OIL CONSERVATION DIVISION
P. O. Box 2088
SANTA FE, NEW MEXICO
87501

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT

ADMINISTRATIVE ORDER
NFL 119

INFILL DRILLING FINDINGS AND WELL-SPACING WAIVER
MADE PURSUANT TO SECTION 271.305(b) OF THE
FEDERAL ENERGY REGULATORY COMMISSION REGULATIONS,
NATURAL GAS POLICY ACT OF 1978 AND OIL CONSERVATION DIVISION
ORDER NO. R-6013

I.

Operator ARCO OIL & GAS COMPANY Well Name and No. State Vacuum Unit Well #24

Location: Unit L Sec. 32 Twp. 17S Rng. 34E Cty. Lea

II.

THE DIVISION FINDS:

(1) That Section 271.305(b) of the Federal Energy Regulatory Commission Interim Regulations promulgated pursuant to the Natural Gas Policy Act of 1978 provides that, in order for an infill well to qualify as a new onshore production well under Section 103 of said Act, the Division must find, prior to the commencement of drilling, that the well is necessary to effectively and efficiently drain a portion of the reservoir covered by the proration unit which cannot be so drained by any existing well within that unit, and must grant a waiver of existing well-spacing requirements.

(2) That by Order No. R-6013, dated June 7, 1979, the Division established an administrative procedure whereby the Division Director and the Division Examiners are empowered to act for the Division and find that an infill well is necessary.

(3) That the well for which a finding is sought is to be completed in the Vacuum Grayburg San Andres Pool, and the standard spacing unit in said pool is 40 acres.

(4) That a 40 -acre proration unit comprising the NW/4 SW/4 of Sec. 32, Twp. 17S, Rng. 34E, is currently dedicated to the applicant's State Vacuum Unit Well No. 12 located in Unit L of said section.

(5) That this proration unit is (X) standard ( ) nonstandard; if nonstandard, said unit was previously approved by Order No. NA.

(6) That said proration unit is not being effectively and efficiently drained by the existing well(s) on the unit.

(7) That the drilling and completion of the well for which a finding is sought should result in the production of an additional 12,950 MCF of gas from the proration unit which would not otherwise be recovered.

(8) That all the requirements of Order No. R-6013 have been complied with, and that the well for which a finding is sought is necessary to effectively and efficiently drain a portion of the reservoir covered by said proration unit which cannot be so drained by any existing well within the unit.

(9) That in order to permit effective and efficient drainage of said proration unit, the subject application should be approved as an exception to the standard well spacing requirements for the pool.

IT IS THEREFORE ORDERED:

(1) That the applicant is hereby authorized to drill the well described in Section I above as an infill well on the existing proration unit described in Section II(4) above. The authorization for infill drilling granted by this order is an exception to applicable well spacing requirements and is necessary to permit the drainage of a portion of the reservoir covered by said proration unit which cannot be effectively and efficiently drained by any existing well thereon.

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

DONE at Santa Fe, New Mexico, on this 30th day of January, 19 86.

DIVISION DIRECTOR EXAMINER

cc: OCD HOBBS
NMO&GEC Hobbs

Received 8/2/84
Release Immediately
By M. Stogner

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT

OIL CONSERVATION DIVISION
P. O. Box 2088
SANTA FE, NEW MEXICO
87501

ADMINISTRATIVE ORDER
NFL 119

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MADE PURSUANT TO SECTION 271.305(b) OF THE
FEDERAL ENERGY REGULATORY COMMISSION REGULATIONS,
NATURAL GAS POLICY ACT OF 1978 AND OIL CONSERVATION DIVISION
ORDER NO. R-6013

I.

Operator ARCO Oil & Gas Company Well Name and No. State Vacuum Unit Well No. 24

Location: Unit L Sec. 32 Twp. 17 South Rng. 34 East Cty. Lea

II.

THE DIVISION FINDS:

(1) That Section 271.305(b) of the Federal Energy Regulatory Commission Interim Regulations promulgated pursuant to the Natural Gas Policy Act of 1978 provides that, in order for an infill well to qualify as a new onshore production well under Section 103 of said Act, the Division must find, prior to the commencement of drilling, that the well is necessary to effectively and efficiently drain a portion of the reservoir covered by the proration unit which cannot be so drained by any existing well within that unit, and must grant a waiver of existing well-spacing requirements.

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(4) That a 40 -acre proration unit comprising the NW/4 SW/4 of Sec. 32, Twp. 17 South, Rng. 34 East, is currently dedicated to the ~~State~~ applicant's State Vacuum Unit Well No. 12 located in Unit L of said section.

(5) That this proration unit is (✓) standard ( ) nonstandard; if nonstandard, said unit was previously approved by Order No. NA.

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DONE at Santa Fe, New Mexico, on this _____ day of _____, 19_____.

DIVISION DIRECTOR ___ EXAMINER ___

C.C. - OCD Hobbs
NMOT&EC Hobbs

ARCO Oil and Gas Company
Permian District
Post Office Box 1610
Midland, Texas 79702
Telephone 915 684 0100

July 27, 1984

Mr. Joe D. Ramey
New Mexico Oil Conservation Division
P. O. Box 2088
Santa Fe, New Mexico 87501

Dear Mr. Ramey:

State Vacuum Unit No. 24
Infill Location
Vacuum Grayburg-S.A. Pool
Lea County, New Mexico

ARCO Oil and Gas Company requests an administrative finding that subject well is needed to effectively drain a portion of the reservoir and for the purpose of requesting gas pricing relating to Section 103 of the Natural Gas Policy Act of 1978. The State Vacuum Unit No. 24, a producing infill well in the active waterflood unit, is located 1690' FSL and 330' FWL, Section 32, Township 17 South, Range 34 East, Lea County, New Mexico. In ARCO's opinion, the SVU No. 24 will recover unswept secondary production that would otherwise be left behind due to premature water breakthrough in the unit. The offsetting proration units to the proposed location all fall within the State Vacuum Unit operated by ARCO and therefore no offset operators were notified of the request.

Attached is the required information and your prompt attention is appreciated.

Very truly yours,

J. A. Fraga
Sr. Operations/Analytical Engineer

JAF:sc
Atts.

Engineering Discussion of Infill Drilling on the State Vacuum Unit

INTRODUCTION

ARCO Oil and Gas Company's State Vacuum Unit produces from the Vacuum Grayburg-San Andres field in Lea County, New Mexico. It has been concluded that to effectively and efficiently produce this reservoir 20-acre well spacing is necessary. The following is a brief history of the State Vacuum Unit and the engineering and geological data supporting this finding.

HISTORY

The State Vacuum Unit was formed by ARCO on November 11, 1976 and water injection began on July 1, 1977. The unit was developed on 40-acre spacing using a 5-spot injection pattern. Primary reserves for this unit were calculated to be 3,266 MBO, or 24.8% of the OOIP. The unit has shown favorable response to the flood producing 347 MBO of secondary reserves as of April, 1983. However several wells have experienced premature water breakthrough which has reduced the efficiency of the waterflood (see Figures 1, 2, and 3).

On January 16, 1984 we completed the State Vacuum Unit No. 24, our third 20-acre infill in the unit (see attached plat, Figure 4). This well had a 24 hour pump potential of 8 BO, 76 BW and 6 MCFPD. Because of the short producing history on this well, it is still too early to make any ultimate reserve predictions. Our first 20 acre infill, the No. 22, completed February, 1983, has been encouraging. The No. 22 had a 24 hour pump potential of 189 BO, 23 BW, and 15 MCFPD. The No. 22 is expected to recover new reserves of approximately 74 MSTBO. Gas production in association with this oil will be 12.95 MMCF. Figure No. 11 shows the Unit's predicted performance with the No. 22 infill. The final stabilized rate on the No. 22 was 75 BOPD and was projected to decline at 30% per year.

ARCO is presently in the process of updating its Engineering Study of 1976 for the State Vacuum Unit. This study will evaluate the current infill drilling program and will also lay out the final devlopment plans for the unit.

GEOLOGY

The Vacuum Grayburg-San Andres field is located on an east-west trending anticline at the east end of the Artesia-Vacuum trend along the southern edge of the northwestern platform. The State Vacuum Unit is located in the western portion of the field (see attached structure map, Figure 5). Oil production is principally from dolomite in the San Andres formation with minor contributions from limestone in the Grayburg. The main pay zone (first porosity zone in the San Andres) is an oolite dolomite continuous throughout the State Vacuum Unit (see cross-section, Figure 6). Attached is Table No. 1 showing basic reservoir data for this unit.

VOLUMETRIC CALCULATIONS

Volumetric calculations for the San Andres formation in the State Vacuum Unit yield an original-oil-in-place of 10,381,109 STB for the main pay and 13,305,882 STB for the total pay zone. The Grayburg formation was not included in any volumetric calculations. These calculations involved determination of porosity-feet (Øh) for each well. Two isopachs were prepared, one for total Øh (Figure 7) and one for main pay Øh (Figure 8). These maps were constructed using logs and core data where available. Acre-Øh numers were determined by planimetering the isopach maps.

The original-oil-in-place numbers were calculated by transforming acre-Øh numbers into net hydrocarbon pore volume and converting to stock tank barrels using a formation volume factor of 1.26. The water saturation used in the conversion was taken from Figure 9, "Average of First Porosity vs. Water Saturation" from a field study of the Wasson San Andres reservoir by Shell Oil Company.

SECONDARY RESERVES FOR 40-ACRE SPACING

ARCO's Engineering Study of 1976 concluded that only the "main pay" section of the San Andres was continuous enough to be economically flooded. Secondary reserves were calculated to be 1,300 MBO which represents a ratio of 0.5:1 of secondary to primary reserves. This low ratio is due to the main pay being the only zone floodable on 40-acre spacing.

Secondary performance was determined with the aid of one of Atlantic Richfield Company's computer programs, which calculated sweep-out for a five-spot pattern. Three five-spot patterns were used to model performance within the 800-acre proposed project area. Each pattern was broken down into quarters five-spot elements. In each element, core and log analysis helped determine porosity, permeability, and net pay. Twelve elements were analyzed in a total of three five-spots. Total performance of the eight five-spots were determined by summing representative five-spots. Permeability distribution was determined for each well having core data with Atlantic Richfield's core data sorting program. Stratification analysis was handled by dividing each five-spot into layers. Table 2 gives the data used in each of the three typical five-spots.

SECONDARY AND PRIMARY RESERVES FOR 20-ACRE SPACING

By infill drilling, additional pay in the San Andres will be floodable on closer spacing. Based on the Engineering-Geological Committe Report, November 1977, (Exhibit No. 4, Case No. 6570) for the East Vacuum Grayburg-San Andres Unit, it was determined that an estimated 3.9% increase in recovery of OOIP for the EVGSAU could be expected on 20-acre spacing. Since the State Vacuum Unit has similar reservoir characteristics and quality, an increase recovery value of 3.9% of the OOIP was used in predicting additional secondary oil reserves with 20-acre infills. This value includes encountering discontinuous intervals of porosity and improvement in recovery efficiency.

Using the 3.9% infill recovery value and the total pay zone OOIP reserves, additional secondary reserves of 518,929 STB were calculated for the unit. The 800 acre unit would require 20 equivalent 20-acre infill wells for a recovery of about 26 MBO/well location. These calculations are outline in Appendix A.

Primary drainage analysis of the State Vacuum Unit were done using volumetrics, decline curves and production data. This analysis indicated that each 20-acre infill well will drain 5 acres previously missed at 40-acre spacing. Incrementally each infill well will recovery 26 MBO (see Appendix A).

The State Vacuum Unit No. 24 will also produce primary reserves from a lower zone near the top of the Lovington Sand (See Figure 10). The porosity logs indicate this zone to contain 8 feet of net pay with about 12% porosity. Estimated recoverable primary reserves for the lower zone, using 20-acre spacing and a 24.8% recovery factor, is 22 MBO. Secondary reserves were not calculated since this zone at present is not being flooded.

Premature water breakthrough has been experienced in several wells, as is seen in the attached plots (see Figures 1-3). The 20-acre spacing will drain reserves being bypassed due to the breakthrough.

CONCLUSION

By drilling the infill Well No. 24 we will recovery new reserves of approximately 74 MSTBO. Gas production in association with this oil will be 12.95 MMCF.

The production history of the State Vacuum Unit and other units in this field indicate that to effectively and efficiently produce the Vacuum Grayburg-San Andres reservoir, 20-acre spacing is necessary. By going to this closer spacing, additional pay will be encountered and flooded. Additional primary reserves that were undrained on 40-acre spacing will be recovered along with secondary reserves bypassed due to premature water breakthrough.

