bbl.
Relative Liquid Volume (2054 psi and 175° F)	1526 Bbl./Bbl. S. T. O.
Thermal Coefficient of Expansion (Sat. Oil & 3000 spig 73° to 150° F)	6.4×10^{-4} Cuft/Cuft/° F.
From 73° F to 175° F	6.55×10^{-4} Cuft/Cuft/psig
Compressibility Coefficient (Saturated Oil @ 175° F)	
From 2054 psi to 2180 psi	13.95×10^{-6} Cuft/cuft/psi
From 2054 psi to 2434 psi	15.40×10^{-6} Cuft/Cuft/psi
From 2054 psi to 2723 psi	15.90×10^{-6} Cuft/Cuft/psi

C O P Y


COPY
FEDERAL LOWELL # - 13
GAS SOLUBILITY
(Differential Liberation @ 175° F)
Gas Solubility Cu. Ft./ Bbl. S.T.O.
Saturation Pressure Psig.
Formation Pressure @ 6575'
0
900
0
500
2400


COPY
FEDERAL DOSWELL # - 13
(Differential Liberation @ 175°F.)
FORMATION VOLUME FACTOR
Formation Volume Factor Bbl./ Bbl. S.T.O.
1.0
1.1
1.2
1.3
1.4
1.5
1.6
400
800
1200
1600
2000
2400
2800
Saturation Pressure Psig.
Formation Pressure @ 6671'.

Case 537

LOWRY et al OPERATING ACCOUNT

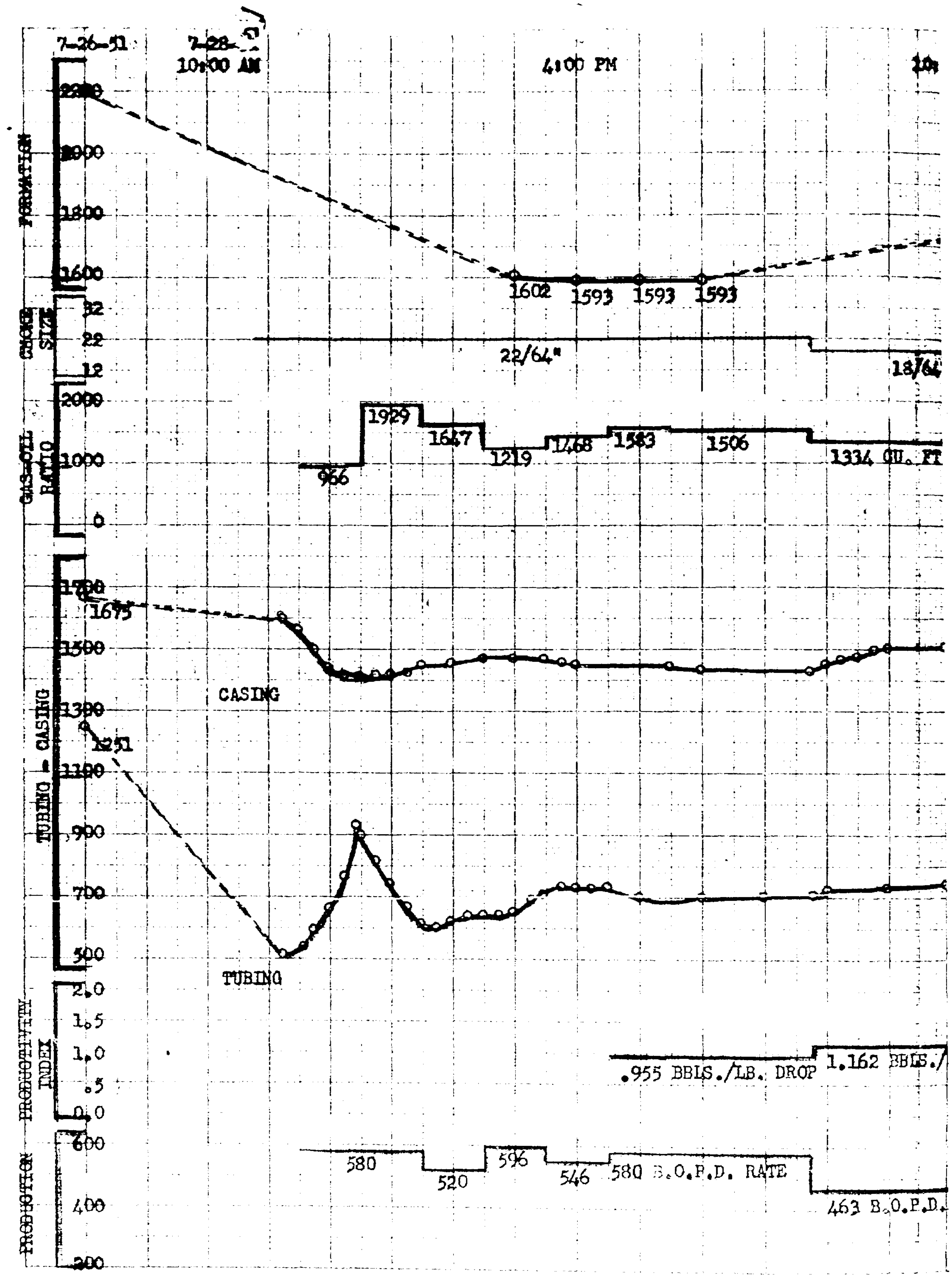
- - - - - - - - - - - - - - - -

PRODUCTIVITY INDEX TESTS

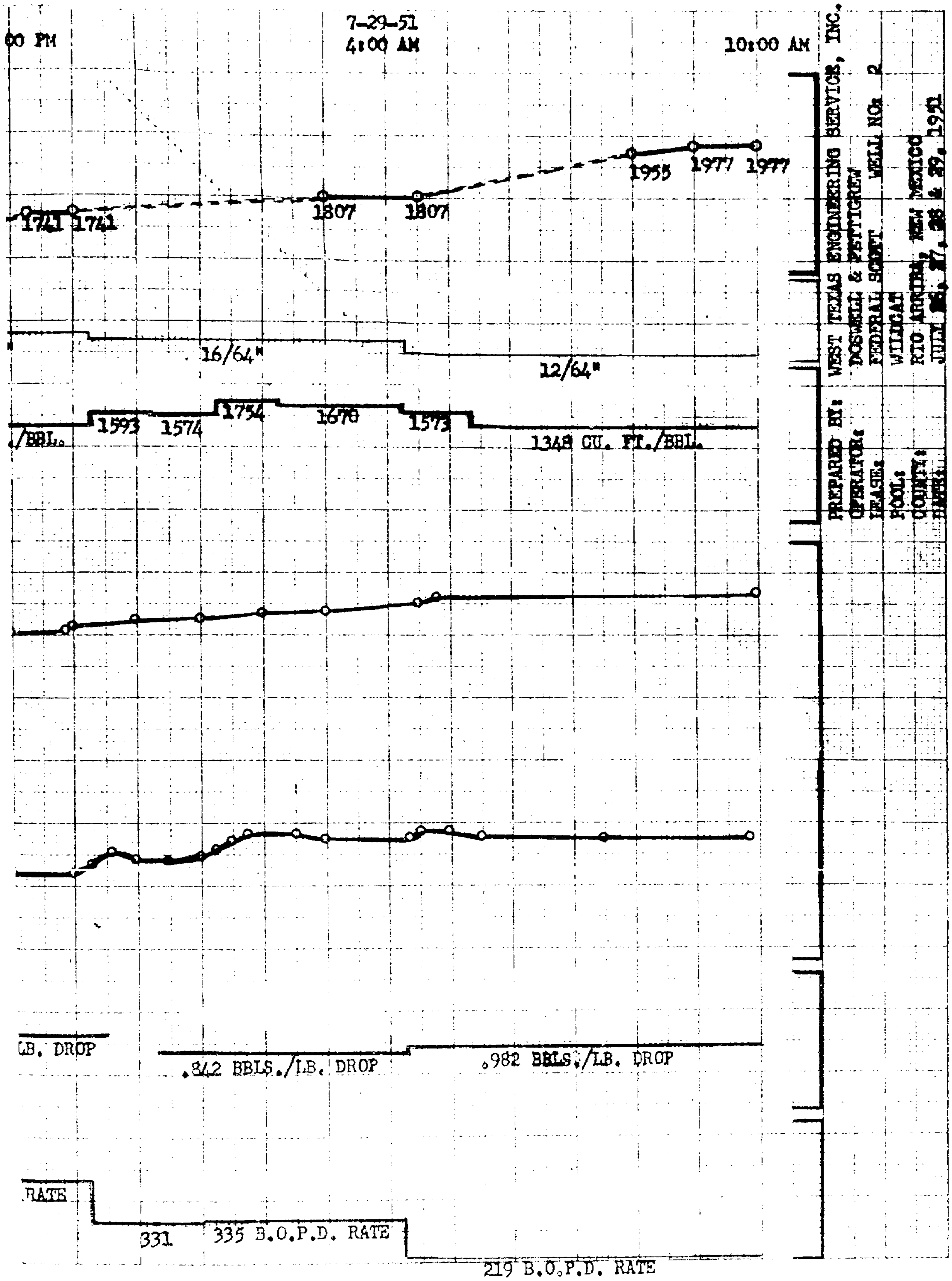
Federal 2-179

March 26, 1951 to March 29, 1951

WEST TEXAS ENGINEERING SERVICE, INC.
Midland, Texas



7-26-51
7-28-51
10:00 AM
4:00 PM
FORMATION
2200
2000
1800
1600
1602
1593
1593
1593
CHOKE SIZE
32
22
12
22/64"
18/64
GAS-OIL RATIO
2000
1000
0
966
1929
1647
1219
1468
1583
1506
1334 CU. FT
TUBING - CASING
1700
1675
1500
CASING
1300
1251
1100
900
700
500
TUBING
PRODUCTIVITY INDEX
2.0
1.5
1.0
.5
0.0
.955 BBLS./LB. DROP
1.162 BBLS./
PRODUCTION
600
400
200
580
520
596
546
580 B.O.P.D. RATE
463 B.O.P.D.


7-29-51
4:00 AM
00 PM
10:00 AM
1741 1741
1807
1807
1955
1977 1977
16/64"
12/64"
/BBL.
1593
1574
1734
1670
1573
1348 CU. FT./BBL.
LB. DROP
.842 BBLS./LB. DROP
.982 BBLS./LB. DROP
RATE
331
335 B.O.P.D. RATE
219 B.O.P.D. RATE
PREPARED BY: WEST TEXAS ENGINEERING SERVICE, INC.
OPERATOR: DOSWELL & PETTIGREW
LEASE: FEDERAL SCOTT WELL NO. 2
POOL: WILDCAT
COUNTY: RIO ARRIBA, NEW MEXICO
DATE: JULY 27, 28 & 29, 1951

W. T. HAGLER
H. L. HAGLER
W. M. CATES
C. H. PICKENS
R. W. HARRINGTON
D. R. WATSON, JR.
B. E. BLACK
FIELD PETROLEUM ENGINEERS

WEST TEXAS Engineering SERVICE INC.

P. O. BOX 1637
TELEPHONE 4-4451
FREETAG BUILDING
223 S. BIG SPRING ST.
MIDLAND, TEXAS
FULL INSURANCE COVERAGE

INDIVIDUAL WELL DATA SHEET

Company Donnell & Pettigrew Lease Federal Scott Well No. 2

Field Hilliard County [illegible] State New Mexico

Test Date 7-26-51 Time 11:05 AM Status of Well S. I.

Top of Pay 6622' Total Depth ______ Producing Formation ______

Tubing 2" EUE Depth 6615' B.H.C. ______ Packer ______ Pressure Datum ______

Casing ______ Depth ______ Perf. ______ Liner ______ Packer ______

Depth Feet	Δ Depth	Pressure Lbs. Sq. In.	Δ Pressure	Gradient Lbs./Ft.		
Surface		1257			Casing Press.	1673
	4910		417	.085	Tubing Press.	1257
4910		[illegible]			Top of Fluid	4900'
	1000		302	.302	Top of Water	No
5910		[illegible]			Hrs.- Shut In	43 Flowing
	715		[illegible]	.[illegible]	Temp. @	6615' = 174° F.
6615		[illegible]			Elev.-D.F.	[illegible] Gr. 6/56
					Last Test Date	Initial
					Press. Last Test	
					B.H.P. Change	
					Gain - Loss/Day	
					Choke Size	
					Oils Bbls/day	
					Water Bbls/day	
					Total Bbls/day	
					Orifice & Line	
					Static & Differential	
					Gas Sp. Gr.	
					Cu. Ft./day	
					GOR	
					GFR	

PRODUCTIVITY INDEX-BBLS./DAY/LBS. DROP

Last Cumulative Production ______ Present Cumulative Production ______ Production Between Tests ______

Instrument ______ Number ______ Recovery Factor Bbls/pound Loss ______

Run By ______ Calibration No ______ Calculated By ______

Calculations and Remarks:

W. T. HAGLER
H. L. HAGLER
W. M. CATES
C. H. PICKENS
R. W. HARRINGTON
D. R. WATSON, JR.
B. E. BLACK
FIELD PETROLEUM ENGINEERS

WEST TEXAS Engineering SERVICE INC.

P. O. BOX 1637
TELEPHONE 4-4451
FREETAG BUILDING
223 S. BIG SPRING ST.
MIDLAND, TEXAS

FULL INSURANCE COVERAGE

INDIVIDUAL WELL DATA SHEET

Company [illegible] Lease [illegible] Well No. 2

Field [illegible] County [illegible] State [illegible]

Test Date [illegible] Time [illegible] Status of Well [illegible]

Top of Pay [illegible] Total Depth ____ Producing Formation ____

Tubing 2" Depth [illegible] B.H.C. ____ Packer ____ Pressure Datum ____

Casing ____ Depth ____ Perf. ____ Liner ____ Packer ____

Depth Feet	Δ Depth	Pressure Lbs. Sq. In.	Δ Pressure	Gradient Lbs./Ft.		
Surface		671			Casing Press.	700
	1915		[illegible]	.127	Tubing Press.	677
1915		[illegible]			Top of Fluid	
	2000		[illegible]	[illegible]	Top of Water	No
[illegible]		[illegible]			Hrs.- Shut In	Flowing 9
	500		[illegible]	.175	Temp. @	6615' = 174° F.
4415		1563			Elev.-D.F.	6507, Gr. 6498
	200		[illegible]	[illegible]	Last Test Date	
4615		[illegible]			~~Press.~~ Last Test	[illegible]
					B.H.P. Change	[illegible]
					Gain - Loss/Day	
6615 [illegible]		[illegible]			Choke Size	[illegible]
					Oils Bbls/day	[illegible]
					Water Bbls/day	[illegible]
					Total Bbls/day	[illegible]
					Orifice & Line	[illegible]
					Static & Differential	
					Gas Sp. Gr.	[illegible]
					Cu. Ft./day	[illegible]
					GOR	[illegible]
					GFR	

PRODUCTIVITY INDEX-BBLS./DAY/LBS. DROP

Last Cumulative Production	Present Cumulative Production	Production Between Tests
Instrument	Number [illegible]	Recovery Factor Bbls/pound Loss
Run By [illegible]	Calibration No [illegible]	Calculated By [illegible]

Calculations and Remarks:

STAPLETON PTG. CO., MIDLAND

W. T. HAGLER
H. L. HAGLER
W. M. CATES
C. H. PICKENS
R. W. HARRINGTON
D. R. WATSON, JR.
B. E. BLACK
FIELD PETROLEUM ENGINEERS

WEST TEXAS ENGINEERING SERVICE INC.

