CASE 7093: MESA PETROLEUM COMPANY AND YATES PETROLEUM CORPORATION FOR DESIGNATION OF A TIGHT FORMATION, TORRANCE, GUADALUPE, DEBACA, LINCOLN, AND CHAVES COUNTIES, NEW MEXICO

Case No.

7093

Application

Transcripts

Small Exhibits

ETC

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO
25 November 1980

EXAMINER HEARING

JUN 1981
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KOCH EXPLORATION COMPANY

IN THE MATTER OF:

Application of Mesa Petroleum Company and Yates Petroleum Corporation for designation of a tight formation, Torrance, Guadalupe, DeBaca, Lincoln, and Chaves Counties, New Mexico.

CASE 7093

BEFORE: Daniel S. Nutter

TRANSCRIPT OF HEARING

APPEARANCES

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MR. NUTTER: The hearing will come to order, please.

The first case this afternoon will be Case Number 7093.

MR. PADILLA: Application of Mesa Petroleum Company and Yates Petroleum Corporation for designation of tight formation, Torrance, Guadalupe, DeBaca, Lincoln, and Chaves Counties, New Mexico.

MR. CARR: May it please the Examiner, I am William F. Carr, with the law firm of Campbell and Black, P. A., Santa Fe, New Mexico, appearing on behalf of the applicant.

I have two witnesses and twenty-eight exhibits.

I also would like the record to note that this case was prepared by the applicants with the assistance of Harold Hensley and Conrad Coffield of the Hinkle firm, and would request that copies of the orders and any other correspondence relating to this hearing be directed to them, as well as to us.

MR. NUTTER: Well now, Mr. Carr, you mentioned you have twenty-eight exhibits.

MR. CARR: Yes, sir. Mr. Nutter, we have marked in addition to the twenty-six exhibits which have been submitted and indicated by exhibit numbers, we are also going

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to offer the summaries which were attached to those exhibits, and have marked them as our Exhibits Twenty-seven and Twenty-eight.

MR. NUTTER: Well, Rule C-4 requires that a complete set of exhibits which applicant proposes to offer or submit at the hearing be furnished in advance. I think we have received twenty-five exhibits; maybe there are twenty-six. What's this one? Maybe there are twenty-six. No, I made this one.

Oh, here's Exhibit Twenty-six, so twenty-six have been submitted.

MR. CARR: And we have marked for the purposes of this hearing, the summaries which we attached to those exhibits which identify each one and explain what their purpose is.

MR. NUTTER: It's not actually an additional exhibit, then.

MR. CARR: It's nothing that you haven't already received. We did include it as an exhibit to be sure it would be included with the record submitted to FERC.

MR. NUTTER: Okay. Fine, proceed.

MR. CARR: The witnesses need to be sworn.

(Witnesses sworn.)

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MR. CARR: At this time I would call Joseph W. Jeffers.

JOSEPH W. JEFFERS

being called as a witness and having been duly sworn upon his oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. CARR:

Q. Mr. Jeffers, for the purpose of the record will you state your full name and your place of residence?

A. Joseph W. Jeffers, Midland, Texas.

Q. By whom are you employed and in what capacity?

A. Mesa Petroleum Company, as Division Geologist.

Q. Have you previously testified before this Commission, had your credentials accepted and made a matter of record?

A. I have.

Q. Are you familiar with the application in this case?

A. I am.

MR. CARR: Are the witness' qualifications acceptable?

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MR. NUTTER: Yes, they are.

Q. Mr. Jeffers, will you briefly state what Mesa and Yates seek with this application?

MR. NUTTER: Mr. Carr, for the sake -- this record goes to FERC. I think it would be appropriate that you should qualify this witness in addition to previous qualifications.

MR. CARR: All right. That's fine, we'll be happy to.

Q. Mr. Jeffers, would you briefly summarize your educational background and work experience?

A. I have a degree in geology in 1954 from Southern Methodist University; a Master of Science in geology in 1955 from Southern Methodist University.

I worked fifteen years for Mobil, Magnolia and Mobil, as a geologist; four years as a geologist with PubCo Petroleum, and the last eight years for Mesa Petroleum.

Q. In your role with Mesa Petroleum are you responsible for the area which is covered by this application?

A. I am.

Q. Are you familiar with the area?

A. Yes, I am.

MR. CARR: Are the witness' qualifications acceptable?

MR. NUTTER: Mr. Jeffers, are you acquainted

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with the Abo formation and its producing characteristics?

A. Yes, sir, I am.

MR. NUTTER: I think Mr. Jeffers is qualified.

Q. Mr. Jeffers, will you briefly state what Mesa and Yates seek with this application?

A. Mesa and Yates Petroleum seek with this application the designation of the tight sand category, FERC 107 category.

Q. For a portion of the Abo formation?

A. For the portion of the Abo formation as designated in the exhibits to follow.

Q. Have each of your exhibits previously been submitted to the Oil Conservation Division and to the United States Geological Survey, as required by the Oil Conservation Division rules?

A. They have.

Q. Would you give us a brief geographical and geological description of the area that we are dealing with in this hearing today?

A. Geographically the tight Abo sandstone gas play is located in southeast New Mexico and covers portions of Guadalupe, DeBaca, Torrance, Lincoln, and Chaves Counties. The northern boundary of the filing area lies just south of Santa Rosa and the southern boundary is southwest of Roswell.

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The Village of Vaughn is near the western boundary and Ft. Sumner lies just within the eastern boundary.

The area described will hereinafter be referred to as the Pecos Slope. You may refer to Exhibits One and Two.

The Lower Permian Abo sandstones of the Pecos Slope were deposited by a series of fluvial systems which derived their sediments from the Pedernal Uplift to the northwest. The Abo sandstones were deposited as elongate lenticular sand bodies on a low relief fluvial plain. Individual sandstone bodies are irregularly shaped, limited in areal extent, and are interbedded with red and green shales.

Gas production has been established in the low permeability sandstones of the Abo "red bed" section. The poor reservoir properties of the Abo sandstones vary both across the Pecos Slope and with individual standstone bodies.

Q. Will you now refer to Applicant's Exhibit One and Two and explain what they are and what they show?

A. Exhibits One and Two, Exhibit One is a 1-inch to approximately 8-mile scale map, showing parts of seven counties in southeast New Mexico with the location of the major cities and towns.

The heavy line on the southeast marks the approximate extent of the Abo sandstones to the southeast.

The remainder of the map has indicated

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presence of Abo sandstones which will be discussed with the cross section exhibits to follow.

The area of the application for tight Abo sandstones is shown by the outline on Exhibit One and is described by township and range in Exhibit Two.

Q Will you now refer to Applicant Exhibit Number Three and explain to Mr. Nutter what this is and what it shows?

A. Exhibit Number Three is a generalized stratigraphic section. The stratigraphic section is presented to show the location of the Abo section in geologic time and to indicate general lithology of the Abo section on the Pecos Slope. All rock units and series shown are not present over the entire area of the Pecos Slope. The stratigraphic section is a compilation of industry accepted stratigraphic sections to fit the Pecos Slope.

Q And this exhibit shows the relationship of the Abo to other formations?

A That is correct.

Q Will you now refer to your Exhibit Number Four and review this for Mr. Nutter?

A Exhibit Number Four is a lithologic description of the Abo sandstone as revealed by cores. This report is presented to show that Abo sandstone is a very fine grained sandstone to siltstone. It consists of subangu-

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lar to subrounded silt-sized grains of quartz, feldspar, and mica, cemented with calcite and agrillaceous material.

Q. Mr. Jeffers, will you now refer to Exhibit Number Five and review this?

A. Exhibit Number Five is in two parts, an east half and a west half. It's a structure map on the top of the Abo. The map scale is 1-inch equals 8000 feet. This map shows the same area as map, Exhibit One.

The wells currently completed as Abo gas wells are colored orange. The fields outlined on the map show their name and producing formation. All of the wells that penetrated the Abo are indicated by black dry hole symbols or are circled or are shown by large completed gas well symbols. The cross section traces are indicated by letter symbol and heavy lines. Control, that's data point wells, are lettered to correspond to the type of engineering data available, shown in the legend. In addition, the map shows the outline of the area of the application, shown on Exhibit One, and described in Exhibit Two.

The Abo structure map is prepared to illustrate the structural relief of the Abo sandstones across the Pecos Slope. Structure appears to be important only with respect to drilling depth to penetrate the sandstone lenses and channels in the Abo. The map is contoured on the top of the Abo formation. The 100-foot contour interval indicates a gen-

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eral east dip with overall relief in excess of 5500 feet across the area filed for tight Abo sandstone.

MR. NUTTER: You mean that would be 5500 feet in the Abo itself?

A. That is correct, sir.

Surface elevations range from 4000 feet to the east, to approximately 6500 feet to the west. The drilling depth to the top of the Abo varies from approximately 4500 feet to the east, to 1800 feet to the west.

Q. Mr. Jeffers, I'm now going to direct your attention to the cross sections. I first would ask you generally, what are these cross sections designed to show?

A. The cross sections which comprise the following exhibits --

MR. NUTTER: Well, just a minute.

A. All right.

MR. NUTTER: How many cross sections are there?

MR. CARR: There are four.

A. There are four.

MR. NUTTER: Okay, might as well get them all out. You're going to go through them one at a time, aren't you?

A. Yes, sir, I am.

MR. NUTTER: Okay, go ahead.

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A. The cross sections which comprise the following exhibit, were designed to show the presence of Abo sandstones over the entire Pecos Slope area. In addition, wells that are completed in the Abo have compretion data described at the bottom of the log.

Q. Will you now refer to Exhibit Number Six, which is your A-A' cross section, and review this for Mr. Nutter?

A. Exhibit Six is a generally north/south trending stratigraphic cross section. This section is hung stratigraphically on the top of the Abo formation. It shows an increase in total Abo section from north to south. In addition, it shows numerous individual sand bodies with the Abo.

The cross section is not designed to show structure, but the logs indicate depth to the top of the sand interval at Well A-1 in Guadalupe County to be 2682 feet, while at Well A-3 in DeBaca it is 3440 feet.

The Abo section is approximately 640 feet thick in the north and 815 feet thick in the south.

This, and the following cross sections, show the variations, the unpredictable nature, and lack of continuity of the sandstone lenses and channels from well to well.

Q. Will you now refer to Exhibit Number Seven, your cross section B-B', and review this?

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A. Exhibit Seven is generally a west to east stratigraphic cross section . The section is hung stratigraphically on the top of the Abo formation. It shows the wedge of the Abo thickening to the east and thinning towards the west, toward the source area for the Abo rocks.

The thickness of the Abo varies from 780 feet in Well B-3 to an estimated thickness of 400 to 500 feet in Well B-1. Well B-1 had a show of flammable gas in sandstone at approximately 1825 feet near the top of the Abo while drilling with cable tools.

Q. Mr. Jeffers, will you now review Exhibit Number Eight, please, for the Examiner?

A. Exhibit Number Eight is regional cross section C-C', a generally west to east stratigraphic cross section. The section is hung stratigraphically on the top of the Abo formation.

This section, like Sections A-A' and B-B', shows the numerous individual sand bodies within the Abo zone. The depth to the top of the Abo in well C-1 is 1900 feet in Lincoln County, while at Well C-4 in Chaves County it is 4405 feet. The wedge shape of the Abo is well demonstrated on this section. The Abo is approximately 340 feet thick to the west and 685 feet thick to the east.

The Abo section in Well C-1 rests on granite wash, which is assumed to be Wolfcamp in age, which

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in turn rests on a quartz diorite basement.

Well C-2 production tested a show of gas, described on the cross section, from an Abo sandstone.

Q. Will you now review the data contained on your Exhibit Number Nine, the E-E' cross section?

A. Exhibit Nine is a generally north/south stratigraphic cross section hung stratigraphically on top of the Abo formation. This section ties Sections A-A', B-B', and C-C' and demonstrates the numerous individual sand bodies within the Abo formation.

In addition, the completed gas wells from the Abo have the completions and production treatments partially described at the respective wells.

Q. What conclusions can you draw from your testimony?

A. The area filed for the tight Abo sand designation on the Pecos Slope includes portions of five counties in southeast New Mexico.

Over this area the Abo formation exhibits remarkably similar lithologic and stratigraphic characteristics. The individual sandstones present in the Abo formation, as exhibited on the cross sections, are erratic and discontinuous.

The Abo sandstones were deposited in a fluvial system, which has all the unpredictability and variation of this type deposition. Reservoir quality within the

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sand zones, as well as within the individual sandstone bodies, is unpredictable due to variations in clay content, cementing, and grain size. The lithologic characteristics tend to make the Abo sandstone a relatively poor reservoir with is difficult to produce without stimulation.

Q. Mr. Jeffers, I would ask you to identify what has been marked for identification as Applicant's Exhibit Twenty seven.

A. It's a summary of the description of the various exhibits as presented for geologic testimony for the tight sand hearing.

Q. Is this the summary that was submitted with the exhibits to the Oil Conservation Division and the USGS?

A. It was.

Q. Were Exhibits One through Nine and Number Twenty-seven either prepared by you or under your direction and supervision?

A. They were.

MR. CARR: At this time, Mr. Nutter, we would offer into evidence Applicant's Exhibits One through Nine and Twenty-seven.

MR. NUTTER: Mr. Jeffers, is Exhibit Twenty-seven the document that was submitted with the application that's entitled Midland, October 29, 1980, Narrative of Testi-

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mony to the NMOCD Hearing for Designation of the Abo Sandstone?

A That is correct, sir.

MR. NUTTER: And the discussion of exhibits you just went through?

A That is right, sir.

MR. NUTTER: Exhibits One through Nine and Twenty-seven will be admitted in evidence.

MR. NUTTER: Are there any questions of Mr. Jeffers? He may be excused. We might want to call him back and ask him some more questions after we get a better feel of the whole thing, Mr. Carr.

MR. CARR: At this time I would call John Jay Keesey.

JOHN JAY KEESEY

being called as a witness and being duly sworn upon his oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. CARR:

Q Will you state your full name and place of residence?

A John Jay Keesey, Midland, Texas.

MR. NUTTER: How do you spell your last name?

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A. K-E-E-S-E-Y.

MR. NUTTER: Thank you.

Q. Mr. Keesey, by whom are you employed and in what capacity?

A. I'm employed by Sipes, Williamson, and Associates, Inc., Petroleum Consultants, and I'm Vice-President and Engineering Manager.

Q. Would you briefly summarize for the Examiner your educational background and your work experience?

A. Yes. I received a Bachelor of Science degree from Texas Tech in 1962. I went to work at that time for the PanAmerican Petroleum Corporation, and later on was renamed to Amoco Production Company.

I worked for that firm for ten and a half years in various phases of engineering in southeastern New Mexico and in the West Texas area, including drilling, production operations, equipment, and also special field studies and secondary recovery operations.

In 1973 I joined the firm of Sipes, Williamson, and Associates, Inc., and have been engaged since that time in property evaluation, special field studies, the State work, reserve analysis, and other associated services that we provide.

Q. Have you been employed by the applicants in this case to perform a study -- to undertake a study of the

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Abo sandstone and to prepare certain data for submission to this Commission?

A. Yes, I have.

Q. And you have made such a study?

A. I have.

Q. Are you familiar with the area and the application?

A. Yes, sir, I am.

MR. CARR: Are the witness' qualifications acceptable?

MR. NUTTER: They are.

Q. Mr. Keesey, initially I would like to direct your attention back to Exhibit Number Five, which was previously introduced in this case, and I would ask you if this exhibit depicts all wells in the area of interest which were completed in the Abo formation as of October 31, 1980?

A. That is correct.

Q. How many wells are completed or being completed in the Abo as of that date?

A. There were 43 wells which had essentially been drilled and completed. Several of them at that specific date had not been tested in any way. I believe that there was 39 wells of those 43 which had been perforated and some type of flow test data taken.

Q. Now, are each of these wells assigned a

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reference number on this exhibit?

A. Yes, they are. We have assigned each of the 43 wells a reference number that we refer to just as the Sipes, Williamson, and Associates, Inc.'s tract number. This is shown immediately to the right of each one of the wells that are colored in orange on Exhibit Five.

Q. Would you explain what each of these numbers represents?

A. It's just a quick reference tract number that we've tried to come down from the north to the south, moving down the map, and this same number will be used on other exhibits which will be submitted.

It's for quick reference purposes.

Q. Will you now refer to what has been marked for identification as Applicant's Exhibit Number Ten and explain to the Examiner what this is and what it shows?

A. Yes. Exhibit Ten is a table presenting completion information on those wells which have been completed in the Abo formation as of the end of October. Information shown includes the Sipes, Williamson, and Associates, Inc.'s tract reference number, the well name, the location, spud date, completion date, total depth, completion interval, initial bottom hole pressure, flow rate data, stimulation data, and the date that the well went on line, and initial producing rate.

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This flow rate data that I mentioned, are presented for the natural flow conditions of the well; that is, prior to any stimulation.

In addition, flow rate data has also been presented for that period of time when the wells were stimulated, either acidizing on a first stimulation, normally followed by a fracturing as a second stimulation. We've also shown the flow rates obtained after those stimulation treatments. In addition, we've also shown the volumes that were used for stimulation on the well.

As can be seen, these treatments usually consisted of acid treatments initially, ranging from 500 to 4000 gallons of acid, normally followed by a fracture stimulation treatment, ranging from 20 to 40,000 gallons of jelled water and sand.

Q Now, Mr. Keesey, certain of the wells were spudded prior to July 16, 1979, is that correct?

A That's correct, yes.

Q And they, therefor, would not qualify for the tight sand classification authorized under Section 107 of the NGPA.

A That is correct. There are seven wells that are on this list. We might point them out. The copy that I have here is maybe a little fuzzy on the dates but on page one of Exhibit Ten we have the McClellan Oil Corporation

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"JJ" Federal No. 1.

MR. NUTTER: Give us the reference number. It will be easier to spot.

A. Okay, Reference No. 40, Reference No. 35.

MR. NUTTER: Okay.

A. On page two we have 42, 28, 36, 38, and on page three, and we may need some clarification on this, but I had originally listed Well No. 15, and I think it's just a typo error here that the initial spud date was left out, which my records show to be June 29th, 1979.

Q. Mr. Keesey, will you now refer --

MR. NUTTER: Now those wells that you just finished talking about were all spudded prior to what date?

A. To July 21st, 1979. I'm sorry, July 16th of 1979.

MR. NUTTER: Go ahead.

Q. Mr. Keesey, will you now refer to Applicant's Exhibit Number Eleven and explain this to Mr. Nutter?

A. Yes. Exhibit Eleven is a list of plugged and abandoned wells within the area of interest, which have penetrated or are believed to have penetrated the Abo formation. A question exists on the penetration of several wells where data were not complete or were not available. Some of these wells are quite old.

There are a total of 123 wells on this

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list and these wells would essentially fall into the area shown by the two maps representing Exhibit Five.

Several of these wells have tested the Abo while the remainder have simply penetrated the Abo formation during drilling to deeper depths.

A high majority of these wells, if not all of them, were drilled by rotary tools. No shows of hydrocarbons through the Abo section were recorded during drilling. Now this does not necessarily condemn the Abo formation for productive gas, but I feel is indicative of the tight nature of the Abo formation.

Q. Did you conduct a study to determine the average in situ gas permeability of the sand section underlying the area in question?

A. Yes, we did.

Q. And what engineering methods did you employ?

A. The estimated average in situ gas permeability of the Abo sand section was calculated using two widely accepted industry methods. These methods include laboratory measurements of cored Abo sand sections and permeability calculations from bottom hole pressure build-up data.

The first method for obtaining the in situ gas permeability by core analysis requires permeability measurements of actual cored sections of Abo sand in the labor-

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atory. Due to poor core recoveries in the field and the increased expense due to coring, only two wells in the area of interest have been cored and have obtained Abo sand sections.

Q Will you now refer to Exhibits Twelve, Thirteen, and Fourteen, identify these, and explain what they show?

A Okay. Exhibit Number Twelve is a log on the Thorpe "MI" Federal No. 2 Well, and this exhibit shows the intervals which were cored in this well, and we also highlight the pay zone within the Abo section. I might point out that the core, now, that we're going to be referring to, the intervals that were tested have also been highlighted. This is shown by the short hatched horizontal line referred to on the exhibit as cored intervals tested in in situ permeability.

We've shown pay zones in yellow. One pay zone is at approximately 3642 to 52 feet. The other is 3952 to about 70 feet; that is 3970 feet.

Exhibit Number Thirteen is a log on the Papalote "OI" State No. 1 Well, which we've also shown the cored section and have illustrated again the pay section shaded in yellow.

This pay section is from approximately 3722 feet to 3733 feet.

Exhibit Number Fourteen is a tabulation of core-derived permeability data for these two wells for those

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pay sections that I have pointed out.

You'll note on Exhibit Fourteen that we have shown the sample numbers, the core depth, and the correlative log depth. The reason we show this correlative log depth is that the logged intervals did not correspond directly on depth measurements with the cored intervals.

The next to last column from the right is the maximum routine permeability determined by core analysis on either hole core or plugged samples by standard tests run at approximately 150 pounds pressure and the use of either nitrogen or air for measurement of permeability.

The average permeability for the Papalote "OI" State No. 1 Well was determined to be 0.048 millidarcies in the pay section.

The average permeability for the Thorpe "MI" No. 2 Well by routine core analysis was determined to be 0.074 millidarcies.

Average permeability for both wells was 0.066 millidarcies.

MR. NUTTER: How did you obtain the average permeability of those wells, simply by dividing total permeability and the total feet?

A. That's correct.

Q. In your opinion --

A. The total number of samples. Excuse me.

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Q In the opinion of Sipes, Williamson, and Associates, is this the best method to use in determining in situ permeability?

A. Yes, we feel like it is because these are actual samples of the productive formation that can be measured at the surface.

Q And is this the method widely accepted in the industry?

A. It is.

Q Do you believe this provides the best possible data as to the permeability?

A. Yes, I do.

Q Were any special tests conducted by you to determine the effects of the overburden pressure on the site?

A. Yes, we did run some overburden tests to determine what is referred to as the in situ permeability of the rock. These were done as soon as the core was obtained and was done to allow us data so that we could correct the routine core analysis, or core permeability, to in situ bottom hole pressure conditions.

Now, in situ means that the tests run in the core are done at a higher pressure than normally used in routine core analysis. I mention that routine core analysis uses a surface pressure during testing of about 150 pounds;

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whereas the bottom hole pressure, or the rock sensing pressure in the formation, is actually feeling the affects of overburden. This is at a much, much higher pressure. So what we did is we had special tests run where they imposed a higher pressure on the core sample and then reran the permeability estimates.

Q. Will you now refer to Exhibit Number Fifteen and explain to the Examinor what this shows?

A. Yes. These in situ permeability tests were conducted on only the core that was available at the time from the Thorpe "MI" Well No. 2.

MR. NUTTER: Mr. Keesey, let me interrupt you right here.

A. Yes.

MR. NUTTER: Now, these wells presumably were drilled some little time back. The Yates well was drilled in October -- no, it's a new well drilled in October of '80. They've both been drilled recently.

A. Yes, sir, that's correct.

MR. NUTTER: Okay, now were these permeability tests and the in situ calculations made immediately following the -- retrieving of the cores?

A. Yes, they were.

MR. NUTTER: So the cores weren't old cores submitted to this high pressure testing then?

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A. No, sir, they were not. They were fresh cores.

Exhibit Fifteen is a plot showing the results of the in situ permeability tests on the Thorpe "MI" Well NO. 2. The horizontal scale is the permeability determined by the routine core analysis. The vertical scale is the permeability obtained on each of the relative samples under in situ conditions.

If you will enter the curve at the horizontal axis, the value of permeability of 0.1 millidarcies, and move vertically until you encounter the heavy dark line drawn, encountering that you move then to the left until you intersect the vertical axis, you will see that the permeability of 0.1 under routine conditions yields an in situ permeability in the order of 0.0105 millidarcies.

What this is saying is that permeability in the formation under more near reservoir conditions is much, much less than is measured at the surface under routine core analysis.

What I would like to point out is that the core analysis, even under routine conditions for both of these wells, show that the permeability is well below the allowed limit of 0.1 millidarcies.

Q Is this correlation depicted on Exhibit Fifteen, is it applied to all the intervals shown on Exhibit

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Fourteen?

A. Yes, it was. In order to go ahead and calculate the in situ permeability, which is reflecting again that we see a reservoir, actual reservoier permeability condition of even a much lower rate; very far below the 0.1 millidarcy limit for tight gas sand qualification.

Q. Does the data you received in this manner confirm the data you received from your core analysis?

A. Yes, it does.

Q. Do you consider these results to be representative of the Abo formation underlying the entire area which is the subject of this application?

A. Yes, I do.

Q. Now, the samples that you had from the Thorpe "MI" Well No. 2 and the Papalote "OI" State No, 1, are these typical samples of the Abo formation?

A. Yes, they are.

Q. And why is that?

A. Well, they're in the same area that has been described -- defined earlier in Mr. Jeffers testimony. This is the Abo section. These sands appear to be typical from a log review of the other Abo sands, and we feel they are typical of the Abo that will be found in the -- in the area of investigation, the area of interest.

Q. Will you now refer to Applicant's Exhibit

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Number Sixteen and explain what it is?

A. Okay. Before we get off, I would like to point out that we have flow test data, I believe, on Exhibit Number Ten relative to production in the Thorpe Well that is completion in a zone that was cored and does show test data very similar to other pre-stimulation and after-stimulation flow test data which we have seen in all other 42 wells for which we have test data available.

This is another reason that we feel that these sections are representative of the entire Abo section.