JAF:jaf

7/26/84

HPP RELEASE 5.4 - PLOT SEQ NO. 2
CONFIDENTIAL, (A B G C)

Figure 1
State Vacuum Unit No. 6

o -AVG. DAILY OIL (BBL)
▲ -AVG. DAILY H2O (BBL)

FIELD, 830 - VACUUM
LEASE, 6441 - STATE VACUUM UNIT PHASE II
RESV., 02 - GRAYBURG SAN ANDRES

Break through

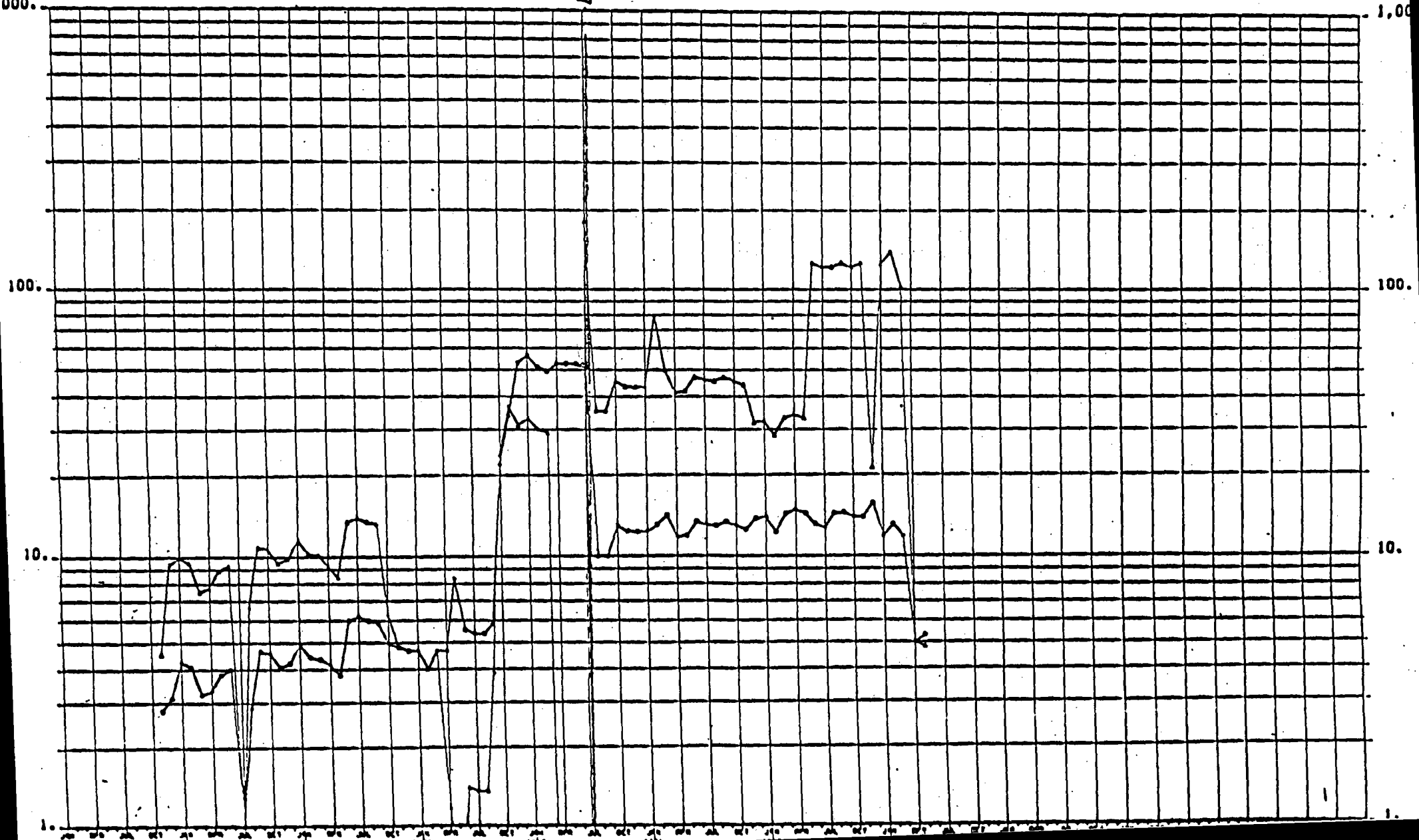


Figure 2
State Vacuum Unit No. 10

LEASE, 6441 - STATE VACUUM UNIT PHASE II
RESV., 02 - GRAYBURG SAN ANDRES
● -AVG. DAILY OIL (BBL)
▲ -AVG. DAILY H2O (BBL)

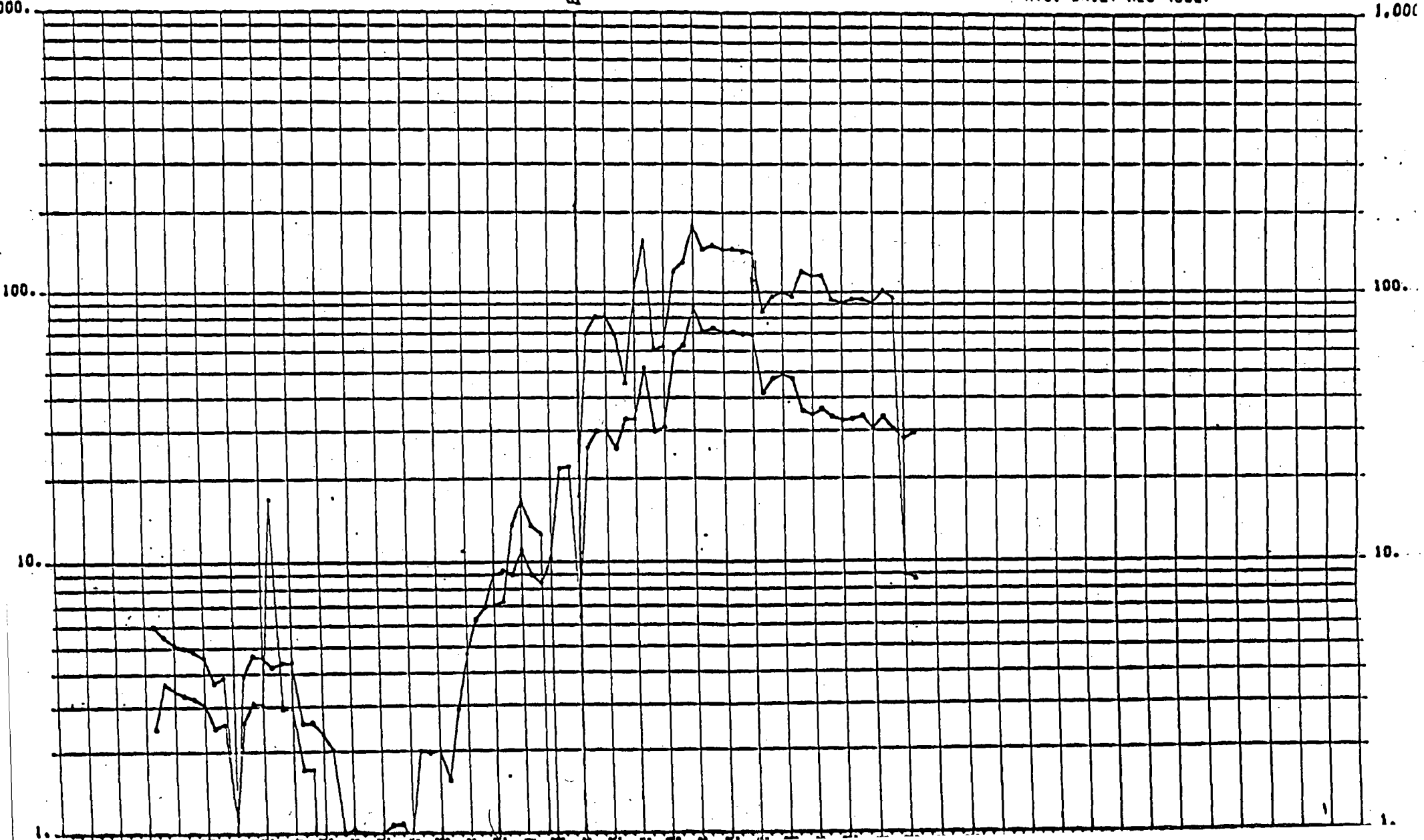
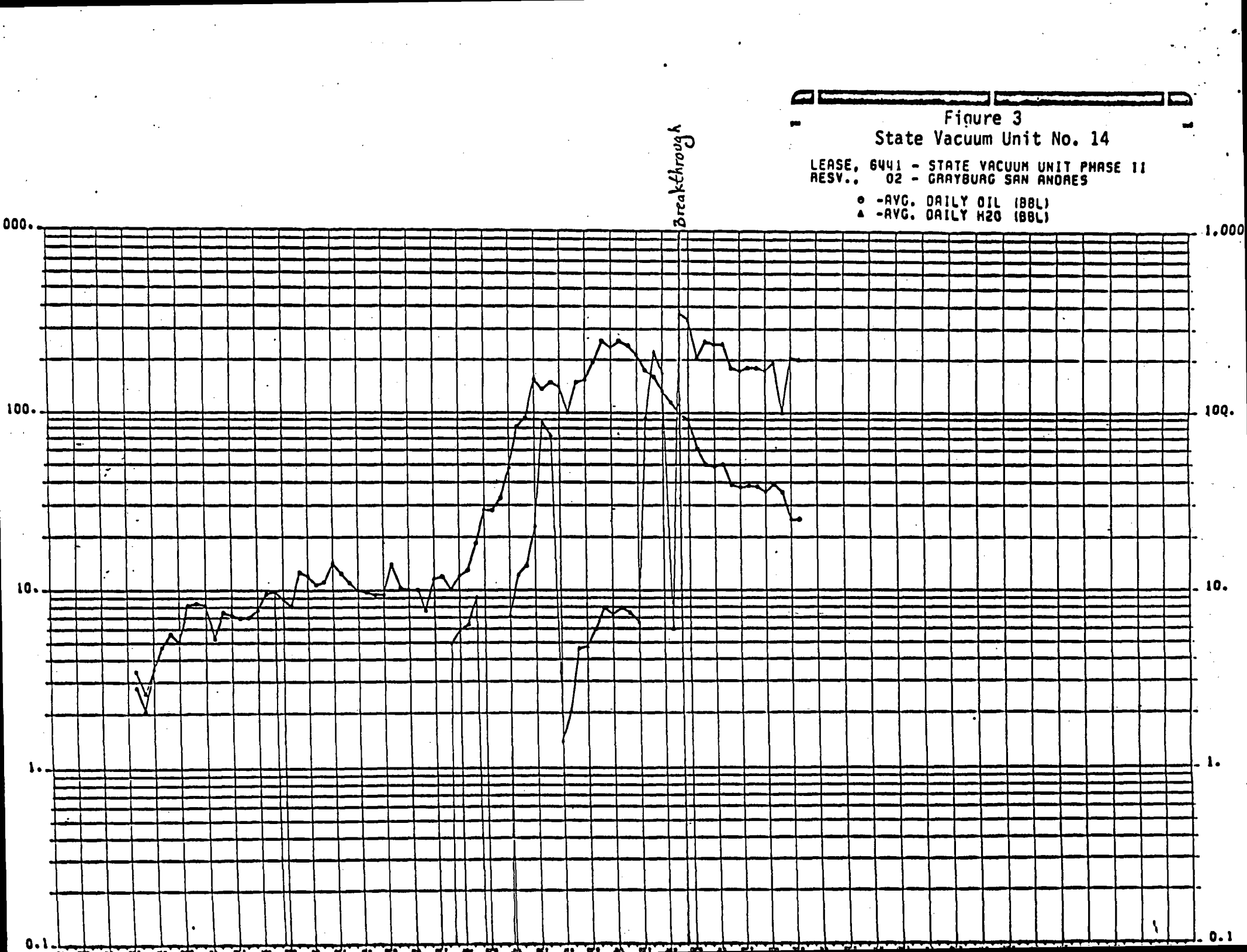
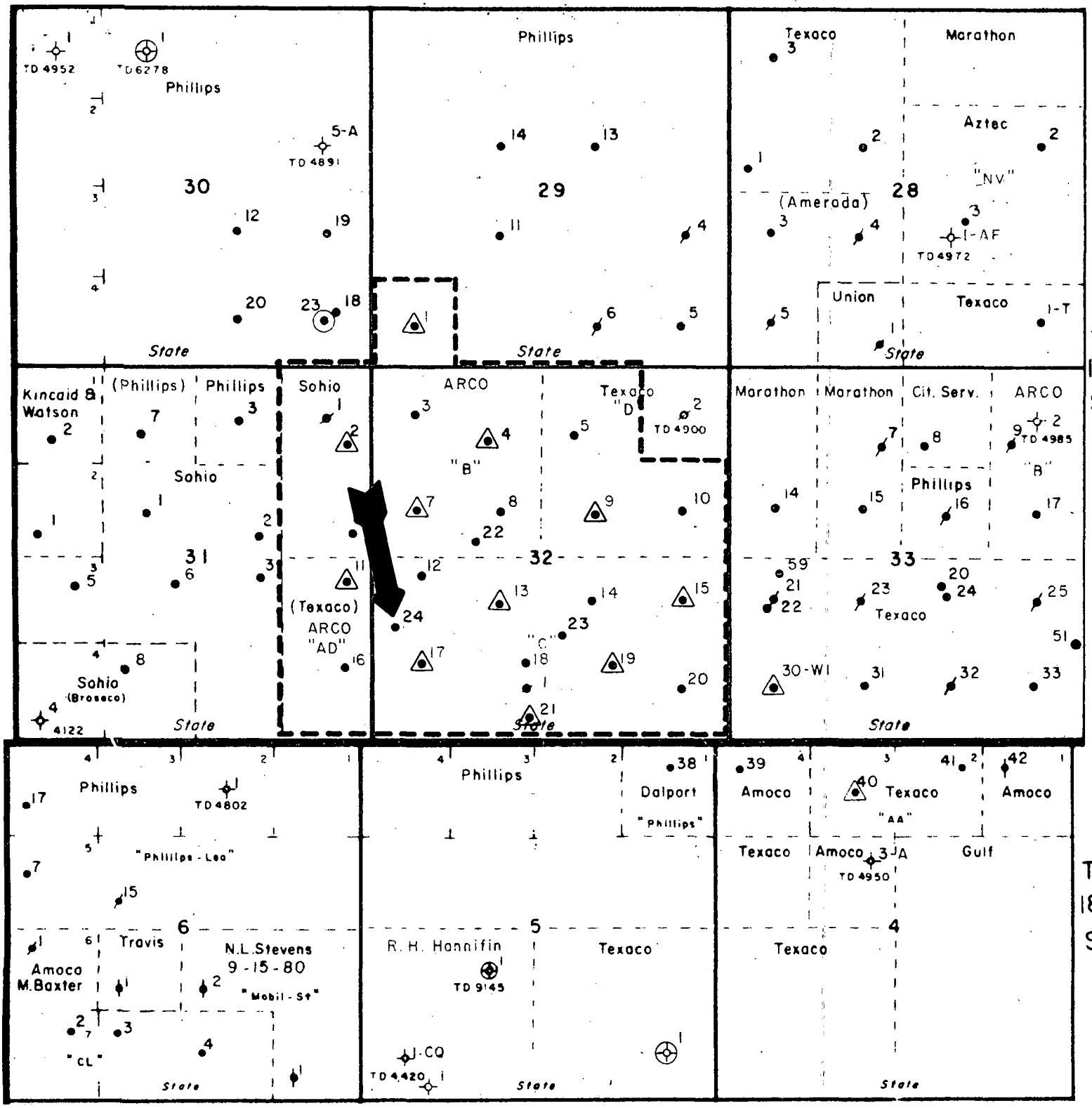