P. O. BOX 1637
TELEPHONE 4-4451
FREETAG BUILDING
223 S. BIG SPRING ST.
MIDLAND, TEXAS

FULL INSURANCE COVERAGE

INDIVIDUAL WELL DATA SHEET

Company Dowell & [illegible] Lease Federal [illegible] Well No. 2

Field Wildcat County [illegible] State [illegible]

Test Date 7-23-[illegible] Time 10:3[illegible] Status of Well [illegible]

Top of Pay 6622' Total Depth ____ Producing Formation ____

Tubing 2" Depth 6[illegible]18' B.H.C. ____ Packer ____ Pressure Datum ____

Casing ____ Depth ____ Perf. ____ Liner ____ Packer ____

Depth Feet	Δ Depth	Pressure Lbs. Sq. In.	Δ Pressure	Gradient Lbs./Ft.			
Surface		73[illegible]			Casing Press.	750	
	4915		701	.142	Tubing Press.	73[illegible]	
4915		1439			Top of Fluid	—	
	1000		1[illegible]	.18[illegible]	Top of Water	—	
5915		1623			Hrs.- Shut In		Flowing
	500		[illegible]	.157	Temp. @	6615' = 192° F.	
6415		17[illegible]			Elev.-D.F.	6207.5 Gr. 6192	
	200		[illegible]	.19[illegible]	Last Test Date		
6615		174[illegible]			Press. Last Test	2[illegible] Static	
					B.H.P. Change		
					Gain - Loss/Day		
6615 [illegible]		15[illegible]			Choke Size	1[illegible]/64	
					Oils Bbls/day		
					Water Bbls/day		
					Total Bbls/day		
					Orifice & Line		
					Static & Differential		
					Gas Sp. Gr.		
					Cu. Ft./day		
					GOR		
					GFR		

PRODUCTIVITY INDEX-BBLS./DAY/LBS. DROP

Last Cumulative Production	Present Cumulative Production	Production Between Tests
Instrument	Number	Recovery Factor Bbls/pound Loss
Run By	Calibration No	Calculated By

Calculations and Remarks:

STAPLETON PTG. CO., MIDLAND

W. T. HAGLER
H. L. HAGLER
W. M. CATES
C. H. PICKENS
R. W. HARRINGTON
D. R. WATSON, JR.
B. E. BLACK
FIELD PETROLEUM ENGINEERS

WEST TEXAS Engineering SERVICE INC.

P. O. BOX 1637
TELEPHONE 4-4451
FREETAG BUILDING
223 S. BIG SPRING ST.
MIDLAND, TEXAS

FULL INSURANCE COVERAGE

INDIVIDUAL WELL DATA SHEET

Company Doswell & Pettigrew Lease Federal Scott Well No. 2

Field Wildcat County Rio Arriba State New Mexico

Test Date 7-29-51 Time 3:45 AM Status of Well Flowing

Top of Pay 6622' Total Depth ______ Producing Formation ______

Tubing 2" Depth 6623' B.H.C. ______ Packer ______ Pressure Datum ______

Casing ______ Depth ______ Perf. ______ Liner ______ Packer ______

Depth Feet	Δ Depth	Pressure Lbs. Sq. In.	Δ Pressure	Gradient Lbs./Ft.			
Surface		834			Casing Press.	850	
	4915		686	.139	Tubing Press.	834	
4915		1520			Top of Fluid	—	
	1000		163	.163	Top of Water	No	
5915		1683			Hrs.- Shut In		Flowing
	500		88	.175	Temp. @	6615' = 172°F.	
6415		1771			Elev.-D.F.	6507 Gr.	6498
	200		36	.180	Last Test Date		
6615 Stabilized		1807			Press. Last Test		
					B.H.P. Change		
					Gain - Loss/Day		
					Choke Size	16/64"	
					Oils Bbls/day	331	
					Water Bbls/day		
					Total Bbls/day		
					Orifice & Line		
					Static & Differential		
					Gas Sp. Gr.		
					Cu. Ft./day		
					GOR		
					GFR		

PRODUCTIVITY INDEX-BBLS./DAY/LBS. DROP

Last Cumulative Production ______ Present Cumulative Production ______ Production Between Tests ______

Instrument ______ Number ______ Recovery Factor Bbls/pound Loss ______

Run By ______ Calibration No ______ Calculated By ______

Calculations and Remarks:

STAPLETON PTG. CO., MIDLAND

W. T. HAGLER
H. L. HAGLER
W. M. CATES
C. H. PICKENS
R. W. HARRINGTON
D. R. WATSON, JR.
B. E. BLACK
FIELD PETROLEUM ENGINEERS

WEST TEXAS Engineering SERVICE INC.

P. O. BOX 1637
TELEPHONE 4-4451
FREETAG BUILDING
223 S. BIG SPRING ST.
MIDLAND, TEXAS

FULL INSURANCE COVERAGE

INDIVIDUAL WELL DATA SHEET

Company [illegible] Lease [illegible] Well No. 2

Field [illegible] County [illegible] State [illegible]

Test Date [illegible] Time [illegible] Status of Well [illegible]

Top of Pay [illegible] Total Depth ____ Producing Formation ____

Tubing 2" Depth [illegible] B.H.C. ____ Packer ____ Pressure Datum ____

Casing ____ Depth ____ Perf. ____ Liner ____ Packer ____

Depth Feet	Δ Depth	Pressure Lbs. Sq. In.	Δ Pressure	Gradient Lbs./Ft.		
Surface		912			Casing Press.	550
	4915		[illegible]	.145	Tubing Press.	912
4915		[illegible]			Top of Fluid	—
	1000		[illegible]	[illegible]	Top of Water	No
5915		[illegible]			Hrs.- Shut In	Flowing
	500		[illegible]	[illegible]	Temp. @	
6415		[illegible]			Elev.-D.F.	[illegible] Gr. [illegible]
	200		[illegible]	[illegible]	Last Test Date	
6615		[illegible]			Press. Last Test	
					B.H.P. Change	
					Gain - Loss/Day	
6615 [illegible]		[illegible]			Choke Size	12/64"
					Oils Bbls/day	[illegible]
					Water Bbls/day	
					Total Bbls/day	
					Orifice & Line	
					Static & Differential	
					Gas Sp. Gr.	
					Cu. Ft./day	
					GOR	
					GFR	

PRODUCTIVITY INDEX-BBLS./DAY/LBS. DROP

Last Cumulative Production ____ Present Cumulative Production ____ Production Between Tests ____

Instrument ____ Number ____ Recovery Factor Bbls/pound Loss ____

Run By ____ Calibration No. ____ Calculated By ____

Calculations and Remarks:

STAPLETON PTG. CO., MIDLAND

Case 537

LOWRY et al OPERATING ACCOUNT

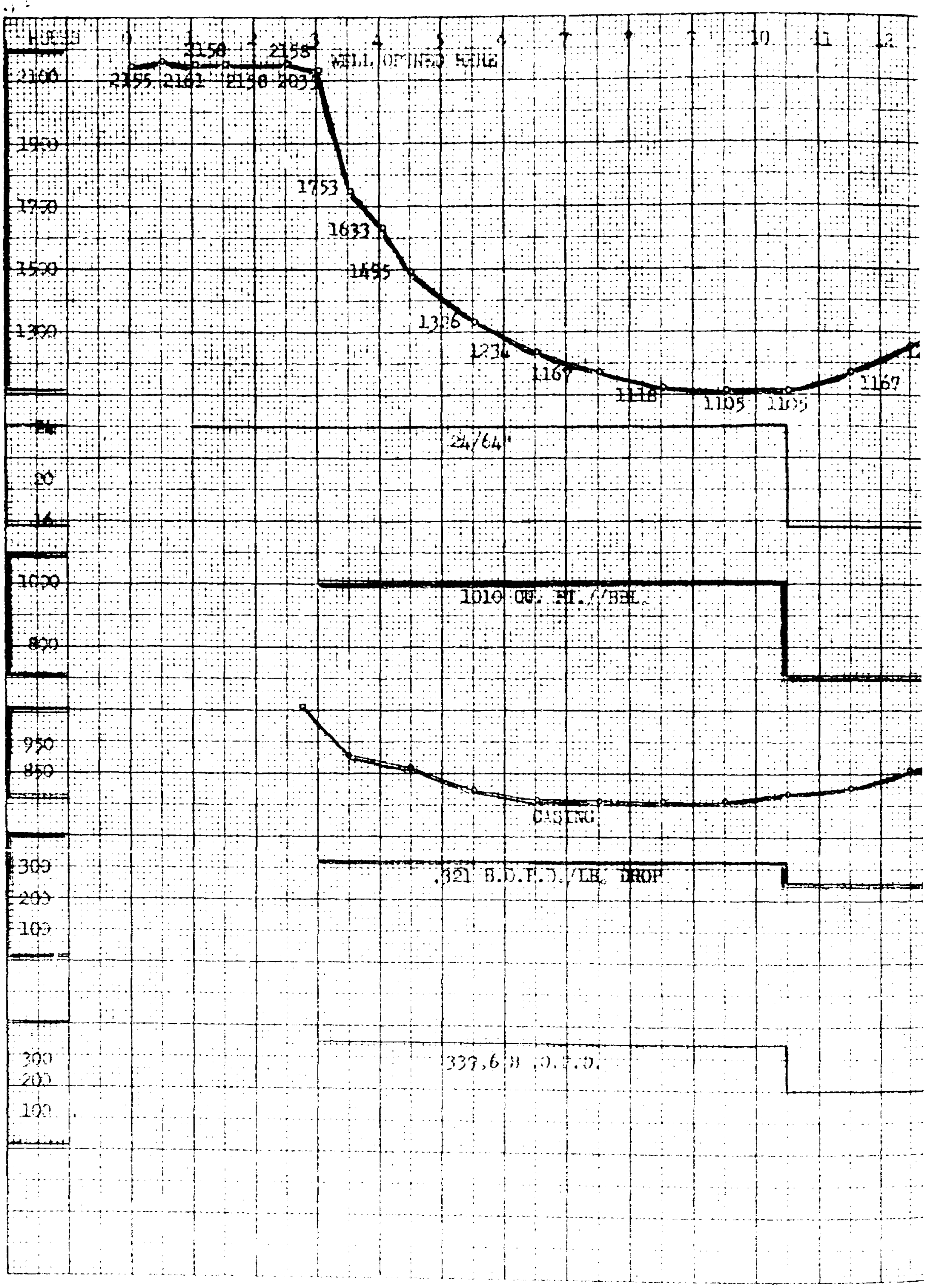
- - - - - - - - - - - - - - -

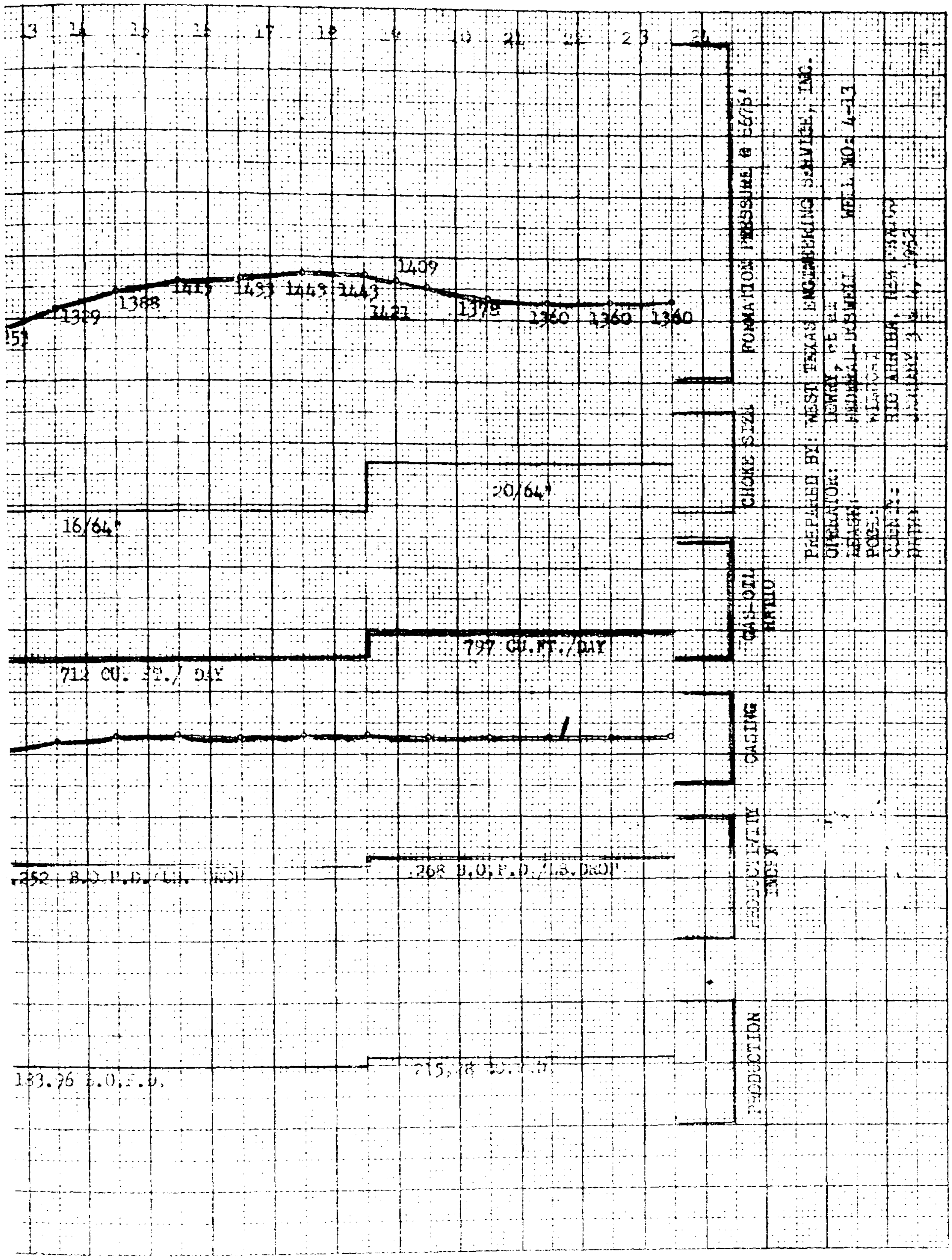
PRODUCTIVITY INDEX TESTS

Federal 4-13-132

- - - - -

January 1, 1952 to January 4, 1952


HOURS
WELL OPENED HERE
2155
2161
2158
2150
2158
2033
1753
1633
1495
1386
1234
1167
1118
1105
1167
24/64"
1010 CU. FT./BBL.
CASING
.321 B.D.P.D./LB. DROP
339.6 B.O.P.D.



FORMATION PRESSURE
CHOKE SIZE
GAS-OIL RATIO
CASING
PRODUCTIVITY INDEX
PRODUCTION
PREPARED BY: WEST TEXAS ENGINEERING SERVICE, INC.
WELL NO: 4-13
1409
1389
1388
1421
1378
1360
1360
1360
16/64"
20/64"
712 CU. FT./ DAY
797 CU.FT./DAY

W. T. HABLER
H. L. HABLER
W. M. CATES
C. H. PICKENS
R. W. HARRINGTON
D. R. WATSON, JR.
B. E. BLACK
J. I. LOWMAN
FIELD PETROLEUM ENGINEERS

WEST TEXAS Engineering SERVICE INC.