MR. NUTTER: Now where is that flow data on Exhibit Number Ten?

A. I believe that well number is 22. It's on page three. Natural flow rate, there was no flow; the well would not produce any gas. It was then acidized with 2000 gallons of acid and nitrogen and flowed 48.6 Mcf per day and was then fractured with 20,000 gallons of jelled water and sand and flowed 1359 Mcf per day.

And this is very typical of the other test results of the wells in the area of interest.

MR. NUTTER: Okay.

Q. Will you now refer to Exhibit Number Sixteen and explain what it is and what it shows?

A. Okay. The second procedure that we looked at for obtaining permeability of the Abo pay section was to

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look at pressure build-up data. These data were obtained on four of the Abo completions, which we have listed the results of this test data on Exhibit Sixteen. Pressure analysis used to calculate the average permeability was the conventional Horner plot technique and we have shown the equation on page five of my testimony, which will be Exhibit Twenty-eight. The value for m is the slope of the straight line portion of the Horner plot of the bottom hole pressure data plotted on a semilog graph where it's a plot of the T plus Delta T over T correlation.

The results of the bottom hole pressure analysis on these four wells are given on Exhibit Sixteen. This technique yielded an average reservoir permeabilities ranging from a low of 0.01 in reference number well 29 to a high of 0.1188 millidarcies in reference well 33. The average permeability for the four wells was determined to be 0.0506 millidarcies.

Q. How does this calculated permeability compare to the results of the core analysis?

A. The average calculated permeability compares -- compares favorably to the permeability determined by the routine core analysis described earlier. It is lower than in the in situ permeabilities determined by the core data method.

Q. Will you now refer to Applicant's Exhibit

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Number Seventeen --

A. Well, let me -- let me back up a minute.

Q. All right.

A. The averaged calculated permeabilities that we have here of 0.0506 I said were lower than the in situ permeabilities. Those are actually higher than the in situ permeabilities that we showed earlier.

The higher permeabilities that were seen here by the pressure data, I feel is a result of the fact that these wells had all received some type of minor stimulation prior to the pressure build-up test data was obtained; therefor, what we're seeing is permeabilities more in line with the actual routine core analysis permeabilities, but still well below the allowed 0.1 millidarcies.

Q. Will you now refer to Exhibit Number Seventeen and explain this for Mr. Nutter?

A. Okay. Exhibit Seventeen is a tabulation of the flow data obtained on Abo gas wells prior to stimulation. These data show that a large percentage of the Abo gas wells would not flow upon initial completion. What we have shown is, again, our tract reference number and then to the right of that the operator and well name, and the third column is the test rate that was actually obtained on the well.

If you'll note on page two a summation of the flow rates encountered yielded a total of 1218 Mcf per

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day. This is a total flow obtained from 24 zones that were tested and where actual test data was recorded. The average daily flow rate, then, was determined by dividing the summation of the flow rates by the number of zones tested and yielded an average flow rate of 51 Mcf per day per well.

Some of these flow rates you will note have sizeable capacities and these were done at surface pressures which were above one atmosphere. Therefor, we needed to correct or adjust those flow rates to determine what the psuedo-steady rate flow rate would be at one atmosphere surface flowing pressure.

The results of this work is shown in column four, which is entitled Corrected to Stabilized Conditions at One Atmosphere.

Referencing Tract Number 30, we have a pre-stimulation flow rate measured as 350 Mcf per day. This was corrected by a theoretical technique to be 230 Mcf per day at one atmosphere.

There were a few flow rates in here, such as for Well No. 27, which had a pre-stimulation flow rate measured as 10 Mcf per day. There was no adjustment made to this particular well, as we felt that this would be a very marginal or non-material type of change. Actually we would expect to see it decline. This well and one or two others, is shown by a double asterisk as those that we did not attempt

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to calculate a stabilized flow rate.

We also show on this exhibit, under test rate, several references as TSTM. This is too small to measure gas flow rate under test conditions. Under this situation we would expect that these flow rates would be all less than 10 Mcf per day.

Re-summarizing the total flow rates including those wells which have been corrected to psuedo-steady state conditions, we now come up with a flow rate, total flow rate, of 839 Mcf per day. Again dividing by 24 test zones, we come up with a 35 Mcf per day per well flow rate.

MR. NUTTER: Mr. Keesey, if we could diverse ourselves here for a moment, you're talking about 24 zones measured. Now what are the 24 zones that you measured here? Are there 24 wells here that you have --

A. There's actually 20 wells there. Some of the wells had dual tests in them. For instance, on the first well, which is the 39 tract number, we see that we have the first interval shown was perforated from 4272 to 4344, and this zone was swab tested and swabbed dry.

MR. NUTTER: Now that counts as one of your 24?

A. That is one of the 24.

MR. NUTTER: Okay.

A. And then the other zone was 4198 to 4210,

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and it swabbed dry with a slight flow of gas.

MR. NUTTER: Okay, now going down the list let's see if I can pick out the ones that you'd call as being among the 24.

The next one would be the 'TSTM', I presume.

A. Yes.

MR. NUTTER: And then 'swab dry'?

A. That's correct.

MR. NUTTER: And then '350' and 'TSTM', 'Swab dry', 'TSTM', 'Swab steady', '250', '80', 'Swab dry'. How about 'Swab with no recovery', would that count?

A. That would, yes, that would be one. All of the --

MR. NUTTER: And then 'Not available' and 'no test' wouldn't count. The '10' down there would count, and getting over on the next page, 'TSTM', 'TSTM', '521'. The '0' on the Smernoff well, would that be a flow rate?

A. Yes, it would.

MR. NUTTER: And 'TSTM' would be a flow rate. The '7'?

A. Yes.

MR. NUTTER: How about 'No show', would that count?

A. I believe we did count that one in there,

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yes. That would be no show of gas.

MR. NUTTER: And 'Would Not Flow', is that --

A. That would be -- that was actually reported and is taken as no flow.

MR. NUTTER: Okay, so that's how you derived your 24 wells to average in the total flow?

A. Yes, that's correct.

Q. Mr. Keesey, I believe you've just testified that the average stabilized flow rate for these wells was 35 Mcf per well per day.

A. That's correct.

Q. Is this stabilized flow rate below the allowed maximum daily flow rate as provided for by Section 107?

A. Yes, it is. For the depth of the wells that we were looking at in the area of investigation, I might refer you back again to Exhibit Number Seventeen, of the wells that we had tested or had test data available on, we had an average depth to the top of the perforation of 3878 feet.

Under Section 107 this interval from 3500 to 4000 feet is allowed a maximum daily flow rate of 105 Mcf per day per well. Therefor, our flow rates of 35 Mcf per day, corrected to stabilized steady state conditions, is well below the allowed limit.

I'd also like to point out that the flow

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rates we encountered under non-corrected conditions, which is 51 Mcf per day per well, is also well below the allowed limit of 105 Mcf per day per well. Not only that, but as testified earlier, the shallowest Abo well anticipated would be to the west and would be an approximate depth of 1600 feet. Under these conditions the maximum allowed rate is 59 Mcf per day per well, as allowed on the 107; therefor, both the uncorrected and the corrected flow rates, both are below the shallowest low limit that we could expect to encounter in the area of interest.

Q. Will you now refer to Applicant's Exhibit Number Eighteen and review this for Mr. Nutter?

A. Exhibit Eighteen is a tabulation of production data and it's submitted for just record purposes. It shows the September, 1980, production rate for the wells that are on-stream. It also shows the cumulative production as of September 30th, 1980. Most of these wells have just gone on-stream a short period before the September 30th date. Several of the wells have gone on early in the year, around February or March.

One thing we would like to point out is that the liquid production reported from these wells has been zero. Now, I do know that several of the Yates wells do produce a very, very small amount of liquid. This liquid is of such small quantities that it has not even been transported at

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this point in time, or at least at the time that these reports were made out.

The gravity of this liquid is 62.7 degrees and therefor would definitely fall into a condensate category, but in addition to that, any production would be well below the allowed 5 barrel per day crude oil limit, and would probably not even be a barrel per well per day. I don't have any figures to verify that at the present time because it hasn't been run.

Q. Will you now refer to Exhibits Nineteen through Twenty-six and --

A. Nineteen through Twenty-six are performance curves on 8 wells for which some history of production was available. These wells are the ones that went on in the early part of 1980, the first wells on-stream.

There's a Boyd operating well, I believe, four wells from the McClellan Oil Corporation, and then three of the Yates Petroleum Corporation wells. These curves show the average monthly production with respect to time, and as would be expected in a tight gas sand like the Abo we are encountering here, the wells come in for relatively high rates, typically in the order of maybe 10,000 Mcf per month. Some of the better wells will exceed this initial rate.

Characteristically, we would expect to see and have seen a very, very sharp decline in producing rates.

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One well that has quite a bit of production history is Exhibit Twenty, the "JJ" Federal No. 1 Well, operated by McClellan Oil Corporation, came in for a peak rate of 6200 Mcf per month since then has dropped very drastically and during the last month we had production for, which was September, produced approximately 1180 Mcf per month.

I'd also like to point out that all the wells that are on production in the field at the present time are producing with compression and that without compression these wells will produce no, if any, gas at all. Compression is drawing the wells down to anywhere between 100 and 300 pounds line pressure.

Q. Will development of the area which is the subject of this application adversely affect fresh water supplies in the area?

A. No, it will not. The typical completion of a well includes the setting of surface casing or conductor pipe at approximately 300 to 400 feet and cementing that casing back to surface. There are some water zones at around 300 to 400 feet. These are not continuous zones and are not artesian flow. The main artesian flow zones are about 800 or 900 feet in depth. Most wells are run with casing and intermediate strings set anywhere from 1200 to 1500 feet. These strings are normally circulated back to surface. Then the production string is finally set on bottom once total depth is reached.

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These casing strings will either be circulated back to where they tie into the intermediate casing string or have at least 500 feet of cement above the top of the Abo.

So in essentially all cases the fresh water sands would be protected by an intermediate casing string cemented back to surface.

Q Now in summary, Mr. Keesey, in your opinion does the Abo gas formation in the area of interest meet all the reservoir criteria for designation as a tight gas sand formation under Section 107(b) of the Natural Gas Policy Act?

A In my opinion it does. The average reservoir permeability determined by the methods discussed averaged much less than the allowed 0.1 millidarcies. In addition, the average flow rate was well below the 105 limit in the particular area of development, and the flow rates would also be less than the allowed flow rate for the shallowest Abo well anticipated in the area of interest.

We also meet the crude oil specifications of less than 5 barrels of crude oil, in essence on that, because these wells did not produce any crude oil; whatever liquids are produced is a condensate.

Q In your opinion would granting this application be in the best interest of conservation of oil and gas?

A Yes, it would.

Q I'd like you to identify what has been

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marked for identification as Applicant's Exhibit Number Twenty-eight.

A. Yes, that's my narrative of testimony to the New Mexico Oil Conservation Division that was submitted along with the other exhibits.

Q. Were Exhibits Ten through Twenty-six and Exhibit Twenty-eight prepared by you or under your direction and supervision?

A. Yes, they were. The only exhibit I might make some exception to was Exhibit Number Eleven, which was a list of plugged and abandoned wells, which was prepared by Mesa Petroleum.

MR. CARR: At this time, Mr. Examiner, we would offer into evidence Applicant's Exhibits Ten through Twenty-six and Twenty-eight.

MR. NUTTER: Applicant's Exhibits Ten through Twenty-six and Twenty-eight will be admitted in evidence.

Q. Mr. Keesey, in your opinion will granting this application prevent waste and protect correlative rights?

A. Yes, it will.

MR. CARR: I have nothing further of this witness on direct.

MR. NUTTER: We'll take a fifteen minute recess.

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(Thereupon a recess was taken.)

CROSS EXAMINATION BY MR. NUTTER OF MR. KEESEY AND MR. JEFFERS, INTERMINGLED:

MR. NUTTER: Mr. Jeffers, now on your cross sections, you've run these cross sections from the extreme north end of the proposed area down to pretty much the south end of it, and a couple of cross sections east and west.

Now, when we get up into the north end and over onto the west end of the proposed area, are we not assuming a lot by saying that a cross section that's eight or nine townships long and that distance in between wells is really showing us anything?

MR. JEFFERS: Well, I think the primary purpose of the sections is to indicate that the Abo is present and extrapolated to be present in between the wells that are available.

MR. NUTTER: Well, you showed the Abo present at one end of the cross section and also at the other end of the cross section; then you assumed it was present in between?

MR. JEFFERS: That's correct.

MR. NUTTER: Now, you mentioned that the sandstones, or the lenses in the Abo are irregularly shaped, limited in areal extent, and comprise individual sandstone

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bodies.

MR. JEFFERS: That's correct.

MR. NUTTER: Do these individual sandstone bodies exhibit a variation in permeability and porosity?

MR. JEFFERS: Yes, sir, in -- in the individual sand bodies they do have variations in the sand bodies themselves.

MR. NUTTER: And would there be a variation from one sand body to the next sand body?

MR. JEFFERS: Yes, sir.

MR. NUTTER: Now what is the mechanism for trapping of gas in the Abo formation when gas is present? Is it a structural feature or is it a stratigraphic feature, or --

MR. JEFFERS: Primarily stratigraphic.

MR. NUTTER: And I think also that you mentioned that the Abo, top of the Abo in the area under consideration varies from about 1800 feet to 4500 feet.

Do you have an idea of what the average depth of the top of the Abo is for your proposed designated area?

MR. JEFFERS: I'd say essentially halfway in between the two.

MR. NUTTER: The contour lines are fairly uniform flowing from west to east as the structure dips at

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whatever rate it dips. What is that rate of dip? I think you mentioned it.

MR. JEFFERS: Essentially 100 feet a mile.

MR. NUTTER: About 100 feet a mile, and you had a total variation in elevation of about 5500 feet.

MR. JEFFERS: That's correct.

MR. NUTTER: So you think that the average top of the pay would be the arithmatic average between 1800 and 4500 feet, which would be approximately 3100 - 3200 feet, then.

MR. JEFFERS: That's correct.

MR. NUTTER: What evidence do you have that the Abo formation is present and constitutes a tight sand in the vicinity of the Town of Vaughn, New Mexico? It's in the northwest portion of your proposed area?

MR. JEFFERS: Well, my assumption is that the Abo is present in that area and that it would be similar to that which we have investigated and would therefor be a tight sand, the same type of deposition, same kind of rock, same source area, so my assumption is it would have the same characteristics as those that we investigated.

MR. NUTTER: Well, actually, you don't have a cross section that goes within 25 miles of the Town of Vaughn, New Mexico.

MR. JEFFERS: Well, the problem is the

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availibility of wells that --

MR. NUTTER: I realize that.

MR. JEFFERS: Satisfactory wells in that area.

MR. NUTTER: Haven't been any wells drilled to prove that there's a tight formation up there, or that it's present.

MR. JEFFERS: I have no wells in that particular area.

MR. NUTTER: There's also been no wells to show that there isn't a bonanza lying up in that --

MR. JEFFERS: Just don't show that it's not present there, either.

MR. NUTTER: All right. As a matter of fact, on your cross sections, Mr. Jeffers, I think you have a total of some 13 wells on the cross sections, and the biggest part of them seem to be concentrated down in the southeast portion of the proposed designated area.

MR. JEFFERS: That's where the most wells are.

MR. NUTTER: And that's where the most drilling has been done.

MR. JEFFERS: Yes, sir.

MR. NUTTER: And most of the data that was submitted by you and also most of the data that was sub-

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mitted by Mr. Keesey in his testimony is from the southeast quadrant of the proposed area.

MR. JEFFERS: Generally an area about 40 by 30 -- 30 by 40 miles, yes.

MR. NUTTER: As a matter of fact, Mr. Jeffers, if we took your plat, being Exhibit Number One, and drew a line across the north side of the Township 1 North, and came to the west to include Township 22 East, and then south down to Township 9 South, we would have nine of the wells upon which you have information included in that area. We would have four wells outside of the area to support, then -- and this area that includes the nine wells constitutes roughly 1/4th of the proposed designated area. You've got nine wells to support 1/4th of the area, and then we would have four wells only to support the remaining 3/4ths of the area to be included in the designated tight formation, wouldn't we?

MR. JEFFERS: Well now, we have additional wells that are not on the cross sections that do have Abo.

MR. NUTTER: But I mean by going by the cross sections to show presence of the formation.

MR. JEFFERS: Correct.

MR. NUTTER: I believe that's all for now, Mr. Jeffers. I may have something else in a minute.

Mr. Keesey, now on -- on your Exhibit Eighteen, I believe it is -- no, it's not either, it's Exhibit

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Number Seventeen.

MR. KEESEY: Yes.

MR. NUTTER: Where you have arrived at your corrected to stabilized conditions at one atmosphere, how did you convert your test rate to your stabilized flow rate at one atmosphere?

MR. KEESEY: Okay, in the testimony narrative discussion on that, it's -- begins basically on page six, it's a technique that takes some transient flow equations and transient radius equations; convert these so that you could calculate the time it would take for stabilization of a well and convert your flow rates at the measured pressures into stabilized flow rates at those same pressures. Then by flow rate ratio equation, converting that calculated rate to a rate at one atmosphere.

MR. NUTTER: And then you arrived at the adjusted figure that you reported for the corrected flow capacity.

MR. KEESEY: Yes, that's correct.

MR. NUTTER: But you didn't bother to reduce the flow on those very small wells, like that one that made 10 Mcf.

MR. KEESEY: No, we didn't. We thought it was kind of immaterial at that point. We kind of saw the results beginning to show.

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MR. NUTTER: Well now, you had a total flow rate without stimulation of 1218 Mcf per day for the 24 flow rates that you analyzed.

MR. KEESEY: Yes.

MR. NUTTER: These 24 flow rates that you analyzed included wells that were swabbed dry or swabbed with no recovery; in effect, they sound like they're dry holes. Now did each of those subsequently after stimulation make a well?

MR. KEESEY: Yes, they did. Everyone of these wells that are on Exhibit Seventeen are one of the 43 wells shown on Exhibit Five colored in orange, which are considered to be completions and they have all responded subsequently to the having fracture stimulation treatments.

MR. NUTTER: Okay, they all were completed as gas wells?

MR. KEESEY: Yes.

MR. NUTTER: Now all of those wells are not on Exhibit Eighteen, however, because Exhibit Eighteen shows only those wells that are producing into the pipeline.

MR. KEESEY: That's correct. That only shows the wells that as of September 30th were actively producing. Several of the operators, in fact, Mesa at that point in time did not have any wells on production. And I think some of the Yates wells. I believe most of the McClellan wells

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were on and Boyd only has one well, which was on the list. Pool has a third well, I believe, that probably is on production now but was not at that time, and then several of the Yates wells were not on production at that time.

In fact, aside from the Boyd and McClellan wells, almost all the other wells went on production some time in July or August.

MR. NUTTER: Was that because they were in a given area and a pipeline went into that area?

MR. KEESEY: Yes, awaiting a pipeline, yes, sir.

MR. NUTTER: Now, where are the bulk of these wells that are shown on Exhibit Seventeen? Are they located in that southeast quadrant of the proposed area that I was discussing with Mr. Jeffers awhile ago?

MR. KEESEY: Yes, they are, as shown on Exhibit Five in those orange wells, that does represent that southeast quadrant area. All the other wells that have been penetrated, some 123, I believe, none of these wells was to our knowledge tested in the Abo, except with a few exceptions that Mr. Jeffers testified to earlier, which are also shown on one or two of the cross sections as wells that they did encounter some gas shows, but for the most part there was no testing done on all of these other wells. Actually, most of them were drilled to a deeper depth and there was no test taken

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in the Abo. Mr. Jeffers might be able to lend some more information on this, but I think this whole play developed by a recompletion in a well, one of the Yates wells, probably back in 1978.

MR. JEFFERS: The Yates McConkey Well was a re-entry and a discovery for this Abo play. It was a re-entry of a Honolulu well, I believe, a Honolulu McConkey.

MR. KEESEY: So the indications are that the sands do exist throughout the area of interest. We have some other wells to the west that are shown on those cross sections that did have some gas shows, but until that recompletion occurred, there was no big incentive to test the Abo zone because during drilling the formation was so tight that in almost all instances the mud, drilling fluid used was enough to overload the formation. So therefor there was no shows, but the indications are that now with what has been found in this southwest -- southeast area, that the same type of production can be established on into the other areas of the area of interest.

MR. NUTTER: Well, probably drilling technique has improved, too, they --

MR. KEESEY: Yes.

MR. NUTTER: -- don't subject the formation to the mud that they once did or do they do a lot of these with air?

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MR. KEESEY: They still do. This improved drilling technology, I believe what actually shows a zone, and Randy Harris with Yates, who is a geologist who intended to be here today, but due to weather conditions could not make it, I believe that what they did is they ran a TDT log.

MR. JEFFERS: Or a CNL density in the McConkey well and it showed gas separation on the log. They re-entered the well for a deeper horizon and after they saw this zone on the log, the new log, the CNL density, they perforated and completed out of it. And none of the other wells and there were -- oh, most of those dry holes that are on that list were already on this map at -- before this well was re-entered.

MR. KEESEY: So we feel now that with new technology, both in drilling, completion, and of course, logging, that has opened up this area.

MR. JEFFERS: And we have gas shows from C-1, I think, my cross section C-1, or is it B-1 log, that had a gas show. C-2 had a gas show, and of course, then we had production at C-3 on cross section C-3. The area you can see outlined on this map has been looked at and does have Abo present in it, even though it is not on a cross section.

MR. NUTTER: And all the producing wells aren't on the cross sections, either, are they?

MR. JEFFERS: No, sir. We've got 40-some

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producing wells. We're only showing five or six.

MR. NUTTER: Okay. But now in making your calculation of -- of average productivity prior to stimulation you have used only wells that were subsequently completed as Abo producers?

MR. KEESEY: Yes. In fact, this is basically the group of wells in the current area of development where we do have test data available. Typically in a tight gas sand like this many of the wells, in fact, some of these wells that have been drilled in the current development, that there was no attempt made to test the wells under natural conditions. Most operators from experience have been able to conclude that they're not going to get any appreciable sustained flow rates, so they immediately proceed upon -- after stimulating proceed with their acid or fracture stimulation treatments.

MR. NUTTER: All right, I think that that's obvious from Exhibit Seventeen. All of these McClellan wells are listed with no test.

MR. KEESEY: That is correct, yes.

MR. NUTTER: I think probably Jack knows enough about an Abo well that he doesn't waste the time to try to test it.

MR. KEESEY: That is absolutely correct. He just moves right on to the stimulation.

MR. NUTTER: And many of these Yates wells

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are shown the same way.

MR. KEESEY: Yes, sir.

MR. NUTTER: So in all probability they could have gotten some amount of gas be it a small amount.

MR. KEESEY: Well --

MR. NUTTER: From an original test.

MR. JEFFERS: Well, we would expect it to be pretty comparable to what we're seeing on those wells that were tested, so it would be a small amount.

MR. NUTTER: And you've mentioned that the average depth to the top of the pay was 3878. Was that for these wells that are listed on this Exhibit Seventeen?

MR. KEESEY: Yes, for the actual wells shown in the area of investigation and shown on this exhibit. That's correct.

MR. NUTTER: That's just simply an arithmatic average of these top of the pays and completion intervals, just take the average?

MR. KEESEY: Yes, just take the top of the pay and then divide it by the number of wells.

MR. NUTTER: Okay.

MR. KEESEY: We also, as a matter of interest, we looked at taking the average pay section from top to bottom, whatever the uppermost and lowermost perforation was within a well, we looked at that and it came out to be a

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little bit over 3900 feet, so we're still within a 3500 to 4000 foot range. It didn't change the depth range that we were looking at.

MR. NUTTER: Would you elaborate on the measures that will be taken to assure that there will be adequate protection to any fresh water aquifers that are being used or expected to be used in the foreseeable future for domestic or agricultural water supplies, please?

MR. KEESEY: Yes. The lowermost water, fresh water availability is down about 800 to 900 feet, and the method of these wells and the way they're completed, either they have a conductor casing that would be set at 300 to 400 feet and circulated cement back to the surface, and then an intermediate string, which is normally about 8-5/8ths inch casing, which would be run to a depth of 1200 to maybe 1500 feet, and this casing is also cemented from the bottom to the surface.

MR. NUTTER: Now, you mentioned this aquifer that's at 800 feet.

MR. KEESEY: Yes.

MR. NUTTER: What formation would that be, Mr. Keesey?

MR. KEESEY: I might have -- I'll probably have to get a little help on that. Randy Harris, who again was supposed to be here today, was going to have some informa-

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tion on that, but this is the one artesian aquifer that will flow in this immediate area. This extends from about 25 miles north of Carlsbad, or Roswell, Roswell, due south, and it's about 12 miles wide in the east-west direction.

MR. NUTTER: I believe that's the San Andres formation, isn't it?

MR. KEESEY: Is that San Andres?

MR. JEFFERS: That's correct.

MR. KEESEY: There are some other shallower water-bearing zones that are not continuous and they're really not used for that type of purpose.

MR. NUTTER: And they would be protected by that shallow surface string.

MR. KEESEY: Yes. So in essence any water-bearing zone in the immediate area would be protected by at least one string of casing and cement behind the casing, so that there would be absolutely minimum possibilities that there would be any contamination of these -- these fresh water sands. Now the only thing that might occur would be a casing leak problem, but there again, there are provisions taken by operators to sense casing leaks and in addition the production string that would be set would also have cement behind it. So I would say the chances of encountering or contaminating any fresh water are nil.

MR. NUTTER: Okay, thank you, Mr. Keesey.