Figure 3
State Vacuum Unit No. 14

LEASE, 6441 - STATE VACUUM UNIT PHASE II
RESV., 02 - GRAYBURG SAN ANDRES

o -AVG. DAILY OIL (BBL)
▲ -AVG. DAILY H2O (BBL)





LEGEND

- UNIT BOUNDARY
- PRODUCER - SAN ANDRES
- INJECTOR - SAN ANDRES
- PROPOSED LOCATION

FIGURE NO. 4

ARCO Oil and Gas Company

Division of Atlantic Richfield Company

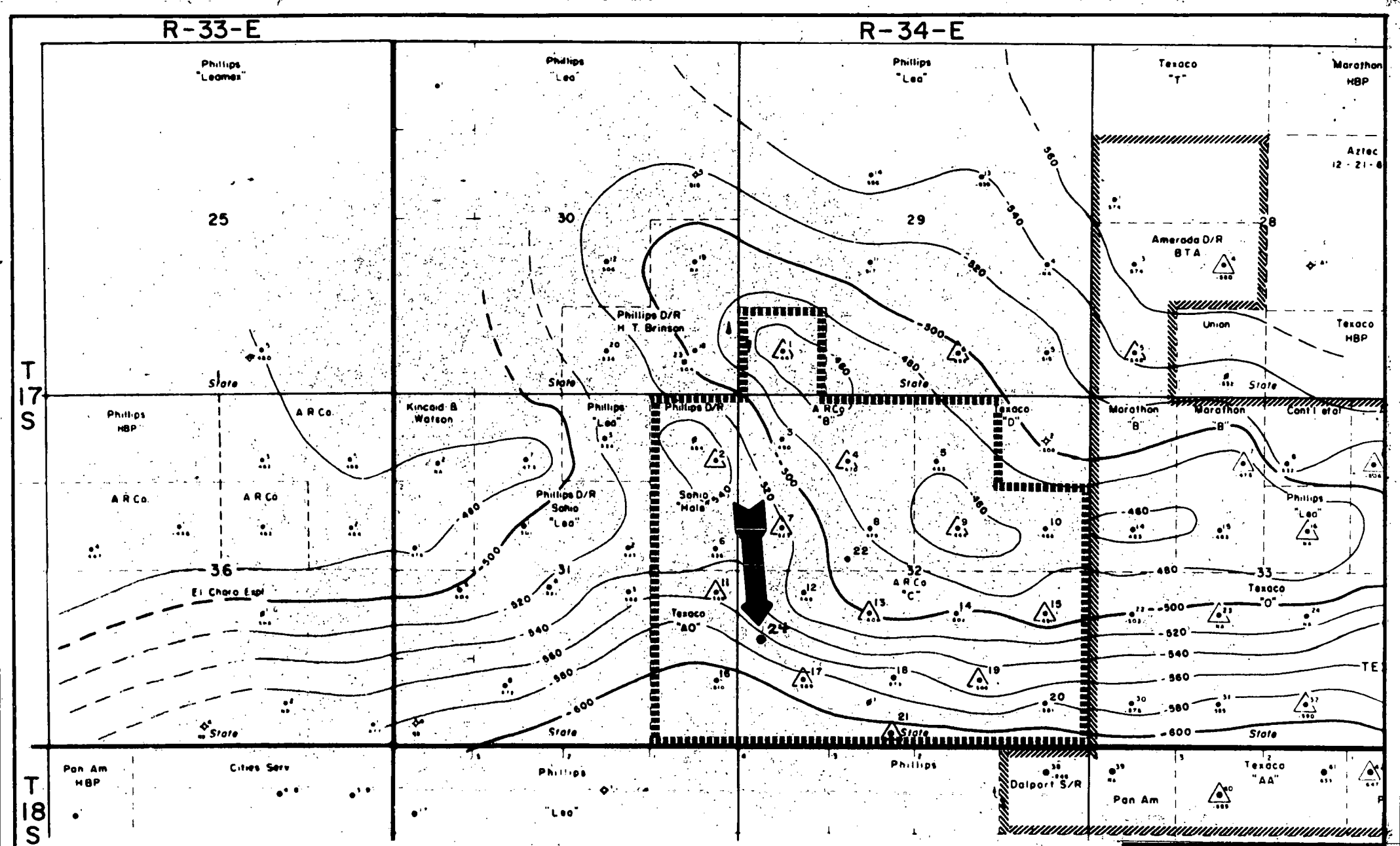
Permian District Midland, Texas

VACUUM (GRBG - S.A.) AREA
STATE VACUUM UNIT

Lea County, New Mexico

Scale 1" = 2000'

By J A Fiego		Drawn By TCB	Date 10-82
Date 12-14-83		Revised By B.S	Date 12-83
Dept West Engineering		Dwg No	



LEGEND

STATE VACUUM UNIT BOUNDARY

PROPOSED WELL LOCATION

FIGURE NO. 5

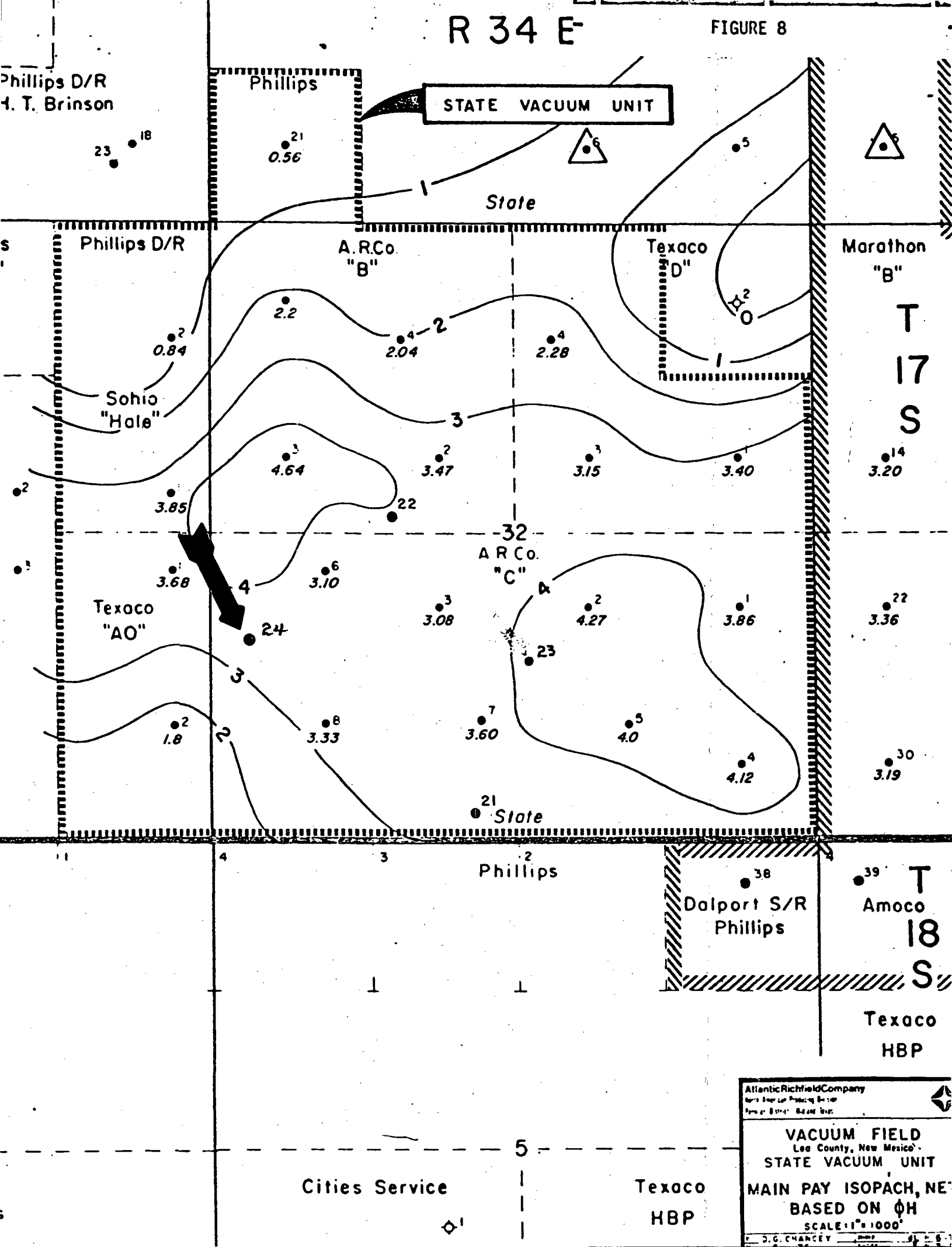
Atlantic Richfield Company
North American Producing Division
Permian District Midland, Texas

VACUUM FIELD
Lea County, New Mexico

STATE VACUUM UNIT

STRUCTURE MAP
TOP OF SAN ANDRES

J. A. PRAGA		J. B-03
B-03		
WEST ENGR.		


R 34 E
FIGURE 8
Phillips D/R
H. T. Brinson
Phillips
STATE VACUUM UNIT
State
Phillips D/R
A.R.Co. "B"
Texaco "D"
Marathon "B"
T 17 S
Sohio "Hale"
A R Co. "C"
Texaco "AO"
Phillips
Dalport S/R Phillips
Amoco
T 18 S
Texaco HBP
Cities Service
Texaco HBP
0.56
0.84
2.2
2.04
2.28
4.64
3.47
3.15
3.40
3.20
3.85
3.68
3.10
3.08
4.27
3.86
3.36
1.8
3.33
3.60
4.0
4.12
3.19
1
2
3
4
32
5
Atlantic Richfield Company
VACUUM FIELD
Lee County, New Mexico
STATE VACUUM UNIT
MAIN PAY ISOPACH, NET
BASED ON φH
SCALE 1" = 1000'
D.G. CHANCEY

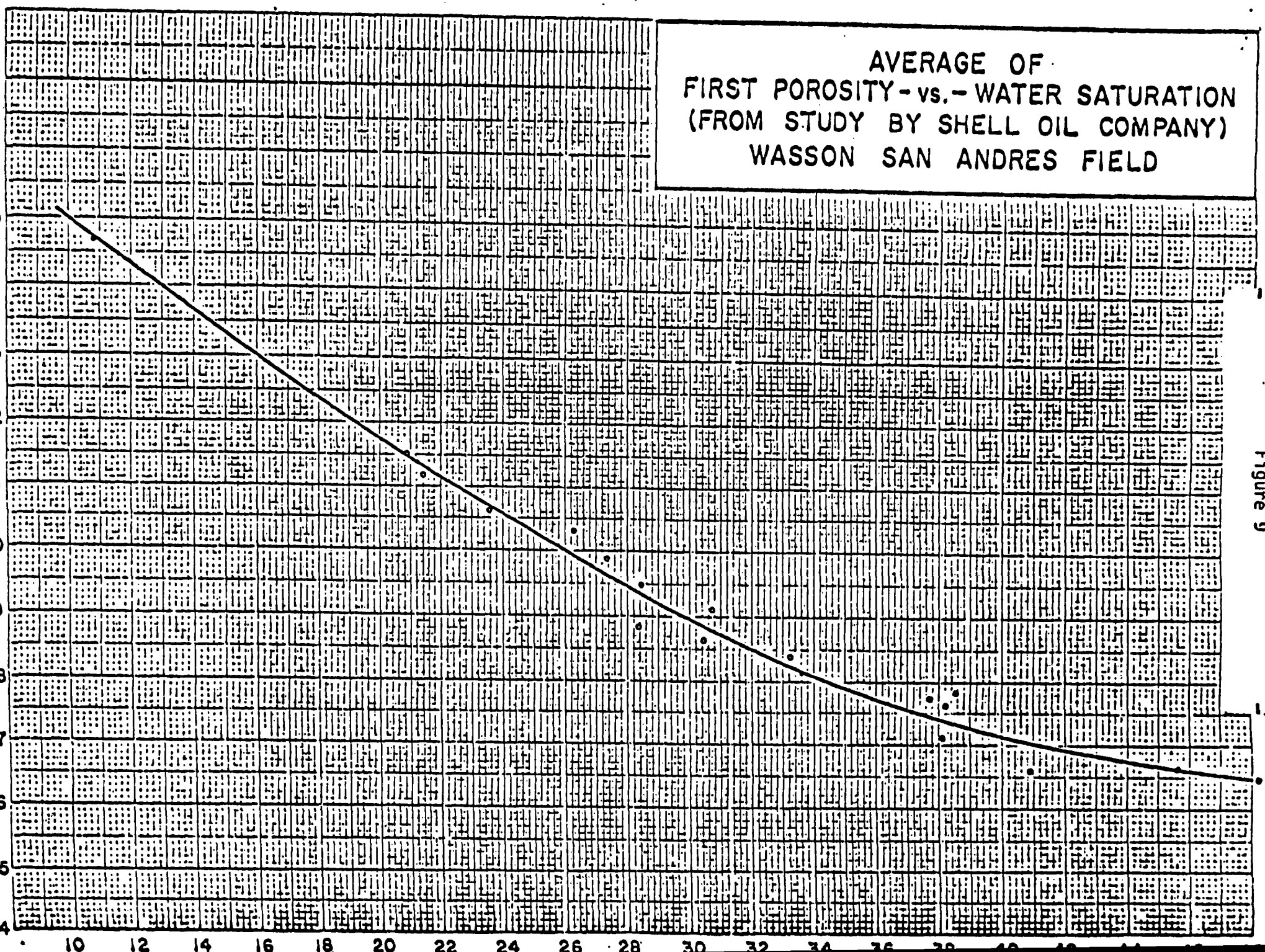

AVERAGE OF
FIRST POROSITY - vs. - WATER SATURATION
(FROM STUDY BY SHELL OIL COMPANY)
WASSON SAN ANDRES FIELD
17
16
15
14
13
12
11
10
9
8
7
6
5
4
10
12
14
16
18
20
22
24
26
28
30
32
34
36