P. O. BOX 1637
TELEPHONE 4-4481
FREETAG BUILDING
223 S. BIG SPRING ST.
MIDLAND, TEXAS

FULL INSURANCE COVERAGE

INDIVIDUAL WELL DATA SHEET

Company Lowry, et al **Lease** Federal - Doswell **Well No.** 4-13

Field Wildcat **County** Rio Arriba **State** New Mexico

Test Date 1-1-52 **Time** 11:57 A.M. **Status of Well** S. I.

Top of Pay 6676' **Total Depth** ______ **Producing Formation** Tocito

Tubing 2" **Depth** 6693' **B.H.C.** ______ **Packer** ______ **Pressure Datum** Top of Pay

Casing 7" **Depth** 6670' **Perf.** ______ **Liner** ______ **Packer** ______

Depth Feet	▲ Depth	Pressure Lbs. Sq. In.	▲ Pressure	Gradient Lbs./Ft.		
Surface		1023			Casing Press.	1025
	3976		261	.065	Tubing Press.	1023
3976		1284			Top of Fluid	3900'
	1000		313	.313	Top of Water	No
4976		1597			Hrs.- Shut In	24 Flowing
	1000		313	.313	Temp. @	6676' = 175°F.
5976		1910			Elev.-D.F.	6502Gr.
	500		156	.312	Last Test Date	Initial
6476		2066			Press. Last Test	
	200		71	.355	B.H.P. Change	
6676 Top of Pay		2137			Gain - Loss/Day	
					Choke Size	
					Oils Bbls/day	
					Water Bbls/day	
					Total Bbls/day	
					Orifice & Line	
					Static & Differential	
					Gas Sp. Gr.	
					Cu. Ft./day	
					GOR	
					GFR	

PRODUCTIVITY INDEX-BBLS./DAY /LBS. DROP

Last Cumulative Production	Present Cumulative Production	Production Between Tests
Instrument Amerada	Number [illegible] BR	Recovery Factor Bbls/pound Loss
Run By W. M. Cates & B. E. Black	Calibration No. [illegible] @ 175°	Calculated By [illegible]. E. Black

Calculations and Remarks:

STAPLETON PTG. CO., MIDLAND

W. T. HAGLER
H. L. HAGLER
W. M. CATES
C. H. PICKENS
R. W. HARRINGTON
D. R. WATSON, JR.
B. E. BLACK
J. I. LOWMAN
FIELD PETROLEUM ENGINEERS

WEST TEXAS Engineering SERVICE INC.

P. O. BOX 1637
TELEPHONE 4-4451
FREETAG BUILDING
223 S. BIG SPRING ST.
MIDLAND, TEXAS
FULL INSURANCE COVERAGE

INDIVIDUAL WELL DATA SHEET

Company Lowry, et al Lease Federal - Doswell Well No. 4-13

Field Wildcat County Rio Arriba State New Mexico

Test Date 1-3-52 Time 12:13 P.M. Status of Well S. I.

Top of Pay 6676' Total Depth ______ Producing Formation Tocito

Tubing ______ Depth 6693' B.H.C. ______ Packer ______ Pressure Datum Top of Pay

Casing ______ Depth 6670' Perf. ______ Liner ______ Packer ______

Depth Feet	Δ Depth	Pressure Lbs. Sq. In.	Δ Pressure	Gradient Lbs./Ft.		
Surface		995			Casing Press.	800
	3976		337	.084	Tubing Press.	995
3976		1332			Top of Fluid	3180'
	1000		307	.307	Top of Water	No
4976		1639			Hrs.- Shut In	73 Flowing
	1000		307	.307	Temp. @	6676' = 175°F.
5976		1946			Elev.-D.F.	6502 Gr.
	500		154	.307	Last Test Date	
6476		2100			Press. Last Test	
	200		61	.307	B.H.P. Change	
6676 Top of Pay		2161			Gain - Loss/Day	
					Choke Size	
					Oils Bbls/day	
					Water Bbls/day	
					Total Bbls/day	
					Orifice & Line	
					Static & Differential	
					Gas Sp. Gr.	
					Cu. Ft./day	
					GOR	
					GFR	

PRODUCTIVITY INDEX-BBLS./DAY /LBS. DROP

Last Cumulative Production		Present Cumulative Production		Production Between Tests	
Instrument	Amerada	Number	[illegible]	Recovery Factor Bbls/pound Loss	
Run By	[illegible]	Calibration No.	[illegible] 175°	Calculated By	[illegible] Pickens

Calculations and Remarks:

Case 537

INTERFERENCE TEST

May 1 - 3, 1952

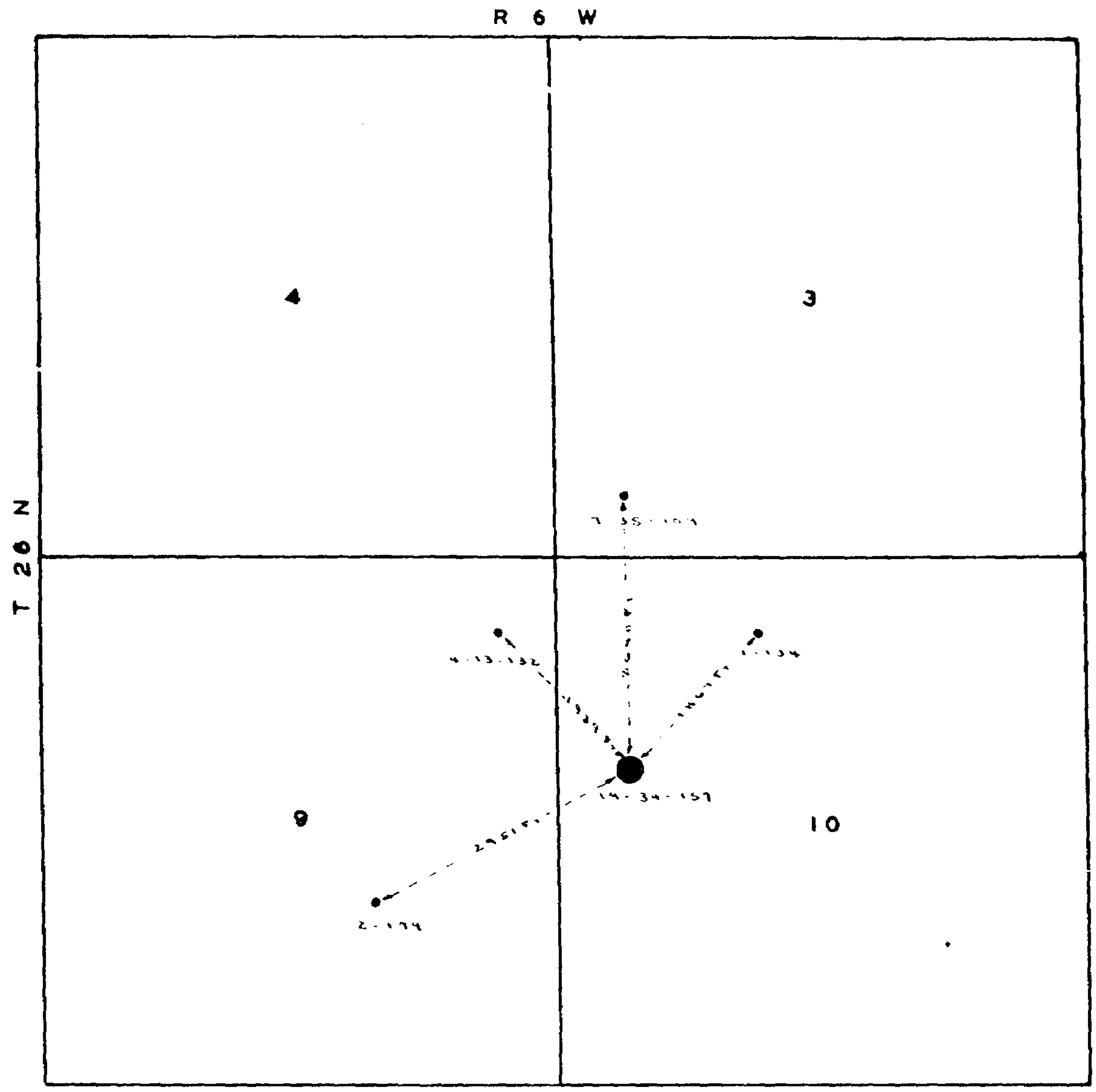
Pettigrew-Tocito Field

Rio Arriba County, N. M.

- - - - - - - - - - - - - - - -

LOWRY et al OPERATING ACCOUNT

WEST TEXAS ENGINEERING SERVICE, INC.
Midland, Texas

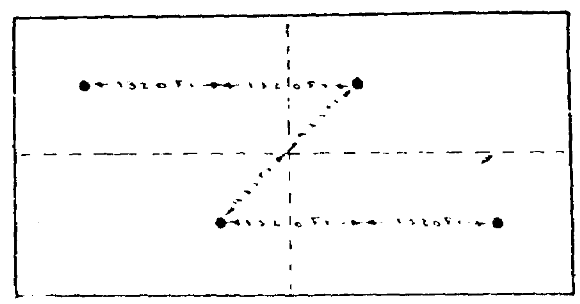


[illegible] test

[illegible] 2, 1952

[illegible]

[illegible]



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DESCRIPTION OF INTERFERENCE TEST

Federal 19-34-157

May 1, 1952 to May 3, 1952

An interference test was conducted during the period 4:45 P.M. May 1, 1952 to 8:45 A.M. May 3, 1952 for Lowry et al Operating Account Well no. 19-34-157 of the Pettigrew-Tocito Pool, Rio Arriba County, New Mexico. This test was conducted by the West Texas Engineering Service of Midland, Texas, to determine if communication in the reservoir could be detected between wells, thereby furnishing evidence as to the effective drainage area for wells of this Pool.

At the time the test was conducted, there were four wells completed, and one well, Federal 1-134, was in the process of being completed in the Tocito formation. All wells, with the exception of Federal 1-134 were shut in prior to the test for bottomhole pressure measurements. Results of this bottomhole pressure survey were as follows:

Well No.	Shut In Time - Hours	Bottomhole pressure Datum -100 feet
Federal 2-179	76½	2,112
Federal 4-13-132	76½	2,069
Federal 19-34-157	99	2,115
Federal 7-35-109	193	2,103

Volumetric average reservoir pressure 2,150 p.s.i.

After completion of the bottomhole pressure tests, the bottomhole pressure gauge was lowered to the top of the Tocito zone for Well Federal 19-34-157, and the gauge remained in the well for a period of forty hours with the well shut in. The remaining wells were placed on production and produced the following amounts of oil:

	Oil Production - Barrels		
Well No.	First 24 hours	Next 16 hours	Total - 40 hours
Federal 1-134	90.19	48.95	139.14
Federal 2-179	490.64	362.50	853.14
Federal 4-13-132	254.21	171.50	425.71
Federal 7-35-109	18.67	0	18.67
	853.71	582.95	1436.66

At the start of the interference test the bottomhole pressure at the top of the Tocito zone (6,819 ft. or -168 feet datum) was 2137 p.s.i., and at the conclusion of the 40-hour test, the bottomhole pressure measured 2130 p.s.i.

It is concluded that this 7 p.s.i. decrease in bottomhole pressure was occasioned by oil being produced from the reservoir by other wells.

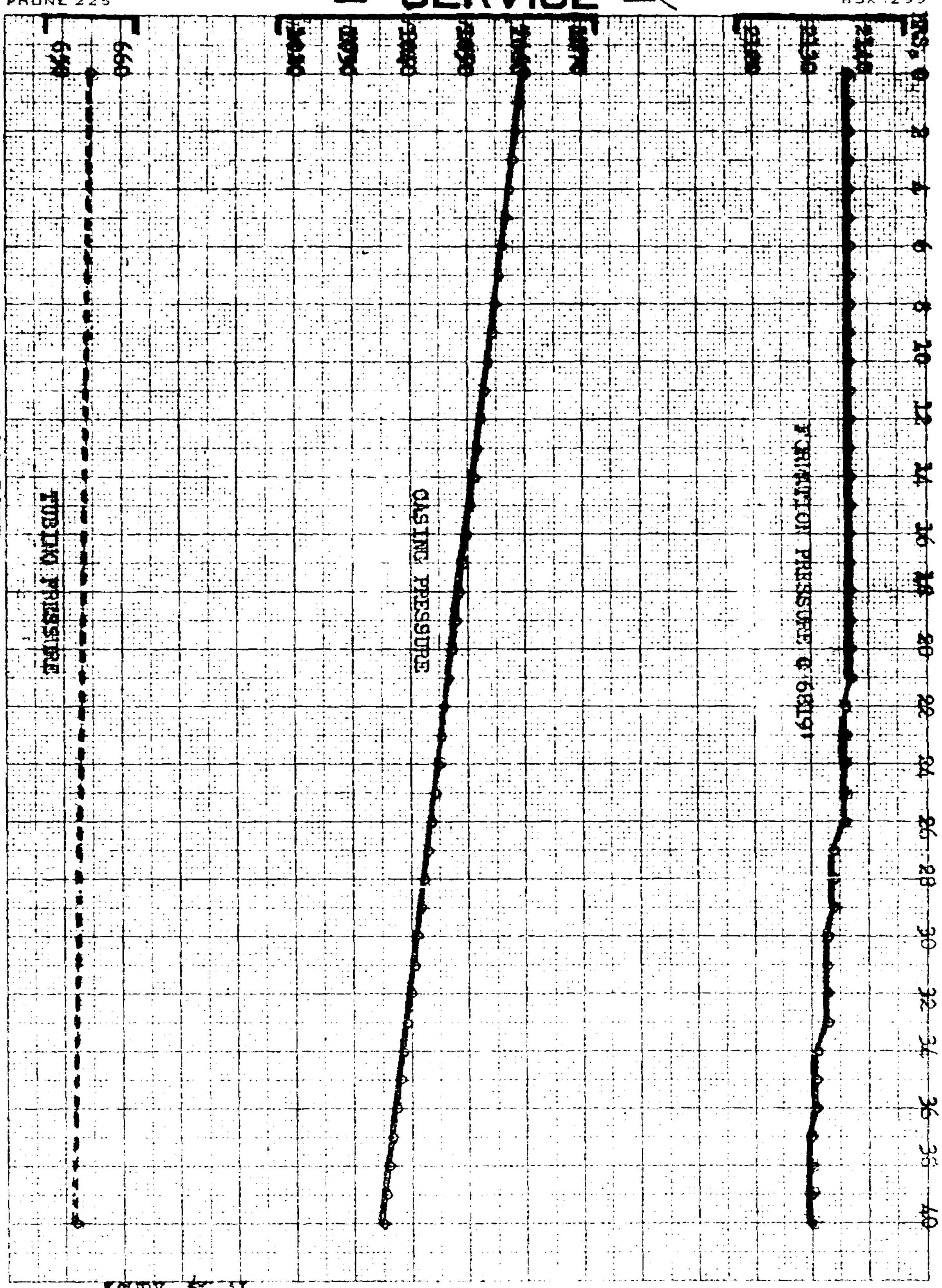
The distance of well Federal 19-34-157 from other wells producing from the same reservoir is as follows:

Federal 1-134	1,867 feet
Federal 2-179	2,951 feet
Federal 4-13-132	1,939 feet
Federal 7-35-109	2,640 feet

From a review of the factual data of the test, it is concluded that oil drainage occurs for a distance of at least 1,867 feet for wells of the Pettigrew-Tocito reservoir. It is concluded that one well will readily drain economically and efficiently an 80-acre proration unit since the maximum drainage area for wells of this proration pattern is 1,320 feet.