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Now, this next question, Mr. Jeffers, would refer to your stratigraphic section, Exhibit Two or Three, I believe, okay, now we have the Abo formation colored in yellow on Exhibit Number Three, Mr. Jeffers. We mentioned that the San Andres is a water-bearing strata that's of commercial use in the area under consideration today. What formations intervene between the San Andres and the Abo formations, Mr. Jeffers?

MR. JEFFERS: The Glorieta and Yeso, both upper and lower, and the Drinkard formation.

MR. NUTTER: Approximately what thickness would those formations be, Mr. Jeffers?

MR. JEFFERS: About 2000 feet.

MR. NUTTER: Would that be sufficient distance between the San Andres formation and the Abo formation to resist fracture attempts in the Abo formation?

MR. JEFFERS: Yes, sir.

MR. NUTTER: And to avoid communication between the Abo and those fresh waters?

MR. JEFFERS: Yes, sir.

MR. NUTTER: So you think that there is enough natural protection vertically to protect from intrusion by massive fracturing?

MR. JEFFERS: I do, sir.

MR. NUTTER: Okay. Are there any other questions of Mr. Jeffers or Mr. Keesey?

MR. PADILLA: Mr. Nutter, I have a couple. Mr. Keesey, would you describe the method of stimulation that would be used in the wells in the Abo formation? I believe that one of your exhibits does indicate what stimulation has been done, and I'd like for you to elaborate more than what you have on Exhibit Ten.

MR. KEESEY: Okay, the -- after perforating the formation and if the operator does try to swab or flow the well, after that point in time the operator would normally run a string of tubing with a packer, setting the packer above the perforations, and then pumping into those perforations with anywhere from 500 to 4000 gallons of acid. There's a variety of sizes used by operators, depending on their experience and knowledge.

A lot of times the operators will use nitrogen mixed in with the acid. The acid, of course, is to try to break down the formation, to cause some fracturing around the wellbore, to get the acid out in the wellbore to get a clean-up treatment and improve the effective wellbore drainage area.

The nitrogen is added as a means of recovering the acid. This is a technique that is often used in low pressure, tight reservoirs, because the reservoirs do not have enough pressure available to rapidly clean up the formation. So the nitrogen is included and this has been ex-

panded and creates an additional pressure source to force the spent acid back out of the well very rapidly. The purpose of this is to avoid these foreign fluids from being in the formation for any period of time. This again is very typical of a tight formation, low permeability, ones that have clays in it where foreign fluids will often cause damage and a resulting loss in flow capacity of the well, and a loss of reserves, ultimately.

Following the acid treatment almost all these wells, and there's only been one that has not been fracture stimulated, and they'll be stimulated with maybe 20-to-40,000 gallons of jelled water and sand. Again, the operator will often include nitrogen or maybe CO_2 in the fracture treatment to again get the fluids back out of the formation as rapidly as possible after they've done their job in the formation.

Pressures at the surface will be in the order of possibly 1000 or 2000 pounds pumping pressure. This will cause a hydraulic fracturing of the formation, but a hydraulic fracturing is limited to the productive interval of the formation, and I agree with Mr. Jeffers testimony that this fracturing would by no means be large enough to cause any type of penetration into the fresh water sands occurring back at say 800 feet.

Once these wells then are cleaned up, they

of course then are put onto the line and in the case of these wells are put onto compression systems for production.

MR. PADILLA: Of Mr. Jeffers, or you, Mr. Keesey, the Abo formation is not subject to infill drilling as defined by the FERC regulations.

MR. KEESEY: No, it is not.

MR. NUTTER: Are there any other questions of Mr. Jeffers or Mr. Keesey? They both may be excused.

Do you have anything further, Mr. Carr?

MR. CARR: Nothing further, Mr. Nutter.

MR. NUTTER: Does anyone have anything they wish to offer in Case Number 7093?

We'll take the case under advisement and the hearing is adjourned.

(Hearing concluded.)

C E R T I F I C A T E

I, SALLY W. BOYD, C.S.R., DO HEREBY CERTIFY that the foregoing Transcript of Hearing before the Oil Conservation Division was reported by me; that the said transcript is a full, true, and correct record of the hearing, prepared by me to the best of my ability.

Sally W. Boyd C.S.R.

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 7093, heard by me on 11/25 1980.

_____, Examiner
Oil Conservation Division

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO
25 November 1980

EXAMINER HEARING

IN THE MATTER OF:

Application of Mesa Petroleum Company and Yates Petroleum Corporation for designation of a tight formation, Torrance, Guadalupe, DeBaca, Lincoln, and Chaves Counties, New Mexico.

CASE 7093

BEFORE: Daniel S. Nutter

TRANSCRIPT OF HEARING

A P P E A R A N C E S

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MR. NUTTER: The hearing will come to order, please.

The first case this afternoon will be Case Number 7093.

MR. PADILLA: Application of Mesa Petroleum Company and Yates Petroleum Corporation for designation of tight formation, Torrance, Guadalupe, DeBaca, Lincoln, and Chaves Counties, New Mexico.

MR. CARR: May it please the Examiner, I am William F. Carr, with the law firm of Campbell and Black, P. A., Santa Fe, New Mexico, appearing on behalf of the applicant.

I have two witnesses and twenty-eight exhibits.

I also would like the record to note that this case was prepared by the applicants with the assistance of Harold Hensley and Conrad Coffield of the Hinkle firm, and would request that copies of the orders and any other correspondence relating to this hearing be directed to them, as well as to us.

MR. NUTTER: Well now, Mr. Carr, you mentioned you have twenty-eight exhibits.

MR. CARR: Yes, sir. Mr. Nutter, we have marked in addition to the twenty-six exhibits which have been submitted and indicated by exhibit numbers, we are also going

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to offer the summaries which were attached to those exhibits, and have marked them as our Exhibits Twenty-seven and Twenty-eight.

MR. NUTTER: Well, Rule C-4 requires that a complete set of exhibits which applicant proposes to offer or submit at the hearing be furnished in advance. I think we have received twenty-five exhibits; maybe there are twenty-six. What's this one? Maybe there are twenty-six. No, I made this one.

Oh, here's Exhibit Twenty-six, so twenty-six have been submitted.

MR. CARR: And we have marked for the purposes of this hearing, the summaries which we attached to those exhibits which identify each one and explain what their purpose is.

MR. NUTTER: It's not actually an additional exhibit, then.

MR. CARR: It's nothing that you haven't already received. We did include it as an exhibit to be sure it would be included with the record submitted to FERC.

MR. NUTTER: Okay. Fine, proceed.

MR. CARR: The witnesses need to be sworn.

(Witnesses sworn.)

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MR. CARR: At this time I would call Joseph W. Jeffers.

JOSEPH W. JEFFERS

being called as a witness and having been duly sworn upon his oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. CARR:

Q. Mr. Jeffers, for the purpose of the record will you state your full name and your place of residence?

A. Joseph W. Jeffers, Midland, Texas.

Q. By whom are you employed and in what capacity?

A. Mesa Petroleum Company, as Division Geologist.

Q. Have you previously testified before this Commission, had your credentials accepted and made a matter of record?

A. I have.

Q. Are you familiar with the application in this case?

A. I am.

MR. CARR: Are the witness' qualifications acceptable?

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MR. NUTTER: Yes, they are.

Q. Mr. Jeffers, will you briefly state what Mesa and Yates seek with this application?

MR. NUTTER: Mr. Carr, for the sake -- this record goes to FERC. I think it would be appropriate that you should qualify this witness in addition to previous qualifications.

MR. CARR: All right. That's fine, we'll be happy to.

Q. Mr. Jeffers, would you briefly summarize your educational background and work experience?

A. I have a degree in geology in 1954 from Southern Methodist University; a Master of Science in geology in 1955 from Southern Methodist University.

I worked fifteen years for Mobil, Magnolia and Mobil, as a geologist; four years as a geologist with PubCo Petroleum, and the last eight years for Mesa Petroleum.

Q. In your role with Mesa Petroleum are you responsible for the area which is covered by this application?

A. I am.

Q. Are you familiar with the area?

A. Yes, I am.

MR. CARR: Are the witness' qualifications acceptable?

MR. NUTTER: Mr. Jeffers, are you acquainted

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with the Abo formation and its producing characteristics?

A. Yes, sir, I am.

MR. NUTTER: I think Mr. Jeffers is qualified.

Q. Mr. Jeffers, will you briefly state what Mesa and Yates seek with this application?

A. Mesa and Yates Petroleum seek with this application the designation of the tight sand category, FERC 107 category.

Q. For a portion of the Abo formation?

A. For the portion of the Abo formation as designated in the exhibits to follow.

Q. Have each of your exhibits previously been submitted to the Oil Conservation Division and to the United States Geological Survey, as required by the Oil Conservation Division rules?

A. They have.

Q. Would you give us a brief geographical and geological description of the area that we are dealing with in this hearing today?

A. Geographically the tight Abo sandstone gas play is located in southeast New Mexico and covers portions of Guadalupe, DeBaca, Torrance, Lincoln, and Chaves Counties. The northern boundary of the filing area lies just south of Santa Rosa and the southern boundary is southwest of Roswell.

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The Village of Vaughn is near the western boundary and Ft. Sumner lies just within the eastern boundary.

The area described will hereinafter be referred to as the Pecos Slope. You may refer to Exhibits One and Two.

The Lower Permian Abo sandstones of the Pecos Slope were deposited by a series of fluvial systems which derived their sediments from the Pedernal Uplift to the northwest. The Abo sandstones were deposited as elongate lenticular sand bodies on a low relief fluvial plain. Individual sandstone bodies are irregularly shaped, limited in areal extent, and are interbedded with red and green shales.

Gas production has been established in the low permeability sandstones of the Abo "red bed" section. The poor reservoir properties of the Abo sandstones vary both across the Pecos Slope and with individual standstone bodies.

Q. Will you now refer to Applicant's Exhibit One and Two and explain what they are and what they show?

A. Exhibits One and Two, Exhibit One is a 1-inch to approximately 8-mile scale map, showing parts of seven counties in southeast New Mexico with the location of the major cities and towns.

The heavy line on the southeast marks the approximate extent of the Abo sandstones to the southeast.

The remainder of the map has indicated

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presence of Abo sandstones which will be discussed with the cross section exhibits to follow.

The area of the application for tight Abo sandstones is shown by the outline on Exhibit One and is described by township and range in Exhibit Two.

Q. Will you now refer to Applicant Exhibit Number Three and explain to Mr. Nutter what this is and what it shows?

A. Exhibit Number Three is a generalized stratigraphic section. The stratigraphic section is presented to show the location of the Abo section in geologic time and to indicate general lithology of the Abo section on the Pecos Slope. All rock units and series shown are not present over the entire area of the Pecos Slope. The stratigraphic section is a compilation of industry accepted stratigraphic sections to fit the Pecos Slope.

Q. And this exhibit shows the relationship of the Abo to other formations?

A. That is correct.

Q. Will you now refer to your Exhibit Number Four and review this for Mr. Nutter?

A. Exhibit Number Four is a lithologic description of the Abo sandstone as revealed by cores. This report is presented to show that Abo sandstone is a very fine grained sandstone to siltstone. It consists of subangu-

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lar to subrounded silt-sized grains of quartz, feldspar, and mica, cemented with calcite and agrillaceous material.

Q. Mr. Jeffers, will you now refer to Exhibit Number Five and review this?

A. Exhibit Number Five is in two parts, an east half and a west half. It's a structure map on the top of the Abo. The map scale is 1-inch equals 8000 feet. This map shows the same area as map, Exhibit One.

The wells currently completed as Abo gas wells are colored orange. The fields outlined on the map show their name and producing formation. All of the wells that penetrated the Abo are indicated by black dry hole symbols or are circled or are shown by large completed gas well symbols. The cross section traces are indicated by letter symbol and heavy lines. Control, that's data point wells, are lettered to correspond to the type of engineering data available, shown in the legend. In addition, the map shows the outline of the area of the application, shown on Exhibit One, and described in Exhibit Two.

The Abo structure map is prepared to illustrate the structural relief of the Abo sandstones across the Pecos Slope. Structure appears to be important only with respect to drilling depth to penetrate the sandstone lenses and channels in the Abo. The map is contoured on the top of the Abo formation. The 100-foot contour interval indicates a gen-

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eral east dip with overall relief in excess of 5500 feet across the area filed for tight Abo sandstone.

MR. NUTTER: You mean that would be 5500 feet in the Abo itself?

A. That is correct, sir.

Surface elevations range from 4000 feet to the east, to approximately 6500 feet to the west. The drilling depth to the top of the Abo varies from approximately 4500 feet to the east, to 1800 feet to the west.

Q. Mr. Jeffers, I'm now going to direct your attention to the cross sections. I first would ask you generally, what are these cross sections designed to show?

A. The cross sections which comprise the following exhibits --

MR. NUTTER: Well, just a minute.

A. All right.

MR. NUTTER: How many cross sections are there?

MR. CARR: There are four.

A. There are four.

MR. NUTTER: Okay, might as well get them all out. You're going to go through them one at a time, aren't you?

A. Yes, sir, I am.

MR. NUTTER: Okay, go ahead.

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A. The cross sections which comprise the following exhibit, were designed to show the presence of Abo sandstones over the entire Pecos Slope area. In addition, wells that are completed in the Abo have compretion data described at the bottom of the log.

Q. Will you now refer to Exhibit Number Six, which is your A-A' cross section, and review this for Mr. Nutter?

A. Exhibit Six is a generally north/south trending stratigraphic cross section. This section is hung stratigraphically on the top of the Abo formation. It shows an increase in total Abo section from north to south. In addition, it shows numerous individual sand bodies with the Abo.

The cross section is not designed to show structure, but the logs indicate depth to the top of the sand interval at Well A-1 in Guadalupe County to be 2682 feet, while at Well A-3 in DeBaca it is 3440 feet.

The Abo section is approximately 640 feet thick in the north and 815 feet thick in the south.

This, and the following cross sections, show the variations, the unpredictable nature, and lack of continuity of the sandstone lenses and channels from well to well.

Q. Will you now refer to Exhibit Number Seven, your cross section B-B', and review this?

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A. Exhibit Seven is generally a west to east stratigraphic cross section. The section is hung stratigraphically on the top of the Abo formation. It shows the wedge of the Abo thickening to the east and thinning towards the west, toward the source area for the Abo rocks.

The thickness of the Abo varies from 780 feet in Well B-3 to an estimated thickness of 400 to 500 feet in Well B-1. Well B-1 had a show of flammable gas in sandstone at approximately 1825 feet near the top of the Abo while drilling with cable tools.

Q. Mr. Jeffers, will you now review Exhibit Number Eight, please, for the Examiner?

A. Exhibit Number Eight is regional cross section C-C', a generally west to east stratigraphic cross section. The section is hung stratigraphically on the top of the Abo formation.

This section, like Sections A-A' and B-B', shows the numerous individual sand bodies within the Abo zone. The depth to the top of the Abo in well C-1 is 1900 feet in Lincoln County, while at Well C-4 in Chaves County it is 4405 feet. The wedge shape of the Abo is well demonstrated on this section. The Abo is approximately 340 feet thick to the west and 685 feet thick to the east.

The Abo section in Well C-1 rests on granite wash, which is assumed to be Wolfcamp in age, which

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in turn rests on a quartz diorite basement.

Well C-2 production tested a show of gas, described on the cross section, from an Abo sandstone.

Q. Will you now review the data contained on your Exhibit Number Nine, the E-E' cross section?

A. Exhibit Nine is a generally north/south stratigraphic cross section hung stratigraphically on top of the Abo formation. This section ties Sections A-A', B-B', and C-C' and demonstrates the numerous individual sand bodies within the Abo formation.

In addition, the completed gas wells from the Abo have the completions and production treatments partially described at the respective wells.

Q. What conclusions can you draw from your testimony?

A. The area filed for the tight Abo sand designation on the Pecos Slope includes portions of five counties in southeast New Mexico.

Over this area the Abo formation exhibits remarkably similar lithologic and stratigraphic characteristics. The individual sandstones present in the Abo formation, as exhibited on the cross sections, are erratic and discontinuous.

The Abo sandstones were deposited in a fluvial system, which has all the unpredictability and variation of this type deposition. Reservoir quality within the

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sand zones, as well as within the individual sandstone bodies, is unpredictable due to variations in clay content, cementing, and grain size. The lithologic characteristics tend to make the Abo sandstone a relatively poor reservoir with is difficult to produce without stimulation.

Q. Mr. Jeffers, I would ask you to identify what has been marked for identification as Applicant's Exhibit Twenty seven.

A. It's a summary of the description of the various exhibits as presented for geologic testimony for the tight sand hearing.

Q. Is this the summary that was submitted with the exhibits to the Oil Conservation Division and the USGS?

A. It was.

Q. Were Exhibits One through Nine and Number Twenty-seven either prepared by you or under your direction and supervision?

A. They were.

MR. CARR: At this time, Mr. Nutter, we would offer into evidence Applicant's Exhibits One through Nine and Twenty-seven.

MR. NUTTER: Mr. Jeffers, is Exhibit Twenty-seven the document that was submitted with the application that's entitled Midland, October 29, 1980, Narrative of Testi-

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mony to the NMOCD Hearing for Designation of the Abo Sandstone?

A. That is correct, sir.

MR. NUTTER: And the discussion of exhibits you just went through?

A. That is right, sir.

MR. NUTTER: Exhibits One through Nine and Twenty-seven will be admitted in evidence.

MR. NUTTER: Are there any questions of Mr. Jeffers? He may be excused. We might want to call him back and ask him some more questions after we get a better feel of the whole thing, Mr. Carr.

MR. CARR: At this time I would call John Jay Keesey.

JOHN JAY KEESEY

being called as a witness and being duly sworn upon his oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. CARR:

Q. Will you state your full name and place of residence?

A. John Jay Keesey, Midland, Texas.

MR. NUTTER: How do you spell your last name?

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A. K-E-E-S-E-Y.

MR. NUTTER: Thank you.

Q. Mr. Keesey, by whom are you employed and in what capacity?

A. I'm employed by Sipes, Williamson, and Associates, Inc., Petroleum Consultants, and I'm Vice-President and Engineering Manager.

Q. Would you briefly summarize for the Examiner your educational background and your work experience?

A. Yes. I received a Bachelor of Science degree from Texas Tech in 1962. I went to work at that time for the PanAmerican Petroleum Corporation, and later on was renamed to Amoco Production Company.

I worked for that firm for ten and a half years in various phases of engineering in southeastern New Mexico and in the West Texas area, including drilling, production operations, equipment, and also special field studies and secondary recovery operations.

In 1973 I joined the firm of Sipes, Williamson, and Associates, Inc., and have been engaged since that time in property evaluation, special field studies, the State work, reserve analysis, and other associated services that we provide.

Q. Have you been employed by the applicants in this case to perform a study -- to undertake a study of the

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Abo sandstone and to prepare certain data for submission to this Commission?

A. Yes, I have.

Q. And you have made such a study?

A. I have.

Q. Are you familiar with the area and the application?

A. Yes, sir, I am.

MR. CARR: Are the witness' qualifications acceptable?

MR. NUTTER: They are.

Q. Mr. Keesey, initially I would like to direct your attention back to Exhibit Number Five, which was previously introduced in this case, and I would ask you if this exhibit depicts all wells in the area of interest which were completed in the Abo formation as of October 31, 1980?

A. That is correct.

Q. How many wells are completed or being completed in the Abo as of that date?

A. There were 43 wells which had essentially been drilled and completed. Several of them at that specific date had not been tested in any way. I believe that there was 39 wells of those 43 which had been perforated and some type of flow test data taken.

Q. Now, are each of these wells assigned a

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reference number on this exhibit?

A. Yes, they are. We have assigned each of the 43 wells a reference number that we refer to just as the Sipes, Williamson, and Associates, Inc.'s tract number. This is shown immediately to the right of each one of the wells that are colored in orange on Exhibit Five.

Q. Would you explain what each of these numbers represents?

A. It's just a quick reference tract number that we've tried to come down from the north to the south, moving down the map, and this same number will be used on other exhibits which will be submitted.

It's for quick reference purposes.

Q. Will you now refer to what has been marked for identification as Applicant's Exhibit Number Ten and explain to the Examiner what this is and what it shows?

A. Yes. Exhibit Ten is a table presenting completion information on those wells which have been completed in the Abo formation as of the end of October. Information shown includes the Sipes, Williamson, and Associates, Inc.'s tract reference number, the well name, the location, spud date, completion date, total depth, completion interval, initial bottom hole pressure, flow rate data, stimulation data, and the date that the well went on line, and initial producing rate.

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This flow rate data that I mentioned, are presented for the natural flow conditions of the well; that is, prior to any stimulation.

In addition, flow rate data has also been presented for that period of time when the wells were stimulated, either acidizing on a first stimulation, normally followed by a fracturing as a second stimulation. We've also shown the flow rates obtained after those stimulation treatments. In addition, we've also shown the volumes that were used for stimulation on the well.

As can be seen, these treatments usually consisted of acid treatments initially, ranging from 500 to 4000 gallons of acid, normally followed by a fracture stimulation treatment, ranging from 20 to 40,000 gallons of jelled water and sand.

Q. Now, Mr. Keesey, certain of the wells were spudded prior to July 16, 1979, is that correct?

A. That's correct, yes.

Q. And they, therefor, would not qualify for the tight sand classification authorized under Section 107 of the NGPA.

A. That is correct. There are seven wells that are on this list. We might point them out. The copy that I have here is maybe a little fuzzy on the dates but on page one of Exhibit Ten we have the McClellan Oil Corporation

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"JJ" Federal No. 1.

MR. NUTTER: Give us the reference number. It will be easier to spot.

A. Okay, Reference No. 40, Reference No. 35.

MR. NUTTER: Okay.

A. On page two we have 42, 28, 36, 38, and on page three, and we may need some clarification on this, but I had originally listed Well No. 15, and I think it's just a typo error here that the initial spud date was left out, which my records show to be June 29th, 1979.

Q. Mr. Keesey, will you now refer --

MR. NUTTER: Now those wells that you just finished talking about were all spudded prior to what date?

A. To July 21st, 1979. I'm sorry, July 16th of 1979.

MR. NUTTER: Go ahead.

Q. Mr. Keesey, will you now refer to Applicant's Exhibit Number Eleven and explain this to Mr. Nutter?

A. Yes. Exhibit Eleven is a list of plugged and abandoned wells within the area of interest, which have penetrated or are believed to have penetrated the Abo formation. A question exists on the penetration of several wells where data were not complete or were not available. Some of these wells are quite old.

There are a total of 123 wells on this

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list and these wells would essentially fall into the area shown by the two maps representing Exhibit Five.

Several of these wells have tested the Abo while the remainder have simply penetrated the Abo formation during drilling to deeper depths.

A high majority of these wells, if not all of them, were drilled by rotary tools. No shows of hydrocarbons through the Abo section were recorded during drilling. Now this does not necessarily condemn the Abo formation for productive gas, but I feel is indicative of the tight nature of the Abo formation.

Q. Did you conduct a study to determine the average in situ gas permeability of the sand section underlying the area in question?

A. Yes, we did.

Q. And what engineering methods did you employ?

A. The estimated average in situ gas permeability of the Abo sand section was calculated using two widely accepted industry methods. These methods include laboratory measurements of cored Abo sand sections and permeability calculations from bottom hole pressure build-up data.

The first method for obtaining the in situ gas permeability by core analysis requires permeability measurements of actual cored sactions of Abo sand in the labor-

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atory. Due to poor core recoveries in the field and the increased expense due to coring, only two wells in the area of interest have been cored and have obtained Abo sand sections.

Q. Will you now refer to Exhibits Twelve, Thirteen, and Fourteen, identify these, and explain what they show?

A. Okay. Exhibit Number Twelve is a log on the Thorpe "MI" Federal No. 2 Well, and this exhibit shows the intervals which were cored in this well, and we also highlight the pay zone within the Abo section. I might point out that the core, now, that we're going to be referring to, the intervals that were tested have also been highlighted. This is shown by the short hatched horizontal line referred to on the exhibit as cored intervals tested in in situ permeability.

We've shown pay zones in yellow. One pay zone is at approximately 3642 to 52 feet. The other is 3952 to about 70 feet; that is 3970 feet.

Exhibit Number Thirteen is a log on the Papalote "OI" State No. 1 Well, which we've also shown the cored section and have illustrated again the pay section shaded in yellow.

This pay section is from approximately 3722 feet to 3733 feet.

Exhibit Number Fourteen is a tabulation of core-derived permeability data for these two wells for those

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pay sections that I have pointed out.

You'll note on Exhibit Fourteen that we have shown the sample numbers, the core depth, and the correlative log depth. The reason we show this correlative log depth is that the logged intervals did not correspond directly on depth measurements with the cored intervals.

The next to last column from the right is the maximum routine permeability determined by core analysis on either hole core or plugged samples by standard tests run at approximately 150 pounds pressure and the use of either nitrogen or air for measurement of permeability.

The average permeability for the Papalote "OI" State No. 1 Well was determined to be 0.048 millidarcies in the pay section.

The average permeability for the Thorpe "MI" No. 2 Well by routine core analysis was determined to be 0.074 millidarcies.

Average permeability for both wells was 0.066 millidarcies.

MR. NUTTER: How did you obtain the average permeability of those wells, simply by dividing total permeability and the total feet?

A. That's correct.

Q. In your opinion --

A. The total number of samples. Excuse me.

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Q. In the opinion of Sipes, Williamson, and Associates, is this the best method to use in determining in situ permeability?

A. Yes, we feel like it is because these are actual samples of the productive formation that can be measured at the surface.