Figure 9

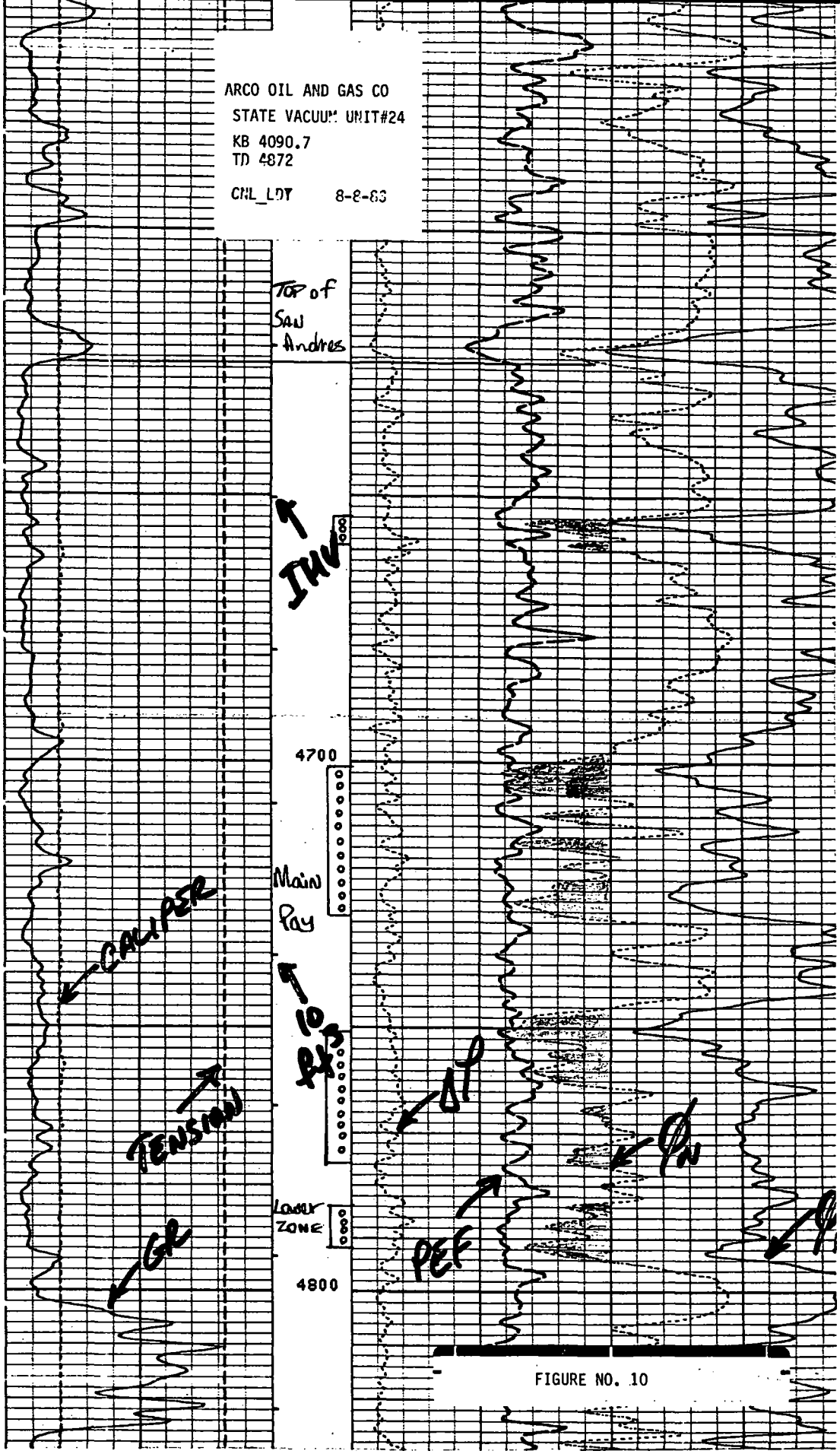

ARCO OIL AND GAS CO
STATE VACUUM UNIT#24
KB 4090.7
TD 4872
CNL_LDT 8-8-83
Top of San Andres
IHW
4700
Main Pay
CALIPER
TO RES
TENSION
ΔP
Pw
Lower ZONE
GR
PEF
4800

FIGURE NO. 10

Figure 11
Continued Operations vs Infill Drilling

LEASE, 6441 - STATE VACUUM UNIT PHASE II
WELL COUNT - 31

- o -AVG. DAILY OIL (BBL)
- ▲ -AVG. DAILY H20 (BBL)
- ◆ -GAS OIL RATIO

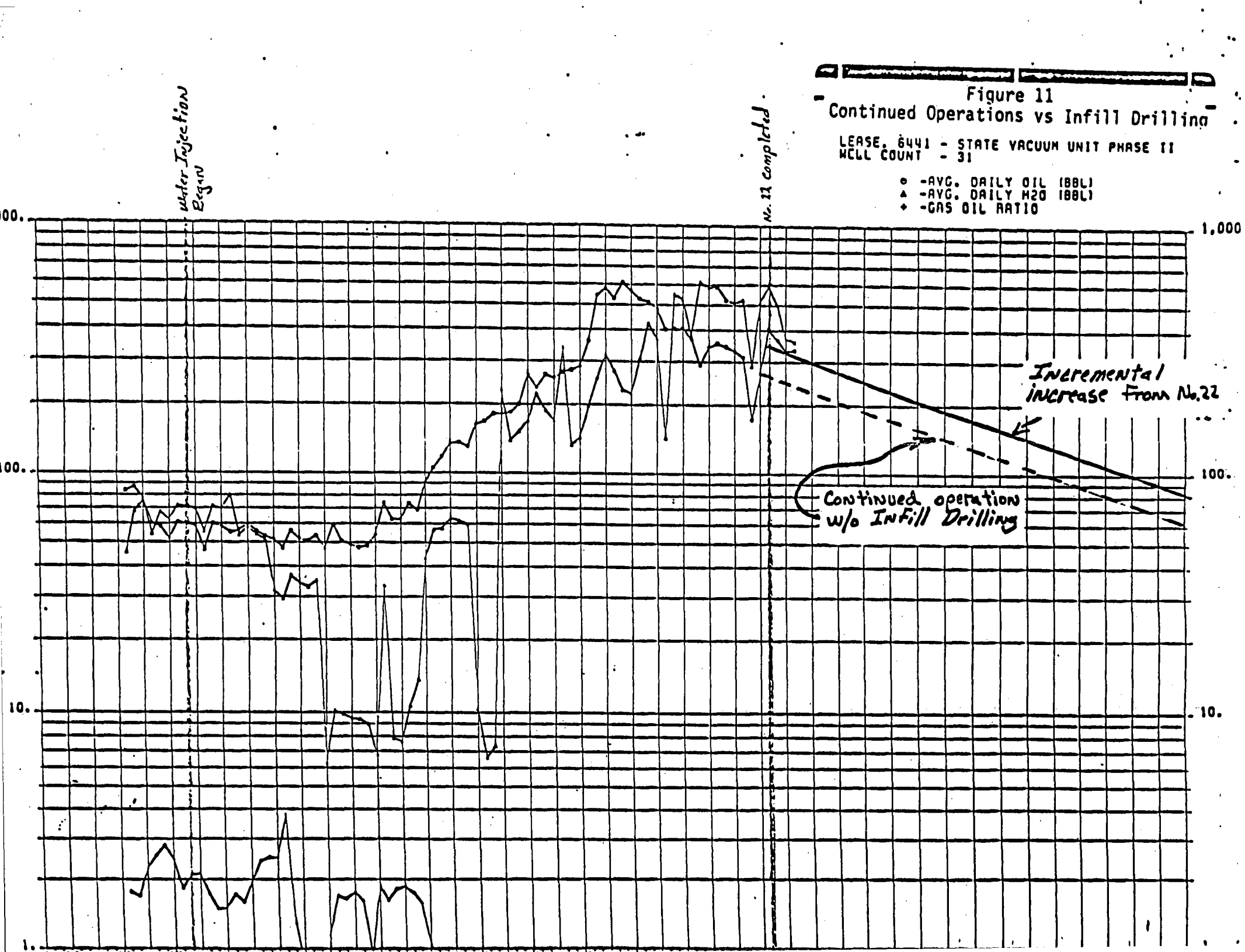


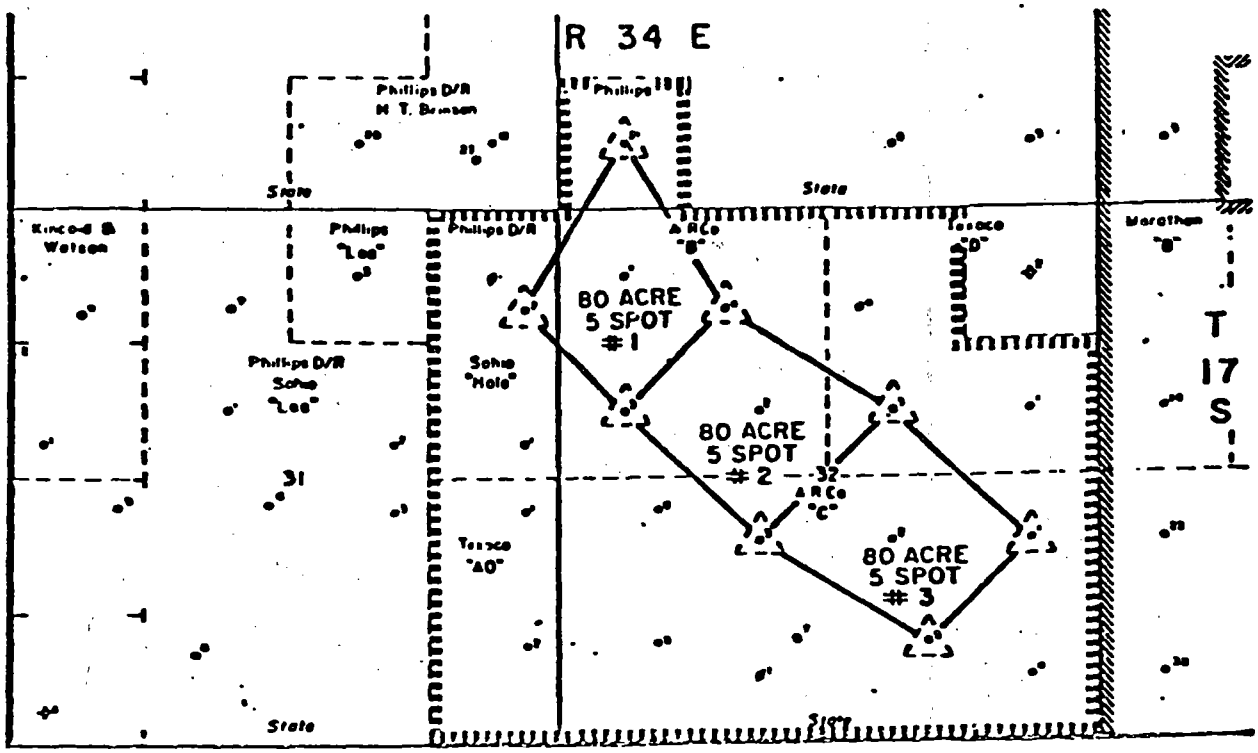
Table I

Basic Reservoir Data

Unit:	State Vacuum Unit
Operator:	ARCO Oil and Gas Company
Field:	Vacuum Grayburg-San Andres
Lithology:	Dolomite and Limestone
Area:	800 Acres
Average Porosity:	9.88%
Average Permeability:	17.8 md
Initial Formation Volume Factor:	1.26 RB/STB
Connate Water Saturation:	26.5%
Residual Oil Saturation:	30.0%
Oil Gravity:	37° API
Average GOR:	175 SCF/bbl
Original Oil In Place:	13,306 MSTBO
Primary Recovery (40-acres):	3,266 MSTBO
Secondary Recovery (40-acres):	1,700 MSTBO

TABLE 2

STRATIFICATION ANALYSIS



	% Thickness of Total	Kl, md	Scw,%	Sgx,%	Sor,%
80-ACRE 5-SPOT NO. 1					
Layer #1	42.1	4.6	26.5	24.0	30.0
Layer #2	37.0	1.7	26.5	24.0	30.0
Layer #3	20.9	0.5	26.5	24.0	30.0
	100.0				
80-ACRE 5-SPOT NO. 2					
Layer #1	25.4	26.0	26.5	24.0	30.0
Layer #2	30.8	8.6	26.5	24.0	30.0
Layer #3	17.6	2.8	26.5	24.0	30.0
Layer #4	14.9	1.0	26.5	24.0	30.0
Layer #5	11.3	0.4	26.5	24.0	30.0
	100.0				
80-ACRE 5-SPOT NO. 3					
Layer #1	18.2	19.8	26.5	24.0	30.0
Layer #2	23.5	7.0	26.5	24.0	30.0
Layer #3	29.4	2.6	26.5	24.0	30.4
Layer #4	12.6	0.9	26.5	24.0	30.4
Layer #5	16.3	0.3	26.5	24.0	30.4
	100.0				

Appendix A

I. Incremental Secondary Reserves with 20-acre Infills:

OOIP = 13,306 MBO (Eng. Study 1976)
Recovery Factor = .039 (EVU Eng. Study, Phillips)
Additional Reserves from 20-acre Spacing = 519 MBO
Unit Area = 800 acres
therefore, Equivalent 20-acre infills required = 20

519 MBO ÷ 20 Wells = 26 MBO/Well Incremental Oil

(26 MBO/Well)(175 SCF/STB) = 4.55 MMCF/Well Incremental Gas

II. Undrained Primary Reserves for Typical 20-acre Infill Location:

ϕh = 4.56 (log data)
Sw = .265 (Eng. Study 1976)
Recovery Factor = .248 (Eng. Study 1976)
Boi = 1.26 RB/STB (Eng. Study 1976)
A = 6 acres (Undrained area planimetered from drainage maps)

$$\frac{7758\ A\phi h(1-Sw)}{Boi} \times R_f = \frac{7758(5)(4.56)(1-.265)}{1.26} \times .248 = 25.6 \text{ MBO Primary Reserves from 20-acre Spacing}$$

25.6 MBO x 175 SCF/STB = 4.48 MMCF Primary Gas

III. New Primary Reserves from A Lower Zone:

ϕh = 0.96
A = 20 acres

$$\frac{7758\ A\phi h(1-Sw)}{Boi} \times R_f = \frac{7758(20)(1)(1-.265)}{1.26} \times .248 = 21.6 \text{ MBO Primary Reserves for Lower Zone}$$

21.6 MBO x (175 SCF/STB) = 3.78 MMCF Primary Gas

ARCO Oil and Gas Company
Permian District
Post Office Box 1610
Midland, Texas 79702
Telephone 915 684 0100

July 27, 1984

Mr. Joe D. Ramey
New Mexico Oil Conservation Division
P. O. Box 2088
Santa Fe, New Mexico 87501

Dear Mr. Ramey:

State Vacuum Unit No. 24
Infill Location
Vacuum Grayburg-S.A. Pool
Lea County, New Mexico

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INTRODUCTION

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HISTORY

The State Vacuum Unit was formed by ARCO on November 11, 1976 and water injection began on July 1, 1977. The unit was developed on 40-acre spacing using a 5-spot injection pattern. Primary reserves for this unit were calculated to be 3,266 MBO, or 24.8% of the OOIP. The unit has shown favorable response to the flood producing 347 MBO of secondary reserves as of April, 1983. However several wells have experienced premature water breakthrough which has reduced the efficiency of the waterflood (see Figures 1, 2, and 3).