WEST TEXAS
Engineering
SERVICE

PHONE 225 BOX 1299



OPERATOR LOWRY, ET AL OPERATING ACCOUNT
LEASE FEDERAL DOSWELL
WELL NO. 19-34-157
POOL PETTIGREW TOCITO
COUNTY RIO ARRIBA
DATE 5-1-52 to 5-3-52

W. T. HAGLER
H. L. HAGLER
D. R. WATSON, JR.
C. H. PICKENS
R. W. HARRINGTON
B. E. BLACK
J. I. LOWMAN

WEST TEXAS Engineering SERVICE INC.

P. O. BOX 1637
TELEPHONE 4-4451
FREETAS BUILDING
323 S. BIG SPRING ST.
MIDLAND, TEXAS

MIDLAND, TEXAS

CONTINUOUS RECORDING OF BOTTOM HOLE PRESSURE
AT A DEPTH OF 6819'.

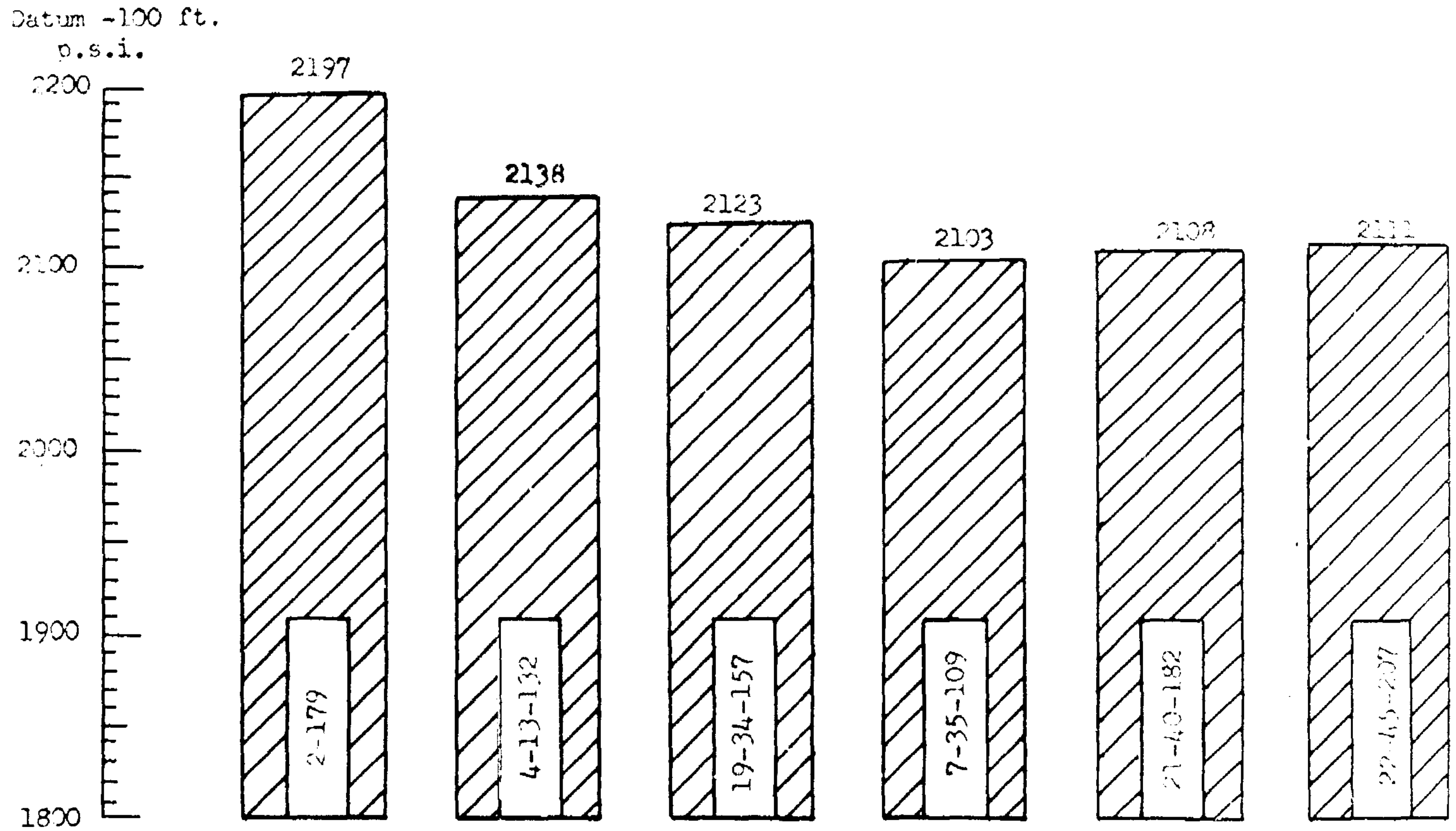
Hours	Pressure	Hours	Pressure
Arrival @ Bottom	2137	21	2137
1	2137	22	2136
2	2137	23	2136
3	2137	24	2136
4	2137	25	2136
5	2137	26	2136
6	2137	27	2134
7	2137	28	2134
8	2137	29	2134
9	2137	30	2133
10	2137	31	2133
11	2137	32	2133
12	2137	33	2133
13	2137	34	2131
14	2137	35	2131
15	2137	36	2131
16	2137	37	2130
17	2137	38	2130
18	2137	39	2130
19	2137	40	2130
20	2137		

INITIAL BOTTOMHOLE [illegible]

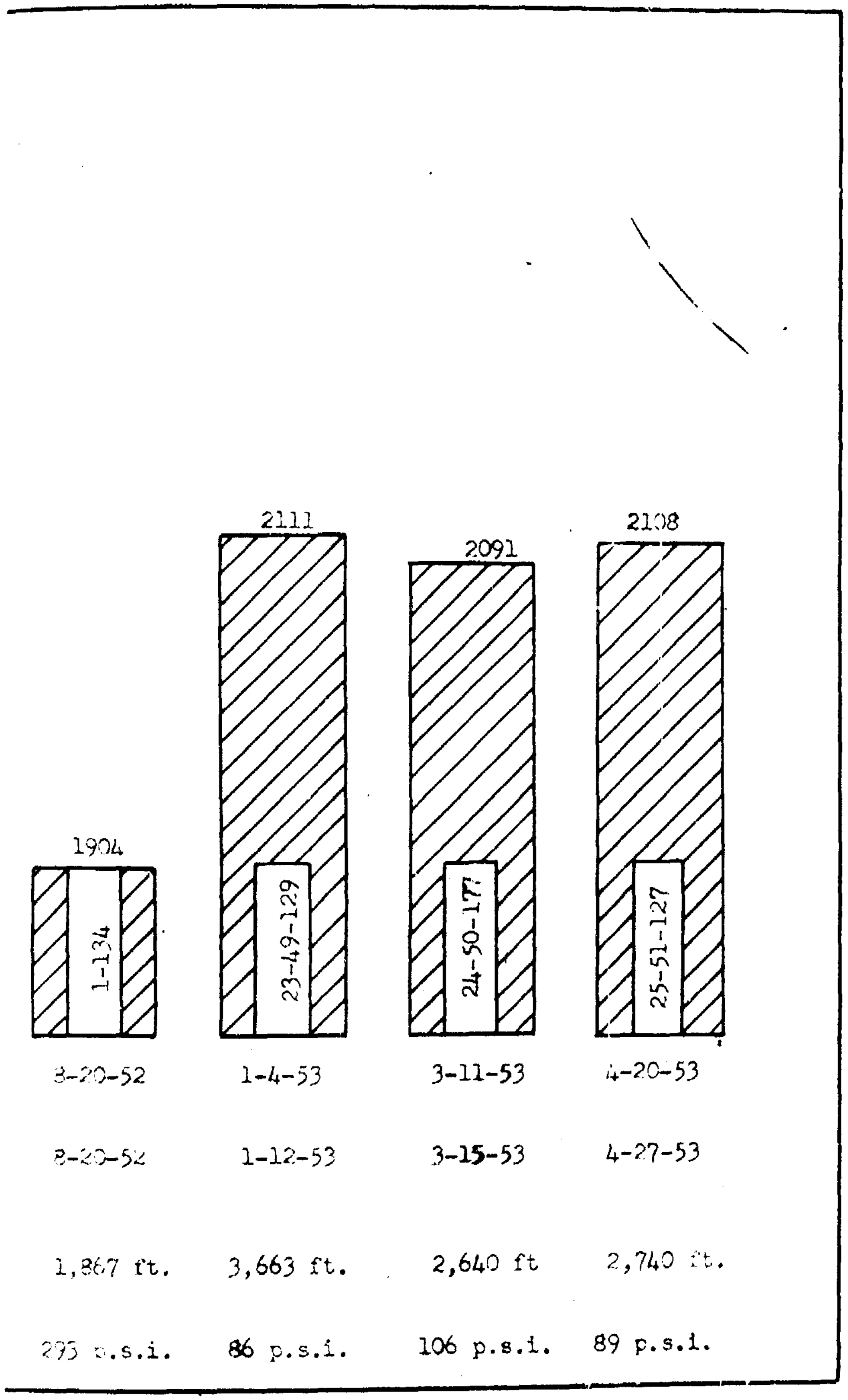
PETTIG[illegible] FIELD

RIO ARRIBA [illegible]

Initial
Bottomhole
Pressure



Date of completion:	7-3-51	11-2-51	3-25-52	4-18-52	5-26-52	7-29-5[illegible]
Date of initial Bottomhole Pressure test :	7-26-51	1-3-52	3-30-52	5-1-52	6-5-52	8-2-5[illegible]
Distance to nearest producing well:		2,908 ft.	1,939 ft.	1,939 ft.	1,93[illegible] ft.	[illegible]
Pressure drop below initial reservoir pressure:		59 p.s.i.	74 p.s.i.	94 p.s.i.	89 p.s.i.	[illegible]


1904
2111
2091
2108
1-134
23-49-129
24-50-177
25-51-127
8-20-52
1-4-53
3-11-53
4-20-53
8-20-52
1-12-53
3-15-53
4-27-53
1,867 ft.
3,663 ft.
2,640 ft
2,740 ft.
293 p.s.i.
86 p.s.i.
106 p.s.i.
89 p.s.i.

Lowry et al Operating Account

Ultimate Oil Recovery Estimates

- - - - - - - - - - - - - - -

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

ULTIMATE OIL RECOVERY ESTIMATES

Pettigrew-Tocito Field

Rio Arriba County, New Mexico

- -

Factors used for Evaluating Pettigrew-Tocito Pool

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

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

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

- -

Present Concept of Pettigrew-Tocito Pool

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

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

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

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

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

Remaining Proven oil reserves: 1,149,558 barrels

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

ECONOMICS OF DEVELOPMENT 40 - acre PRORATION UNITS

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

- -

Crude Oil Price	$ 2.4500 /bbl.	2.70
Less Royalty (1/8 - .3063/bbl.)	2.1437	
Less Severance Tax (.025% - .0536/bbl)	2.0901	
Less Conservation tax (.00125% - .0027/bbl)	2.0874	
Less Production tax (.020896% of 50% Value -) ($.0224/bbl.)	2.0650 .45 2.515	
Lifting Cost	.40 2.115	
Number of Productive Acres	2,535	
Average Sand Thickness - Feet		
Upper Portion	9.4	
Lower Portion	11.0	
Ultimate Oil Recovery, Barrels	3,330,230	
Ultimate Oil Recovery - Barrels per acre	1,314	
Ultimate Oil Recovery - 40 acre, Barrels	52,560	
Operating Income - 40 acre tract (52,560 barrels @ $2.07/bbl) 2.11	$108,799.20	$ 111,100
Total Cost of Drilling and Completing Tocito wells	$110,609.34	

Note: No Operating Costs considered in computing Operating Income

COST OF DRILLING AND COMPLETING TOCITO OIL WELLS

Pettigrew-Tocito Field

Rio Arriba County, New Mexico

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

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

Note: No overhead charges included in above completion costs.

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

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

TOTAL TO COMPLETE WELL (less tank battery) $102,505.29

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

- -

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

TOTAL [illegible] WELL ([illegible] battery) $99,610.93

TANK BATTERY FOR WELL NOS:	Federal Doswell 21-40-182 Federal Doswell 22-45-207
FIELD:	Pettigrew-Tocito
LOCATION:	Section 10, 26N-6W Rio Arriba County, New Mexico

- -

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

TOTAL FOR TANK BATTERY $19,103.46

OCC Case 537

RESERVOIR STUDY

of the

TOCITO SAND RESERVOIR

LOWRY OIL COMPANY ET AL PROPERTIES

in the

PETTIGREW TOCITO FIELD
Rio Arriba County, New Mexico

as of

April 28, 1953

Amstutz and Yates, Inc.

May 14, 1953

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

Dear Mr. Moulton:

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

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

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

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

Very truly yours,

AMSTUTZ AND YATES, INC.

/s/ George L. Yates

George L. Yates

GLY:am

TABLE OF CONTENTS

Amstutz and Yates, Inc.

OBJECT

The purpose of this engineering report is as follows:

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

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

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

CONCLUSIONS AND RECOMMENDATIONS

(1) It is our opinion that the Pettigrew Tocito Sand Reservoir originally contained approximately 17,000,000 barrels of stock tank oil in place. This conclusion is based upon the reservoir performance in the field from its discovery to April 28, 1953. In view of the fact that the reservoir is still partially undeveloped, our present opinion of its magnitude must be conside1ed a preliminary estimate and may be subject to some revision when additional data are available.

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

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

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

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

* Measured at 14.7 psia and 60° F.

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

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

SCOPE OF INVESTIGATION

This report supplements our previous report entitled "Material Balance Analysis of the Tocito Sand Reservoir" as of August 13, 1952, and includes the reservoir performance history up to April 28, 1953. Mr. A. F. Holland of the Lowry Oil Company in Albuquerque, New Mexico has furnished us with the basic data used in our analysis. This information consisted of the complete monthly oil production history of each well, all gas-oil ratio tests, the initial bottom hole pressures on each well and four bottom hole pressure surveys of the field made on May 1, and August 20, 1952, and on January 13, and April 28, 1953, two bottom hole fluid sample analyses, core analyses on four of the Tocito sand wells, electric logs on all of the wells drilled, two productivity tests, interference tests between some of the wells, a map of the field, and other pertinent data. The basic statistics concerning the performance history of the entire Tocito Sand Reservoir are set forth in Schedule 1, which includes the number of producing wells, the oil and gas production histories by months, the average monthly and cumulative gas-oil ratios, the areally weighted average bottom hole pressures at the various survey dates, the reservoir pressure decline, and the oil production in barrels per pound drop in reservoir pressure. A graphic history of the reservoir pressure and oil and gas production rates versus time is shown in Figure No. 1.

DISCUSSION

Volumetric Calculation of Oil in Place

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

The Tocito sand section has been diamond cored using an oil emulsion mud in three wells and a water base mud in a fourth well. These cores were analyzed and the weighted average values as determined from the analyses are as follows: Porosity of 15 per cent, connate water saturation 28 per cent, average permeability 118 millidarcys. Using these figures and a formation volume factor at the original reservoir pressure of 1.545, the stock tank oil originally in place was calculated to be 542 barrels per acre foot of net pay sand. Thus, the volumetric calculations indicate that there were originally 16,100,000 barrels of stock tank oil in place in the total Tocito Sand Reservoir.