Q. And is this the method widely accepted in the industry?

A. It is.

Q. Do you believe this provides the best possible data as to the permeability?

A. Yes, I do.

Q. Were any special tests conducted by you to determine the effects of the overburden pressure on the site?

A. Yes, we did run some overburden tests to determine what is referred to as the in situ permeability of the rock. These were done as soon as the core was obtained and was done to allow us data so that we could correct the routine core analysis, or core permeability, to in situ bottom hole pressure conditions.

Now, in situ means that the tests run in the core are done at a higher pressure than normally used in routine core analysis. I mention that routine core analysis uses a surface pressure during testing of about 150 pounds;

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whereas the bottom hole pressure, or the rock sensing pressure in the formation, is actually feeling the affects of overburden. This is at a much, much higher pressure. So what we did is we had special tests run where they imposed a higher pressure on the core sample and then reran the permeability estimates.

Q. Will you now refer to Exhibit Number Fifteen and explain to the Examiner what this shows?

A. Yes. These in situ permeability tests were conducted on only the core that was available at the time from the Thorpe "MI" Well No. 2.

MR. NUTTER: Mr. Keesey, let me interrupt you right here.

A. Yes.

MR. NUTTER: Now, these wells presumably were drilled some little time back. The Yates well was drilled in October -- no, it's a new well drilled in October of '80. They've both been drilled recently.

A. Yes, sir, that's correct.

MR. NUTTER: Okay, now were these permeability tests and the in situ calculations made immediately following the -- retrieving of the cores?

A. yes, they were.

MR. NUTTER: So the cores weren't old cores submitted to this high pressure testing then?

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A. No, sir, they were not. They were fresh cores.

Exhibit Fifteen is a plot showing the results of the in situ permeability tests on the Thorpe "MI" Well NO. 2. The horizontal scale is the permeability determined by the routine core analysis. The vertical scale is the permeability obtained on each of the relative samples under in situ conditions.

If you will enter the curve at the horizontal axis, the value of permeability of 0.1 millidarcies, and move vertically until you encounter the heavy dark line drawn, encountering that you move then to the left until you intersect the vertical axis, you will see that the permeability of 0.1 under routine conditions yields an in situ permeability in the order of 0.0105 millidarcies.

What this is saying is that permeability in the formation under more near reservoir conditions is much, much less than is measured at the surface under routine core analysis.

What I would like to point out is that the core analysis, even under routine conditions for both of these wells, show that the permeability is well below the allowed limit of 0.1 millidarcies.

Q. Is this correlation depicted on Exhibit Fifteen, is it applied to all the intervals shown on Exhibit

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Fourteen?

A. Yes, it was. In order to go ahead and calculate the in situ permeability, which is reflecting again that we see a reservoir, actual reservoier permeability condition of even a much lower rate, very far below the 0.1 millidarcy limit for tight gas sand qualification.

Q. Does the data you received in this manner confirm the data you received from your core analysis?

A. Yes, it does.

Q. Do you consider these results to be representative of the Abo formation underlying the entire area which is the subject of this application?

A. Yes, I do.

Q. Now, the samples that you had from the Thorpe "MI" Well No. 2 and the Papalote "OI" State No, 1, are these typical samples of the Abo formation?

A. Yes, they are.

Q. And why is that?

A. Well, they're in the same area that has been described -- defined earlier in Mr. Jeffers testimony. This is the Abo section. These sands appear to be typical from a log review of the other Abo sands, and we feel they are typical of the Abo that will be found in the -- in the area of investigation, the area of interest.

Q. Will you now refer to Applicant's Exhibit

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Number Sixteen and explain what it is?

A. Okay. Before we get off, I would like to point out that we have flow test data, I believe, on Exhibit Number Ten relative to production in the Thorpe Well that is completion in a zone that was cored and does show test data very similar to other pre-stimulation and after-stimulation flow test data which we have seen in all other 42 wells for which we have test data available.

This is another reason that we feel that these sections are representative of the entire Abo section.

MR. NUTTER: Now where is that flow data on Exhibit Number Ten?

A. I believe that well number is 22. It's on page three. Natural flow rate, there was no flow; the well would not produce any gas. It was then acidized with 2000 gallons of acid and nitrogen and flowed 48.6 Mcf per day and was then fractured with 20,000 gallons of jelled water and sand and flowed 1359 Mcf per day.

And this is very typical of the other test results of the wells in the area of interest.

MR. NUTTER: Okay.

Q. Will you now refer to Exhibit Number Sixteen and explain what it is and what it shows?

A. Okay. The second procedure that we looked at for obtaining permeability of the Abo pay section was to

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look at pressure build-up data. These data were obtained on four of the Abo completions, which we have listed the results of this test data on Exhibit Sixteen. Pressure analysis used to calculate the average permeability was the conventional Horner plot technique and we have shown the equation on page five of my testimony, which will be Exhibit Twenty-eight. The value for m is the slope of the straight line portion of the Horner plot of the bottom hole pressure data plotted on a semilog graph where it's a plot of the T plus Delta T over T correlation.

The results of the bottom hole pressure analysis on these four wells are given on Exhibit Sixteen. This technique yielded an average reservoir permeabilities ranging from a low of 0.01 in reference number well 29 to a high of 0.1188 millidarcies in reference well 33. The average permeability for the four wells was determined to be 0.0506 millidarcies.

Q. How does this calculated permeability compare to the results of the core analysis?

A. The average calculated permeability compares -- compares favorably to the permeability determined by the routine core analysis described earlier. It is lower than in the in situ permeabilities determined by the core data method.

Q. Will you now refer to Applicant's Exhibit

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Number Seventeen --

A. Well, let me -- let me back up a minute.

Q. All right.

A. The averaged calculated permeabilities that we have here of 0.0506 I said were lower than the in situ permeabilities. Those are actually higher than the in situ permeabilities that we showed earlier.

The higher permeabilities that were seen here by the pressure data, I feel is a result of the fact that these wells had all received some type of minor stimulation prior to the pressure build-up test data was obtained; therefor, what we're seeing is permeabilities more in line with the actual routine core analysis permeabilities, but still well below the allowed 0.1 millidarcies.

Q. Will you now refer to Exhibit Number Seventeen and explain this for Mr. Nutter?

A. Okay. Exhibit Seventeen is a tabulation of the flow data obtained on Abo gas wells prior to stimulation. These data show that a large percentage of the Abo gas wells would not flow upon initial completion. What we have shown is, again, our tract reference number and then to the right of that the operator and well name, and the third column is the test rate that was actually obtained on the well.

If you'll note on page two a summation of the flow rates encountered yielded a total of 1218 Mcf per

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day. This is a total flow obtained from 24 zones that were tested and where actual test data was recorded. The average daily flow rate, then, was determined by dividing the summation of the flow rates by the number of zones tested and yielded an average flow rate of 51 Mcf per day per well.

Some of these flow rates you will note have sizeable capacities and these were done at surface pressures which were above one atmosphere. Therefor, we needed to correct or adjust those flow rates to determine what the psuedo-steady rate flow rate would be at one atmosphere surface flowing pressure.

The results of this work is shown in column four, which is entitled Corrected to Stabilized Conditions at One Atmosphere.

Referencing Tract Number 30, we have a pre-stimulation flow rate measured as 350 Mcf per day. This was corrected by a theoretical technique to be 230 Mcf per day at one atmosphere.

There were a few flow rates in here, such as for Well No. 27, which had a pre-stimulation flow rate measured as 10 Mcf per day. There was no adjustment made to this particular well, as we felt that this would be a very marginal or non-material type of change. Actually we would expect to see it decline. This well and one or two others, is shown by a double asterisk as those that we did not attempt

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to calculate a stabilized flow rate.

We also show on this exhibit, under test rate, several references as TSTM. This is too small to measure gas flow rate under test conditions. Under this situation we would expect that these flow rates would be all less than 10 Mcf per day.

Re-summarizing the total flow rates including those wells which have been corrected to psuedo-steady state conditions, we now come up with a flow rate, total flow rate, of 839 Mcf per day. Again dividing by 24 test zones, we come up with a 35 Mcf per day per well flow rate.

MR. NUTTER: Mr. Keesey, if we could diverse ourselves here for a moment, you're talking about 24 zones measured. Now what are the 24 zones that you measured here? Are there 24 wells here that you have --

A. There's actually 20 wells there. Some of the wells had dual tests in them. For instance, on the first well, which is the 39 tract number, we see that we have the first interval shown was perforated from 4272 to 4344, and this zone was swab tested and swabbed dry.

MR. NUTTER: Now that counts as one of your 24?

A. That is one of the 24.

MR. NUTTER: Okay.

A. And then the other zone was 4198 to 4210,

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and it swabbed dry with a slight flow of gas.

MR. NUTTER: Okay, now going down the list let's see if I can pick out the ones that you'd call as being among the 24.

The next one would be the 'TSTM', I presume.

A. Yes.

MR. NUTTER: And then 'swab dry'?

A. That's correct.

MR. NUTTER: And then '350' and 'TSTM', 'Swab dry', 'TSTM', 'Swab steady', '250', '80', 'Swab dry'. How about 'Swab with no recovery', would that count?

A. That would, yes, that would be one. All of the --

MR. NUTTER: And then 'Not available' and 'no test' wouldn't count. The '10' down there would count, and getting over on the next page, 'TSTM', 'TSTM', '521'. The '0' on the Smernoff well, would that be a flow rate?

A. Yes, it would.

MR. NUTTER: And 'TSTM' would be a flow rate. The '7'?

A. Yes.

MR. NUTTER: How about 'No show', would that count?

A. I believe we did count that one in there,

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yes. That would be no show of gas.

MR. NUTTER: And 'Would Not Flow', is that --

A. That would be -- that was actually reported and is taken as no flow.

MR. NUTTER: Okay, so that's how you derived your 24 wells to average in the total flow?

A. Yes, that's correct.

Q. Mr. Keesey, I believe you've just testified that the average stabilized flow rate for these wells was 35 Mcf per well per day.

A. That's correct.

Q. Is this stabilized flow rate below the allowed maximum daily flow rate as provided for by Section 107?

A. Yes, it is. For the depth of the wells that we were looking at in the area of investigation, I might refer you back again to Exhibit Number Seventeen, of the wells that we had tested or had test data available on, we had an average depth to the top of the perforation of 3878 feet.

Under Section 107 this interval from 3500 to 4000 feet is allowed a maximum daily flow rate of 105 Mcf per day per well. Therefor, our flow rates of 35 Mcf per day, corrected to stabilized steady state conditions, is well below the allowed limit.

I'd also like to point out that the flow

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rates we encountered under non-corrected conditions, which is 51 Mcf per day per well, is also well below the allowed limit of 105 Mcf per day per well. Not only that, but as testified earlier, the shallowest Abo well anticipated would be to the west and would be an approximate depth of 1800 feet. Under these conditions the maximum allowed rate is 59 Mcf per day per well, as allowed on the 107; therefor, both the uncorrected and the corrected flow rates, both are below the shallowest low limit that we could expect to encounter in the area of interest.

Q. Will you now refer to Applicant's Exhibit Number Eighteen and review this for Mr. Nutter?

A. Exhibit Eighteen is a tabulation of production data and it's submitted for just record purposes. It shows the September, 1980, production rate for the wells that are on-stream. It also shows the cumulative production as of September 30th, 1980. Most of these wells have just gone on-stream a short period before the September 30th date. Several of the wells have gone on early in the year, around February or March.

One thing we would like to point out is that the liquid production reported from these wells has been zero. Now, I do know that several of the Yates wells do produce a very, very small amount of liquid. This liquid is of such small quantities that it has not even been transported a

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this point in time, or at least at the time that these reports were made out.

The gravity of this liquid is 62.7 degrees and therefor would definitely fall into a condensate category, but in addition to that, any production would be well below the allowed 5 barrel per day crude oil limit, and would probably not even be a barrel per well per day. I don't have any figures to verify that at the present time because it hasn't been run.

Q. Will you now refer to Exhibits Nineteen through Twenty-six and --

A. Nineteen through Twenty-six are performance curves on 8 wells for which some history of production was available. These wells are the ones that went on in the early part of 1980, the first wells on-stream.

There's a Boyd operating well, I believe, four wells from the McClellan Oil Corporation, and then three of the Yates Petroleum Corporation wells. These curves show the average monthly production with respect to time, and as would be expected in a tight gas sand like the Abo we are encountering here, the wells come in for relatively high rates, typically in the order of maybe 10,000 Mcf per month. Some of the better wells will exceed this initial rate.

Characteristically, we would expect to see and have seen a very, very sharp decline in producing rates.

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One well that has quite a bit of production history is Exhibit Twenty, the "JJ" Federal No. 1 Well, operated by McClellan Oil Corporation, came in for a peak rate of 6200 Mcf per month since then has dropped very drastically and during the last month we had production for, which was September, produced approximately 1180 Mcf per month.

I'd also like to point out that all the wells that are on production in the field at the present time are producing with compression and that without compression these wells will produce no, if any, gas at all. Compression is drawing the wells down to anywhere between 100 and 300 pounds line pressure.

Q. Will development of the area which is the subject of this application adversely affect fresh water supplies in the area?

A. No, it will not. The typical completion of a well includes the setting of surface casing or conductor pipe at approximately 300 to 400 feet and cementing that casing back to surface. There are some water zones at around 300 to 400 feet. These are not continuous zones and are not artesian flow. The main artesian flow zones are about 800 or 900 feet in depth. Most wells are run with casing and intermediate strings set anywhere from 1200 to 1500 feet. These strings are normally circulated back to surface. Then the production string is finally set on bottom once total depth is reached.

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These casing strings will either be circulated back to where they tie into the intermediate casing string or have at least 500 feet of cement above the top of the Abo.

So in essentially all cases the fresh water sands would be protected by an intermediate casing string cemented back to surface.

Q. Now in summary, Mr. Keesey, in your opinion does the Abo gas formation in the area of interest meet all the reservoir criteria for designation as a tight gas sand formation under Section 107(b) of the Natural Gas Policy Act?

A. In my opinion it does. The average reservoir permeability determined by the methods discussed averaged much less than the allowed 0.1 millidarcies. In addition, the average flow rate was well below the 105 limit in the particular area of development, and the flow rates would also be less than the allowed flow rate for the shallowest Abo well anticipated in the area of interest.

We also meet the crude oil specifications of less than 5 barrels of crude oil, in essence on that, because these wells did not produce any crude oil; whatever liquids are produced is a condensate.

Q. In your opinion would granting this application be in the best interest of conservation of oil and gas?

A. Yes, it would.

Q. I'd like you to identify what has been

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marked for identification as Applicant's Exhibit Number Twenty-eight.

A. Yes, that's my narrative of testimony to the New Mexico Oil Conservation Division that was submitted along with the other exhibits.

Q. Were Exhibits Ten through Twenty-six and Exhibit Twenty-eight prepared by you or under your direction and supervision?

A. Yes, they were. The only exhibit I might make some exception to was Exhibit Number Eleven, which was a list of plugged and abandoned wells, which was prepared by Mesa Petroleum.

MR. CARR: At this time, Mr. Examiner, we would offer into evidence Applicant's Exhibits Ten through Twenty-six and Twenty-eight.

MR. NUTTER: Applicant's Exhibits Ten through Twenty-six and Twenty-eight will be admitted in evidence.

Q. Mr. Keesey, in your opinion will granting this application prevent waste and protect correlative rights?

A. Yes, it will.

MR. CARR: I have nothing further of this witness on direct.

MR. NUTTER: We'll take a fifteen minute recess.

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(Thereupon a recess was taken.)

CROSS EXAMINATION BY MR. NUTTER OF MR. KEESEY AND MR. JEFFERS, INTERMINGLED:

MR. NUTTER: Mr. Jeffers, now on your cross sections, you've run these cross sections from the extreme north end of the proposed area down to pretty much the south end of it, and a couple of cross sections east and west.

Now, when we get up into the north end and over onto the west end of the proposed area, are we not assuming a lot by saying that a cross section that's eight or nine townships long and that distance in between wells is really showing us anything?

MR. JEFFERS: Well, I think the primary purpose of the sections is to indicate that the Abo is present and extrapolated to be present in between the wells that are available.

MR. NUTTER: Well, you showed the Abo present at one end of the cross section and also at the other end of the cross section; then you assumed it was present in between?

MR. JEFFERS: That's correct.

MR. NUTTER: Now, you mentioned that the sandstones, or the lenses in the Abo are irregularly shaped, limited in areal extent, and comprise individual sandstone

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bodies.

MR. JEFFERS: That's correct.

MR. NUTTER: Do these individual sandstone bodies exhibit a variation in permeability and porosity?

MR. JEFFERS: Yes, sir, in -- in the individual sand bodies they do have variations in the sand bodies themselves.

MR. NUTTER: And would there be a variation from one sand body to the next sand body?

MR. JEFFERS: Yes, sir.

MR. NUTTER: Now what is the mechanism for trapping of gas in the Abo formation when gas is present? Is it a structural feature or is it a stratigraphic feature, or --

MR. JEFFERS: Primarily stratigraphic.

MR. NUTTER: And I think also that you mentioned that the Abo, top of the Abo in the area under consideration varies from about 1800 feet to 4500 feet.

Do you have an idea of what the average depth of the top of the Abo is for your proposed designated area?

MR. JEFFERS: I'd say essentially halfway in between the two.

MR. NUTTER: The contour lines are fairly uniform flowing from west to east as the structure dips at

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whatever rate it dips. What is that rate of dip? I think you mentioned it.

MR. JEFFERS: Essentially 100 feet a mile.

MR. NUTTER: About 100 feet a mile, and you had a total variation in elevation of about 5500 feet.

MR. JEFFERS: That's correct.

MR. NUTTER: So you think that the average top of the pay would be the arithmatic average between 1800 and 4500 feet, which would be approximately 3100 - 3200 feet, then.

MR. JEFFERS: That's correct.

MR. NUTTER: What evidence do you have that the Abo formation is present and constitutes a tight sand in the vicinity of the Town of Vaughn, New Mexico? It's in the northwest portion of your proposed area?

MR. JEFFERS: Well, my assumption is that the Abo is present in that area and that it would be similar to that which we have investigated and would therefor be a tight sand, the same type of deposition, same kind of rock, same source area, so my assumption is it would have the same characteristics as those that we investigated.

MR. NUTTER: Well, actually, you don't have a cross section that goes within 25 miles of the Town of Vaughn, New Mexico.

MR. JEFFERS: Well, the problem is the

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availibility of wells that --

MR. NUTTER: I realize that.

MR. JEFFERS: Satisfactory wells in that area.

MR. NUTTER: Haven't been any wells drilled to prove that there's a tight formation up there, or that it's present.

MR. JEFFERS: I have no wells in that particular area.

MR. NUTTER: There's also been no wells to show that there isn't a bonanza lying up in that --

MR. JEFFERS: Just don't show that it's not present there, either.

MR. NUTTER: All right. As a matter of fact, on your cross sections, Mr. Jeffers, I think you have a total of some 13 wells on the cross sections, and the biggest part of them seem to be concentrated down in the southeast portion of the proposed designated area.

MR. JEFFERS: That's where the most wells are.

MR. NUTTER: And that's where the most drilling has been done.

MR. JEFFERS: Yes, sir.

MR. NUTTER: And most of the data that was submitted by you and also most of the data that was sub-

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mitted by Mr. Keesey in his testimony is from the southeast quadrant of the proposed area.

MR. JEFFERS: Generally an area about 40 by 30 -- 30 by 40 miles, yes.

MR. NUTTER: As a matter of fact, Mr. Jeffers, if we took your plat, being Exhibit Number One, and drew a line across the north side of the Township 1 North, and came to the west to include Township 22 East, and then south down to Township 9 South, we would have nine of the wells upon which you have information included in that area. We would have four wells outside of the area to support, then -- and this area that includes the nine wells constitutes roughly 1/4th of the proposed designated area. You've got nine wells to support 1/4th of the area, and then we would have four wells only to support the remaining 3/4ths of the area to be included in the designated tight formation, wouldn't we?

MR. JEFFERS: Well now, we have additional wells that are not on the cross sections that do have Abo.

MR. NUTTER: But I mean by going by the cross sections to show presence of the formation.

MR. JEFFERS: Correct.

MR. NUTTER: I believe that's all for now, Mr. Jeffers. I may have something else in a minute.

Mr. Keesey, now on -- on your Exhibit Eighteen, I believe it is -- no, it's not either, it's Exhibit

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Number Seventeen.

MR. KEESEY: Yes.

MR. NUTTER: Where you have arrived at your corrected to stabilized conditions at one atmosphere, how did you convert your test rate to your stabilized flow rate at one atmosphere?

MR. KEESEY: Okay, in the testimony narrative discussion on that, it's -- begins basically on page six, it's a technique that takes some transient flow equations and transient radius equations; convert these so that you could calculate the time it would take for stabilization of a well and convert your flow rates at the measured pressures into stabilized flow rates at those same pressures. Then by flow rate ratio equation, converting that calculated rate to a rate at one atmosphere.

MR. NUTTER: And then you arrived at the adjusted figure that you reported for the corrected flow capacity.

MR. KEESEY: Yes, that's correct.

MR. NUTTER: But you didn't bother to reduce the flow on those very small wells, like that one that made 10 Mcf.

MR. KEESEY: No, we didn't. We thought it was kind of immaterial at that point. We kind of saw the results beginning to show.

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MR. NUTTER: Well now, you had a total flow rate without stimulation of 1218 Mcf per day for the 24 flow rates that you analyzed.

MR. KEESEY: Yes.

MR. NUTTER: These 24 flow rates that you analyzed included wells that were swabbed dry or swabbed with no recovery; in effect, they sound like they're dry holes. Now did each of those subsequently after stimulation make a well?

MR. KEESEY: Yes, they did. Everyone of these wells that are on Exhibit Seventeen are one of the 43 wells shown on Exhibit Five colored in orange, which are considered to be completions and they have all responded subsequently to the having fracture stimulation treatments.

MR. NUTTER: Okay, they all were completed as gas wells?

MR. KEESEY: Yes.

MR. NUTTER: Now all of those wells are not on Exhibit Eighteen, however, because Exhibit Eighteen shows only those wells that are producing into the pipeline.

MR. KEESEY: That's correct. That only shows the wells that as of September 30th were actively producing. Several of the operators, in fact, Mesa at that point in time did not have any wells on production. And I think some of the Yates wells. I believe most of the McClellan wells

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were on and Boyd only has one well, which was on the list. Pool has a third well, I believe, that probably is on production now but was not at that time, and then several of the Yates wells were not on production at that time.

In fact, aside from the Boyd and McClellan wells, almost all the other wells went on production some time in July or August.

MR. NUTTER: Was that because they were in a given area and a pipeline went into that area?

MR. KEESEY: Yes, awaiting a pipeline, yes, sir.

MR. NUTTER: Now, where are the bulk of these wells that are shown on Exhibit Seventeen? Are they located in that southeast quadrant of the proposed area that I was discussing with Mr. Jeffers awhile ago?

MR. KEESEY: Yes, they are, as shown on Exhibit Five in those orange wells, that does represent that southeast quadrant area. All the other wells that have been penetrated, some 123, I believe, none of those wells was to our knowledge tested in the Abo, except with a few exceptions that Mr. Jeffers testified to earlier, which are also shown on one or two of the cross sections as wells that they did encounter some gas shows, but for the most part there was no testing done on all of these other wells. Actually most of them were drilled to a deeper depth and there was no test taken

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in the Abo. Mr. Jeffers might be able to lend some more information on this, but I think this whole play developed by a re-completion in a well, one of the Yates wells, probably back in 1978.

MR. JEFFERS: The Yates McConkey Well was a re-entry and a discovery for this Abo play. It was a re-entry of a Honolulu well, I believe, a Honolulu McConkey.

MR. KEESEY: So the indications are that the sands do exist throughout the area of interest. We have some other wells to the west that are shown on those cross sections that did have some gas shows, but until that recompletion occurred, there was no big incentive to test the Abo zone because during drilling the formation was so tight that in almost all instances the mud, drilling fluid used was enough to overload the formation. So therefor there was no shows, but the indications are that now with what has been found in this southwest -- southeast area, that the same type of production can be established on into the other areas of the area of interest.

MR. NUTTER: Well, probably drilling technique has improved, too, they --

MR. KEESEY: Yes.

MR. NUTTER: -- don't subject the formation to the mud that they once did or do they do a lot of these with air?

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MR. KEESEY: They still do. This improved drilling technology, I believe what actually shows a zone, and Randy Harris with Yates, who is a geologist who intended to be here today, but due to weather conditions could not make it, I believe that what they did is they ran a TDT log.

MR. JEFFERS: Or a CNL density in the McConkey well and it showed gas separation on the log. They re-entered the well for a deeper horizon and after they saw this zone on the log, the new log, the CNL density, they perforated and completed out of it. And none of the other wells and there were -- oh, most of those dry holes that are on that list were already on this map at -- before this well was re-entered.

MR. KEESEY: So we feel now that with new technology, both in drilling, completion, and of course, logging, that has opened up this area.

MR. JEFFERS: And we have gas shows from C-1, I think, my cross section C-1, or is it B-1 log, that had a gas show. C-2 had a gas show, and of course, then we had production at C-3 on cross section C-3. The area you can see outlined on this map has been looked at and does have Abo present in it, even though it is not on a cross section.

MR. NUTTER: And all the producing wells aren't on the cross sections, either, are they?

MR. JEFFERS: No, sir. We've got 40-some

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producing wells. We're only showing five or six.

MR. NUTTER: Okay. But now in making your calculation of -- of average productivity prior to stimulation you have used only wells that were subsequently completed as Abo producers?