On January 16, 1984 we completed the State Vacuum Unit No. 24, our third 20-acre infill in the unit (see attached plat, Figure 4). This well had a 24 hour pump potential of 8 BO, 76 BW and 6 MCFPD. Because of the short producing history on this well, it is still too early to make any ultimate reserve predictions. Our first 20 acre infill, the No. 22, completed February, 1983, has been encouraging. The No. 22 had a 24 hour pump potential of 189 BO, 23 BW, and 15 MCFPD. The No. 22 is expected to recover new reserves of approximately 74 MSTBO. Gas production in association with this oil will be 12.95 MMCF. Figure No. 11 shows the Unit's predicted performance with the No. 22 infill. The final stabilized rate on the No. 22 was 75 BOPD and was projected to decline at 30% per year.

ARCO is presently in the process of updating its Engineering Study of 1976 for the State Vacuum Unit. This study will evaluate the current infill drilling program and will also lay out the final devlopment plans for the unit.

GEOLOGY

The Vacuum Grayburg-San Andres field is located on an east-west trending anticline at the east end of the Artesia-Vacuum trend along the southern edge of the northwestern platform. The State Vacuum Unit is located in the western portion of the field (see attached structure map, Figure 5). Oil production is principally from dolomite in the San Andres formation with minor contributions from limestone in the Grayburg. The main pay zone (first porosity zone in the San Andres) is an oolite dolomite continuous throughout the State Vacuum Unit (see cross-section, Figure 6). Attached is Table No. 1 showing basic reservoir data for this unit.

VOLUMETRIC CALCULATIONS

Volumetric calculations for the San Andres formation in the State Vacuum Unit yield an original-oil-in-place of 10,381,109 STB for the main pay and 13,305,882 STB for the total pay zone. The Grayburg formation was not included in any volumetric calculations. These calculations involved determination of porosity-feet (Øh) for each well. Two isopachs were prepared, one for total Øh (Figure 7) and one for main pay Øh (Figure 8). These maps were constructed using logs and core data where available. Acre-Øh numers were determined by planimetering the isopach maps.

The original-oil-in-place numbers were calculated by transforming acre-Øh numbers into net hydrocarbon pore volume and converting to stock tank barrels using a formation volume factor of 1.26. The water saturation used in the conversion was taken from Figure 9, "Average of First Porosity vs. Water Saturation" from a field study of the Wasson San Andres reservoir by Shell Oil Company.

SECONDARY RESERVES FOR 40-ACRE SPACING

ARCO's Engineering Study of 1976 concluded that only the "main pay" section of the San Andres was continuous enough to be economically flooded. Secondary reserves were calculated to be 1,300 MBO which represents a ratio of 0.5:1 of secondary to primary reserves. This low ratio is due to the main pay being the only zone floodable on 40-acre spacing.

Secondary performance was determined with the aid of one of Atlantic Richfield Company's computer programs, which calculated sweep-out for a five-spot pattern. Three five-spot patterns were used to model performance within the 800-acre proposed project area. Each pattern was broken down into quarters five-spot elements. In each element, core and log analysis helped determine porosity, permeability, and net pay. Twelve elements were analyzed in a total of three five-spots. Total performance of the eight five-spots were determined by summing representative five-spots. Permeability distribution was determined for each well having core data with Atlantic Richfield's core data sorting program. Stratification analysis was handled by dividing each five-spot into layers. Table 2 gives the data used in each of the three typical five-spots.

SECONDARY AND PRIMARY RESERVES FOR 20-ACRE SPACING

By infill drilling, additional pay in the San Andres will be floodable on closer spacing. Based on the Engineering-Geological Committe Report, November 1977, (Exhibit No. 4, Case No. 6570) for the East Vacuum Grayburg-San Andres Unit, it was determined that an estimated 3.9% increase in recovery of OOIP for the EVGSAU could be expected on 20-acre spacing. Since the State Vacuum Unit has similar reservoir characteristics and quality, an increase recovery value of 3.9% of the OOIP was used in predicting additional secondary oil reserves with 20-acre infills. This value includes encountering discontinuous intervals of porosity and improvement in recovery efficiency.

Using the 3.9% infill recovery value and the total pay zone OOIP reserves, additional secondary reserves of 518,929 STB were calculated for the unit. The 800 acre unit would require 20 equivalent 20-acre infill wells for a recovery of about 26 MBO/well location. These calculations are outline in Appendix A.

Primary drainage analysis of the State Vacuum Unit were done using volumetrics, decline curves and production data. This analysis indicated that each 20-acre infill well will drain 5 acres previously missed at 40-acre spacing. Incrementally each infill well will recovery 26 MBO (see Appendix A).

The State Vacuum Unit No. 24 will also produce primary reserves from a lower zone near the top of the Lovington Sand (See Figure 10). The porosity logs indicate this zone to contain 8 feet of net pay with about 12% porosity. Estimated recoverable primary reserves for the lower zone, using 20-acre spacing and a 24.8% recovery factor, is 22 MBO. Secondary reserves were not calculated since this zone at present is not being flooded.

Premature water breakthrough has been experienced in several wells, as is seen in the attached plots (see Figures 1-3). The 20-acre spacing will drain reserves being bypassed due to the breakthrough.

CONCLUSION

By drilling the infill Well No. 24 we will recovery new reserves of approximately 74 MSTBO. Gas production in association with this oil will be 12.95 MMCF.

The production history of the State Vacuum Unit and other units in this field indicate that to effectively and efficiently produce the Vacuum Grayburg-San Andres reservoir, 20-acre spacing is necessary. By going to this closer spacing, additional pay will be encountered and flooded. Additional primary reserves that were undrained on 40-acre spacing will be recovered along with secondary reserves bypassed due to premature water breakthrough.

JAF:jaf

7/26/84

HPP RELEASE 6.6 - PLOT SEQ NO. 2
CONFIDENTIAL. (A B G C)

Figure 1

State Vacuum Unit No. 6

o -AVG. DAILY OIL (BBL)
▲ -AVG. DAILY H2O (BBL)

FIELD. 830 - VACUUM
LEASE. 6441 - STATE VACUUM UNIT PHASE II
RESV.. 02 - GRAYBURG SAN ANDRES

Breakthrough

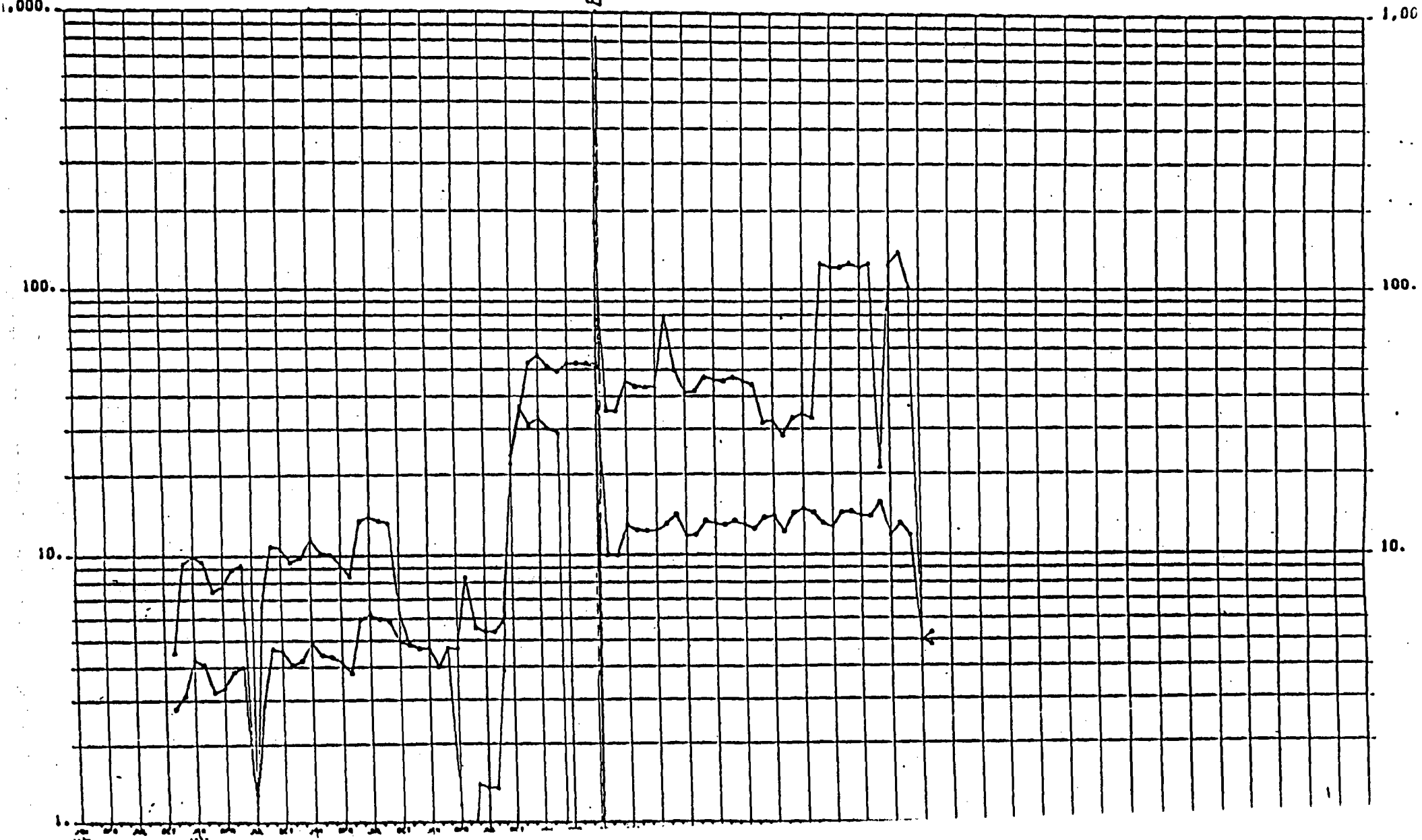


Figure 2
State Vacuum Unit No. 10

LEASE, 6441 - STATE VACUUM UNIT PHASE II
RESV., 02 - GRAYBURG SAN ANDRES
● -AVG. DAILY OIL (BBL)
▲ -AVG. DAILY H2O (BBL)