Material Balance Calculations of Oil in Place

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

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

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

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

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

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

Future Production Rates

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

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

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

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

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

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

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

*Measured at 14.7 psia and 60° F.

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

Most Efficient Production Rates

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

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

Anticipated Primary Recovery

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

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

Pressure Maintenance

Experience with other solution gas drive reservoirs of this type has revealed that the inherently low primary recoveries can usually be increased by the application of pressure maintenance operations by the injection of gas and/or water. In our previous report it was pointed out that pressure maintenance by gas injection did not appear too attractive. This statement was made because of the high "apparent" relative permeability ratio of gas to oil inferred by our calculations. As discussed in the preceding section of this report, this situation has not changed during the interim but has in fact been aggravated. However, all such calculations assume that the reservoir is in equilibrium and this is not true in the subject reservoir as revealed by the recent bottom hole pressure and gas-oil ratio surveys. These show a pressure gradient across the reservoir of approximately 480 pounds per square inch and a variation in measured gas-oil ratios of from 723 to 3923 cubic feet per barrel. The possible economic benefits from pressure maintenance of the Pettigrew Tocito Sand Reservoir appear to be greater than normal due to the low primary recovery anticipated, and no possible method of increasing the primary oil recovery should be ignored in any analysis of pressure maintenance operations. When the reservoir is more completely defined by additional development and the relative permeability data are available, a detailed analysis of pressure maintenance by gas and/or water injection should be made and possibly a pilot injection program should be attempted prior to making any commitment for a particular program for the entire field.

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

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

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

Remedial Work on Well No. 1-134

One of the operational problems involving the Tocito Sand Reservoir is the peculiar behavior of Well No. 1-134. This well was originally completed as a small gas well in a deeper formation during the summer of 1950. It apparently produced from this formation or remained shut in until September 1951, at which time it was plugged back to the Tocito formation and tested five barrels of oil per hour from this zone after the casing was perforated. The well was then acidized with 500 gallons of mud acid with apparently no improvement in its performance. Rotary tools were moved in and the seven inch casing was milled out from 6728 to 6770 feet. A six-hour drill stem test from this zone, after milling out the casing, recovered gas to the surface in 16 minutes and 1620 feet of gas cut mud with a very small show of oil. Rotary tools were then moved out during December 1951, and cable tools moved in. On February 4, 1952, the hole was shot with 120 quarts, the results of which are not known to the writer. In March 1952, it was acidized with 2,000 gallons of mud acid, and under the results is noted "no recovery". On April 27, 1952, 1000 barrels of distillate and 1000 barrels of oil were pumped into the formation after which tubing was run and the well put on production. The test recorded on August 21, 1952, indicated that the well flowed 38 barrels of oil in 55 minutes. However, the production history reveals that the well has never produced over 664 barrels of oil in any one month, an average of 22 barrels per day. The cumulative production from the well to April 28, 1953, was 5,166 barrels. This well is currently producing approximately 10 barrels of oil per day. On each bottom hole pressure survey it has had the lowest pressure of any well in the field, and its pressure had decreased to 1721 psig on April 28, 1953. During 1953, three gas-oil ratio tests have been made on the well and the results of these tests varied from 2867 cubic feet per barrel to 3460 cubic feet per barrel.

The bottom hole pressure map of the April 1953, survey (Figure 7) and the April 1953, gas-oil ratio map (Figure 4) indicate that the well is in a portion of the field where the depletion has been considerably greater than the remainder of the reservoir. Since it contributes very little to the current field production and since it is in a low pressure area, it would be logical to use Well No. 134 as an injection well if a pilot pressure maintenance project were to be started. However, it is evident that the formation surrounding the well has been blocked possibly by drilling mud, water, or by an emulsion. It would be necessary to remedy this situation, because the present injectivity characteristics of the well to gas or water are undoubtedly so low that no appreciable volumes of these fluids could be pumped into the reservoir. It is our opinion that the results obtained under similar conditions by Halliburton's "mud clean-out agent" are such that a treatment with this chemical on a trial basis is warranted here. We therefore recommend that a 500-gallon treatment of the "mud clean-out agent" be made, and if any mud or water are recovered from the well and any improvement is noted in its performance after this treatment, a second treatment using the same amount of chemical might be tried. The total cost of one treatment would be approximately $330, and it would not be necessary to move a rig over the hole for the job. If the foregoing procedure does not greatly increase the capacity of the well, it is suggested that a sand-oil formation fracture job be performed. This procedure, although not as desirable in our opinion as the chemical treatment first recommended, should fracture the formation surrounding the well a sufficient distance from the bore hole to break through the existing mechanical block. The cost of the sand-oil fracture job would be approximately $750. The results achieved by one or both of the above mentioned procedures should improve the productivity and the injectivity characteristics of the well.

AMSTUTZ AND YATES, INC.

By /s/ George L. Yates

George L. Yates

Date Signed: May 14, 1953

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

Year and Month	No. of Producing Wells	Oil Production - Barrels: Per Well Per Day	Oil: Per Day	Oil: Per Month	Oil: Cumulative	Gas Production-Mcf @ 14.7 psia and 60°F: Per Day	Gas: Per Month	Gas: Cumulative	Average Gas/Oil Cubic Feet/Barrel: Per Month	Gas/Oil: Cumulative
51 June		0	0	0	0				0	0
July	1	193	193	5,970	5,970	335	10,376	10,376	1,738	[illegible]
August	1	327	327	10,143	16,113	507	15,722	26,098	1,550	[illegible]
September	1	366	366	10,973	27,086	516	15,472	41,570	1,410	[illegible]
October	1	356	356	11,027	38,113	462	14,335	55,905	1,300	[illegible]
November	2	210	420	12,599	50,712	480	14,405	70,310	1,113	[illegible]
December	2	213	426	13,215	63,927	416	12,905	83,215	977	[illegible]
52 January	2	158	315	9,761	73,688	291	9,011	92,226	923	[illegible]
February	2	385	769	21,540	95,228	697	20,208	112,434	938	[illegible]
March	[illegible]	10	363	11,245	106,473	368	11,406	123,840	1,014	[illegible]
April	5	157	785	23,535	130,008	848	25,442	149,282	1,081	[illegible]
P Survey 5/1/52 tals for Period			428	130,008		489	149,282		1,148	
May	5	211	1,057	32,772	162,780	1,382	42,854	192,136	1,308	[illegible]
June	6	152	914	27,426	190,206	1,180	35,402	227,538	1,291	[illegible]
July	7	126	885	27,425	217,631	1,137	35,243	262,781	1,285	[illegible]
August 1 - 19	7	125	877	16,664	234,295	1,199	22,790	285,571	1,368	[illegible]
Survey 8/20/52 tals for Period			940	104,287		1,228	136,289		1,307	
August 20 - 31	7	220	1,539	18,471	252,766	2,177	26,120	311,691	[illegible]	[illegible]
September	7	168	1,181	35,428	288,194	1,679	50,360	362,051	1,421	[illegible]
October	7	177	1,242	38,510	326,704	1,929	59,804	421,855	1,553	[illegible]
November	7	166	1,161	34,827	361,531	1,953	58,584	480,439	1,682	[illegible]
December	7	145	1,018	31,572	393,103	1,938	60,088	540,527	1,903	[illegible]
53 January 1 - 12	6	98	781	7,030	400,133	1,152	13,826	554,353	1,967	[illegible]
Survey 1/13/53 ls for Period			1,136	165,838		1,841	268,782		1,621	
January 13 - 31	8	143	1,142	21,169	421,302	1,919	36,459	590,812	1,722	[illegible]
February	8	149	1,193	33,394	454,696	2,004	56,114	646,926	1,680	[illegible]
March	9	123	1,111	34,438	489,134	1,754	54,376	701,302	1,579	[illegible]
April 1 - 27	10	111	1,106	27,641	516,775	2,000	50,007	751,309	1,809	[illegible]
P Survey 4/28/53 tals for Period			1,144	116,642		1,931	196,956		1,689	

…eservoir …essure …– psig …00 …st.	Reservoir Pressure Decline - psi Period	Reservoir Pressure Decline - psi Cumulative	Oil Production Barrels / 1 psi Pressure Drop Period	Oil Production Barrels / 1 psi Pressure Drop Cumulative
…54	46	46	2,826	2,826
…16	38	84	2,744	2,789
…65	52	135	3,252	2,964
…30	35	170	3,333	3,040

GASOLINE PLANT CONSTRUCTION CORPORATION

May 19, 1953

Lowry Oil Company
616 East Central Avenue
Albuquerque, New Mexico

Attention: Mr. A. F. Holland

Gentlemen:

In accordance with your request we herewith submit our report on the economics of a compressor plant in your Pettigrew-Tocito Field, Rio Arriba County, New Mexico, comprising the following described exhibits:

Exhibit "A" - Assumed gas analysis.
"B" - Assumed gas and oil flow schedule.
"C" - Annual revenue for three types of plants.
"D" - Plant cost estimates.
"E" - Average daily production.
"F" - Operating costs.
"G" - Income before depreciation, income tax, etc.
"H" - Casinghead gas gathering system layout.
"I" - Flow diagram for compressor plant with compression gasoline recovery.
"J" - Flow diagram for compressor plant with maximum 12# gasoline recovery.
"K" - Flow diagram for compressor plant with crude stabilization for maximum butane recovery.
"L" - Unit prices used.

We have analyzed the economics for three types of plants that could be installed. Plant I would be the minimum installation possible to compress the gas to the 500# El Paso Natural gathering system. This plant would also contain equipment to stabilize and recover 12# vapor pressure gasoline which would be produced by compression. This 12# gasoline could be added to the crude oil from the field.

Plant II would be the same as Plant I except that a refrigeration unit would be added to recover substantially all of the 12# gasoline that is in the casinghead gas. This process would strip the gas to such an extent that there would be no liquid production payments possible from El Paso Natural's plant. In the case of Plant I the residue gas would be rich enough that El Paso Natural would make payments for liquid production recoveries. The income realized from Plant II would be greater than from Plant I because of the fact that Lowry would retain all of the 12# gasoline instead of being paid only a portion of it by El Paso Natural.

Plant III would consist of a compressor station as in Plant I plus a crude stabilization unit and a simple absorption type recovery plant. The crude stabilization unit would consist of a fractionating column whereby the propane and lighter fractions would be stripped from the crude oil reducing the vapor pressure so that a larger quantity of natural gasoline and butane could be added to the oil without exceeding the atmospheric vapor pressure. By removing these light fractions it is possible to add back to the crude all of the butane and heavier fractions leaving the well. According to analyses available, this would increase the crude production approximately 8 to 12%. An absorption type recovery system has been included in Plant III so that substantially all of the butane can be recovered from the gas. As in the case of Plant II, there would be no liquid production payments from El Paso Natural.

Due to the small percentage difference in horsepower required in compressing the gas to 500# as compared to 250#, we have not shown an analysis of a compressor plant with a 250# discharge pressure. The additional 1¢ per MCF paid by El Paso Natural for the 500# gas figures to produce an additional income several times the additional cost of the compressor station.

The gas analyses used in this report are shown in Exhibit "A". An analysis was taken on April 13, 1953, to determine the present content of the casinghead gas. We have estimated that this gas will lean up gradually as the field is depleted and the gas-oil ratio goes up. This decline in content is also shown in Exhibit "A".

As shown in Exhibit "B" we have estimated that the maximum gas production allowed will be 4 MMCF/D. Gas production, crude production and gas-oil ratio information for this Exhibit was taken from information given us by Mr. Holland.

Cost estimates of the three types of plants as shown in Exhibit "D" are conservative. Some saving should be realized if the plant is constructed for minimum installation cost taking into consideration the relatively short life of the field. We have assumed that the compressor equipment for the maximum amount of gas would be installed initially because of saving in installed cost and because of the fact that a gas rate equal to more than half of the ultimate maximum would be realized in the first year of operation. It would therefore be impractical to plan on installing part of the plant at any later date.

Operating costs have been estimated on the basis of having an operator in attendance 24 hours a day. It is possible that with the addition of some extra controls the plant could be operated as an unattended station during the night and the operating cost reduced somewhat. We have used the higher figure in order to give a conservative payout appraisal.

We have shown in Exhibit "G" the total income for the life of the field that could be realized from the three described types of plants. This income is shown before depreciation, income tax, etc. In order to show the total income we have assumed a plant salvage value of 40%, which we believe conservative for this type of plant.

Our study indicates that a plant with the crude stabilization unit would produce the greatest income. This is, of course, due to the fact that stabilized crude can contain a large volume of light components and because these components can be recovered from the gas with only a slight additional cost when operating under the proposed conditions.

Exhibit "L" shows the various unit prices and other data used in this study.

If there is any further information which we can supply in this regard we will be happy to do so. We appreciate the opportunity of submitting this report and look forward with pleasure to serving you further.

Yours very truly,

GASOLINE PLANT CONSTRUCTION CORPORATION

John C Breeker

John C. Breeker, Vice-President

GASOLINE PLANT CONSTRUCTION CORPORATION

ASSUMED GAS ANALYSIS

Average Separator Vent Composition @ 20 psig, 48°F, on April 13, 1953

(Federal #22-45-207 & 19-34-157)

Component	Mol %	GPM
$CO_2 + C_1$	69.58	-
C_2	15.26	-
C_3	8.96	2.459
i C_4	1.29	0.421
C_4	2.71	0.854
i C_5	0.69	0.252
C_5	0.41	0.148
C_6+	1.10	0.466
	100.00	4.600

Estimated Separator Vent Composition in GPM @ 20 psig, 48°F

	1954	1955	1956	1957	1958	1959	1960
C_3	2.459	2.459	2.459	2.459	2.459	2.459	2.459
C_4	1.275	1.192	1.108	1.024	0.941	0.857	0.927
C_5+	0.866	0.809	0.753	0.697	0.640	0.584	0.629
	4.600	[illegible]	4.320	4.180	4.040	3.900	4.015

GASOLINE PLANT CONSTRUCTION CORPORATION

ASSUMED GAS AND OIL FLOW SCHEDULE

Year	Gas MCF/D	Oil BBL/D	Gas/Oil MCF/BBL
1954	2,500	1,200	2.08
1955	3,750	1,130	3.32
1956	4,000	790	5.07
1957	4,000	620	6.45
1958	2,800	420	6.67
1959	1,300	240	5.42
1960	700	140	5.00

GASOLINE PLANT CONSTRUCTION CORPORATION

ANNUAL REVENUE FOR THREE TYPES OF PLANTS

Plant I: Compression only.