MR. KEESEY: Yes. In fact, this is basically the group of wells in the current area of development where we do have test data available. Typically in a tight gas sand like this many of the wells, in fact, some of these wells that have been drilled in the current development, that there was no attempt made to test the wells under natural conditions. Most operators from experience have been able to conclude that they're not going to get any appreciable sustained flow rates, so they immediately proceed upon -- after stimulating proceed with their acid or fracture stimulation treatments.

MR. NUTTER: All right, I think that that's obvious from Exhibit Seventeen. All of these McClellan wells are listed with no test.

MR. KEESEY: That is correct, yes.

MR. NUTTER: I think probably Jack knows enough about an Abo well that he doesn't waste the time to try to test it.

MR. KEESEY: That is absolutely correct. He just moves right on to the stimulation.

MR. NUTTER: And many of these Yates wells

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are shown the same way.

MR. KEESEY: Yes, sir.

MR. NUTTER: So in all probability they could have gotten some amount of gas be it a small amount.

MR. KEESEY: Well --

MR. NUTTER: From an original test.

MR. JEFFERS: Well, we would expect it to be pretty comparable to what we're seeing on those wells that were tested, so it would be a small amount.

MR. NUTTER: And you've mentioned that the average depth to the top of the pay was 3878. Was that for these wells that are listed on this Exhibit Seventeen?

MR. KEESEY: Yes, for the actual wells shown in the area of investigation and shown on this exhibit. That's correct.

MR. NUTTER: That's just simply an arithmatic average of these top of the pays and completion intervals, just take the average?

MR. KEESEY: Yes, just take the top of the pay and then divide it by the number of wells.

MR. NUTTER: Okay.

MR. KEESEY: We also, as a matter of interest, we looked at taking the average pay section from top to bottom, whatever the uppermost and lowermost perforation was within a well, we looked at that and it came out to be a

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little bit over 3900 feet, so we're still within a 3500 to 4000 foot range. It didn't change the depth range that we were looking at.

MR. NUTTER: Would you elaborate on the measures that will be taken to assure that there will be adequate protection to any fresh water aquifers that are being used or expected to be used in the foreseeable future for domestic or agricultural water supplies, please?

MR. KEESEY: Yes. The lowermost water, fresh water availability is down about 800 to 900 feet, and the method of these wells and the way they're completed, either they have a conductor casing that would be set at 300 to 400 feet and circulated cement back to the surface, and then an intermediate string, which is normally about 8-5/8ths inch casing, which would be run to a depth of 1200 to maybe 1500 feet, and this casing is also cemented from the bottom to the surface.

MR. NUTTER: Now, you mentioned this aquifer that's at 800 feet.

MR. KEESEY: Yes.

MR. NUTTER: What formation would that be, Mr. Keesey?

MR. KEESEY: I might have -- I'll probably have to get a little help on that. Randy Harris, who again was supposed to be here today, was going to have some informa-

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tion on that, but this is the one artesian aquifer that will flow in this immediate area. This extends from about 25 miles north of Carlsbad, or Roswell, Roswell, due south, and it's about 12 miles wide in the east-west direction.

MR. NUTTER: I believe that's the San Andres formation, isn't it?

MR. KEESEY: Is that San Andres?

MR. JEFFERS: That's correct.

MR. KEESEY: There are some other shallower water-bearing zones that are not continuous and they're really not used for that type of purpose.

MR. NUTTER: And they would be protected by that shallow surface string.

MR. KEESEY: Yes. So in essence any water-bearing zone in the immediate area would be protected by at least one string of casing and cement behind the casing, so that there would be absolutely minimum possibilities that there would be any contamination of these -- these fresh water sands. Now the only thing that might occur would be a casing leak problem, but there again, there are provisions taken by operators to sense casing leaks and in addition the production string that would be set would also have cement behind it. So I would say the chances of encountering or contaminating any fresh water are nil.

MR. NUTTER: Okay, thank you, Mr. Keesey.

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Now, this next question, Mr. Jeffers, would refer to your stratigraphic section, Exhibit Two or Three, I believe, okay, now we have the Abo formation colored in yellow on Exhibit Number Three, Mr. Jeffers. We mentioned that the San Andres is a water-bearing strata that's of commercial use in the area under consideration today. What formations intervene between the San Andres and the Abo formations, Mr. Jeffers?

MR. JEFFERS: The Glorieta and Yeso, both upper and lower, and the Drinkard formation.

MR. NUTTER: Approximately what thickness would those formations be, Mr. Jeffers?

MR. JEFFERS: About 2000 feet.

MR. NUTTER: Would that be sufficient distance between the San Andres formation and the Abo formation to resist fracture attempts in the Abo formation?

MR. JEFFERS: Yes, sir.

MR. NUTTER: And to avoid communication between the Abo and those fresh waters?

MR. JEFFERS: Yes, sir.

MR. NUTTER: So you think that there is enough natural protection vertically to protect from intrusion by massive fracturing?

MR. JEFFERS: I do, sir.

MR. NUTTER: Okay. Are there any other questions of Mr. Jeffers or Mr. Keesey?

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MR. PADILLA: Mr. Nutter, I have a couple. Mr. Keesey, would you describe the method of stimulation that would be used in the wells in the Abo formation? I believe that one of your exhibits does indicate what stimulation has been done, and I'd like for you to elaborate more than what you have on Exhibit Ten.

MR. KEESEY: Okay, the -- after perforating the formation and if the operator does try to swab or flow the well, after that point in time the operator would normally run a string of tubing with a packer, setting the packer above the perforations, and then pumping into those perforations with anywhere from 500 to 4000 gallons of acid. There's a variety of sizes used by operators, depending on their experience and knowledge.

A lot of times the operators will use nitrogen mixed in with the acid. The acid, of course, is to try to break down the formation, to cause some fracturing around the wellbore, to get the acid out in the wellbore to get a clean-up treatment and improve the effective wellbore drainage area.

The nitrogen is added as a means of recovering the acid. This is a technique that is often used in low pressure, tight reservoirs, because the reservoirs do not have enough pressure available to rapidly clean up the formation. So the nitrogen is included and this has been ex-

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panded and creates an additional pressure source to force the spent acid back out of the well very rapidly. The purpose of this is to avoid these foreign fluids from being in the formation for any period of time. This again is very typical of a tight formation, low permeability, ones that have clays in it where foreign fluids will often cause damage and a resulting loss in flow capacity of the well, and a loss of reserves, ultimately.

Following the acid treatment almost all these wells, and there's only been one that has not been fracture stimulated, and they'll be stimulated with maybe 20-to-40,000 gallons of jelled water and sand. Again, the operator will often include nitrogen or maybe CO_2 in the fracture treatment to again get the fluids back out of the formation as rapidly as possible after they've done their job in the formation.

Pressures at the surface will be in the order of possibly 1000 or 2000 pounds pumping pressure. This will cause a hydraulic fracturing of the formation, but a hydraulic fracturing is limited to the productive interval of the formation, and I agree with Mr. Jeffers testimony that this fracturing would by no means be large enough to cause any type of penetration into the fresh water sands occurring back at say 800 feet.

Once these wells then are cleaned up, they

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of course then are put onto the line and in the case of these wells are put onto compression systems for production.

MR. PADILLA: Of Mr. Jeffers, or you, Mr. Keesey, the Abo formation is not subject to infill drilling as defined by the FERC regulations.

MR. KEESEY: No, it is not.

MR. NUTTER: Are there any other questions of Mr. Jeffers or Mr. Keesey? They both may be excused.

Do you have anything further, Mr. Carr?

MR. CARR: Nothing further, Mr. Nutter.

MR. NUTTER: Does anyone have anything they wish to offer in Case Number 7093?

We'll take the case under advisement and the hearing is adjourned.

(Hearing concluded.)

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C E R T I F I C A T E

I, SALLY W. BOYD, C.S.R., DO HEREBY CERTIFY that the foregoing Transcript of Hearing before the Oil Conservation Division was reported by me; that the said transcript is a full, true, and correct record of the hearing, prepared by me to the best of my ability.

Sally W. Boyd C.S.R.

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 7013 heard by me on 11/25 1980.

, Examiner
Oil Conservation Division

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October 29, 1980

Narrative of Testimony to the New Mexico Oil Conservation Division hearing for Designation of the Abo Sandstone as a Tight Gas Sand in southeast New Mexico

The Geological testimony will be presented by Joseph W. Jeffers of Mesa Petroleum Co., Midland, Texas.

Joseph W. Jeffers is a Division Geologist for Mesa Petroleum Co. in the Permian Basin Division headquartered in Midland, Texas. Part of his responsibilities is the Abo gas play in New Mexico.

Prior to his association with Mesa Petroleum in 1973, Mr. Jeffers worked as District Geologist for Pubco Petroleum for four years. Prior to his association with Pubco in 1969 Mr. Jeffers was employed by Mobil Oil Corporation for 15 years as both exploration and development geologist with primary responsibilities the search for the development of hydrocarbons in Permian Basin of Texas and New Mexico.

Mr. Jeffers received a bachelor of science degree in geology from Southern Methodist University in 1954 and a master of science degree in geology in 1955 from the same institution.

Mr. Jeffers has been accepted as an expert witness on numerous occasions before the Oil Conservation Division of New Mexico.

Ex 27
Ca 7093

PECOS SLOPE

ABO SANDSTONE TIGHT GAS PLAY

IN SOUTHEAST NEW MEXICO

GEOGRAPHICAL AND GEOLOGICAL DESCRIPTION

Geographically, the tight Abo sandstone gas play is located in southeast New Mexico and covers portions of Guadalupe, DeBaca, Torrance, Lincoln and Chaves Counties. The northern boundary of the filing area lies just south of Santa Rosa and the southern boundary is southwest of Roswell. The village of Vaughn is near the western boundary and Fort Sumner lies just within the eastern boundary. The area described will hereinafter be referred to as the Pecos Slope. (Refer to Exhibits #1 & #2)

The Lower Permian Abo sandstones of the Pecos Slope were deposited by a series of fluvial systems which derived their seliments from the Pedernal Uplift to the northwest. The Abo sandstones were deposited as elongate lenticular sand bodies on a low relief, fluvial plain. Individual sandstone bodies are irregularly shaped, limited in areal extent and are interbedded with red and green shales.

Gas production has been established in the low permeability sandstones of the Abo "red bed" section. The poor reservoir properties of the Abo sandstones vary both across the Pecos Slope and within individual sandstone bodies.

Ex 27

EXHIBITS 1 & 2: Area Map & Political Subdivision Description

This 1" = APPROXIMATELY 8 miles scale map shows parts of seven counties in Southeast New Mexico with the location of the major cities and towns.

The heavy line on the southeast marks the approximate extent of the Abo sandstones to the southeast.

The remainder of the map has indicated presence of Abo sandstones which will be discussed with the Cross-Section exhibits to follow.

The area of the application for tight Abo sandstones is shown by the outline on Exhibit #1 and is described by township and range in Exhibit #2.

EXHIBIT 3: Generalized Stratigraphic Section

The stratigraphic section is presented to show the location of the Abo section in geologic time and to indicate general lithology of the Abo section on the Pecos Slope. All rock units and Series shown are not present over the entire area of the Pecos Slope. The stratigraphic section is a compilation of industry accepted stratigraphic sections to fit the Pecos Slope.

EXHIBIT #4: Lithologic Description

This report is presented to show the Abo sandstone is a very fine-grained sandstone to siltstone. It consists of subangular to subrounded silt-sized grains of quartz, feldspar and mica, cemented with calcite and ~~agrillaceous~~ arg material.

EXHIBIT 5: Structure Map - Top of Abo

This map is on a scale of 1" = 8000'. It shows the same area as the Map Exhibit #1. The wells currently completed as Abo gas wells are colored orange. The fields outlined on the map show their name and producing formation. All of the wells that penetrate the Abo are indicated by black dry hole symbols or are circled or are shown by large completed gas well symbols. The cross-section traces are indciated by letter symbol and heavy lines. Control (data) point wells are lettered to correspond to the type of engineering data available (shown in the legend). In addition, the map shows the outline of the area of the application shown on Exhibit #1 and described in Exhibit #2.

The Abo structure map was prepared to illustrate the structural relief of the Abo sandstones across the Pecos Slope. Structure appears to be important only with respect to drilling depth to penetrate the sandstone lenses and channels in the Abo. The map is contoured on top of the Abo formation. The 100' contour interval indicates the general east dip with overall relief in excess of 5,500 feet across the area filed for tight Abo sandstone. Surface elevations range from 4,000 feet to the east to approximately 6,500 feet to the west. The drilling depth to the top of the Abo varies from approximately 4,500 feet to the east to 1,800 feet to the west.

CROSS SECTIONS

The cross sections which comprise the following exhibits were designed to show the presence of Abo sandstones over the entire Pecos Slope area. In addition wells that are completed in the Abo have completion data described at bottom of the log.

1800
4500
2700
3150

EXHIBIT 6: Regional Cross Section A-A'

Exhibit 6 is a generally North-South trending stratigraphic cross-section. This section is hung stratigraphically on the top of the Abo formation. It shows an increase in the total Abo section from north to south. In addition it shows numerous individual sand bodies within the Abo.

The cross-section is not designed to show structure but the logs indicate depth to the top of the sand inverval at well A-1 in Guadalupe County to be 2,682 feet while at well A-3 in DeBaca County it is 3,440 feet. The Abo section is approximately 640' thick in the north and 815' thick in the south. This, and the following cross-sections, show the variations, the unpredictable nature and the lack of continuity of the sandstone lenses and channels from well to well.

EXHIBIT 7: Regional Cross Section B-B'

Exhibit 7 is a generally West-East stratigraphic cross-section. The section is hung stratigraphically on the top of the Abo formation. It shows the wedge of the Abo thickening to the east and thinning to the west toward the source area for the Abo rocks. The thickness of the Abo varies from 780' in well B-3 to an estimated thickness of 400' to 500' in well B-1. Well B-1 had a show of flammable gas in sandstone at approximately 1,825 feet near the top of the Abo while drilling with cable tools.

EXHIBIT 8: Regional Cross Section C-C'

Exhibit 8 is a generally West-East stratigraphic cross-section. The section is hung stratigraphically on the top of the Abo formation. This section, like Sections A-A' & B-B',

shows the numerous individual sand bodies within the Abo zone. The depth to the top of the Abo in well C-1 is 1,900 feet in Lincoln County while, at well C-4 in Chaves County, it is 4,405 feet. The wedge shape of the Abo is well demonstrated on this section. The Abo is approximately 340 feet thick to the west and 685 feet thick to the east.

The Abo section in well C-1 rests on granite wash, which is assumed to be Wolfcamp in age, which in turn rests on a Quartz Diorite basement.

Well C-2 production tested a show of gas (described on the cross-section) from an Abo sandstone.

EXHIBIT 9: Regional Cross Section D-D'

Exhibit 9 is a generally North-South stratigraphic cross-section hung stratigraphically on the top of the Abo formation. This section ties Sections A-A', B-B' and C-C' and demonstrates the numerous individual sand bodies within the Abo formation. In addition, the completed gas wells from the Abo have the completions and production treatments partially described at the respective wells.

CONCLUSIONS:

The area filed for Abo tight sand designation on the Pecos Slope includes portions of five counties in Southeast New Mexico. Over this area the Abo formation exhibits remarkably similar lithologic and stratigraphic characteristics. The individual sandstones present in the Abo formation as exhibited on the cross-sections, are erratic and discontinuous.

The Abo sandstones were deposited in a fluvial system which has all the unpredictability and variation of this type deposition. Reservoir quality within the sand zones, as well as within the individual sandstone bodies, is unpredictable due to variations in clay content, cementing and grain size. The lithologic characteristics tend to make the Abo sandstone a relatively poor reservoir which is difficult to produce without stimulation.

Docket No. 37-80

Dockets Nos. 40-80 and 41-80 are tentatively set for December 10 and 30, 1980. Applications for hearing must be filed at least 22 days in advance of hearing date.

DOCKET: COMMISSION HEARING - TUESDAY - NOVEMBER 18, 1980

OIL CONSERVATION COMMISSION - 9 A.M. - ROOM 205
STATE LAND OFFICE BUILDING, SANTA FE, NEW MEXICO

CASE 7088: Application of Southern Union Exploration Co. for reconsideration of Division Order No. R-6175, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks (a) that Order No. R-6175 be set aside, or (b) to except the E/2 of Section 32, Township 25 South, Range 24 East, Eddy County, New Mexico, from the terms of said order, or (c) clarify said order with respect to the E/2 of Section 32, Township 25 South, Range 24 East.

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Docket No. 38-80

DOCKET: COMMISSION HEARING - MONDAY - NOVEMBER 24, 1980

OIL CONSERVATION COMMISSION - 9 A.M. - ROOM 205
STATE LAND OFFICE BUILDING, SANTA FE, NEW MEXICO

CASE 7075: (Continued and Readvertised)

Application of Benson-Montin-Greer Drilling Corporation for the amendment of pool rules, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks the amendment of the Special Rules and Regulations for the West Puerto Chiquito-Mancos Oil Pool as promulgated by Order No. R-2565-B and amended by Order No. R-6469, to require that wells completed or recompleted on standard units in said pool be located in the west half of the section at least 1650 feet from the outer boundary of the spacing and proration unit, and that the drilling of wells be controlled so as to allow no more than a 330-foot horizontal deviation from the surface location. Further, that the location of wells on certain specified non-standard proration units approved by Order No. R-6469 should be no closer than 660 feet to the outer boundary of the non-standard unit nor closer than 330 feet to a quarter section line or 10 feet to a quarter-quarter section line. Said specified non-standard units are the two 640-acre units in Township 24 North, Range 1 West; the two 480-acre units in Township 24 North, Range 1 East; the four 640-acre units in Township 26 North, Range 1 West; the 640-acre unit in Township 26 North, Range 1 East; and the two 640-acre units, the three 600-acre units, and the 400-acre unit, all in Township 27 North, Range 1 West. Applicant further seeks an administrative procedure whereby unorthodox locations could be approved upon receipt of written waivers from all offsetting operators being "crowded" by the unorthodox location.

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Docket No. 39-80

DOCKET: EXAMINER HEARING - TUESDAY - NOVEMBER 25, 1980

9 A.M. - OIL CONSERVATION DIVISION CONFERENCE ROOM,
STATE LAND OFFICE BUILDING, SANTA FE, NEW MEXICO

The following cases will be heard before Daniel S. Nutter, Examiner, or Richard L. Stamets, Alternate Examiner:

CASE 7055: (Continued from October 29, 1980, Examiner Hearing)

Application of Union Oil Company of California for a unit agreement, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the Eaves-Lea Unit Area, comprising 2209 acres, more or less, of State and Federal lands in Township 21 South, Ranges 32 and 33 East.

CASE 7077: (Continued from November 12, 1980, Examiner Hearing)

Application of Threshold Development Company for a dual completion, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the dual completion of its Conoco "10" State Com Well No. 1 located in Unit I of Section 10, Township 19 South, Range 29 East, Turkey Track Field, to produce oil from the Wolfcamp formation and gas from the Atoka formation through parallel strings of tubing.

CASE 7089: Application of Summit Energy, Inc. for a waterflood project, Lea County, New Mexico. Applicant, in the above-styled cause, seeks authority to institute a waterflood project by the injection of water into the Blinebry formation through its Gulf Bunin Well No. 2 located in Unit C of Section 13, Township 21 South, Range 37 East.

CASE 7090: Application of Dorchester Exploration, Inc. for directional drilling and an unorthodox gas well location, Chaves County, New Mexico. Applicant, in the above-styled cause, seeks authority to re-enter the old Union Hill Well No. 1, the surface location of which is 2310 feet from the North and West lines of Section 27, Township 12 South, Range 28 East, and to directionally drill in an indeterminate direction from a kick-off point at 7300 feet, bottoming said well at an approximate depth of 8100 feet in the Mississippian formation less than 330 feet away from the surface location. The W/2 of said Section 27 would be dedicated to the well.

CASE 7091: Application of Layton Enterprises, Inc. for a non-standard proration unit, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for an 80-acre non-standard oil proration unit comprising the N/2 NW/4 of Section 14, Township 9 South, Range 34 East, Vada-Pennsylvanian Pool, to be dedicated to an old well to be re-entered 660 feet from the North line and 1830 feet from the West line of said Section 14.

CASE 7051: (Continued from October 15, 1980, Examiner Hearing)

Application of Petro Lewis Corporation for downhole commingling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the downhole commingling of Blinebry and Drinkard production in the wellbore of its L. G. Warlick "B" Well No. 2 located in Unit G of Section 19, Township 21 South, Range 37 East.

CASE 6940: (Continued from October 1, 1980, Examiner Hearing)

Application of Adobe Oil Company for compulsory pooling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests down through the Wolfcamp formation underlying the NW/4 SE/4 for oil and the SE/4 for gas, Section 23, Township 20 South, Range 38 East, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision, designation of applicant as operator of the well, and a charge for risk involved in drilling said well.

CASE 6996: (Continued from October 1, 1980, Examiner Hearing) (To be continued to December 10, 1980, Examiner Hearing)

Application of John E. Schalk for compulsory pooling, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Blanco Mesaverde Pool underlying the NE/4 of Section 8, Township 25 North, Range 3 West, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision, designation of applicant as operator of the well, and a charge for risk involved in drilling said well.

CASE 6668: (Continued and Readvertised)

In the matter of Case 6668 being reopened pursuant to the provisions of Order No. R-6139 which order promulgated temporary special rules and regulations for the South Culebra Bluff-Bone Spring Pool in Eddy County, New Mexico, including a provision for 80-acre spacing units. Operators in said pool may appear and show cause why the pool should not be developed on 40-acre spacing units.

CASE 7092: Application of Delta Drilling Company for pool extension, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks the extension of the South Culebra Bluff-Bone Spring Pool to include all of Sections 2, 11, 13, 14, 23, and 24, Township 23 South, Range 28 East.

CASE 7093: Application of Mesa Petroleum Company and Yates Petroleum Corporation for designation of a tight formation, Torrance, Guadalupe, DeBaca, Lincoln, and Chaves Counties, New Mexico. Pursuant to Section 107 of the Natural Gas Policy Act of 1978 and 18 CFR Section 271.701-705, applicants, in the above-styled cause, seek the designation as a tight formation of the Abo formation underlying the following described lands in the above-named counties:
all of Townships 1 North thru 4 North, Ranges 14 East thru 27 East; all of Townships 5 North thru 7 North, Ranges 14 East thru 26 East; all of Townships 1 South thru 5 South, Ranges 14 East thru 27 East; all of Township 6 South, Ranges 14 thru 28 East; N/2 only of Township 7 South, Ranges 14 East thru 17 East; all of Townships 7 South and 8 South, Ranges 18 East thru 28 East; all of Townships 9 South and 10 South, Ranges 18 East thru 27 East; all of Township 11 South, Ranges 18 East thru 25 East; all of Township 12 South, Ranges 18 East thru 24 East; all of Township 13 South, Ranges 18 East thru 23 East; and all of Township 14 South, Ranges 18 East thru 22 East; also all of Township 9 1/2 South, Range 24 East.