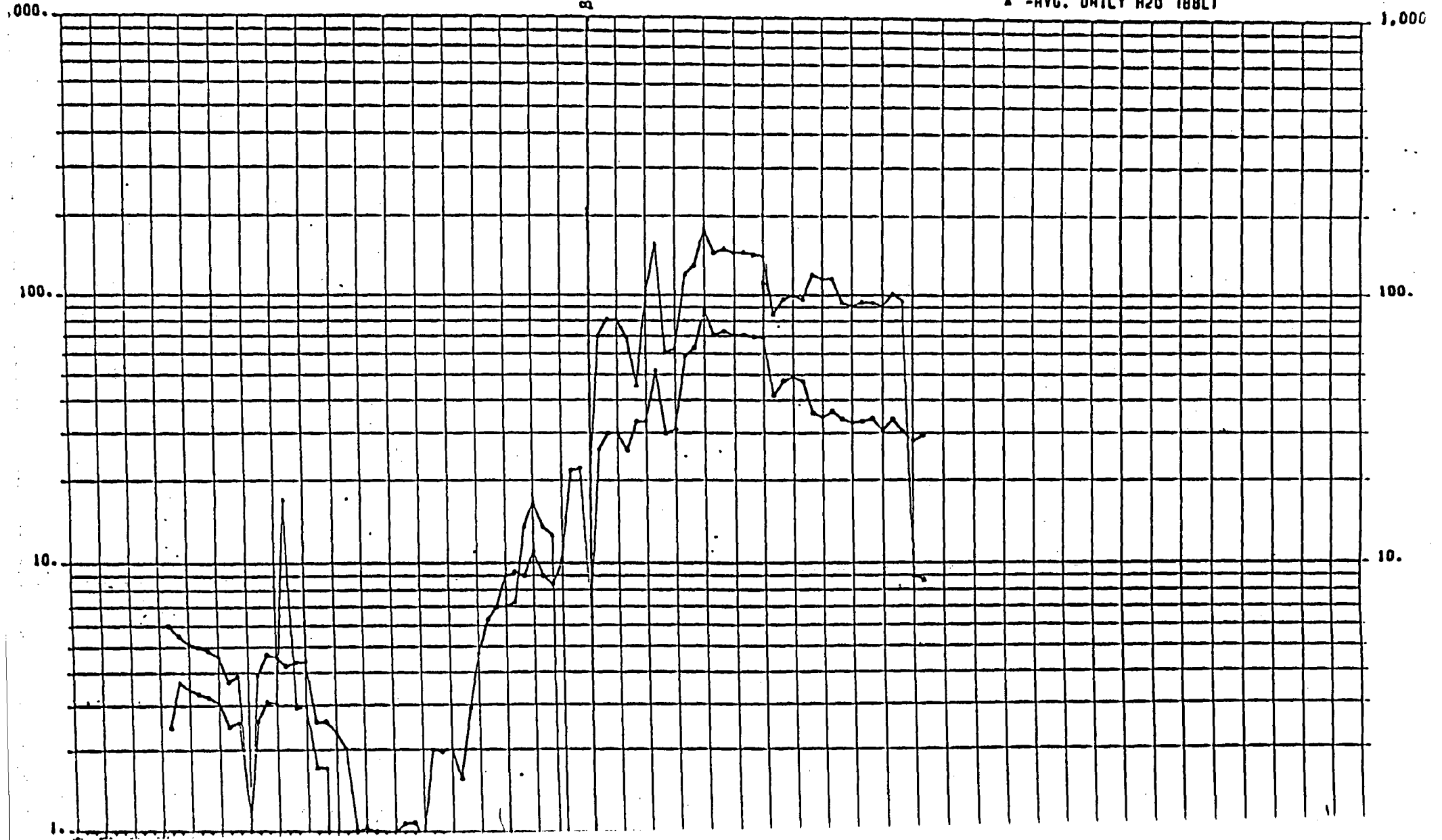
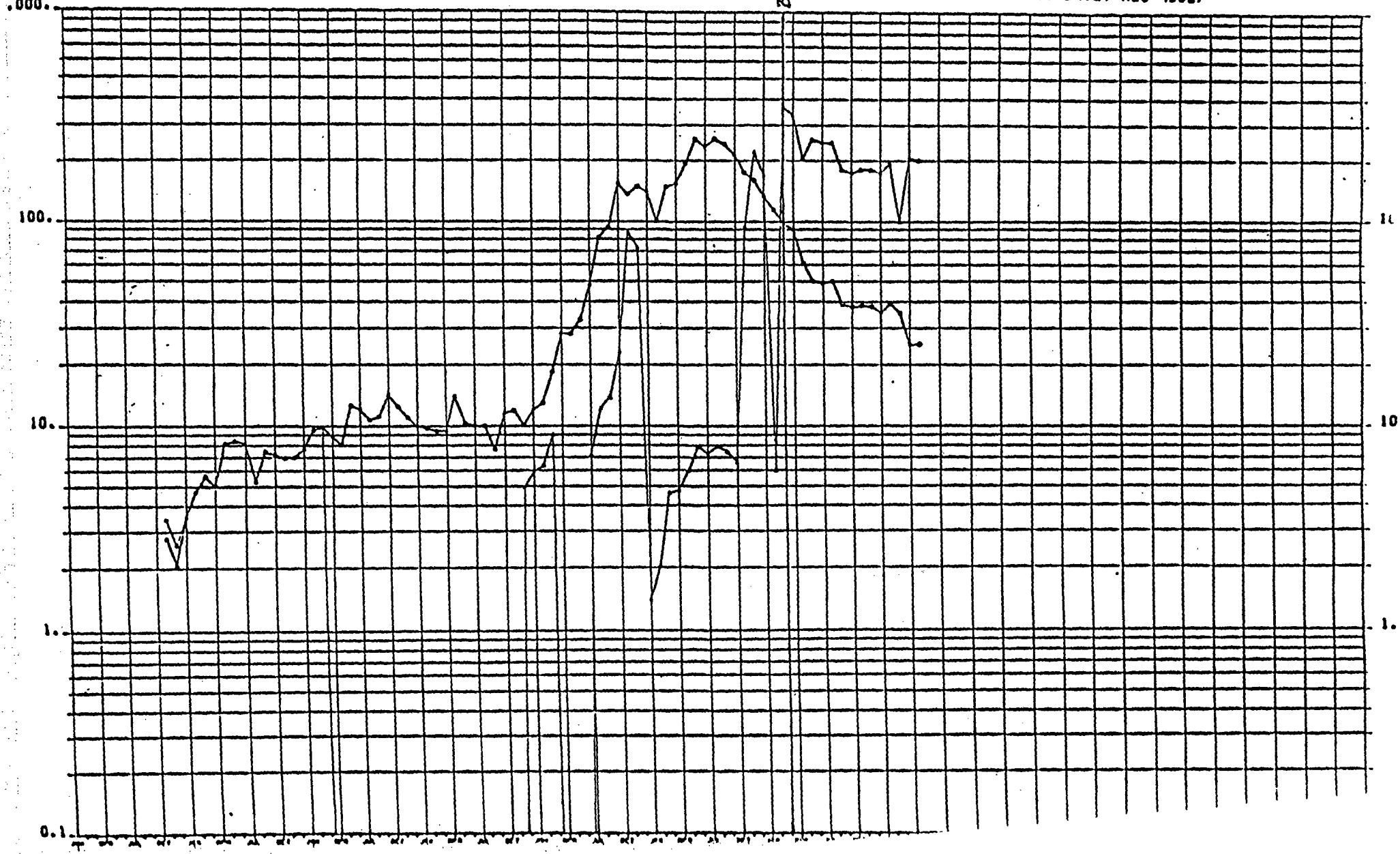


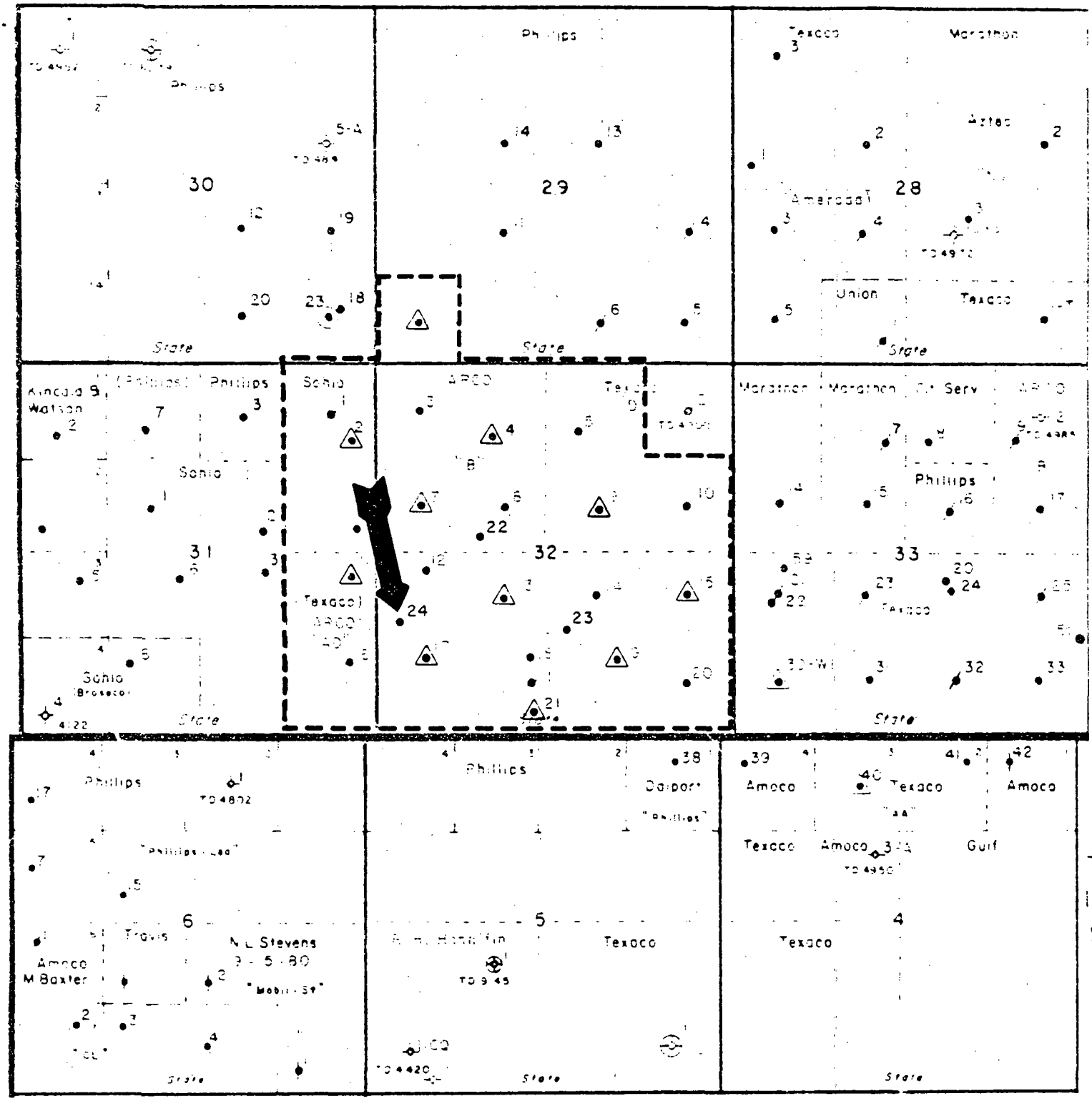
Figure 3
State Vacuum Unit No. 14

LEASE, 6441 - STATE VACUUM UNIT PHASE II
RESV., 02 - GRAYBURG SAN ANDRES

• -AVG. DAILY OIL (BBL)
▲ -AVG. DAILY H2O (BBL)

Breakthrough





LEGEND

- UNIT BOUNDARY
- PRODUCER - SAN ANDRES
- INJECTOR - SAN ANDRES
- PROPOSED LOCATION

FIGURE NO. 4

ARCO Oil and Gas Company

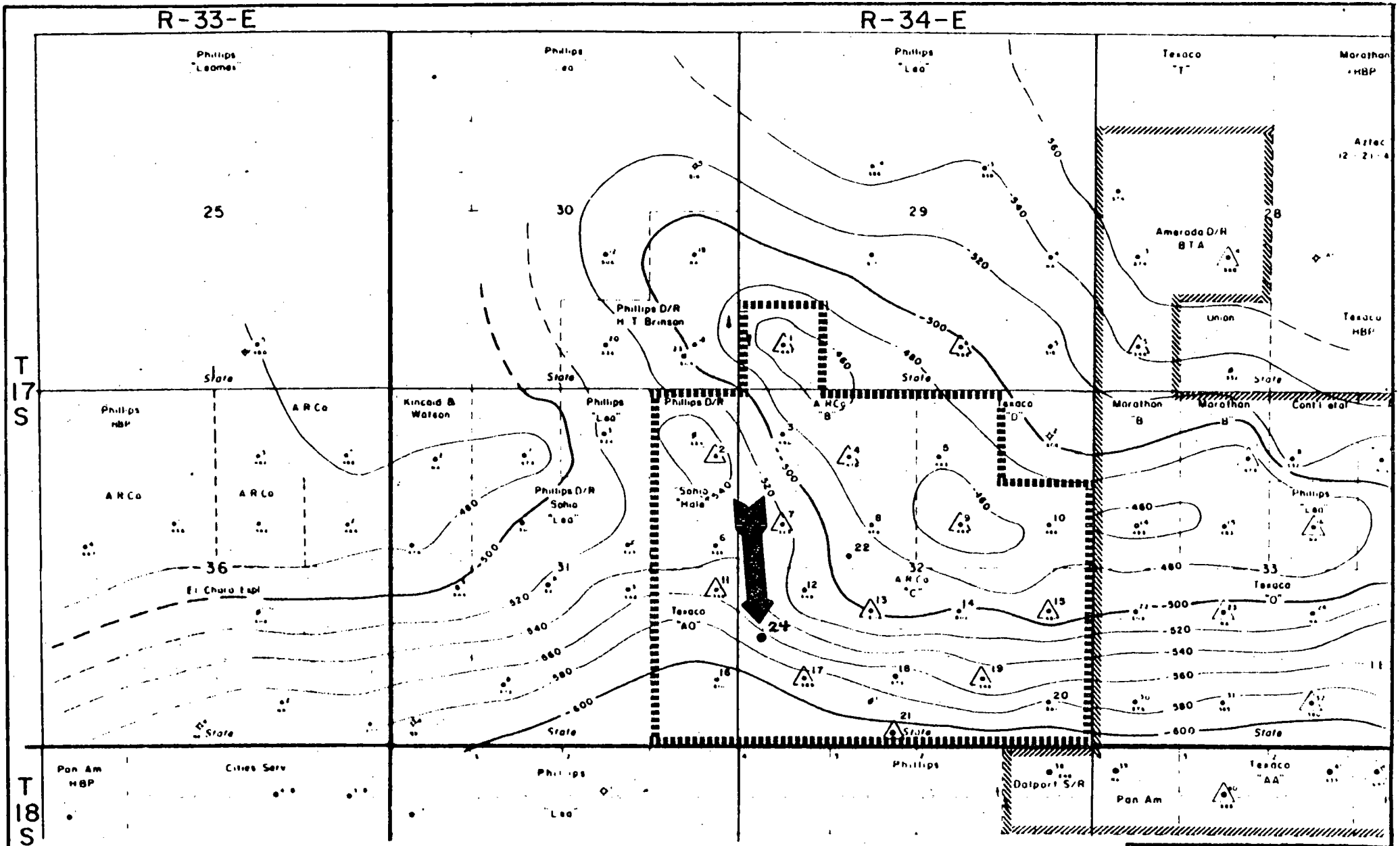
Permian District Midland, Texas

VACUUM (GRBG - S.A.) AREA
STATE VACUUM UNIT

Lea County, New Mexico

Scale 1"=2000'