Year	Sales Gas	El Paso Prods.	12# RVP	Total $/Year
1954	$ 89,790	$ 14,965	$ 25,550	$ 130,305
1955	134,685	21,535	35,405	191,625
1956	144,175	21,900	35,405	201,480
1957	144,175	20,440	32,850	197,465
1958	101,470	13,505	21,170	136,145
1959	51,465	5,840	8,760	66,065
1960	27,740	3,650	5,110	36,500
				$ 959,585

Plant II: Compression plus Refrigeration

Year	Sales Gas	El Paso Prods.	12# RVP	Total $/Year
1954	$ 94,535		$ 42,340	$ 136,875
1955	141,620		59,130	200,750
1956	151,475		58,765	210,240
1957	151,475		54,385	205,860
1958	105,850		35,040	140,890
1959	53,655		14,965	68,620
1960	28,835		8,760	37,595
				$ 1,000,830

Plant III: Compression plus Absorption-Crude Stabilization

Year	Sales Gas	El Paso Prods.	12# RVP	Total $/Year
1954	90,520		111,325	201,845
1955	139,065		126,655	265,720
1956	150,015		108,405	258,420
1957	150,380		94,535	244,915
1958	104,755		61,685	166,440
1959	52,195		29,200	81,395
1960	28,105		17,155	45,260
				$ 1,263,995

EXHIBIT "C"

GASOLINE PLANT CONSTRUCTION CORPORATION

PLANT COST ESTIMATES

Plant I - Compressor Plant with Compression Gasoline Recovery

Gathering System	$ 40,000
Compressor Plant, 1250 HP @ 230.00	287,000
Generator Units, 2 - 25 KW	10,000
Gasoline Recovery and Storage	25,000
Miscellaneous	10,000
	$ 392,000

Plant II - Compressor Plant with Refrigeration Unit for maximum 12# Gasoline Recovery

Gathering System	$ 40,000
Compressor and Refrigeration Plant, 1320 HP @ 230.00	303,000
Generator Units, 2 - 40 KW	14,000
Gasoline Recovery and Gas Dehydration Units	50,000
Miscellaneous	15,000
	$ 422,000

Plant III - Compressor Plant with Crude Stabilization

Gathering System	$ 40,000
Compressor Plant	287,000
Generator Units, 2 - 40 KW	14,000
Crude Stabilization	25,000
Gasoline Absorption Unit	75,000
Miscellaneous	20,000
	$ 461,000

EXHIBIT "D"

GASOLINE PLANT CONSTRUCTION CORPORATION

AVERAGE DAILY PRODUCTION

Plant	Year	Sales Gas MCF/D	* El Paso Products LPG-Gal/D	26#-Gal/D	Plant 12# Gaso. Gal/D
I	1954	2,235	634	440	1,165
	1955	3,350	934	620	1,615
	1956	3,590	967	620	1,615
	1957	3,590	934	560	1,500
	1958	2,530	634	360	967
	1959	1,175	267	160	400
	1960	634	167	100	233
II	1954	2,355			1,935
	1955	3,530			2,700
	1956	3,770			2,680
	1957	3,770			2,480
	1958	2,635			1,600
	1959	1,225			684
	1960	658			400
					12# Crude Vol. Increase
III	1954	2,255			5,080
	1955	3,470			5,780
	1956	3,740			4,950
	1957	3,745			4,320
	1958	2,610			2,815
	1959	1,190			1,333
	1960	642			783

* Portion of recovered products for which Lowry would receive payment.

EXHIBIT "E"

GASOLINE PLANT CONSTRUCTION CORPORATION

OPERATING COSTS

	Cost/Year
* Operator Salaries	$ 25,000
Lube Oil and Operating Supplies	12,000
Maintenance Materials @ 1%/year	4,000
Insurance and Taxes @ 1%/year	4,000
General Overhead @ 15% of above	7,000
	$ 52,000

* Includes General Foreman and one operator per shift.

Operating Costs of any one of the three types of plants described would be approximately the same.

GASOLINE PLANT CONSTRUCTION CORPORATION

INCOME BEFORE DEPRECIATION, INCOME TAX, ETC.

Plant I:

Gross Income for Seven Year Period	$ 959,585	
Operating Expenses	364,000	
Income After Operating Expenses		$ 595,585
Cost of Plant	392,000	
Salvage Value of Plant @ 40%	157,000	
Cost of Plant After Salvage		235,000
Net Income Before Depreciation, Taxes		$ 360,585

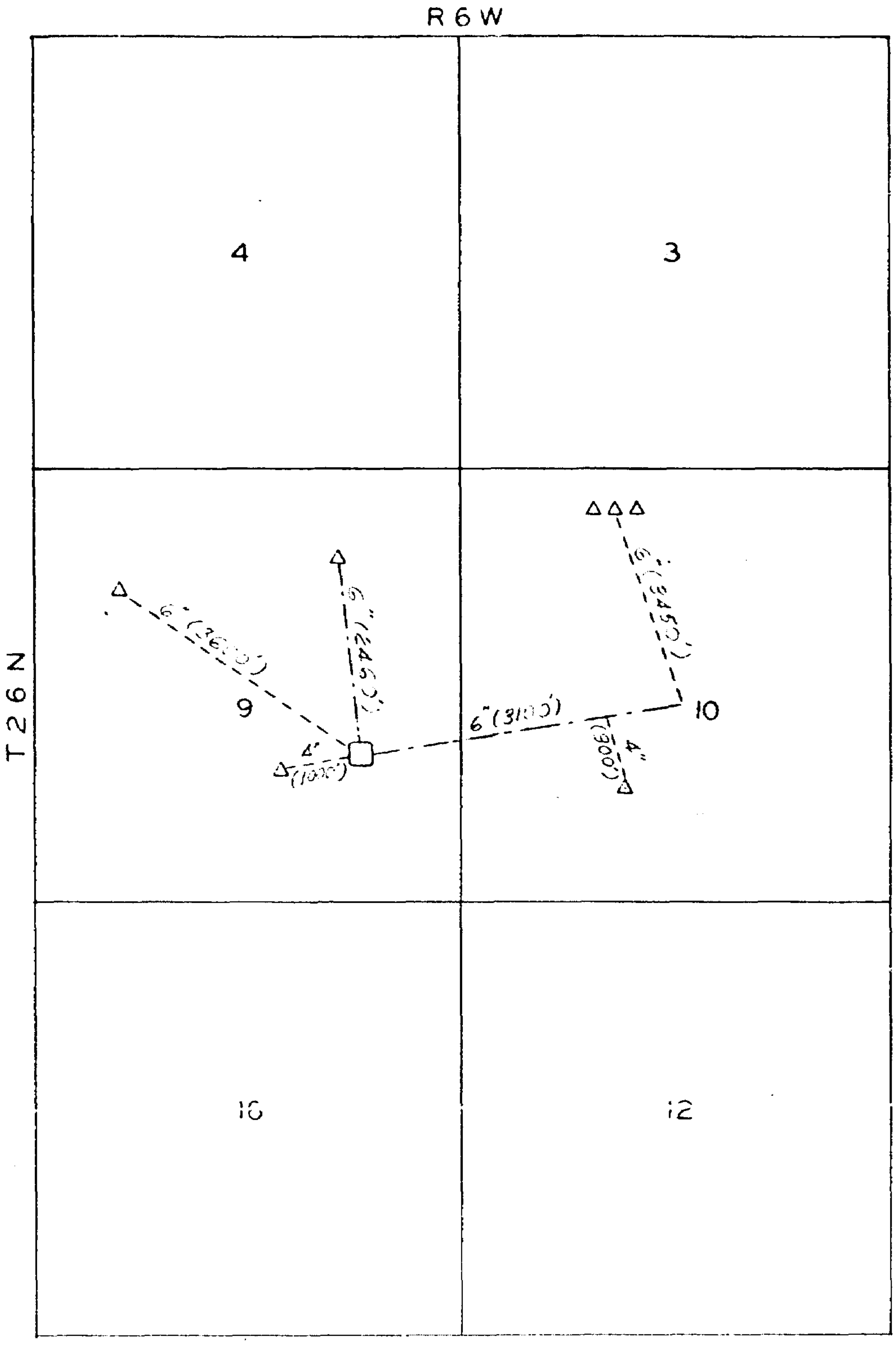
Plant II:

Gross Income for Seven Year Period	1,000,830	
Operating Expenses	364,000	
Income After Operating Expenses		$ 636,830
Cost of Plant	422,000	
Salvage Value of Plant @ 40%	169,000	
Cost of Plant After Salvage		253,000
Net Income Before Depreciation, Taxes		$ 383,830

Plant III:

Gross Income for Seven Year Period	1,263,995	
Operating Expenses	364,000	
Income After Operating Expenses		$ 899,995
Cost of Plant	461,000	
Salvage Value of Plant @ 40%	185,000	
Cost of Plant After Salvage		276,000
Net Income Before Depreciation, Taxes		$ 623,995

EXHIBIT "G"



LEGEND

△ TANK BATTERY

☐ COMPRESSOR SITE

- - - PROPOSED LINES

GASOLINE PLANT CONSTRUCTION CORP.
HOUSTON – CORPUS CHRISTI

CASINGHEAD GAS GATHERING SYSTEM
FOR
LOWRY OIL CO. — RIO ARRIBA COUNTY, N.M.

DR. TURER	DATE 5-18-53	
CK.	SCALE 1" = 2000'	

EXHIBIT "H"

UNIT PRICES USED

* Sales Gas:	1954 - 58				11¢/MCF
	1959 - 60				12¢/MCF

** Product payment from El Paso Natural Gas Company used with Plant I only.

El Paso Recovery			x fraction	x	price
C_3	25%	) LPG	x 20.0%	x	3¢/gal.
C_4	70%	) 26#	x 33.3%	x	5¢/gal.
C_5	100%				

Price of Increased Crude: 6¢/gal.
(equivalent to 12# RVP natural gasoline)

* Volumes used in Plant I are after El Paso Natural Gas Company shrinkage.
Volumes used in Plants II and III are before El Paso Natural Gas Company shrinkage.
Volume measurements are: MCF @ 15.025 psia.

** Sales gas contents of Plants II and III not sufficient in pentanes-plus to rate payment on products.

MATERIAL BALANCE ANALYSIS

of the

TOCITO SAND RESERVOIR

for

LOWRY ET AL OPERATING ACCOUNT

MATERIAL BALANCE ANALYSIS

of the

TOCITO SAND RESERVOIR

LOWRY ET AL PROPERTIES

in the

DOGIE CANYON FIELD

RIO ARRIBA COUNTY, NEW MEXICO

As of

August 18, 1952

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AMSTUTZ AND YATES, INC.

October 23, 1952

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

Dear Sir:

On August 15 you authorized us to make a study of the performance of the Tocito oil reservoir in the Bogie Canyon Field located in Township 26 north, Range 6 west, Rio Arriba County, New Mexico. The object of this analysis was to attempt to determine the magnitude of the reservoir using material balance calculations. The purpose of this letter is to report our conclusions and recommendations and to discuss the calculations briefly.

Our preliminary conclusions, based on the performance data from the discovery of the field in July, 1951, to August 18, 1952, are set forth below.

(1) The entire Tocito sand reservoir of the Bogie Canyon Field originally contained approximately 15,000,000 barrels of stock tank oil in place.

(2) Calculations concerning the relative permeability of the gas to the oil indicate a lower recovery than might normally be anticipated for this type of reservoir. Our best estimate at this time is that a recovery factor on the order of fifteen per cent (95 barrels per acre foot) of the stock tank oil originally

in place may be expected by primary production. This implies a total recovery from the reservoir of approximately 2,200,000 barrels of stock tank oil

(3) Preliminary calculations indicate that the total recovery of casing-head gas from the entire reservoir will be approximately 10 to 12 billion cubic feet. At an assumed price of ten cents per thousand cubic feet, a total gas revenue on the order of $1,000,000 is indicated, provided the gas is marketed.

As a result of our analysis we have the following recommendations to make.

(a) In order to alleviate excessive production rates for the present wells, we reiterate our previous recommendation, made orally to you and Mr. Lowry, that at least one and possibly two additional wells be drilled immediately. In our opinion the first well should be located in the center of the NW/4 NW/4 of Section 9 - T26N-R6W. Final selection of the location for the second well should be held in abeyance pending analysis of the information gained from the first one. Valuable additional data on the reservoir would also be secured by an analysis of a diamond core of the Tocito sand in this well.

(b) In view of the [illegible] increase in gas-oil ratios experienced to date and the resultant increased voidage of reservoir space per barrel of oil produced, more accurate gas production data are necessary if future material balance calculations are to be reliable. We therefore recommend that gas-oil ratio tests, at the normal producing rates, be made at frequent intervals on each well.

(c) Because of the short performance history and the incomplete development of the reservoir, the conclusions set forth in this report must be considered preliminary and subject to correction as more performance history becomes available and development of the reservoir progresses. It is our recommendation therefore that upon the completion of the next well the entire field be shut in and another complete bottom hole pressure and gas-oil ratio survey be made, after which our preliminary conclusions of this report should be checked by additional calculations.

(d) Serious consideration should be given to installing a casing-head gas gathering system and compressor to permit selling the gas produced with the oil, since it appears that its value would approximate one-fifth of the anticipated net operating income to be derived from the future oil production under primary production methods.

(e) If the low recovery efficiency now indicated is corroborated by later analyses, early consideration should be given to a program of pressure maintenance, possibly by water injection, to increase the recoverable oil from the reservoir.

The basic data used in our analysis were furnished by your office and by Mr. Holland of the Lowry Oil Company. The information consisted of the complete production history of each well up to August 18, 1952, initial and periodic gas-oil ratio tests on all wells, initial bottom hole pressure tests on each well, two complete bottom hole pressure surveys made on May 1, and August 18, 1952, productivity tests on several of the wells, interference tests between some of the wells, two bottom hole fluid sample analyses, core analyses of the Tocito sand on two wells, electric logs on all of the wells, a map of the field, and other pertinent information.

The material balance method of reservoir analysis can be most useful, but must be carefully applied if reliable results are to be obtained. Predictions of future reservoir performance and calculations of the amount of active oil in place which are made during the early life of a reservoir, are less accurate than those which are possible from similar calculations made later in the productive life. For this reason it is important that all data used in the calculations be carefully examined and analyzed for accuracy and validity. The three basic factors in all material balance calculations are the pressure-volume-temperature relationships of the reservoir fluids, the reservoir pressures, and the gas, oil, and water production. In the following paragraphs our analysis of these basic data is briefly discussed.

All material balance equations are predicated upon the assumption that the reservoir is in complete pressure equilibrium, that is, that the static reservoir pressures at a given datum are equal throughout the reservoir. Though this is seldom true in actual practice, satisfactory accuracy in the calculations can be obtained if the individual well pressures are properly weighted. Areally weighted average bottom hole pressures are generally satisfactory for this purpose, and this method of averaging was used in this analysis. In order to arrive at a reasonable approximation of the extent of the total reservoir in light of the presently available data, a sand volume (isopachous) map of the net pay thickness was constructed and is included herein as Figure 1. The area enclosed within the zero contour on the isopachous map is 2,730 acres, and this projected total area of the reservoir has been used in determining the areally weighted average bottom hole pressures. All pressures reported to us and used in these calculations were at a subsea datum of 100 feet. The first bottom hole pressure measured on the discovery well (No. 179) was 2,197 pounds per square inch gauge (psig) after a total of 6,000 barrels of oil had been produced. From this and the later performance history, we estimate that the virgin reservoir pressure was 2,200 psig, and this figure was used in our calculations. The first significant bottom hole pressure survey was made May 1, 1952, at which time a total of 129,770 barrels of stock tank oil had been produced from the reservoir. The arithmetic average of the four pressures was 2,100 psig. However, the attached isobaric map (Figure 2) indicates that when these pressures are weighted areally over the entire reservoir, the average reservoir pressure is 2,159 psig, and this figure was used. The next general bottom hole pressure survey was made August 18 to 20, 1952. The arithmetic average bottom hole pressure at that time was 2,041 psig, and the areally weighted average pressure of the reservoir was 2,112 psig. A cumulative oil production of 233,049 barrels had been produced to the time of this survey. The isobaric map (Figure 3) used to determine this average pressure is attached.