CASE 7094: In the matter of the hearing called by the Oil Conservation Division on its own motion for an order creating, assigning a discovery allowable, contracting, and extending certain pools in Chaves, Eddy, and Lea Counties, New Mexico:

(a) CREATE a new pool in Lea County, New Mexico, classified as an oil pool for Yates production and designated as the Northeast Lusk-Yates Pool. Further, to assign approximately 14,790 barrels of discovery allowable to the discovery well, Sun Oil Company Jennings B Federal Well No. 1 located in Unit K of Section 15, Township 19 South, Range 32 East, NMPM. Said pool would comprise:

TOWNSHIP 19 SOUTH, RANGE 32 EAST, NMPM
Section 15: SW/4

(b) CREATE a new pool in Lea County, New Mexico, classified as a gas pool for Yates production and designated as the North Querecho Plains-Yates Gas Pool. The discovery well is Lewis B. Burleson, Inc. Berry Federal Well No. 1 located in Unit E of Section 35, Township 18 South, Range 32 East, NMPM. Said pool would comprise:

TOWNSHIP 18 SOUTH, RANGE 32 EAST, NMPM
Section 35: NW/4

(c) CREATE a new pool in Lea County, New Mexico, classified as a gas pool for Atoka production and designated as the Triple X-Atoka Gas Pool. The discovery well is Getty Oil Company HNG 4F State Well No. 1 located in Unit F of Section 4, Township 24 South, Range 33 East, NMPM. Said pool would comprise:

TOWNSHIP 24 SOUTH, RANGE 33 EAST, NMPM
Section 4: W/2

(d) CREATE a new pool in Lea County, New Mexico, classified as an oil pool for Devonian production and designated as the Tulk-Devonian Pool. The discovery well is Santa Fe Energy Company State NM3 Well No. 1 located in Unit P of Section 3, Township 15 South, Range 32 East, NMPM. Said pool would comprise:

TOWNSHIP 15 SOUTH, RANGE 32 EAST, NMPM
Section 3: SE/4

(e) CREATE a new pool in Lea County, New Mexico, classified as a gas pool for Morrow production and designated as the Vaca Draw-Morrow Gas Pool. The discovery well is HNG Oil Company Bell Lake 11 Federal Well No. 1 located in Unit B of Section 11, Township 25 South, Range 33 East, NMPM. Said pool would comprise:

TOWNSHIP 25 SOUTH, RANGE 33 EAST, NMPM
Section 11: N/2

(f) CREATE a new pool in Lea County, New Mexico, classified as an oil pool for Bone Spring production and designated as the North Young-Bone Spring Pool. The discovery well is Harvey E. Yates Company Young Deep Unit Well No. 1 located in Unit D of Section 10, Township 18 South, Range 32 East, NMPM. Said pool would comprise:

TOWNSHIP 18 SOUTH, RANGE 32 EAST, NMPM
Section 10: NW/4

(g) CONTRACT the Anderson Ranch-Wolfcamp Pool in Lea County, New Mexico, by the deletion of the following described area:

TOWNSHIP 16 SOUTH, RANGE 32 EAST, NMPM
Section 3: Lots 9, 10, 15, and 16

(h) CONTRACT the Querecho Plains-Yates Pool in Lea County, New Mexico, by the deletion of the following described area:

TOWNSHIP 18 SOUTH, RANGE 32 EAST, NMPM
Section 35: NW/4

(i) CONTRACT the South Red Lake-Seven Rivers Pool in Eddy County, New Mexico, by the deletion of the following described area:

TOWNSHIP 17 SOUTH, RANGE 28 EAST, NMPM
Section 15: W/2 SW/4
Section 22: NW/4

(j) EXTEND the Airstrip-Lower Bone Spring Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 18 SOUTH, RANGE 34 EAST, NMPM
Section 23: SE/4

(k) EXTEND the North Anderson Ranch-Wolfcamp Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 16 SOUTH, RANGE 32 EAST, NMPM
Section 2: Lots 11, 12, 13, and 14
Section 3: Lots 9, 10, 15, and 16

(l) EXTEND the Antelope Ridge-Bone Spring Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 23 SOUTH, RANGE 34 EAST, NMPM
Section 24: SW/4
Section 25: NW/4

(m) EXTEND the West Arkansas Junction-San Andres Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 18 SOUTH, RANGE 36 EAST, NMPM
Section 20: SW/4
Section 29: NW/4

(n) EXTEND the Bass-Morrow Gas Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 21 SOUTH, RANGE 28 EAST, NMPM
Section 21: E/2
Section 28: All

(o) EXTEND the Bell Lake-Bone Spring Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 23 SOUTH, RANGE 34 EAST, NMPM
Section 29: N/2
Section 30: E/2
Section 31: NE/4

(p) EXTEND the Blinebry Oil and Gas Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 20 SOUTH, RANGE 38 EAST, NMPM
Section 22: SE/4

TOWNSHIP 21 SOUTH, RANGE 37 EAST, NMPM
Section 8: NW/4

(q) EXTEND the Bull's Eye-San Andres Pool in Chaves County, New Mexico, to include therein:

TOWNSHIP 8 SOUTH, RANGE 29 EAST, NMPM
Section 6: E/2 SW/4
Section 7: E/2 NW/4

(r) EXTEND the Denton-Wolfcamp Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 14 SOUTH, RANGE 37 EAST, NMPM
Section 22: SE/4

(s) EXTEND the Diamond Mound-Morrow Gas Pool in Chaves and Eddy Counties, New Mexico, to include therein:

TOWNSHIP 15 SOUTH, RANGE 27 EAST, NMPM
Section 35: S/2

TOWNSHIP 15 SOUTH, RANGE 28 EAST, NMPM
Section 31: E/2

TOWNSHIP 16 SOUTH, RANGE 28 EAST, NMPM
Section 3: Lots 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16
Section 4: Lots 1, 2, 7, 8, 9, 10, 15, and 16

(t) EXTEND the Dublin Ranch-Morrow Gas Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 22 SOUTH, RANGE 28 EAST, NMPM
Section 28: All
Section 29: N/2

(u) EXTEND the Eagle Creek Permo-Pennsylvanian Gas Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 17 SOUTH, RANGE 24 EAST, NMPM
Section 36: E/2

(v) EXTEND the South Empire-Morrow Gas Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 17 SOUTH, RANGE 29 EAST, NMPM
Section 18: All

(w) EXTEND the East Empire Yates-Seven Rivers Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 17 SOUTH, RANGE 28 EAST, NMPM
Section 22: NW/4

(x) EXTEND the East Grama Ridge-Morrow Gas Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 22 SOUTH, RANGE 34 EAST, NMPM
Section 2: SE/4

(y) EXTEND the Hardy-Blinebry Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 21 SOUTH, RANGE 36 EAST, NMPM
Section 1: S/2

(z) EXTEND the Hardy-Drinkard Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 21 SOUTH, RANGE 36 EAST, NMPM
Section 1: S/2

(aa) EXTEND the Leamex-Wolfcamp Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 17 SOUTH, RANGE 33 EAST, NMPM
Section 21: S/2 NW/4

(bb) EXTEND the Loco Hills Queen-Grayburg-San Andres Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 18 SOUTH, RANGE 30 EAST, NMPM
Section 2: SW/4 SW/4
Section 3: All
Section 4: E/2
Section 11: NW/4 NW/4

(cc) EXTEND the South Loco Hills Queen-Grayburg-San Andres Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 18 SOUTH, RANGE 29 EAST, NMPM
Section 31: NE/4 NE/4

(dd) EXTEND the Northeast Lovington-Pennsylvanian Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 16 SOUTH, RANGE 37 EAST, NMPM
Section 29: NW/4

(ee) EXTEND the Penasco Draw Permo-Pennsylvanian Gas Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 18 SOUTH, RANGE 24 EAST, NMPM
Section 25: S/2
Section 36: All

TOWNSHIP 19 SOUTH, RANGE 24 EAST, NMPM
Section 1: N/2

(ff) EXTEND the Saunders Permo-Upper Pennsylvanian Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 14 SOUTH, RANGE 33 EAST, NMPM
Section 28: NW/4

(gg) EXTEND the Scharb-Bone Spring Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 19 SOUTH, RANGE 35 EAST, NMPM
Section 4: SW/4
Section 5: SE/4

(hh) EXTEND the Tom-Tom San Andres Pool in Chaves County, New Mexico, to include therein:

TOWNSHIP 7 SOUTH, RANGE 31 EAST, NMPM
Section 29: SE/4

(ii) EXTEND the Twin Lakes-San Andres Associated Pool in Chaves County, New Mexico, to include therein:

TOWNSHIP 8 SOUTH, RANGE 29 EAST, NMPM
Section 19: W/2 NE/4 and NW/4 SE/4
Section 31: E/2

(jj) EXTEND the Vacuum-Abo Reef Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 18 SOUTH, RANGE 35 EAST, NMPM
Section 9: SW/4

IN THE OIL CONSERVATION DIVISION

ENERGY AND MINERALS DEPARTMENT

STATE OF NEW MEXICO

RECEIVED
OCT 20 1980
OIL CONSERVATION DIVISION
SANTA FE

IN THE MATTER OF THE APPLICATION OF MESA PETROLEUM COMPANY AND YATES PETROLEUM CORPORATION FOR DESIGNATION OF A TIGHT FORMATION IN CHAVES, DE BACA, GUADALUPE, LINCOLN AND TORRANCE COUNTIES, NEW MEXICO)

Date of Filing:

Case 7093

APPLICATION FOR DESIGNATION OF TIGHT FORMATION

COME NOW Mesa Petroleum Company and Yates Petroleum Corporation, pursuant to Order R-6388 of the New Mexico Oil Conservation Division, and state:

1. Applicants are the owners of interests in the Abo formation underlying portions of the lands described in Exhibit "A" attached hereto and made a part hereof.

2. If productive sands are encountered, the Abo formation underlying the lands described in Exhibit "A" is expected to have an estimated average *in situ* gas permeability throughout the pay section of less than 0.1 millidarcy.

3. The average depth to the top of the Abo formation is 3800 feet. The stabilized production rate, either at atmospheric pressure or calculated against atmospheric pressure, of wells completed for production in the formation, without stimulation, is not expected to exceed 105 MCF of gas per day.

4. No well drilled into the Abo formation underlying the lands described in Exhibit "A" is expected to produce more than five barrels of crude oil per day prior to application of stimulation techniques or processes.

WHEREFORE, Applicants pray that the New Mexico Oil Conservation Division enter its order recommending to the Federal Energy Regulatory Commission that, pursuant to 18 CFR §271.701, the Abo formation underlying the lands described in Exhibit "A" be designated as a tight formation, together with such other and further relief as the Division may deem just and proper.

HINKLE, COX, EATON, COFFIELD & HENSLEY

By _____
Attorneys for Mesa Petroleum Company
and Yates Petroleum Corporation

EXHIBIT "A"

CHAVES COUNTY

All of the following described Real Properties:

Township 3 South, Range 20 East, N.M.P.M.
Township 3 South, Range 27 East, N.M.P.M.

Township 4 South, Range 20 East, N.M.P.M.
Township 4 South, Range 21 East, N.M.P.M.
Township 4 South, Range 22 East, N.M.P.M.
Township 4 South, Range 23 East, N.M.P.M.
Township 4 South, Range 24 East, N.M.P.M.
Township 4 South, Range 25 East, N.M.P.M.
Township 4 South, Range 26 East, N.M.P.M.
Township 4 South, Range 27 East, N.M.P.M.

Township 5 South, Range 20 East, N.M.P.M.
Township 5 South, Range 21 East, N.M.P.M.
Township 5 South, Range 22 East, N.M.P.M.
Township 5 South, Range 23 East, N.M.P.M.
Township 5 South, Range 24 East, N.M.P.M.
Township 5 South, Range 25 East, N.M.P.M.
Township 5 South, Range 26 East, N.M.P.M.
Township 5 South, Range 27 East, N.M.P.M.

Township 6 South, Range 21 East, N.M.P.M.
Township 6 South, Range 22 East, N.M.P.M.
Township 6 South, Range 23 East, N.M.P.M.
Township 6 South, Range 24 East, N.M.P.M.
Township 6 South, Range 25 East, N.M.P.M.
Township 6 South, Range 26 East, N.M.P.M.
Township 6 South, Range 27 East, N.M.P.M.
Township 6 South, Range 28 East, N.M.P.M.

Township 7 South, Range 21 East, N.M.P.M.
Township 7 South, Range 22 East, N.M.P.M.
Township 7 South, Range 23 East, N.M.P.M.
Township 7 South, Range 24 East, N.M.P.M.
Township 7 South, Range 25 East, N.M.P.M.
Township 7 South, Range 26 East, N.M.P.M.
Township 7 South, Range 27 East, N.M.P.M.
Township 7 South, Range 28 East, N.M.P.M.

Township 8 South, Range 21 East, N.M.P.M.
Township 8 South, Range 22 East, N.M.P.M.
Township 8 South, Range 23 East, N.M.P.M.
Township 8 South, Range 24 East, N.M.P.M.
Township 8 South, Range 25 East, N.M.P.M.
Township 8 South, Range 26 East, N.M.P.M.
Township 8 South, Range 27 East, N.M.P.M.
Township 8 South, Range 28 East, N.M.P.M.

Township 9 South, Range 21 East, N.M.P.M.
Township 9 South, Range 22 East, N.M.P.M.
Township 9 South, Range 23 East, N.M.P.M.
Township 9 South, Range 24 East, N.M.P.M.
Township 9 South, Range 25 East, N.M.P.M.
Township 9 South, Range 26 East, N.M.P.M.
Township 9 South, Range 27 East, N.M.P.M.

Township 9½ South, Range 24 East, N.M.P.M.

Township 10 South, Range 21 East, N.M.P.M.
Township 10 South, Range 22 East, N.M.P.M.
Township 10 South, Range 23 East, N.M.P.M.
Township 10 South, Range 24 East, N.M.P.M.
Township 10 South, Range 25 East, N.M.P.M.
Township 10 South, Range 26 East, N.M.P.M.
Township 10 South, Range 27 East, N.M.P.M.
Township 11 South, Range 21 East, N.M.P.M.
Township 11 South, Range 22 East, N.M.P.M.
Township 11 South, Range 23 East, N.M.P.M.
Township 11 South, Range 24 East, N.M.P.M.
Township 11 South, Range 25 East, N.M.P.M.

Township 12 South, Range 21 East, N.M.P.M.
Township 12 South, Range 21½ East, N.M.P.M.
Township 12 South, Range 22 East, N.M.P.M.
Township 12 South, Range 23 East, N.M.P.M.
Township 12 South, Range 24 East, N.M.P.M.

Township 13 South, Range 21 East, N.M.P.M.
Township 13 South, Range 22 East, N.M.P.M.
Township 13 South, Range 23 East, N.M.P.M.

Township 14 South, Range 18 East, N.M.P.M.
Township 14 South, Range 19 East, N.M.P.M.
Township 14 South, Range 20 East, N.M.P.M.
Township 14 South, Range 21 East, N.M.P.M.
Township 14 South, Range 22 East, N.M.P.M.

DE BACA COUNTY

All of the following described Real Properties:

Township 1 North, Range 20 East, N.M.P.M.
Township 1 North, Range 21 East, N.M.P.M.
Township 1 North, Range 22 East, N.M.P.M.
Township 1 North, Range 23 East, N.M.P.M.
Township 1 North, Range 24 East, N.M.P.M.
Township 1 North, Range 25 East, N.M.P.M.
Township 1 North, Range 26 East, N.M.P.M.
Township 1 North, Range 27 East, N.M.P.M.

Township 2 North, Range 20 East, N.M.P.M.
Township 2 North, Range 21 East, N.M.P.M.
Township 2 North, Range 22 East, N.M.P.M.
Township 2 North, Range 23 East, N.M.P.M.
Township 2 North, Range 24 East, N.M.P.M.
Township 2 North, Range 25 East, N.M.P.M.
Township 2 North, Range 26 East, N.M.P.M.
Township 2 North, Range 27 East, N.M.P.M.

Township 3 North, Range 20 East, N.M.P.M.
Township 3 North, Range 21 East, N.M.P.M.
Township 3 North, Range 22 East, N.M.P.M.
Township 3 North, Range 23 East, N.M.P.M.
Township 3 North, Range 24 East, N.M.P.M.
Township 3 North, Range 25 East, N.M.P.M.
Township 3 North, Range 26 East, N.M.P.M.
Township 3 North, Range 27 East, N.M.P.M.

Township 4 North, Range 20 East, N.M.P.M.
Township 4 North, Range 21 East, N.M.P.M.
Township 4 North, Range 22 East, N.M.P.M.
Township 4 North, Range 23 East, N.M.P.M.
Township 4 North, Range 24 East, N.M.P.M.
Township 4 North, Range 25 East, N.M.P.M.
Township 4 North, Range 26 East, N.M.P.M.
Township 4 North, Range 27 East, N.M.P.M.

Township 5 North, Range 24 East, N.M.P.M.
Township 5 North, Range 25 East, N.M.P.M.
Township 5 North, Range 26 East, N.M.P.M.

Township 6 North, Range 25 East, N.M.P.M.
Township 6 North, Range 26 East, N.M.P.M.

Township 1 South, Range 20 East, N.M.P.M.
Township 1 South, Range 21 East, N.M.P.M.
Township 1 South, Range 22 East, N.M.P.M.
Township 1 South, Range 23 East, N.M.P.M.
Township 1 South, Range 24 East, N.M.P.M.
Township 1 South, Range 25 East, N.M.P.M.
Township 1 South, Range 26 East, N.M.P.M.
Township 1 South, Range 27 East, N.M.P.M.

Township 2 South, Range 20 East, N.M.P.M.
Township 2 South, Range 21 East, N.M.P.M.
Township 2 South, Range 22 East, N.M.P.M.
Township 2 South, Range 23 East, N.M.P.M.
Township 2 South, Range 24 East, N.M.P.M.
Township 2 South, Ramge 25 East, N.M.P.M.
Township 2 South, Range 26 East, N.M.P.M.
Township 2 South, Range 27 East, N.M.P.M.

Township 3 South, Range 21 East, N.M.P.M.
Township 3 South, Range 22 East, N.M.P.M.

Township 3 South, Range 23 East, N.M.P.M.
Township 3 South, Range 24 East, N.M.P.M.
Township 3 South, Range 25 East, N.M.P.M.
Township 3 South, Range 26 East, N.M.P.M.

GUADALUPE COUNTY

All of the following described Real Properties:

Township 2 North, Range 16 East, N.M.P.M.
Township 2 North, Range 17 East, N.M.P.M.
Township 2 North, Range 18 East, N.M.P.M.
Township 2 North, Range 19 East, N.M.P.M.

Township 3 North, Range 16 East, N.M.P.M.
Township 3 North, Range 17 East, N.M.P.M.
Township 3 North, Range 18 East, N.M.P.M.
Township 3 North, Range 19 East, N.M.P.M.

Township 4 North, Range 16 East, N.M.P.M.
Township 4 North, Range 17 East, N.M.P.M.
Township 4 North, Range 18 East, N.M.P.M.
Township 4 North, Range 19 East, N.M.P.M.

Township 5 North, Range 16 East, N.M.P.M.
Township 5 North, Range 17 East, N.M.P.M.
Township 5 North, Range 18 East, N.M.P.M.
Township 5 North, Range 19 East, N.M.P.M.
Township 5 North, Range 20 East, N.M.P.M.
Township 5 North, Range 21 East, N.M.P.M.
Township 5 North, Range 22 East, N.M.P.M.
Township 5 North, Range 23 East, N.M.P.M.

Township 6 North, Range 16 East, N.M.P.M.
Township 6 North, Range 17 East, N.M.P.M.
Township 6 North, Range 18 East, N.M.P.M.
Township 6 North, Range 19 East, N.M.P.M.
Township 6 North, Range 20 East, N.M.P.M.
Township 6 North, Range 21 East, N.M.P.M.
Township 6 North, Range 22 East, N.M.P.M.
Township 6 North, Range 23 East, N.M.P.M.
Township 6 North, Range 24 East, N.M.P.M.

Township 7 North, Range 16 East, N.M.P.M.
Township 7 North, Range 17 East, N.M.P.M.
Township 7 North, Range 18 East, N.M.P.M.
Township 7 North, Range 19 East, N.M.P.M.
Township 7 North, Range 20 East, N.M.P.M.
Township 7 North, Range 21 East, N.M.P.M.
Township 7 North, Range 22 East, N.M.P.M.
Township 7 North, Range 23 East, N.M.P.M.
Township 7 North, Range 24 East, N.M.P.M.
Township 7 North, Range 25 East, N.M.P.M.
Township 7 North, Range 26 East, N.M.P.M.

LINCOLN COUNTY

All of the following described Real Properties:

Township 1 North, Range 16 East, N.M.P.M.
Township 1 North, Range 17 East, N.M.P.M.
Township 1 North, Range 18 East, N.M.P.M.
Township 1 North, Range 19 East, N.M.P.M.

Township 1 South, Range 14 East, N.M.P.M.
Township 1 South, Range 15 East, N.M.P.M.
Township 1 South, Range 16 East, N.M.P.M.
Township 1 South, Range 17 East, N.M.P.M.
Township 1 South, Range 18 East, N.M.P.M.
Township 1 South, Range 19 East, N.M.P.M.

Township 2 South, Range 14 East, N.M.P.M.
Township 2 South, Range 15 East, N.M.P.M.
Township 2 South, Range 16 East, N.M.P.M.
Township 2 South, Range 17 East, N.M.P.M.
Township 2 South, Range 18 East, N.M.P.M.
Township 2 South, Range 19 East, N.M.P.M.

Township 3 South, Range 14 East, N.M.P.M.
Township 3 South, Range 15 East, N.M.P.M.
Township 3 South, Range 16 East, N.M.P.M.
Township 3 South, Range 17 East, N.M.P.M.
Township 3 South, Range 18 East, N.M.P.M.
Township 3 South, Range 19 East, N.M.P.M.

Township 4 South, Range 14 East, N.M.P.M.
Township 4 South, Range 15 East, N.M.P.M.
Township 4 South, Range 16 East, N.M.P.M.
Township 4 South, Range 17 East, N.M.P.M.
Township 4 South, Range 18 East, N.M.P.M.
Township 4 South, Range 19 East, N.M.P.M.

Township 5 South, Range 14 East, N.M.P.M.
Township 5 South, Range 15 East, N.M.P.M.
Township 5 South, Range 16 East, N.M.P.M.
Township 5 South, Range 17 East, N.M.P.M.
Township 5 South, Range 18 East, N.M.P.M.
Township 5 South, Range 19 East, N.M.P.M.

Township 6 South, Range 14 East, N.M.P.M.
Township 6 South, Range 15 East, N.M.P.M.
Township 6 South, Range 16 East, N.M.P.M.
Township 6 South, Range 17 East, N.M.P.M.
Township 6 South, Range 18 East, N.M.P.M.
Township 6 South, Range 19 East, N.M.P.M.
Township 6 South, Range 20 East, N.M.P.M.

Township 7 South, N½ Range 14 East, N.M.P.M.
Township 7 South, N½ Range 15 East, N.M.P.M.

Township 7 South, N½ Range 16 East, N.M.P.M.
Township 7 South, N½ Range 17 East, N.M.P.M.
Township 7 South, Range 18 East, N.M.P.M.
Township 7 South, Range 19 East, N.M.P.M.
Township 7 South, Range 20 East, N.M.P.M.

Township 8 South, Range 18 East, N.M.P.M.
Township 8 South, Range 19 East, N.M.P.M.
Township 8 South, Range 20 East, N.M.P.M.

Township 9 South, Range 18 East, N.M.P.M.
Township 9 South, Range 19 East, N.M.P.M.
Township 9 South, Range 20 East, N.M.P.M.

Township 10 South, Range 18 East, N.M.P.M.
Township 10 South, Range 19 East, N.M.P.M.
Township 10 South, Range 20 East, N.M.P.M.

Township 11 South, Range 18 East, N.M.P.M.
Township 11 South, Range 19 East, N.M.P.M.
Township 11 South, Range 20 East, N.M.P.M.

Township 12 South, Range 18 East, N.M.P.M.
Township 12 South, Range 19 East, N.M.P.M.
Township 12 South, Range 20 East, N.M.P.M.

Township 13 South, Range 18 East, N.M.P.M.
Township 13 South, Range 19 East, N.M.P.M.
Township 13 South, Range 20 East, N.M.P.M.

TORRANCE COUNTY

All of the following described Real Properties:

Township 1 North, Range 14 East, N.M.P.M.
Township 1 North, Range 15 East, N.M.P.M.

Township 2 North, Range 14 East, N.M.P.M.
Township 2 North, Range 15 East, N.M.P.M.

Township 3 North, Range 14 East, N.M.P.M.
Township 3 North, Range 15 East, N.M.P.M.

Township 4 North, Range 14 East, N.M.P.M.
Township 4 North, Range 15 East, N.M.P.M.

Township 5 North, Range 14 East, N.M.P.M.
Township 5 North, Range 15 East, N.M.P.M.

Township 6 North, Range 14 East, N.M.P.M.
Township 6 North, Range 15 East, N.M.P.M.

Township 7 North, Range 14 East, N.M.P.M.
Township 7 North, Range 15 East, N.M.P.M.