12-14-83	B.S	12-83



L E G E N D

STATE VACUUM UNIT BOUNDARY

PROPOSED WELL LOCATION

FIGURE NO. 5

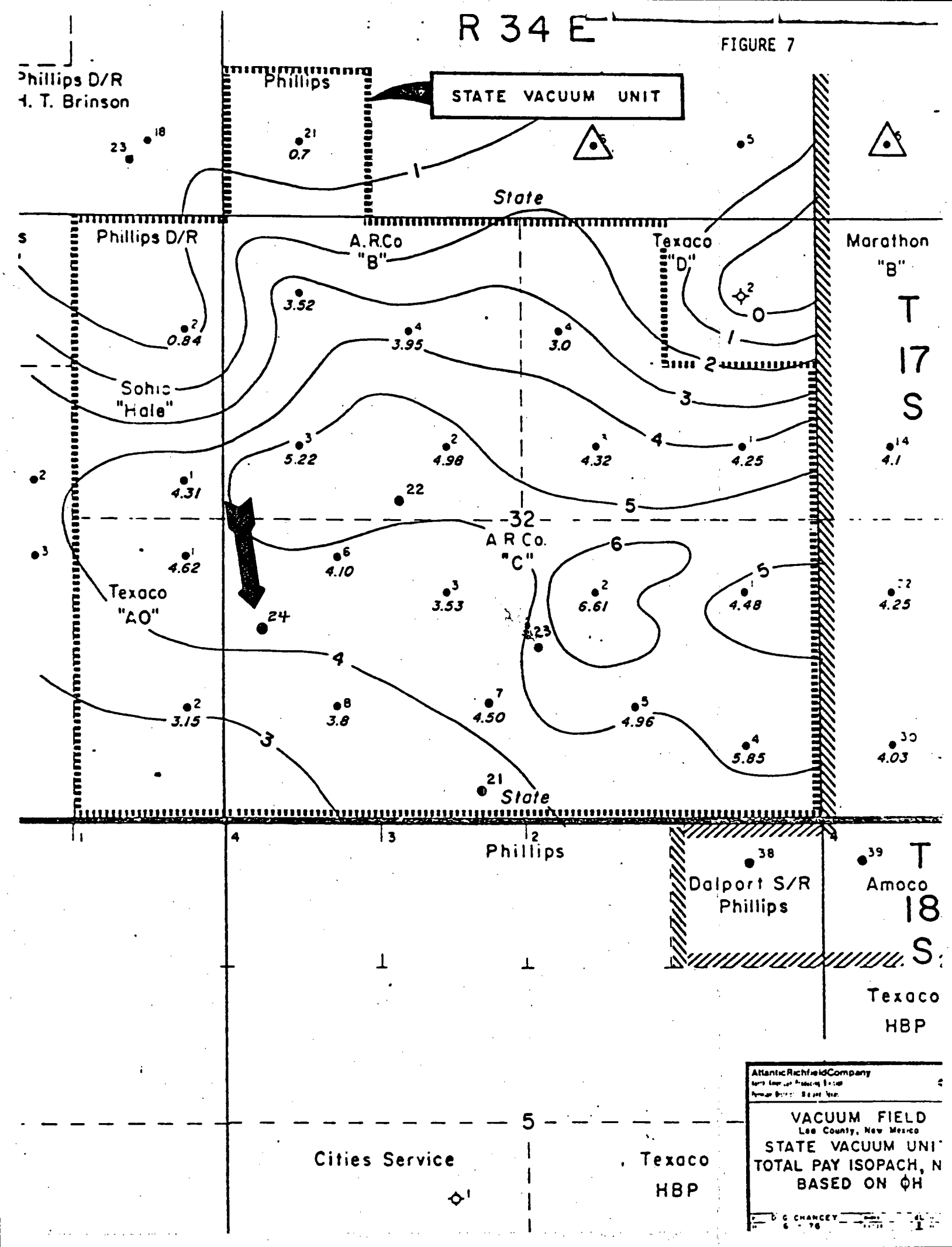
AtlanticRichfieldCompany
North American Producing Division
Permian District Midland Texas

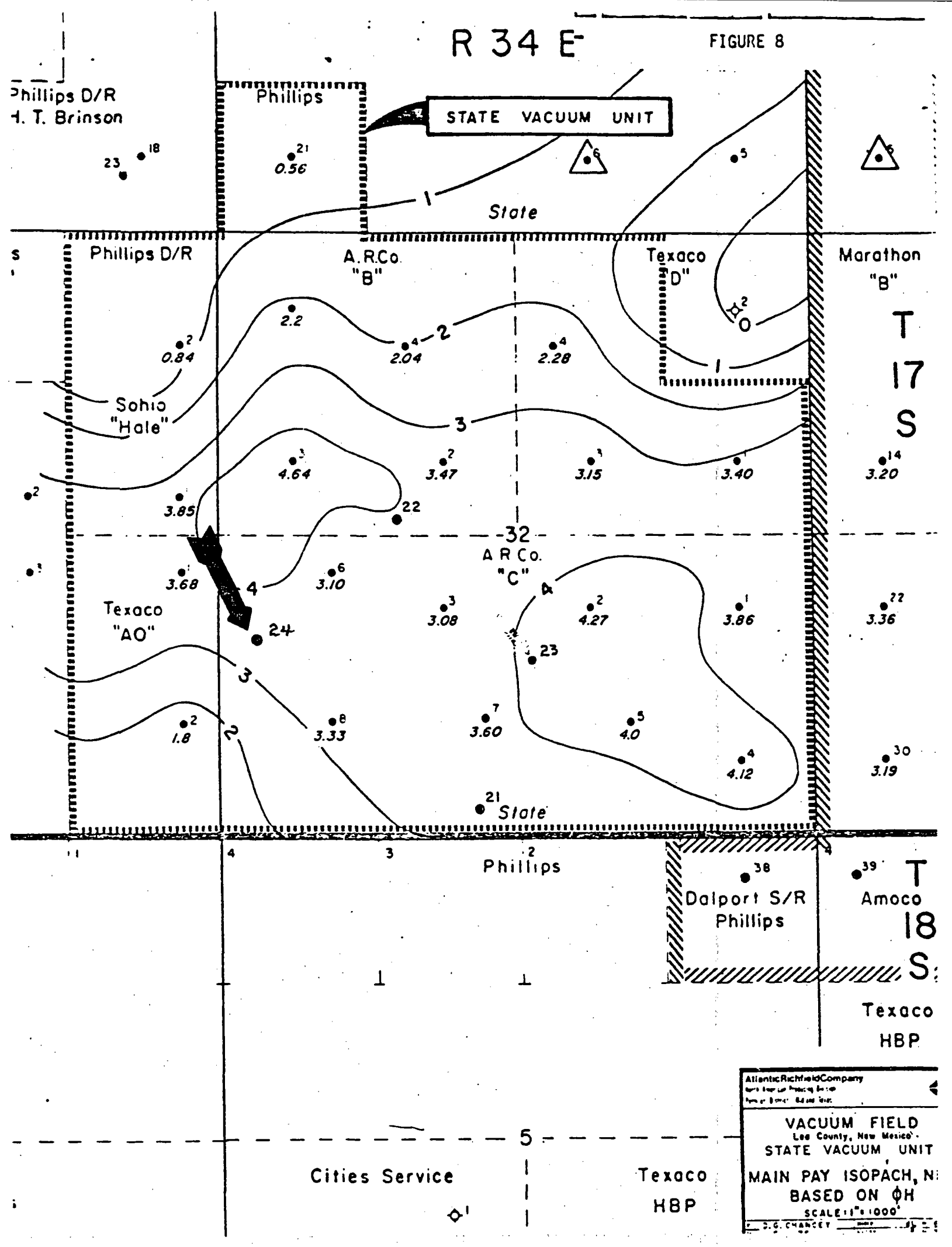
VACUUM FIELD
Lea County, New Mexico

STATE VACUUM UNIT

STRUCTURE MAP
TOP OF SAN ANDRES

J. A. PRAGA
3-83


R 34 E
FIGURE 7
Phillips D/R
H. T. Brinson
Phillips
STATE VACUUM UNIT
State
Phillips D/R
A.R.Co "B"
Texaco "D"
Marathon "B"
T 17 S
Sohio "Hale"
A R Co. "C"
Texaco "AO"
Phillips
Dalport S/R Phillips
Amoco
T 18 S
Texaco HBP
Cities Service
Texaco HBP
Atlantic Richfield Company
VACUUM FIELD
Lea County, New Mexico
STATE VACUUM UNIT
TOTAL PAY ISOPACH, N
BASED ON ϕH
D. C. CHANCEY


R 34 E
FIGURE 8
Phillips D/R
H. T. Brinson
Phillips
STATE VACUUM UNIT
State
Phillips D/R
A.R.Co. "B"
Texaco "D"
Marathon "B"
T 17 S
Sohio "Hale"
A R Co. "C"
Texaco "AO"
Phillips
Dalport S/R Phillips
Amoco
T 18 S
Texaco HBP
Cities Service
Texaco HBP
0.56
0.84
2.2
2.04
2.28
4.64
3.47
3.15
3.40
3.20
3.85
3.68
3.10
3.08
4.27
3.86
3.36
1.8
3.33
3.60
4.0
4.12
3.19
Atlantic Richfield Company
VACUUM FIELD
Lea County, New Mexico
STATE VACUUM UNIT
MAIN PAY ISOPACH, N
BASED ON ϕH
SCALE 1" = 1000'
D.G. CHANCEY

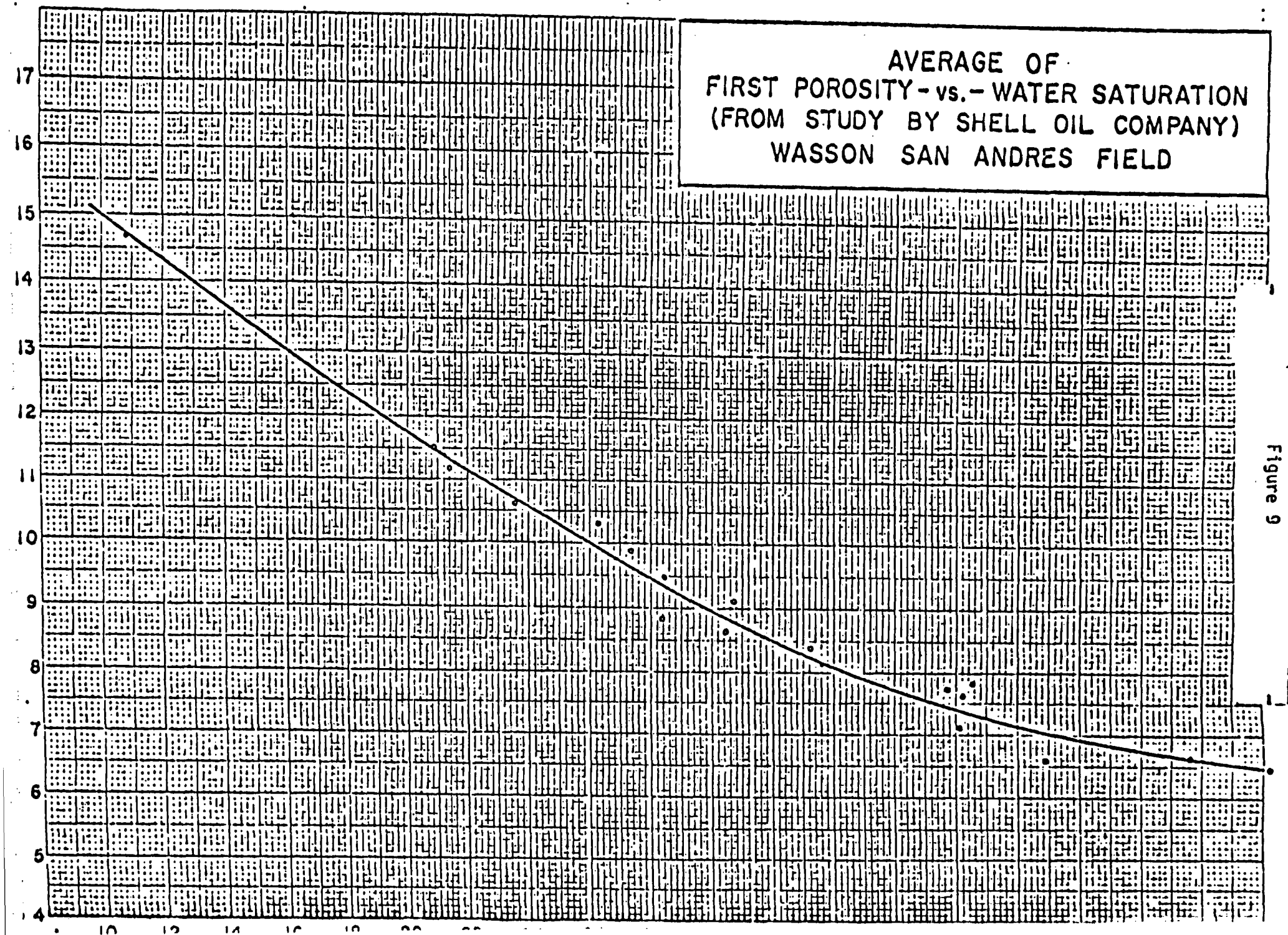

AVERAGE OF
FIRST POROSITY - vs. - WATER SATURATION
(FROM STUDY BY SHELL OIL COMPANY)
WASSON SAN ANDRES FIELD
17
16
15
14
13
12
11
10
9
8
7
6
5
4