A second factor in these calculations was the pressure-volume-temperature relationships of the reservoir fluid as revealed by the two bottom hole fluid sample analyses. The first sample was taken on Well No. 132 on January 2, 1952, after the well had been produced for over a month and had then been shut in for 24 hours prior to sampling. The saturation pressure indicated by this analysis was 2,054 psig, the formation volume factor was 1.526 barrels of reservoir oil per barrel of stock tank oil, and the solution gas-oil ratio was 862 cubic feet per barrel. Since the well had been produced at a fairly high rate just previous to being shut in and at a gas-oil ratio materially in excess of the indicated solution gas-oil ratio, the pressure in the well opposite the formation was drawn down considerably below the static reservoir pressure at the time the well was shut in. The shut in period, prior to sampling, of 24 hours is believed to have been insufficient to permit equilibrium conditions to have been reached between the static reservoir and the well bore. Hence it would have been impossible to have obtained a sample of fluid which would be truly representative of the static reservoir fluid. It is our opinion therefore that, while the solubility-shrinkage relationships below the indicated saturation pressure are reliable, the saturation pressure itself could easily be in error by 150 pounds per square inch. For the purpose of checking the original fluid sample analysis, another sample was taken on Well No. 182 on August 19, 1952, the results of which apparently corroborated those secured in the first analysis since a saturation pressure of 2,051 psig, a formation volume factor of 1.512 barrels of reservoir fluid per barrel of stock tank oil, and a solubility of 862 standard cubic feet of gas per barrel of stock tank oil were obtained. However, it should be observed that the saturation pressure obtained by the laboratory analysis could not exceed the bottom hole pressure at the point of sampling so long as the sample was representative of equilibrium conditions at that pressure. This can be seen readily from the fact that, had the original saturation pressure been greater than the sampling pressure, some gas would have been evolved from the fluid at the sampling point, but that gas would have separated out and moved on up the hole prior to sampling. Hence, the sample can be representative of sampling conditions only, static reservoir pressure at the time the well was shut in. The shut in period, prior to sampling, of 24 hours is believed to have been insufficient to permit equilibrium conditions to have been reached betweenthe static reservoir and the well bore. Hence it would have been impossible to have obtained a sample of fluid which would be truly representative of the static reservoir fluid. It is our opinion therefore that, while the solubility-shrinkage relationships below the indicated saturation pressure are reliable, the saturation pressure itself could easily be in error by 150 pounds per square inch. For the purpose of checking the original fluid sample analysis, another sample was taken on well No. 182 on August 19, 1952, the results of which apparently corroborated those secured in the first analysis since a saturation pressure of 2,051 psig, a formation volume factor of 1.512 barrels of reservoir fluid per barrel of stock tank oil, and a solubility of 862 standard cubic feet of gas per barrel of stock tank oil were obtained. However, it should be observed that the saturation pressure obtained by the laboratory analysis could not exceed the bottom hole pressure at the point of sampling so long as the sample was representative of equilibrium conditions at that pressure. This can be seen readily from the fact that, had the original saturation pressure been greater than the sampling pressure, some gas would have been evolved from the fluid at the sampling point, but that gas would have separated out and moved on up the hole prior to sampling. Hence, the sample can be representative of sampling conditions only, and the similar sampling conditions can account nicely for the agreement in the bottom hole sample analyses. In addition, practically all gas-oil ratios have been materially in excess of the solution gas-oil ratio at the saturation pressure. Likewise, other tangible evidence from some of the calculations points to a reservoir fluid which was saturated at virgin reservoir conditions. We therefore believe that the oil in the reservoir was saturated at the original reservoir pressure of 2,200 psig, and this saturation pressure has been assumed in the material balance calculations reported herein.

A series of four material balance calculations were made on the Tocito reservoir covering the performance up to August 18, 1952. In all of these calculations the Schilthuis formula and nomenclature were used. In the following paragraphs each of these calculations is briefly discussed and the basic conditions and assumptions and answers derived therefrom are set forth.

The first of these calculations covers the entire producing life of the field from July, 1951, to August 18, 1952. It assumes that there was no gas cap present initially, and that there is no effective water drive in the reservoir. The original saturation pressure used was 2,200 psig and the solubility obtained by extrapolating the fluid sample analysis of Well No. 182 to 2,200 psig indicated a solution gas-oil ratio of 923 standard cubic feet per barrel of stock tank oil. The formation volume factor curve on the above mentioned analysis was also extrapolated to 2,200 psig and was 1.542 at this pressure. The total gas production was estimated to be 282,100,00 standard cubic feet, as determined by the various gas-oil ratio surveys. Since the cumulative oil production was 233,049, the cumulative gas-oil ratio was 1,210 standard cubic feet per barrel of stock tank oil. On this basis the total volume of stock tank oil originally in place in the Tocito reservoir was calculated to be 13,800,000 barrels.

The second material balance calculation covered the period from the intiial discovery of the field to May 1, 1952. The average reservoir pressure on that date was 2,159 psig and the cumulative oil production was 129,770 barrels while the estimated cumulative gas production was 139,000,000 standard cubic feet. Except for these items, the other basic figures and assumptions of the first calculation were used here. The total volume of stock tank oil originally in the reservoir was calculated to be 14,100,000 barrels.

The third calculation covered the period from May 1 to August 18, 1952. During this time the average reservoir pressure dropped from 2,159 pounds to 2,112 psig and 103,279 barrels of stock tank oil were produced. The total gas production during the same period amounted to 143,000,000 standard cubic feet. These calculations indicated that 10,500,000 barrels of stock tank oil were originally in place in the reservoir.

In view of the relatively low pressure drop covered by these calculations, amounting to 3.5, 1.9, and 2.1 per cent of the total initial reservoir pressure, we believe that the agreement in the answers is good.

However, it should be realized that these answers are probably minimum figures, and it is our opinion that the actual total volume of stock tank oil originally in place in the reservoir is approximately 15,000,000 barrels.

A fourth material balance calculation was made assuming that the saturation pressure of the oil was 2,054 psig, and that inasmuch as the latest pressure survey revealed a static average bottom hole pressure of 2,112 psig, the entire production up to August 18, 1952, had resulted from liquid expansion of the reservoir fluids. These calculations indicated that there were originally 136,000,000 barrels of stock tank oil in place in the reservoir. Based on core analysis data, this volume of oil would require 215,900 acre feet of net reservoir volume. If the average thickness of the reservoir were assumed to be 10 feet, a total productive area of 33.7 square miles would be required to contain this oil. In light of our present knowledge of the reservoir, this size does not appear to be reasonable.

Prior to our material balance calculations, we analyzed the two core analyses available on the Tocito sand and electric logs on all the other wells and prepared an isopacnous map of the net sand pay, and this is attached (Figure 1) to this report. The total volume of pay sand included in the reservoir, as projected, was 24,100 acre feet. The two core analyses available indicated an average porosity of 15 per cent and a connate water saturation of 22 per cent. The formation volume factor used in our material balance work (1.542 barrels of reservoir oil per barrel of stock tank oil) was applied here. On this basis, 630 barrels of stock tank oil per acre foot were calculated to have been in place in the reservoir originally. Applying these figures, the total volume of stock tank oil originally in the reservoir is 15,200,000 barrels. This figure corroborates the results of the first three material balance calculations.

By use of material balance it is also possible to make reasonable predictions of the performance characteristics of the field once the developmental phase is past. This presupposes that the necessary data are obtained which, beside all those already innumerated, include relative permeability data on the reservoir rock. A number of exhaustive relative permeability studies have been made on other reservoirs, and where such data are not available on the reservoir being analyzed, the usual practice is to select a Kg/Ko versus fluid saturation curve from what is considered a similar reservoir rock. Later a Kg/Ko curve can be constructed from the actual field performance and this curve can then be utilized to complete the prediction.

We have made a calculation of the Kg/Ko relationship for the Dogie Canyon Tocito reservoir assuming the initial active oil in place was 10,200,000 (note that this is the lowest of the several calculations and would give the highest gas-oil ratio predictions). The free-gas saturation in the reservoir on August 18, 1952, was calculated to be 2.7 per cent and the corresponding Kg/Ko was 0.023. The actual gas-oil ratio is unusually high for such a low free-gas saturation and from our knowledge of the performance of other reservoirs a low primary recovery is implied.

Conservation of the reservoir energy to permit improving the low per cent recovery indicated is of paramount importance. This will require careful study to determine the optimum flowing rates (minimum gas-oil ratios and drawdowns of bottom hole pressure). The magnitude of possible benefits seems to justify the necessary field tests and application of production rates thus determined as best. The low per acre yield suggested by our estimate of 2,200,000 barrels of oil to be recovered by primary means, will require wide spacing of wells in order that the over all program will have shown a profit commensurate with the risks. The recommendation to drill in the center of the NW/4 NW/4 of Section 9 constitutes a recommendation to continue development on a spacing of 160 acres per well. This procedure could be modified when the economics of closer spacing are better known.

Pressure maintenance by return of gas to the reservoir does not appear to be attractive. The rapid rise in gas-oil ratios are indicative of higher gas saturation near the wells, which has resulted from producing the wells at high rates. Thus a wide variation in gas saturations in the reservoir must be expected to develop as time goes on, which would tend to promote gas channelling and ineffective cycling. Water injection in structurally low wells might be beneficial if sufficient quantities of water can be handled.

The detailed calculations discussed in this report are available in our office if you care to review them with us.

Yours very truly,

AMSTUTZ AND YATES, INC.

/s/ George L. Yates

George L. Yates

cc: Mr. Tim G. Lowry
Eckert, Peterson & Leeming
135 South La Salle Street
Chicago, 3, Illinois

FORM F-11A

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS

Page 1 of 1
File FNML-56 FC
Well Federal 22-45-207

CORE SUMMARY AND CALCULATED RECOVERABLE OIL

CORE SUMMARY				
FORMATION NAME	Tocito			
DEPTH, FEET	6644.0-6661.0			
% CORE RECOVERY	100	12'		
FEET OF PERMEABLE, PRODUCTIVE FORMATION RECOVERED	12.0			
AVERAGE PERMEABILITY MILLIDARCYS	78			
CAPACITY — AVERAGE PERMEABILITY X FEET PRODUCTIVE FORMATION	936			
AVERAGE POROSITY, PERCENT	16.8			
AVERAGE RESIDUAL OIL SATURATION, % PORE SPACE	22.2			
GRAVITY OF OIL, °A.P.I.	40			
AVERAGE TOTAL WATER SATURATION, % PORE SPACE	24.5			
AVERAGE CALCULATED CONNATE WATER SATURATION, % PORE SPACE	22			
SOLUTION GAS-OIL RATIO, CUBIC FEET PER BARREL (1)	790			
FORMATION VOLUME FACTOR—VOLUME THAT ONE BARREL OF STOCK TANK OIL OCCUPIES IN RESERVOIR (1)	1.46			
CALCULATED RECOVERABLE OIL	**Prediction dependent upon complete isolation of each division. Structural position of well, total permeable thickness of oil zone and drainage area of well should be considered.**			
BY NATURAL OR GAS EXPANSION, BBLS. PER ACRE FOOT (2)	154			
INCREASE DUE TO WATER DRIVE, BBLS. PER ACRE FOOT	253			
TOTAL AFTER COMPLETE WATER DRIVE, BBLS. PER ACRE FOOT (3)	407			

Core Laboratories, Inc.

J D Harris (PB)

J. D. Harris

NOTE:

(*) REFER TO ATTACHED LETTER.

(1) REDUCTION IN PRESSURE FROM estimated SATURATION PRESSURE TO ATMOSPHERIC PRESSURE.

(2) AFTER REDUCTION FROM ORIGINAL RESERVOIR PRESSURE TO ZERO POUNDS PER SQUARE INCH.

(3) RESERVOIR PRESSURE MAINTAINED BY WATER DRIVE AT OR ABOVE estimated ORIGINAL SATURATION PRESSURE.

(4) NO ESTIMATE FOR GAS PHASE RESERVOIRS.

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

August 5, 1952

Lowry, et al. Operating Account
616 East Central Avenue
Room 215
Albuquerque, New Mexico

Attention: Mr. Arthur Holland

Subject: Core Analysis
Federal 22-45-207 Well
Largo Canyon Field
Rio Arriba County, New Mexico

Gentlemen:

Diamond conventional cores from the subject well in the Tocito formation have been sampled and quick-frozen by a representative of Core Laboratories, Inc. and later analyzed in our Farmington, New Mexico laboratory. Results of analysis are presented in tabular and graphical form on the attached Coregraph. Oil emulsion mud was used as the drilling fluid.

Tocito formation analyzed from 6642 to 6644 feet is interpreted to be nonproductive due to low permeability.

Sand analyzed from 6644 to 6661 feet is interpreted to be oil productive where permeable.

Sand analyzed from 6661 to 6663.5 feet is interpreted to be nonproductive due to low permeability.

Recovery estimates for the zone, 6644 to 6661 feet, are given on page one of the report.

We hope these data prove beneficial in the evaluation of this well.

Very truly yours,

Core Laboratories, Inc.

J D Harris (PB)

J. D. Harris,
District Engineer

JDH:ma

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

September 9, 1952

RESERVOIR FLUID DIVISION
T. L. KENNERLY, ***Manager***

Lowry, et al., Operating Account
616 East Central Avenue
Albuquerque, New Mexico

Attention: Mr. A. F. Holland

Subject: Reservoir Fluid Study
Federal Doswell No. 21-40-182 Well
Pettigrew Field
Rio Arriba County, New Mexico

Gentlemen:

This report presents the results of laboratory studies performed on sub-surface samples collected from the subject well on August 19, 1952.

The fluid exhibited a saturation pressure of 2051 psig at the reservoir temperature of 175° F. The reservoir pressure at sampling depth, transmitted to us in a letter of August 25, 1952, was reported to be 2060 psig. Comparison of these two pressures indicates that a representative sample was obtained. Since the pressure at the top of the producing zone was calculated to be 2096 psig, there is sufficient agreement to indicate that the reservoir exists in a saturated condition. The reported produced gas-oil ratios are further substantiation of this fact since they are somewhat in excess of the solution gas-oil ratios determined in this study.

Differential vaporization of the reservoir fluid at reservoir temperature resulted in the evolution of 862 standard cubic feet of vapor, measured at 14.7 psia and 60° F., per barrel of residual liquid measured at 60° F. The corresponding formation volume factor was determined to be 1.512 barrels of saturated fluid per barrel of residual liquid. The viscosity of the liquid phase was determined at several pressure levels and varied from a value of 0.39 centipoise at saturation pressure to a maximum of 1.32 centipoises at zero pressure.

Samples of the fluid were vaporized through separators operating at various pressures in order to determine the effect of separator pressure upon the quantity and properties of the products. These studies indicate that maximum stock tank yield, per unit of reservoir withdrawal, will occur under an operating pressure of 130 psig. Maximum stock tank liquid gravity will also occur at approximately this pressure; however, the fluid should remain above 40^{o} API under any normal operating conditions.

The composition of the fluid, as determined by low temperature fractional distillation, is presented on page six. A significant amount of the intermediate materials, plus a relatively low molecular weight residue, indicate the volatile nature of the fluid. These properties are responsible for the very pronounced effect which separator pressure has upon this fluid.

If we can serve you in any further manner please call upon us. We would be pleased to discuss this study further with you if you should so desire.

Very truly yours,

Core Laboratories, Inc.