PECOS SLOPE
ABO TIGHT GAS PLAY
SOUTHEASTERN NEW MEXICO

TABULATION OF CORE-DERIVED PERMEABILITY

SU&A TRACT NUMBER	WELL NAME Operator Location	SAMPLE NUMBER	CORE DEPTH, FEET	CORRELATIVE LOG DEPTH, FEET	MAXIMUM ROUTINE PERMEABILITY, md	CORRECTED IN SITU PERMEABILITY, md
55	PAPALOTE "01" STATE NO. 1 Texas Petroleum Corporation Section 16, T-7-S, R-25-E	29	3,718-19	3,720-21	0.010	0.0033
		30	3,719-20	3,721-22	0.010	0.0033
		31	3,720-21	3,722-23	0.044	0.0070
		32	3,721-22	3,723-24	0.030	0.0058
		33	3,722-23	3,724-25	0.130	0.0120
		34	3,723-24	3,725-26	0.027	0.0055
		35	3,724-25	3,726-27	0.029	0.0057
		36	3,725-26	3,727-28	0.027	0.0055
		37	3,726-27	3,728-29	0.020	0.0047
		38	3,727-28	3,729-30	0.000	0.0081
		39	3,728-29	3,730-31	0.091	0.0100
		40	3,729-30	3,731-32	0.080	0.0095
		41	3,730-31	3,732-33	0.039	0.0065
		42	3,731-32	3,733-34	0.073	0.0090
	TOTAL				0.670	0.0939
	AVERAGE PERMEABILITY OF THE PAPALOTE "01" STATE NO. 1				0.048	0.0069
22	THORPE "HI" NO. 2 Texas Petroleum Corporation Section 3, T-7-S, R-25-E	15	3,644-45	3,640-41	0.030	0.0058
		16	3,645-46	3,641-42	0.030	0.0058
		17	3,646-47	3,642-43	0.040	0.0066
		18	3,647-48	3,643-44	0.020	0.0047
		19	3,648-49	3,644-45	0.030	0.0058
		20	3,649-50	3,645-46	0.040	0.0066
		21	3,650-51	3,646-47	0.020	0.0058
		22	3,651-52	3,647-48	0.020	0.0047
		23	3,652-53	3,648-49	0.020	0.0047
		24	3,653-54	3,649-50	0.020	0.0047
		25	3,654-55	3,650-51	0.040	0.0066
		26	3,655-56	3,651-52	0.010	0.0033
		27	3,656-57	3,652-53	1.100	0.0360
		34	3,945-46	3,956-57	0.110	0.0110
		35	3,946-47	3,957-58	<0.010	<0.0033
		36	3,947-48	3,958-59	0.300	0.0170
		37	3,948-49	3,959-60	0.200	0.0150
		38	3,949-50	3,960-61	<0.010	<0.0033
		39	3,950-51	3,961-62	<0.010	<0.0033
		40	3,951-52	3,962-63	0.090	0.0100
		41	3,952-53	3,963-64	0.010	0.0033
		42	3,953-54	3,964-65	<0.010	<0.0033
		43	3,954-55	3,965-66	0.020	0.0047
		44	3,955-56	3,966-67	<0.010	<0.0033
		45	3,956-57	3,967-68	<0.010	<0.0033
		46	3,957-58	3,968-69	<0.010	<0.0033
		47	3,958-59	3,969-70	<0.010	<0.0033
		48	3,959-60	3,970-71	<0.010	<0.0033
		49	3,960-61	3,971-72	<0.010	<0.0033
		50	3,961-62	3,972-73	<0.010	<0.0033
		51	3,962-63	3,973-74	<0.010	<0.0033
	TOTAL				2.280	0.2017
	AVERAGE PERMEABILITY OF THE THORPE "HI" NO. 2				0.074	0.0065
	AVERAGE PERMEABILITY OF ALL WELLS				0.066	0.0066

EXHIBIT 14

SIPES, WILLIAMSON & ASSOCIATES, INC.
1200 BLANKS BUILDING MIDLAND, TEXAS 79701
JOHN JAY KEESEY, P.E./CT/wpe/vjv OCTOBER 30, 1980

PECOS SLOPE
ABO TIGHT GAS PLAY
SOUTHEASTERN NEW MEXICO

TABULATION OF CORE-DERIVED PERMEABILITY

SWEA TRACT NUMBER	WELL NAME Operator Location	SAMPLE NUMBER	CORE DEPTH, FEET	CORRELATIVE LOG DEPTH, FEET	MAXIMUM ROUTINE PERMEABILITY, md	CORRECTED IN SITU PERMEABILITY, md
45	PAPALOTE "OI" STATE NO. 1					
	Yates Petroleum Corporation					
	Section 16, T-7-S, R-25-E	29	3,718-19	3,720-21	0.010	0.0033
		30	3,719-20	3,721-22	0.010	0.0033
		31	3,720-21	3,722-23	0.044	0.0070
		32	3,721-22	3,723-24	0.030	0.0058
		33	3,722-23	3,724-25	0.130	0.0120
		34	3,723-24	3,725-26	0.027	0.0055
		35	3,724-25	3,726-27	0.029	0.0057
		36	3,725-26	3,727-28	0.027	0.0055
		37	3,726-27	3,728-29	0.020	0.0047
		38	3,727-28	3,729-30	0.060	0.0081
		39	3,728-29	3,730-31	0.091	0.0100
		40	3,729-30	3,731-32	0.080	0.0095
		41	3,730-31	3,732-33	0.039	0.0065
		42	3,731-32	3,733-34	0.073	0.0090
	TOTAL				0.670	0.0959
	AVERAGE PERMEABILITY OF THE PAPALOTE "OI" STATE NO. 1				0.048	0.0069
22	THORPE "HI" NO. 2					
	Texas Petroleum Corporation					
	Section 13, T-7-S, R-25-E	15	3,644-45	3,640-41	0.030	0.0058
		16	3,645-46	3,641-42	0.030	0.0058
		17	3,646-47	3,642-43	0.040	0.0066
		18	3,647-48	3,643-44	0.020	0.0047
		19	3,648-49	3,644-45	0.030	0.0058
		20	3,649-50	3,645-46	0.040	0.0066
		21	3,650-51	3,646-47	0.030	0.0058
		22	3,651-52	3,647-48	0.020	0.0047
		23	3,652-53	3,648-49	0.020	0.0047
		24	3,653-54	3,649-50	0.020	0.0047
		25	3,654-55	3,650-51	0.040	0.0066
		26	3,655-56	3,651-52	0.010	0.0033
		27	3,656-57	3,652-53	1.100	0.0360
		34	3,945-46	3,956-57	0.110	0.0110
		35	3,946-47	3,957-58	<0.010	<0.0033
		36	3,947-48	3,958-59	0.300	0.0170
		37	3,948-49	3,959-60	0.200	0.0150
		38	3,949-50	3,960-61	<0.010	<0.0033
		39	3,950-51	3,961-62	<0.010	<0.0033
		40	3,951-52	3,962-63	0.090	0.0100
		41	3,952-53	3,963-64	0.010	0.0033
		42	3,953-54	3,964-65	<0.010	<0.0033
		43	3,954-55	3,965-66	0.020	0.0047
		44	3,955-56	3,966-67	<0.010	<0.0033
		45	3,956-57	3,967-68	<0.010	<0.0033
		46	3,957-58	3,968-69	<0.010	<0.0033
		47	3,958-59	3,969-70	<0.010	<0.0033
		48	3,959-60	3,970-71	<0.010	<0.0033
		49	3,960-61	3,971-72	<0.010	<0.0033
		50	3,961-62	3,972-73	<0.010	<0.0033
		51	3,962-63	3,973-74	<0.010	<0.0033
	TOTAL				2.280	0.2017
	AVERAGE PERMEABILITY OF THE THORPE "HI" NO. 2				0.074	0.0065
	AVERAGE PERMEABILITY OF ALL WELLS				0.066	0.0066

SIPES, WILLIAMSON & ASSOCIATES, INC.
1200 BLANKS BUILDING MIDLAND, TEXAS 79701
JOHN JAY KEESEY, P.E./CT/wpe/vjv OCTOBER 30, 1980

EXHIBIT 14

PECOS SLOPE
ABO TIGHT GAS PLAY
SOUTHEASTERN NEW MEXICO
IN SITU GAS PERMEABILITY, millidarcies
versus
ROUTINE PERMEABILITY TO AIR, millidarcies
CORE DATA: THORPE "MI" NO. 2, SECTION 3, T7S-R25E
OPERATED BY YATES PETROLEUM CORPORATION

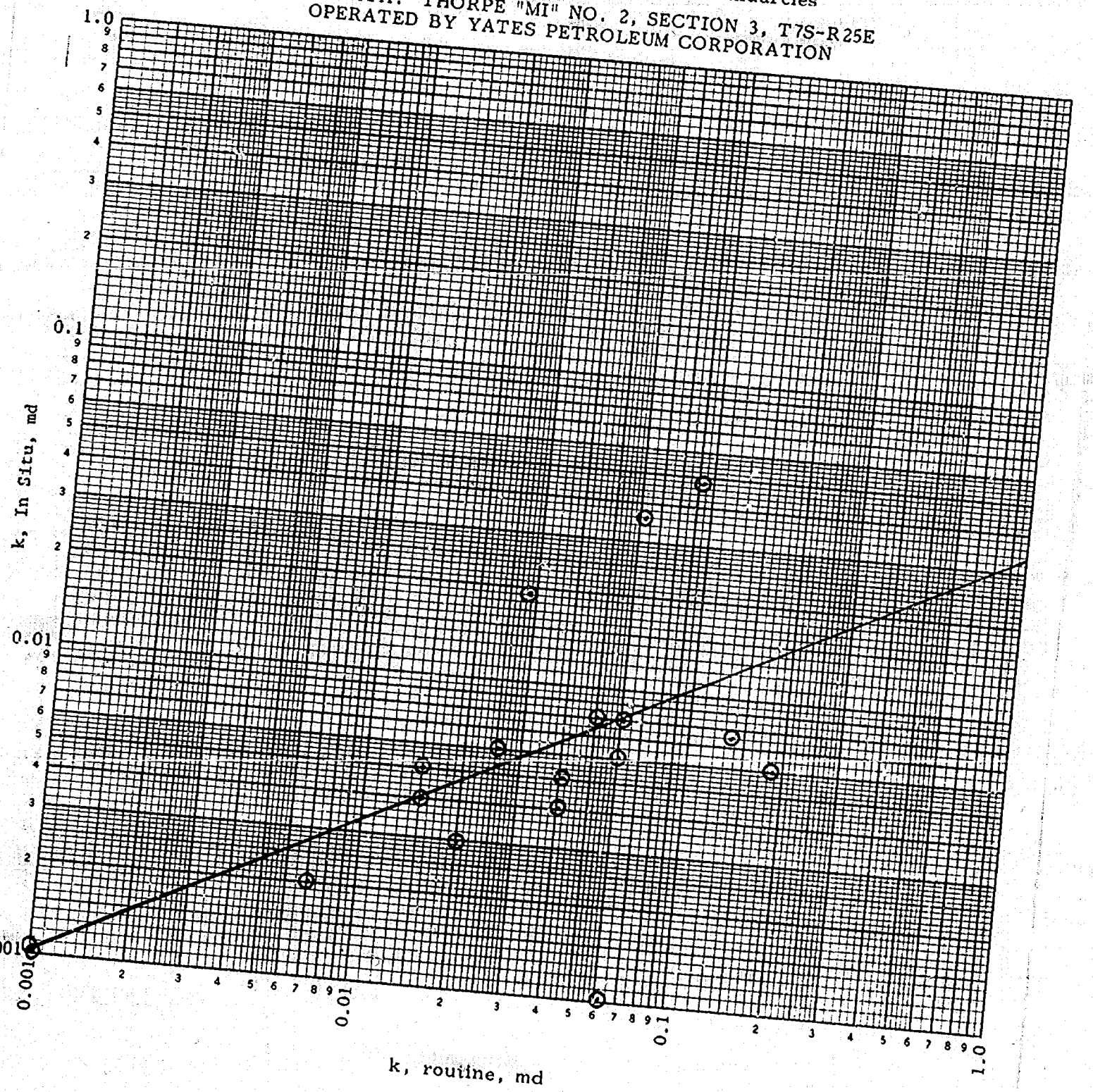


EXHIBIT 15

PECOS SLOPE
ABO TIGHT GAS PLAY
SOUTHEASTERN NEW MEXICO

TABULATION OF AVERAGE PERMEABILITY DERIVED FROM BOTTOM-HOLE PRESSURE BUILD-UP DATA

SW&A TRACT NUMBER	NAME OF WELL OPERATOR	CALCULATED AVERAGE PERMEABILITY BASED ON BOTTOM-HOLE PRESSURE BUILD-UP DATA, md
33	ACME NO. 1 MESA PETROLEUM CO.	0.1188
29	ROCK FEDERAL NO. 2 MESA PETROLEUM CO.	0.0100
20	SELMAN DRAW "NS" STATE NO. 1 YATES PETROLEUM CORPORATION	0.0220
16	THOMAS "LN" FEDERAL NO. 1 YATES PETROLEUM CORPORATION	0.0516

Average "k," 4 wells = 0.0506 md

SIPES, WILLIAMSON & ASSOCIATES, INC.
1200 BLANKS BUILDING MIDLAND, TEXAS 79701
JOHN JAY KEESEY, P.E./CT/wps/vjv OCTOBER 30, 1980

EXHIBIT 16

PECOS SLOPE
ABO TIGHT GAS PLAY
SOUTHEASTERN NEW MEXICO

TABULATION OF FLOW RATES PRIOR TO STIMULATION

SWEA TRACT NUMBER	OPERATOR / WELL NAME	FLOW RATE PRIOR TO STIMULATION: TEST RATE, MCFPD	FLOW RATE PRIOR TO STIMULATION: CORRECTED TO STABILIZE CONDITIONS AT 1 ATMOSPHERE	COMPLETION INTERVAL, FEET: TOP	COMPLETION INTERVAL, FEET: BOTTOM	COMPLETION INTERVAL, FEET: AVERAGE
39	BOYD OPERATING COMPANY BLAKEMORE FEDERAL NO. 1	Swab Dry Swab Blow Gas	0 0	4,272 4,198	4,344 4,210	4,308 4,204
41	McCLELLAN OIL CORPORATION "JJ" FEDERAL NO. 1	No Test	-	4,448	4,456	4,452
40	"MM" FEDERAL NO. 1	No Test	-	4,274	4,468	4,321
37	"PJ" FEDERAL NO. 1	No Test	-	4,334	4,514	4,424
43	PENJACK FEDERAL NO. 1	No Test	-	4,314	4,334	4,324
35	TOLMAC STATE NO. 1		-	4,034	4,272	4,153
33	MESA PETROLEUM COMPANY ACHE NO. 1	TSTM*				
34	BESTWELL NO. 1	Swab Dry	0	4,634	4,652	4,643
30	ROCK FEDERAL NO. 1	350 TSTM	0 230	3,846 3,355	3,864 3,363	3,855 3,359
29	ROCK FEDERAL NO. 2	Swab Dry	0	2,923	3,020	2,972
31	ROCK FEDERAL NO. 5	TSTM	0	2,810	2,819	2,815
23	SAVAGE FEDERAL NO. 1	Swab/Steadr Gas TSTM 250	0 0	2,876 3,916	3,351 3,954	3,114 3,935
5	STANCEL FEDERAL NO. 1	80 Swab Dry	129 32	3,600 3,942	3,656 3,966	3,628 3,954
4	STANCEL FEDERAL NO. 2	Swab With No Recovery	0	3,786	3,812	3,799
13	POOL, FRED DRILLING COMPANY CATHERINE CON. FEDERAL NO. 1		0	3,710	3,830	3,770
7	CORN NO. 1-24	Not Available	-	3,778	3,796	3,787
6	CORN NO. 2-24	Not Available	-	3,822	3,860	3,841
		No Test	-	3,706	3,866	3,786
	YATES PETROLEUM CORPORATION COPPERAS "AY" FEDERAL NO. 1	10	10**			
	COTTONWOOD RANCH "MK" STATE NO. 1	Not Available	-	4,046	4,053	4,051
	FEDERAL NO. 1-Y	No Flow	0	3,809	3,824	3,817
	STATE NO. 1	No Flow	0	3,876	3,884	3,880
	2	Not Available	-	4,238	4,258	4,248
	1	Not Available	-	3,548	3,880	3,714
	"LK" FEDERAL NO. 1	Not Available	-	4,810	4,822	4,816
	NO. 1	Not Available	-	3,816	3,836	3,826
	AL NO. 1	Not Available	-	3,758	3,772	3,765
	E NO. 1	Not Available	-	4,012	4,022	4,017
	NO. 1	Not Available	-	3,910	3,946	3,928
	NO. 1	Not Available	-	3,770	3,780	3,775
			-	4,024	4,030	4,027

PECOS SLOPE
ABO TIGHT GAS PLAY
SOUTHEASTERN NEW MEXICO

TABULATION OF FLOW RATES PRIOR TO STIMULATION

SWGA TRACT NUMBER	OPERATOR / WELL NAME	FLOW RATE PRIOR TO STIMULATION: TEST RATE, MCFPD	FLOW RATE PRIOR TO STIMULATION: CORRECTED TO STABILIZE CONDITIONS AT 1 ATMOSPHERE	COMPLETION INTERVAL, FEET: TOP	BOTTOM	AVERAGE
	YATES PETROLEUM CORPORATION			128,097		
24	HILLTOP "NQ" STATE NO. 1	Not Available	-	3,958	3,961	3,960
14	IWANOWSKI "MM" FEDERAL NO. 1	TSTM	0	3,404	3,414	3,409
12	McCLELLAN "MB" FEDERAL NO. 1	TSTM	0	3,930	3,960	3,945
38	McCONKEY NO. 1	521	431	4,764	4,782	4,773
20	SELLMAN DRAW "NS" STATE NO. 1	Not Available	-	3,335	3,346	3,341
3	SHERNOFF "NL" STATE NO. 1	0	0	3,630	3,662	3,646
13	SOUTH ALKALI "LK" FEDERAL NO. 1	TSTM	0	3,714	3,724	3,719
		Not Available	-	3,896	3,926	3,911
17	TECKLA "MD" FEDERAL NO. 2	7	7**	3,961	3,978	3,970
16	THOMAS "LM" FEDERAL NO. 1	No Show of Gas or Oil	0	3,968	3,990	3,979
22	THORPE "MI" FEDERAL NO. 2	Would Not Flow	0	3,958	3,964	3,961
	SUMMATION OF:					
	Flow Rates, MCFPD	1,218	839			
	Number of Zones Measured	24	24			
	Average Daily Flow Rate, MCFPD	51	35			
	Average Depth to the Tops of the Perforations		3,878			
	Allowed Maximum Daily Flow Rate, MCF per Section 107(b) of the Natural Gas Policy Act of 1978		105			

*TSTM - Gas Rate is too small to measure.

**Low Gas Rate - Adjustment for stability not material and not calculated.

PECOS SLOPE
ABO TIGHT GAS PLAY
SOUTHEASTERN NEW MEXICO

TABULATION OF PRODUCTION DATA

SWSA TRACT NUMBER	OPERATOR / WELL NAME	SEPTEMBER 1980 PRODUCTION RATE* LIQUIDS, BBLPM	SEPTEMBER 1980 PRODUCTION RATE* GAS, MCFPM	CUMULATIVE PRODUCTION AS OF SEPTEMBER 30, 1980* LIQUIDS, BBL	CUMULATIVE PRODUCTION AS OF SEPTEMBER 30, 1980* GAS, MCF
	BOYD OPERATING COMPANY				
39	BLAKEMORE FEDERAL NO. 1	0	1,374	0	20,757
	McCLELLAN OIL CORPORATION				
41	"JJ" FEDERAL NO. 1	0	1,185	0	20,091
40	"MM" FEDERAL NO. 1	0	3,453	0	43,013
37	"PJ" FEDERAL NO. 1	0	16,497	0	23,023
43	PENJACK FEDERAL NO. 1	0	2,359	0	35,337
35	TOLMAC STATE NO. 1	0	9,172	0	49,214
	POOL, FRED DRILLING COMPANY				
7	CORN NO. 1-24	0	6,875	0	6,875
6	CORN NO. 2-24	0	1,847	0	1,847
	YATES PETROLEUM CORPORATION				
18	COTTONWOOD RANCH "MK" STATE NO. 1	0	10,978	0	32,246
32	DUNCAN "LH" FEDERAL NO. 1-Y	0	11,829	0	28,114
42	ERICKSON "KI" STATE NO. 1	0	1,318	0	10,687
28	FEDERAL "HY" NO. 2	0	3,894	0	5,677
36	FEDERAL "IX" NO. 1	0	3,799	0	35,286
44	FIVE MILE DRAW "LX" FEDERAL NO. 1	0	11,888	0	30,977
2	GLOBE "MN" FEDERAL NO. 1	0	15,391	0	38,291
26	GODFREY "MP" FEDERAL NO. 1	0	19,785	0	43,110
10	GRYNBERG "LZ" STATE NO. 1	0	21,590	0	48,365
9	GYP "MO" FEDERAL NO. 1	0	20,330	0	48,931
12	McCLELLAN "MB" FEDERAL NO. 1	0	28,275	0	60,155

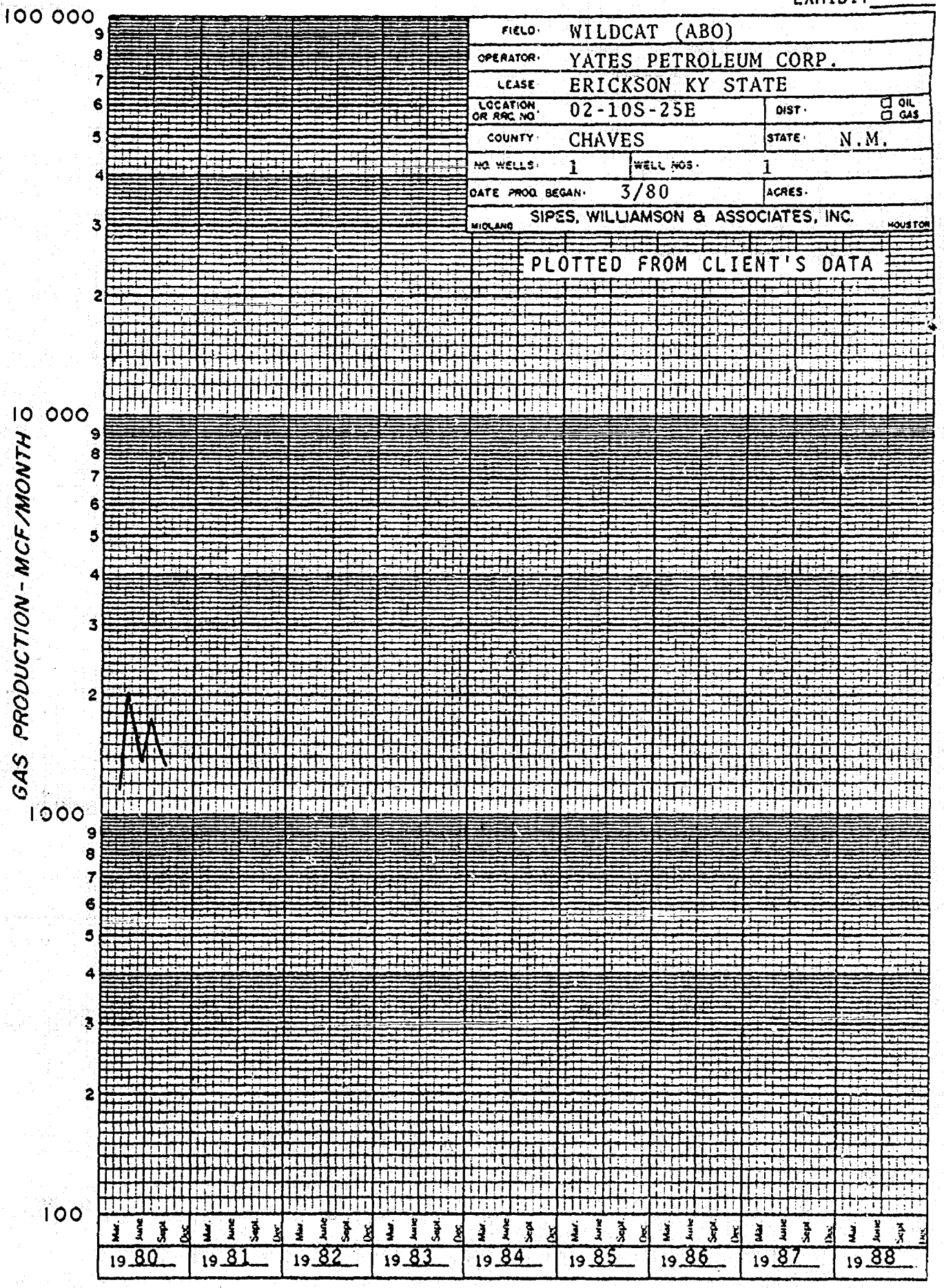
PECOS SLOPE
ABO TIGHT GAS PLAY
SOUTHEASTERN NEW MEXICO

TABULATION OF PRODUCTION DATA

SW&A TRACT NUMBER	OPERATOR / WELL NAME	SEPTEMBER 1980 PRODUCTION RATE* LIQUIDS, BBLPM	SEPTEMBER 1980 PRODUCTION RATE* GAS, MCFPM	CUMULATIVE PRODUCTION AS OF SEPTEMBER 30, 1980* LIQUIDS, BBL	CUMULATIVE PRODUCTION AS OF SEPTEMBER 30, 1980* GAS, MCF
	YATES PETROLEUM CORPORATION				
38	McCONKEY NO. 1	0	26,615	0	185,765
3	SMERNOFF "NL" STATE NO. 1	0	13,870	0	19,410
15	SOUTH ALKALI "LK" FEDERAL NO. 1	0	14,360	0	33,271
17	TECKLA "MD" FEDERAL NO. 2	0	13,724	0	13,724
16	THOMAS "LN" FEDERAL NO. 1	0	20,771	0	48,013

*Based on production data provided by client.