Figure 9

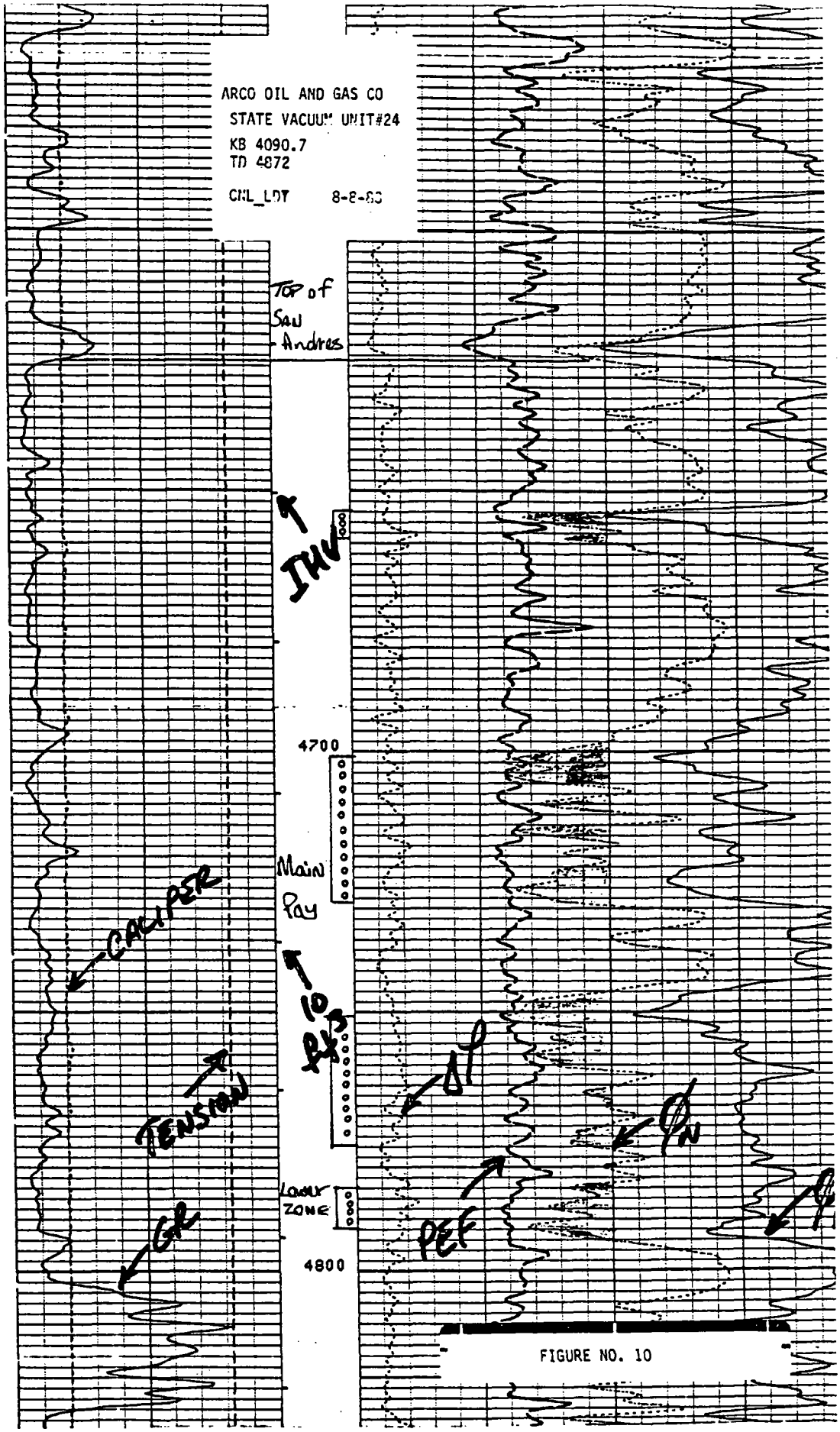

ARCO OIL AND GAS CO
STATE VACUUM UNIT#24
KB 4090.7
TD 4872
CNL_LDT 8-8-80
Top of San Andres
IHV
4700
Main Pay
CALIPER
10 Ω
TENSION
Δt
Ø_N
Lower ZONE
PEF
4800

FIGURE NO. 10

Figure 11
Continued Operations vs Infill Drilling

LEASE, 6441 - STATE VACUUM UNIT PHASE II
WELL COUNT - 31

o -AVG. DAILY OIL (BBL)
▲ -AVG. DAILY H20 (BBL)
♦ -GAS OIL RATIO

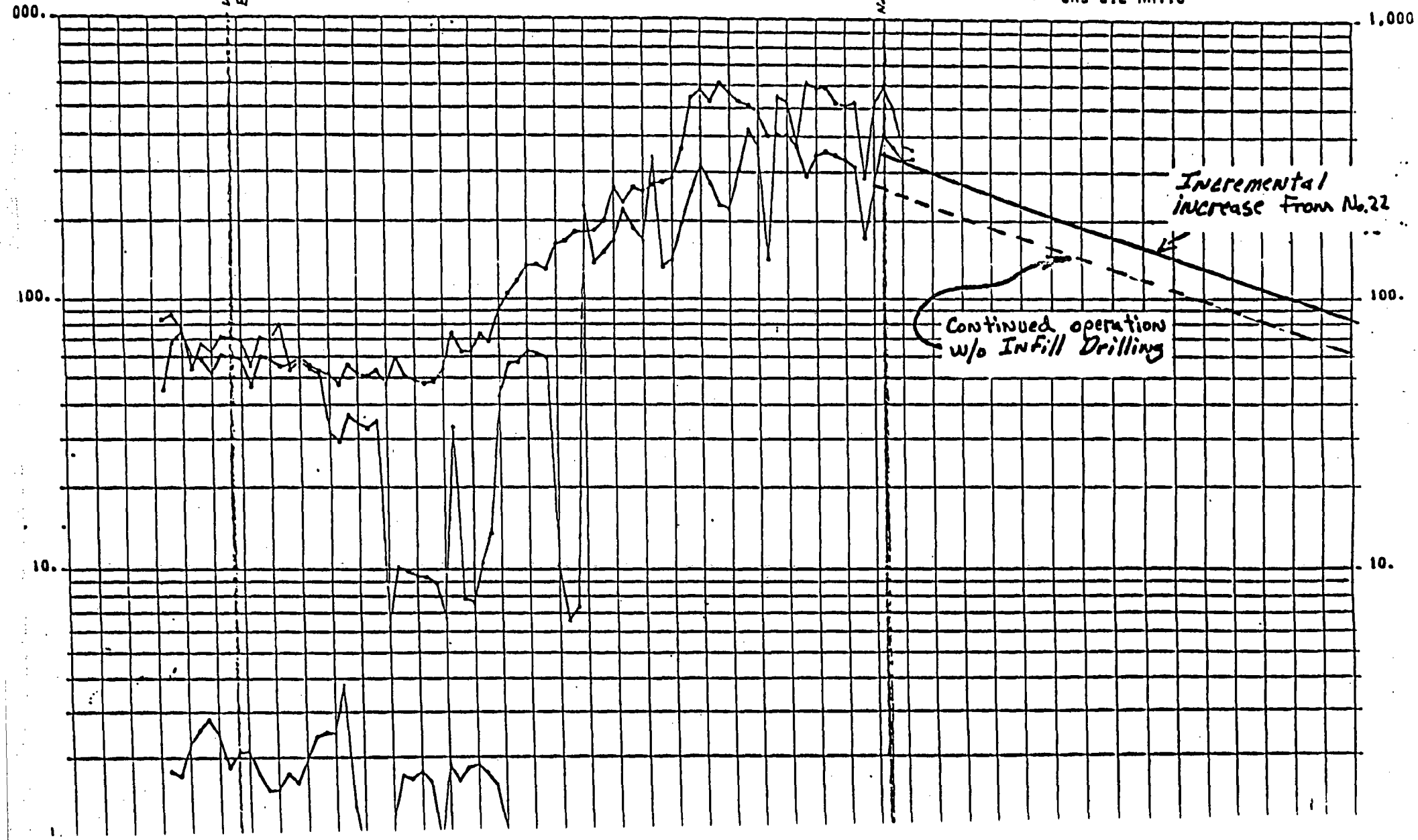


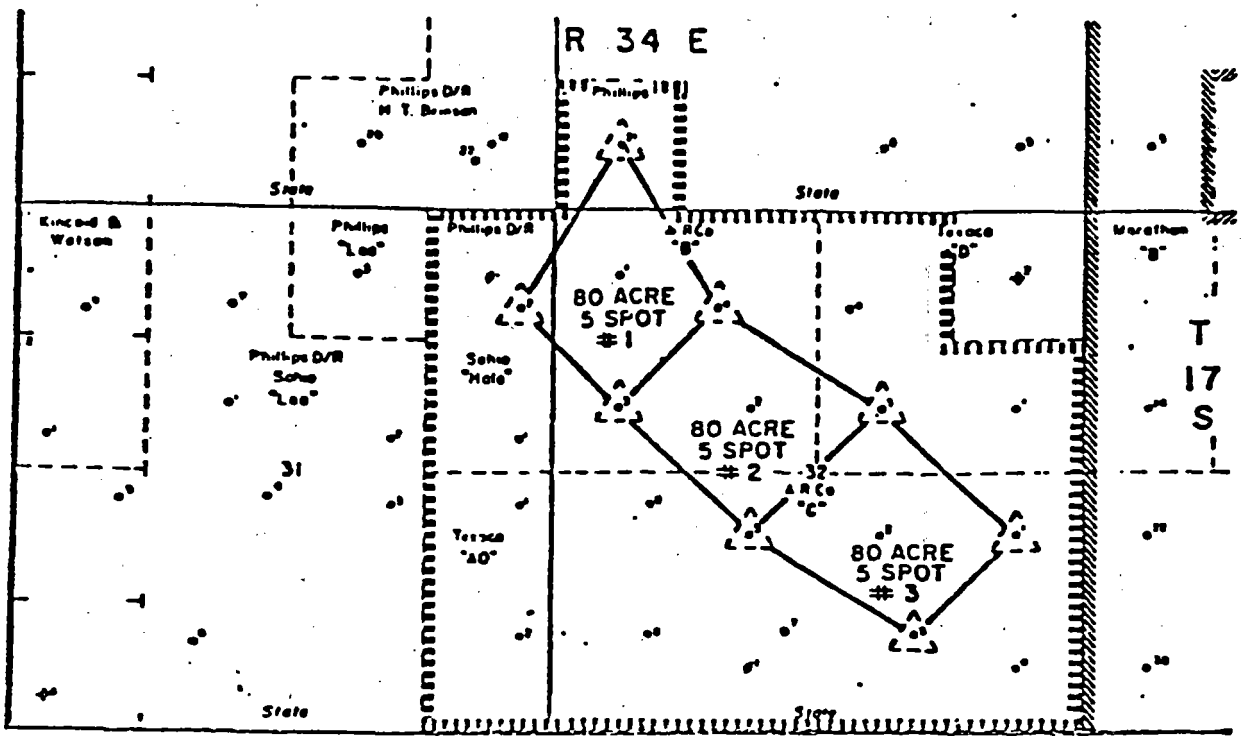
Table I

Basic Reservoir Data

Unit:	State Vacuum Unit
Operator:	ARCO Oil and Gas Company
Field:	Vacuum Grayburg-San Andres
Lithology:	Dolomite and Limestone
Area:	800 Acres
Average Porosity:	9.88%
Average Permeability:	17.8 md
Initial Formation Volume Factor:	1.26 RB/STB
Connate Water Saturation:	26.5%
Residual Oil Saturation:	30.0%
Oil Gravity:	37° API
Average GOR:	175 SCF/bbl
Original Oil In Place:	13,306 MSTBO
Primary Recovery (40-acres):	3,266 MSTBO
Secondary Recovery (40-acres):	1,700 MSTBO

TABLE 2

STRATIFICATION ANALYSIS



	% Thickness of Total	Kl, md	Scw,%	Sgx,%	Sor,%
80-ACRE 5-SPOT NO. 1					
Layer #1	42.1	4.6	26.5	24.0	30.0
Layer #2	37.0	1.7	26.5	24.0	30.0
Layer #3	20.9	0.5	26.5	24.0	30.0
	100.0				
80-ACRE 5-SPOT NO. 2					
Layer #1	25.4	26.0	26.5	24.0	30.0
Layer #2	30.8	8.6	26.5	24.0	30.0
Layer #3	17.6	2.8	26.5	24.0	30.0
Layer #4	14.9	1.0	26.5	24.0	30.0
Layer #5	11.3	0.4	26.5	24.0	30.0
	100.0				
80-ACRE 5-SPOT NO. 3					
Layer #1	18.2	19.8	26.5	24.0	30.0
Layer #2	23.5	7.0	26.5	24.0	30.0
Layer #3	29.4	2.6	26.5	24.0	30.4
Layer #4	12.6	0.9	26.5	24.0	30.4
Layer #5	16.3	0.3	26.5	24.0	30.4
	100.0				

Appendix A

I. Incremental Secondary Reserves with 20-acre Infills:

OOIP = 13,306 MBO (Eng. Study 1976)
Recovery Factor = .039 (EVU Eng. Study, Phillips)
Additional Reserves from 20-acre Spacing = 519 MBO
Unit Area = 800 acres
therefore, Equivalent 20-acre infills required = 20

519 MBO ÷ 20 Wells = 26 MBO/Well Incremental Oil

(26 MBO/Well)(175 SCF/STB) = 4.55 MMCF/Well Incremental Gas

II. Undrained Primary Reserves for Typical 20-acre Infill Location:

Øh = 4.56 (log data)
Sw = .265 (Eng. Study 1976)
Recovery Factor = .248 (Eng. Study 1976)
Boi = 1.26 RB/STB (Eng. Study 1976)
A = 6 acres (Undrained area planimetered from drainage maps)

$$\frac{7758\ A\emptyset h(1-Sw)}{Boi} \times R_f = \frac{7758(5)(4.56)(1-.265)}{1.26} \times .248 = 25.6 \text{ MBO Primary Reserves from 20-acre Spacing}$$

25.6 MBO x 175 SCF/STB = 4.48 MMCF Primary Gas

III. New Primary Reserves from A Lower Zone:

Øh = 0.96
A = 20 acres

$$\frac{7758\ A\emptyset h(1-Sw)}{Boi} \times R_f = \frac{7758(20)(1)(1-.265)}{1.26} \times .248 = 21.6 \text{ MBO Primary Reserves for Lower Zone}$$

21.6 MBO x (175 SCF/STB) = 3.78 MMCF Primary Gas