FOReudelhuber

F. O. Reudelhuber,
Division Engineer

FOR:ma

Form 69385

CORE LABORATORIES, Inc.
Petroleum Reservoir Engineering
DALLAS, TEXAS

File RFL 85

Company	Lowry, et al., Operating Account	Date Sampled	August 19, 1952
Well	Federal Doswell No. 21-40-182	County	Rio Arriba
Field	Pettigrew	State	New Mexico

FORMATION CHARACTERISTICS

Formation Name	Tocito
Date First Well Completed	July, 1951
Original Reservoir Pressure	2197 PSI @ -100 ft.
Original Produced Gas-Oil Ratio	1400 cu. ft./bbl.
Production Rate	250 bbl./d.
Separator Pressure and Temperature	25 PSI, ° F.
Oil Gravity at 60° F.	42 ° API
Datum	100 ft. subsea
Original Gas Cap	

WELL CHARACTERISTICS

Elevation	6561 Feet K.B.
Total Depth	6761 ft.
Completion Depth	6705-25 ft.
Tubing Size and Depth	2.5 in. to 6720 ft.
Productivity Index	bbl./d./PSI @ bbl./d.
Last Reservoir Pressure	2060 PSI @ 6603 ft.
Date	August 19, 1952
Reservoir Temperature	175 ° F. @ 6603 ft.
Status of Well	Shut-In 90 Hours
Pressure Gauge	Amerada (Lowry)
Normal Production Rate	250 bbl./d.
Gas-Oil Ratio	1100 cu. ft./bbl.
Separator Pressure and Temperature	25 PSI, ° F.
Base Pressure	15.025 PSI Abs.
Well Making Water	None % Cut

SAMPLING CONDITIONS

Sampled at	6603 Feet K.B. *
Status of Well	Shut-In 90 Hours
Gas-Oil Ratio	cu. ft./bbl.
Separator Pressure and Temperature	PSI, ° F.
Tubing Pressure	1050 PSI
Casing Pressure	1590 PSI
Core Laboratories Engineer	WTL
Type Sampler	Perco

REMARKS:

* Necessary point of sampling due to presence of water

Form 64801

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

File RFL 85

Well Federal Doswell
No. 21-40-182

VOLUMETRIC DATA OF Reservoir Fluid SAMPLE

1. Saturation pressure (bubble-point pressure) 2051 PSI @ 175 °F.
2. Thermal expansion of saturated oil @ 5000 PSI = $\frac{V @ 175\ °F.}{V @ 76\ °F.}$ = 1.05973
3. Compressibility of saturated oil @ reservoir temperature: Vol./Vol./PSI:

   From 5000 PSI to 4000 PSI = 11.65×10^{-6}

   From 4000 PSI to 3000 PSI = 13.34×10^{-6}

   From 3000 PSI to 2051 PSI = 16.20×10^{-6}
4. Specific volume at saturation pressure: cu. ft./# 0.02432 @ 175 °F.

Form 50870

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

File RFL 85

Well Federal Dosvell No. 21-40-182

Reservoir Fluid SAMPLE TABULAR DATA

PRESSURE PSI GAUGE	PRESSURE-VOLUME RELATIONS @ 175 °F., RELATIVE VOLUME OF OIL AND GAS, V/Vs	VISCOSITY OF OIL @ 175 °F., CENTIPOISES	DIFFERENTIAL VAPORIZATION @ 175 °F. LIBERATED GAS SCF PER BARREL OF RESIDUAL OIL	SOLUTION GAS SCF PER BARREL OF RESIDUAL OIL	RELATIVE OIL VOLUME, V/VR
5000	0.9602				1.452
4500	0.9656				1.460
4425		0.46			
4000	0.9715				1.469
3835		0.44			
3500	0.9780				1.479
3330		0.43			
3000	0.9846				1.489
2850		0.42			
2500	0.9920				1.500
2410		0.41			
2210		0.40			
2200	0.9973				1.508
2100	0.9989				1.511
2051	1.0000	0.39	0	862	1.512
2032	1.0041				
2002	1.0110				
1940		0.39			
1899	1.0360				
1815		0.40			
1805			100	762	1.462
1704	1.0958				
1570		0.43			
1569			187	675	1.421
1501	1.1798				
1305	1.2989				
1260		0.48			
1245			301	561	1.367
1085	1.4902				
970		0.52			
950			400	462	1.319
900	1.7464				
740		0.57			

V = Volume at given pressure.

Vs = Volume at saturation pressure at the specified temperature.

VR = Residual oil volume at 14.7 PSI absolute and 60° F.

Form 50870

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

File RFL 85

Well Federal Doswell No. 21-40-182

Reservoir Fluid SAMPLE TABULAR DATA

PRESSURE PSI GAUGE	PRESSURE-VOLUME RELATIONS @ 175 °F. RELATIVE VOLUME OF OIL AND GAS, V/Vs	VISCOSITY OF OIL @ 175 °F. CENTIPOISES	DIFFERENTIAL VAPORIZATION @ 175 °F. LIBERATED GAS SCF PER BARREL OF RESIDUAL OIL	SOLUTION GAS SCF PER BARREL OF RESIDUAL OIL	RELATIVE OIL VOLUME, V/VR
735	2.1032				
650			500	362	1.272
504	3.0194				
451		0.70			
405	3.7737				
352			606	256	1.221
291	5.3454				
155			698	164	1.170
82			749	113	1.142
0		1.32	862	0	1.061

@ 60° F. = 1.000

Gravity of Residual Oil =

41.8° API @ 60° F.

V = Volume at given pressure.

V_s = Volume at saturation pressure at the specified temperature.

V_R = Residual oil volume at 14.7 PSI absolute and 60° F.

Form 54802

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

File RFL 85

Well Federal Doswell No. 21-40-182

SEPARATOR TESTS OF Reservoir Fluid SAMPLE

SEPARATOR PRESSURE, PSI GAUGE	SEPARATOR TEMPERATURE, °F.	SEPARATOR GAS/OIL RATIO See Foot Note (1)	STOCK TANK GAS/OIL RATIO See Foot Note (1)	STOCK TANK GRAVITY, °API @ 60° F.	SHRINKAGE FACTOR, V_R/V_S See Foot Note (2)	FORMATION VOLUME FACTOR, V_S/V_R See Foot Note (3)	SPECIFIC GRAVITY OF FLASHED GAS
0	76	876		41.8	0.6435	1.554	1.0269
25	75	782	23	42.9	0.6707	1.491	
50	74	724	45	44.2	0.6859	1.458	
150	73	600	135	44.4	0.6974	1.434	

(1) Separator and stock tank gas/oil ratio in cubic feet of gas @ 60° F. and 14.7 PSI absolute per barrel of stock tank oil @ 60° F.

(2) Shrinkage Factor: V_R/V_S is barrels of stock tank oil @ 60° F. per barrel of saturated oil @ 2051 PSI gauge and 175 °F.

(3) Formation Volume Factor: V_S/V_R is barrels of saturated oil @ 2051 PSI gauge and 175 °F. per barrel of stock tank oil @ 60° F.

Form 55849

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

File RFL 85

Company Lowry, et al., Operating Account Formation Tocito

Well Federal Doswell No. 21-40-182 County Rio Arriba

Field Pettigrew State New Mexico

HYDROCARBON ANALYSIS OF Reservoir Fluid SAMPLE

COMPONENT	WEIGHT %	MOL %	DENSITY @ 60° F. GRAMS PER CUBIC CENTIMETER	° API @ 60° F.	MOLECULAR WEIGHT
Methane	5.70	31.98			
Ethane	4.01	11.98			
Propane	4.04	8.23			
Iso-butane	0.75	1.16			
N-butane	2.79	4.32			
Iso-pentane	1.47	1.83			
N-pentane	1.83	2.28			
Hexanes	3.37	3.52			
Heavier	76.04	34.70	0.8342	38.0	197
	100.00	100.00			

Core Laboratories, Inc.

F. O. Reudelhuber

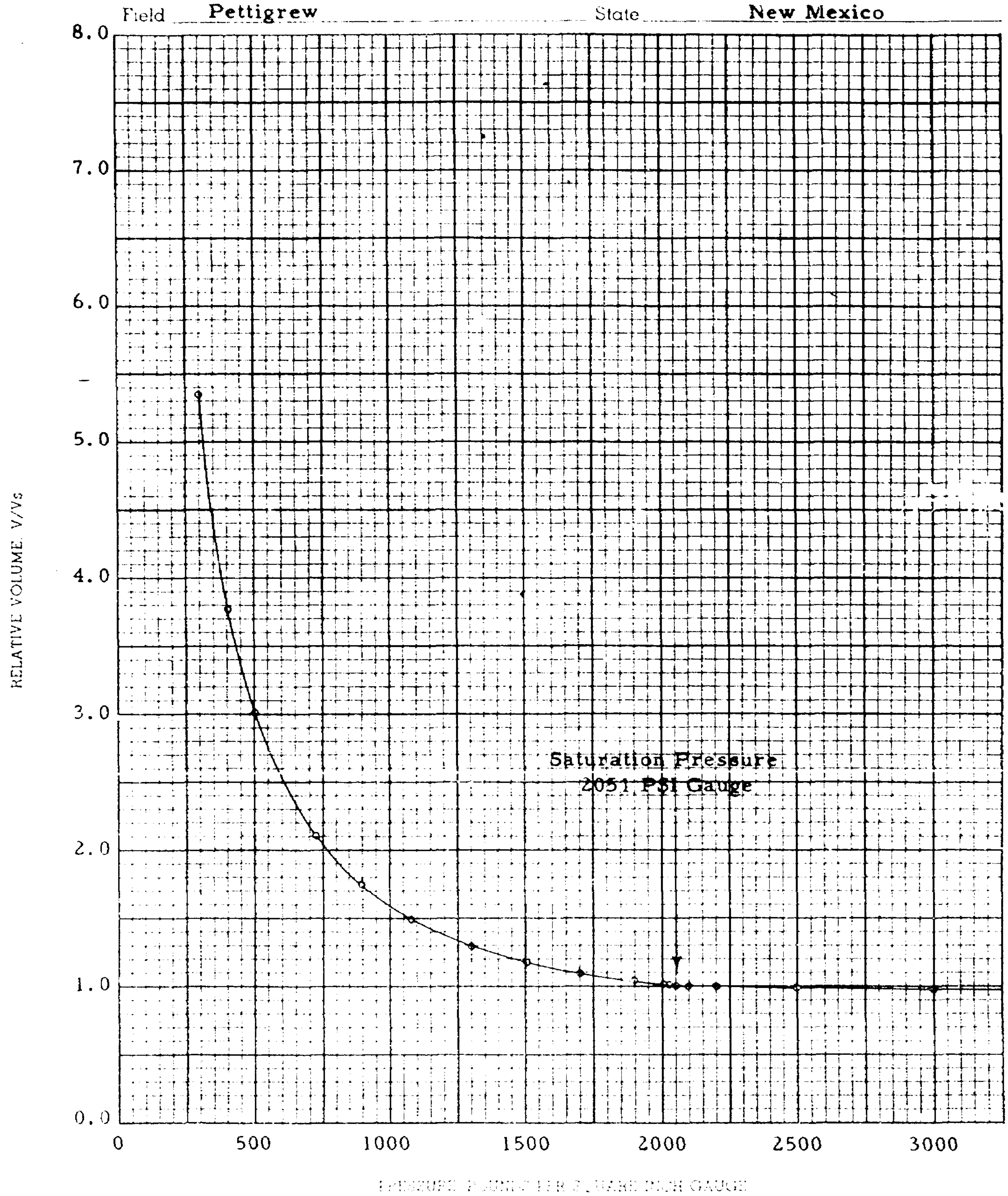
F. O. Reudelhuber

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

File RFL 85

PRESSURE VOLUME RELATIONS OF RESERVOIR FLUID

Company Lowry, et al., Operating Account Formation Tocito
Well Federal Doswell No. 21-40-182 County Rio Arriba
Field Pettigrew State New Mexico



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DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID

Company Lowry, et al., Operating Account Formation Tocito
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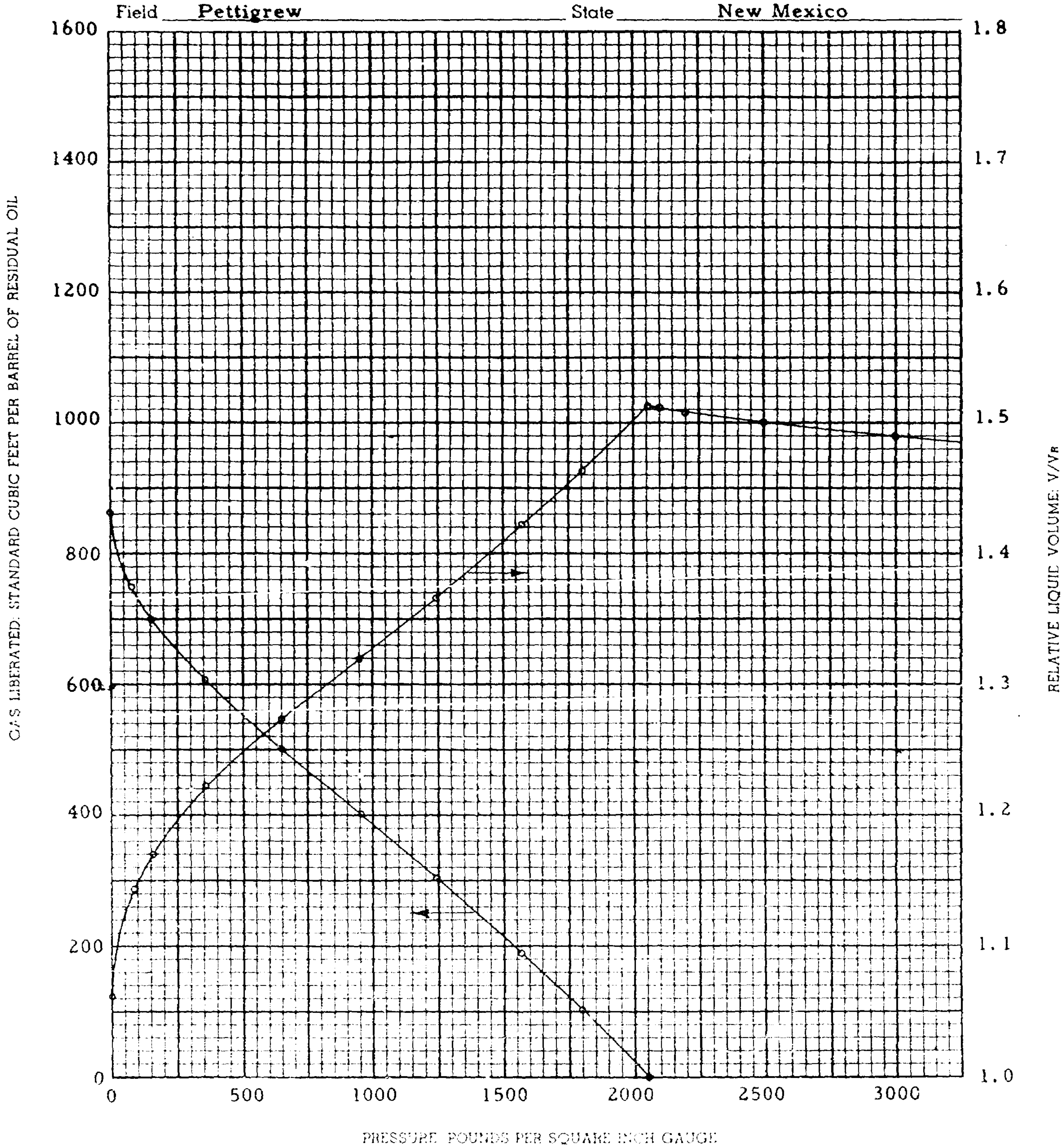

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VISCOSITY OF RESERVOIR FLUID

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