EXHIBIT 24



SWA TR 42

EXHIBIT 25

FIELD	WILDCAT (ABO)
OPERATOR	YATES PETROLEUM CORP.
LEASE	FEDERAL IX
LOCATION OR ABC NO.	03-9S-26E
DIST	☐ OIL ☐ GAS
COUNTY	CHAVES
STATE	N.M.
NO. WELLS	1
WELL NOS.	1
DATE PROD. BEGAN	2/80
ACRES	

SIPES, WILLIAMSON & ASSOCIATES, INC.
MIDLAND HOUSTON

PLOTTED FROM CLIENT'S DATA

GAS PRODUCTION - MCF/MONTH

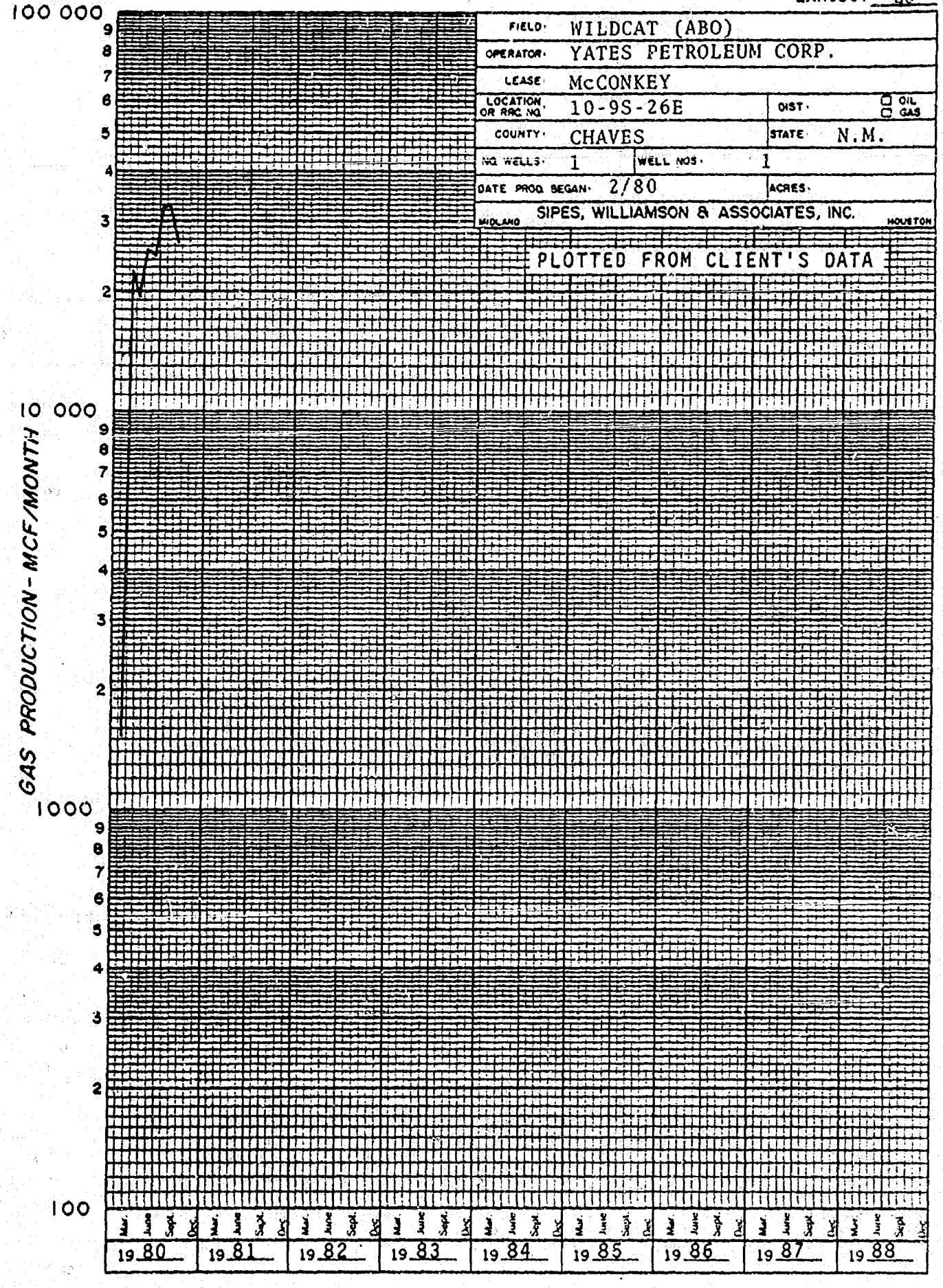
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Mar. June Sept. Dec.

19 80 | 19 81 | 19 82 | 19 83 | 19 84 | 19 85 | 19 86 | 19 87 | 19 88

SWA TR 36

EXHIBIT 26



SWA TR 38

EXHIBIT 23

FIELD:	WILDCAT (ABO)
OPERATOR:	McCLELLAN OIL CORP.
LEASE:	TOLMAC STATE
LOCATION OR RRC NO.:	36-9S-25E
DIST.:	☐ OIL ☐ GAS
COUNTY:	CHAVES
STATE:	N.M.
NO. WELLS:	1
WELL NOS.:	1
DATE PROD. BEGAN:	2-80
ACRES:	

MIDLAND SIPES, WILLIAMSON & ASSOCIATES, INC. HOUSTON

PLOTTED FROM CLIENT'S DATA

GAS PRODUCTION - MCF/MONTH

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Mar. June Sept. Dec.

19 80 | 19 81 | 19 82 | 19 83 | 19 84 | 19 85 | 19 86 | 19 87 | 19 88

SWA TR 35

EXHIBIT 22

FIELD:	WILDCAT (ABO)
OPERATOR:	McCLELLAN OIL CORP.
LEASE:	PENJACK
LOCATION OR SEC. NO.:	06-10S-26E
DIST.:	☐ OIL ☐ GAS
COUNTY:	CHAVES
STATE:	N.M.
NO. WELLS:	1
WELL NOS.:	1
DATE PROD. BEGAN:	2/80
ACRES:	

SIPES, WILLIAMSON & ASSOCIATES, INC. MIDLAND HOUSTON

PLOTTED FROM CLIENT'S DATA

GAS PRODUCTION - MCF/MONTH

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Mar. June Sept. Dec.

19 80 | 19 81 | 19 82 | 19 83 | 19 84 | 19 85 | 19 86 | 19 87 | 19 88

SWA TR 43

EXHIBIT 19

FIELD	BITTER LAKES (ABO)
OPERATOR	BOYD OPERATING CO.
LEASE	BLAKEMORE FEDERAL
LOCATION OR RRC NO.	20-9S-26E
DIST.	☐ OIL ☐ GAS
COUNTY	CHAVES
STATE	N.M.
NO. WELLS	1
WELL NOS.	1
DATE PROD. BEGAN	3/80
ACRES	

SIPES, WILLIAMSON & ASSOCIATES, INC.
MIDLAND HOUSTON

PLOTTED FROM CLIENT'S DATA

GAS PRODUCTION - MCF/MONTH

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Mar. June Sept. Dec.

19 80 | 19 81 | 19 82 | 19 83 | 19 84 | 19 85 | 19 86 | 19 87 | 19 88

SWA TR 39

EXHIBIT 20

FIELD	WILDCAT (ABO)
OPERATOR	McCLELLAN OIL CORP.
LEASE	J. J. FEDERAL
LOCATION OR SEC NO	01-10S-25E
DIST	☐ OIL ☐ GAS
COUNTY	CHAVES
STATE	N.M.
NO WELLS	1
WELL NOS	1
DATE PROD BEGAN	2/80
ACRES	

SIPES, WILLIAMSON & ASSOCIATES, INC. MIDLAND HOUSTON

PLOTTED FROM CLIENT'S DATA

GAS PRODUCTION - MCF/MONTH

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Mar. June Sept. Dec.

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SWA TR 41

EXHIBIT 21

FIELD:	WILDCAT (ABO)
OPERATOR:	McCLELLAN OIL CORP.
LEASE:	M. M. FEDERAL
LOCATION OR RRC NO.	31-9S-26E
DIST:	☐ OIL ☐ GAS
COUNTY:	CHAVES
STATE:	N.M.
NO. WELLS:	1
WELL NOS:	1
DATE PROD. BEGAN:	3/80
ACRES:	

SIPES, WILLIAMSON & ASSOCIATES, INC.
MIDLAND HOUSTON

PLOTTED FROM CLIENT'S DATA

GAS PRODUCTION - MCF/MONTH

100 000
10 000
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Mar. June Sept. Dec.

19 80 | 19 81 | 19 82 | 19 83 | 19 84 | 19 85 | 19 86 | 19 87 | 19 88

SWA TR 40

GENERALIZED STATIGRAPHIC SECTION
PECOS SLOPE AND PORTIONS OF SOUTHEASTERN , NEW MEXICO

SYSTEM	SERIES	ROCK UNIT	LITHOLOGY
PERMIAN	OCHOAN	RUSTLER	
		SALADO	
	GUADALUPIAN	TANSILL	
		YATES	
		SEVEN RIVERS	
		QUEEN	
		GRAYBURG	
		SAN ANDRES	
	LEONARDIAN	"GLORIETA"	
		UPPER YESO	
		DRINKARD	
		LOWER YESO	
		ABO	
	WOLFCAMPIAN	HUECO	
PENNSYLVANIAN	VIRGILIAN	CISCO	
	MISSOURIAN	CANYON	
	DESMOINESIAN	STRAWN	
	ATOKAN	" ATOKA"	
	MORROWAN	"MORROW"	
MISSISSIPPIAN	CHESTERAN	"CHESTER"	
	MERAMECIAN OSAGIAN KINDERHOOKIAN	MISSISSIPPIAN LIME	
DEVONIAN		WOODFORD	
SILURIAN		"UNDIFFERENTIATED SILURIAN"	
ORDOVICIAN		MONTOYA	
		SIMPSON	
		ELLENBURGER	
PRECAMBRIAN		UNNAMED	

PECOS SLOPE
ABO TIGHT GAS PLAY
SOUTHEASTERN , NEW MEXICO

GENERALIZED

STRATIGRAPHIC SECTION

EXHIBIT # 3

PECOS SLOPE

ABO SANDSTONE TIGHT GAS PLAY

IN SOUTHEAST NEW MEXICO

List of plugged and abandoned wells that have or may have penetrated the Abo inside the recommended area for Abo Tight Gas Play.

COUNTY	OPERATOR	WELL NAME	LOCATION	FOOTAGE	SPUD	COMPLETION	TOTAL
Guadalupe	Baker & Taylor	#1 Dale Smith	15-7N-22E	1980' FNL & 1980' FEL	4/9/52	5/20/52	6299
DeBaca	Armor Oil	#1 Federal	9-6N-25E	660' FSL & 660' FEL	6/13/64	9/11/64	7065
DeBaca	Abercrambie	#1-X Nappier	22-5N-26E	1980' FEL & 1950' FSL	10/8/49	12/8/49	7149
Guadalupe	C.W. Williams	#1 Salado Dome	11-4N-19E	990' FNL & 990' FEL	12/17/76	4/12/77	4766
DeBaca	South Basin	#1 Goode	5-4N-20E	661' FNL & 330' FEL	1/22/42	12/8/42	4779
DeBaca	Matador	#2 State	6-4N-20E	NE SW SW		1/9/32	4666
DeBaca	Griggs	#1 Steele	26-4N-24E	330' FNL & 330' FEL	6/26/44	9/25/44	5553
DeBaca	Griggs	#1 State	11-4N-26E	660' FNL & 660' FEL	9/30/44	6/25/46	5570
DeBaca	Sandefer	#1 Goode State	21-4N-27E	664' FNL & 663' FEL	6/7/74	7/10/74	7000
Guadalupe	Navajo	#1 Transport	10-3N-17E	NE NE	7/11/28	1/4/29	3075
DeBaca	Pair Oil	#1 Overton-Fed.	20-2N-22E	660' FNL & 1980' FWL	3/12/59	4/27/59	5427
DeBaca	Hawkins	#1 Myrick	17-2N-25E	660' FSL & 1980' FWL	5/13/49	6/30/49	6174
Torrance	Ressler	#1 Nalde	27-1N-15E	660' FSL & 660' FEL	7/23/45	1/7/46	3350
DeBaca	Peters	#1-X State	2-1N-20E	860' FSL & 860' FEL	4/26/63	9/6/63	4597
DeBaca	Katz	#1 Mabel Field	13-1N-22E	660' FSL & 660' FWL	10/21/53	11/30/53	5581
DeBaca	Nearburg	#1 Milton	28-1S-25E	1980' FNL & 660' FWL	7/24/60	8/15/60	5589
DeBaca	Sandefer	#1 Vaughn	21-1S-26E	659' FNL & 658' FWL	7/16/74	8/12/74	5800
DeBaca	Amoco	#1 State "GK"	32-1S-26E	1980' FNL & 1980' FWL	11/27/78	2/4/80	4900
DeBaca	Cities Ser.	#1 Hobson	12-1S-27E	660' FNL & 660' FEL	10/30/52	1/5/53	6742
DeBaca	Landowners	#1 State	16-1S-27E	SW NE		4/17/35	5760
Lincoln	Malcom	#1 Franks	23-2S-15E	2013' FSL & 660' FWL	8/13/53	9/2/53	2140

	WELL NAME	LOCATION	FOOTAGE	SPUD	COMPLETION	TOTAL DEPTH
Taylor	#1 Dale Smith	15-7N-22E	1980' FNL & 1980' FEL	4/9/52	5/20/52	6299'
l	#1 Federal	9-6N-25E	660' FSL & 660' FEL	6/13/64	9/11/64	7065'
ble	#1-X Nappier	22-5N-26E	1980' FEL & 1950' FSL	10/8/49	12/8/49	7149'
lliams	#1 Salado Dome	11-4N-19E	990' FNL & 990' FEL	12/17/76	4/12/77	4766'
sin	#1 Goode	5-4N-20E	661' FNL & 330' FEL	1/22/42	12/8/42	4779'
	#2 State	6-4N-20E	NE SW SW		1/9/32	4666'
	#1 Steele	26-4N-24E	330' FNL & 330' FEL	6/26/44	9/25/44	5553'
	#1 State	11-4N-26E	660' FNL & 660' FEL	9/30/44	6/25/46	5570'
	#1 Goode State	21-4N-27E	664' FNL & 663' FEL	6/7/74	7/10/74	7000'
	#1 Transport	10-3N-17E	NE NE	7/11/28	1/4/29	3075'
	#1 Overton-Fed.	20-2N-22E	660' FNL & 1980' FWL	3/12/59	4/27/59	5427'
	#1 Myrick	17-2N-25E	660' FSL & 1980' FWL	5/13/49	6/30/49	6174'
	#1 Nalde	27-1N-15E	660' FSL & 660' FEL	7/23/45	1/7/46	3350'
	#1-X State	2-1N-20E	860' FSL & 860' FEL	4/26/63	9/6/63	4597'
	#1 Mabel Field	13-1N-22E	660' FSL & 660' FWL	10/21/53	11/30/53	5581'
	#1 Milton	28-1S-25E	1980' FNL & 660' FWL	7/24/60	8/15/60	5589'
	#1 Vaughn	21-1S-26E	659' FNL & 658' FWL	7/16/74	8/12/74	5800'
	#1 State "GK"	32-1S-26E	1980' FNL & 1980' FWL	11/27/78	2/4/80	4900'
	#1 Hobson	12-1S-27E	660' FNL & 660' FEL	10/30/52	1/5/53	6742'
	#1 State	16-1S-27E	SW NE		4/17/35	5760'
	#1 Franks	23-2S-15E	2013' FSL & 660' FWL	8/13/53	9/2/53	2140'

EXHIBIT II
PAGE 2 OF 7

COUNTY	OPERATOR	WELL NAME	LOCATION	FOOTAGE	SPUD	COMPLETION	TOTAL DEPTH
DeBaca	Talbert	#1 Andre	20-2S-22E	1980' FSL & 660' FEL	12/11/57	3/2/58	5354'
DeBaca	CIG Expl.	#1 S.E.A. "18"	18-2S-27E	1980' FNL & 1980' FEL	5/22/78	6/26/78	6701'
DeBaca	Transcont'l	#1 McWhortor	6-3S-22E	2310' FNL & 990' FWL		12/12/29	4770'
DeBaca	Nearburg	#1 Murray	23-3S-24E	660' FNL & 1980' FWL	5/15/60	6/8/60	5372'
Chaves	W.K. Byrom	#1 State "AK"	14-3S-27E	660' FSL & 1980' FWL	5/21/69	5/31/69	6913'
Lincoln	Albuquerque	#1 Basinski	15-4S-16E	660' FNL & 2180' FWL	10/10/53	2/29/56	1962'
Chaves	Yates	#1 Willow Creek	16-4S-25E	1980' FNL & 1980' FEL	11/27/79	1/4/80	6670'
Chaves	MESA	#1 Camp State	6-4S-26E	1980' FNL & 880' FEL	11/21/79	12/4/79	4773'
Chaves	Shenandoah	#1 Sea Prop.	13-4S-26E	660' FSL & 1980' FEL	12/3/72	5/3/73	6550'
Chaves	Leonard	#1 Fed-White	9-4S-27E	660' FSL & 660' FWL	7/11/58	8/14/58	6713'
Chaves	Nearburg	#1 Gratton-St.	18-4S-27E	660' FSL & 660' FEL	10/4/70	10/26/70	6610'
Chaves	Miller	#1 State	20-4S-27E	660' FNL & 1980' FWL	8/1/56	11/28/56	6786'
Chaves	Mountain	#1 State	20-4S-27E	1980' FNL & 1980' FWL	5/19/72	6/7/72	6480'
Lincoln	Elliott	#1-10 Federal	10-5S-16E	660' FSL & 1980' FWL	3/16/62	4/32/62	3429'
Chaves	Sanders	#1 Sanders	25-5S-24E	1980' FNL & 660' FEL	10/29/50	12/1/50	5355'
Chaves	MESA	#1 Crockett St.	36-5S-25E	990' FSL & 1980' FEL	11/4/79	11/20/79	4733'
Chaves	McBee	#1-14 Warren	14-5S-26E	990' FSL & 990' FWL	12/11/59	1/17/60	6606'
Chaves	French	#1 Buried	19-5S-26E	2093' FSL & 2128' FEL	6/27/73	7/25/73	5843'
Chaves	El Paso	#1 Buried	33-5S-26E	660' FNL & 660' FEL	5/10/71	5/30/71	6506'
Chaves	Phillips	#1 Van "A"	6-5S-27E	2020' FSL & 2010' FEL	2/13/70	3/13/70	6833'
Chaves	Yates	#1 Red Rock	28-6S-25E	1980' FSL & 660' FEL	2/28/80		5000'

WELL NAME	LOCATION	FOOTAGE	SPUD	COMPLETION	TOTAL DEPTH
#1 Andre	20-2S-22E	1980' FSL & 660' FEL	12/11/57	3/2/58	5354'
#1 S.E.A. "18"	18-2S-27E	1980' FNL & 1980' FEL	5/22/78	6/26/78	6701'
#1 McWhortor	6-3S-22E	2310' FNL & 990' FWL		12/12/29	4770'
#1 Murray	23-3S-24E	660' FNL & 1980' FWL	5/15/60	6/8/60	5372'
#1 State "AK"	14-3S-27E	660' FSL & 1980' FWL	5/21/69	5/31/69	6913'
#1 Basinski	15-4S-16E	660' FNL & 2180' FWL	10/10/53	2/29/56	1962'
#1 Willow Creek	16-4S-25E	1980' FNL & 1980' FEL	11/27/79	1/4/80	6670'
#1 Camp State	6-4S-26E	1980' FNL & 880' FEL	11/21/79	12/4/79	4773'
#1 Sea Prop.	13-4S-26E	660' FSL & 1980' FEL	12/3/72	5/3/73	6550'
#1 Fed-White	9-4S-27E	660' FSL & 660' FWL	7/11/58	8/14/58	6713'
#1 Gratton-St.	18-4S-27E	660' FSL & 660' FEL	10/4/70	10/26/70	6610'
#1 State	20-4S-27E	660' FNL & 1980' FWL	8/1/56	11/28/56	6786'
#1-10 Federal	10-5S-16E	1980' FNL & 1980' FWL	5/19/72	6/7/72	6480'
#1 Sanders	25-5S-24E	660' FSL & 1980' FWL	3/16/62	4/32/62	3429'
#1 Crockett St.	36-5S-25E	1980' FNL & 660' FEL	10/29/50	12/1/50	5355'
#1-14 Warren	14-5S-26E	990' FSL & 1980' FEL	11/4/79	11/20/79	4733'
#1 Buried	19-5S-26E	990' FSL & 990' FWL	12/11/59	1/17/60	6606'
#1 Buried	33-5S-26E	2093' FSL & 2128' FEL	6/27/73	7/25/73	5843'
#1 Van "A"	6-5S-27E	660' FNL & 660' FEL	5/10/71	5/30/71	6506'
#1 Red Rock	28-6S-25E	2020' FSL & 2010' FEL	2/13/70	3/13/70	6833'
		1980' FSL & 660' FEL	2/28/80		5000'

EXHIBIT 11
PAGE 3 OF 7

COUNTY	OPERATOR	WELL NAME	LOCATION	FOOTAGE	SPUD	COMPLETION	TOTAL D
Chaves	Samedan	#1 Chatten	11-6S-27E	660' FNL & 660' FEL	3/30/58	4/27/58	6923'
Chaves	Southern Mine.	#1 Chatten	11-6S-27E	1980' FSL & 1980' FWL	8/3/68	8/22/68	6619'
Chaves	Southern Mine.	#1 G.F. Bannon	15-6S-27E	660' FSL & 660' FEL	6/5/66	7/9/66	6808'
Chaves	Read & Stevens	#1-16 State	16-6S-27E	1980' FSL & 660' FEL	11/3/72	11/5/73	6549'
Chaves	Forest	#1 Fed.-Haystack	20-6S-27E	660' FSL & 660' FWL	3/15/65	5/22/65	6315'
Chaves	Shenandoah	#1 Read & Stevens "Q"	20-6S-27E	1980' FNL & 1980' FEL	8/12/71	9/13/71	6600'
Chaves	Shenandoah	#1 Van Eaton	22-6S-27E	1980' FSL & 660' FWL	10/23/70	11/25/70	6579'
Chaves	Samedan	#1 Smith Ranch	26-6S-27E	660' FNL & 660' FWL	3/27/59	5/21/59	6732'
Chaves	Shenandoah	#1 Read & Stevens "S"	30-6S-27E	1980' FSL & 2310' FEL	1/9/72	2/23/72	6210'
Chaves	Anschutz	#1 State	32-6S-27E	330' FSL & 1650' FEL	4/13/75	5/13/75	6800'
Chaves	Hanagan	#1 Borica	25-7S-27E	660' FSL & 660' FWL	7/13/78	8/31/78	6930'
Chaves	Hanagan	#1 Faircloth	29-7S-27E	660' FSL & 660' FWL	9/2/78	9/27/78	6766'
Chaves	Coquina	#1 Jennings	32-7S-27E	1980' FNL & 1980' FEL	6/20/74	7/29/74	6933'
Chaves	Layton	#1 Elkins-St.	1-7S-28E	660' FSL & 1980' FWL	4/1/77	3/28/78	7203'
Chaves	C&K	#1-O'Brien	26-7S-28E	990' FSL & 990' FEL	11/28/72	1/2/73	7020'
Chaves	Sinclair	#1-O'Brien	26-7S-28E	1980' FNL & 1980' FEL	1/20/63	3/2/63	7109'
Chaves	Western	#1 Macho-St.	16-8S-23E	1980' FNL & 660' FEL	7/27/72	8/10/72	4197'
Chaves	Yates	#1 Williamson "LC"	4-8S-25E	1980' FNL & 1980' FEL	5/15/79	10/8/79	5404'
Chaves	Union	#1-5 Federal	5-8S-26E	660' FSL & 660' FWL	5/15/71	6/2/71	5680'
Chaves	Dekalb	#1 Joan Duke	14-8S-26E	660' FSL & 1980' FEL	11/17/74	12/30/54	6457'
Chaves	Norsworthy	#1 Dekalb-Fed.	21-8S-26E	660' FNL & 1980' FWL	1/4/61	1/28/61	6463'

WELL NAME	LOCATION	FOOTAGE	SPUD	COMPLETION	TOTAL DEPTH
#1 Chatten	11-6S-27E	660' FNL & 660' FEL	3/30/58	4/27/58	6923'
#1 Chatten	11-6S-27E	1980' FSL & 1980' FWL	8/3/68	8/22/68	6619'
#1 G.F. Bannon	15-6S-27E	660' FSL & 660' FEL	6/5/66	7/9/66	6808'
#1-16 State	16-6S-27E	1980' FSL & 660' FEL	11/3/72	11/5/73	6549'
#1 Fed.-Haystack	20-6S-27E	660' FSL & 660' FWL	3/15/65	5/22/65	6315'
#1 Read & Stevens "Q"	20-6S-27E	1980' FNL & 1980' FEL	8/12/71	9/13/71	6600'
#1 Van Eaton	22-6S-27E	1980' FSL & 660' FWL	10/23/70	11/25/70	6579'
#1 Smith Ranch	26-6S-27E	660' FNL & 660' FWL	3/27/59	5/21/59	6732'
#1 Read & Stevens "S"	30-6S-27E	1980' FSL & 2310' FEL	1/9/72	2/23/72	6210'
#1 State	32-6S-27E	330' FSL & 1650' FEL	4/13/75	5/13/75	6800'
#1 Borica	25-7S-27E	660' FSL & 660' FWL	7/13/78	8/31/78	6930'
#1 Faircloth	29-7S-27E	660' FSL & 660' FWL	9/2/78	9/27/78	6766'
#1 Jennings	32-7S-27E	1980' FNL & 1980' FEL	6/20/74	7/29/74	6933'
#1 Elkins-St.	1-7S-28E	660' FSL & 1980' FWL	4/1/77	3/28/78	7203'
#1-O'Brien	26-7S-28E	990' FSL & 990' FEL	11/28/72	1/2/73	7020'
#1-O'Brien	26-7S-28E	1980' FNL & 1980' FEL	1/20/63	3/2/63	7109'
#1 Macho-St.	16-8S-23E	1980' FNL & 660' FEL	7/27/72	8/10/72	4197'
#1 Williamson "LC"	4-8S-25E	1980' FNL & 1980' FEL	5/15/79	10/8/79	5404'
#1-5 Federal	5-8S-26E	660' FSL & 660' FWL	5/15/71	6/2/71	5680'
#1 Joan Duke	14-8S-26E	660' FSL & 1980' FEL	11/17/74	12/30/54	6457'
#1 Dekalb-Fed.	21-8S-26E	660' FNL & 1980' FWL	1/4/61	1/28/61	6463'

EXHIBIT 11
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COUNTY	OPERATOR	WELL NAME	LOCATION	FOOTAGE	SPUD	COMPLETION	TOTAL DEPTH
Chaves	Adobe	#1 Montgomery	2-8S-27E	660' FSL & 1980' FWL	8/5/71	11/4/71	6675'
Chaves	Sinclair	#1-119 State	17-8S-27E	1980' FSL & 1980' FWL	4/12/57	5/29/57	7022'
Chaves	Hamon	#1 N. Salisbury	6-8S-29E	1980' FNL & 1880' FWL	10/3/59	11/27/59	7390'
Lincoln	Texam	#1 Boyle	11-9S-20E	2033' FNL & 2015' FEL	2/5/55	5/21/55	3562'
Chaves	Union	#1 Kitchens	6-9S-26E	1980' FSL & 1980' FWL	11/6/67	12/4/67	5755'
Chaves	Yates	#1 Smith St.	14-9S-26E	1980' FSL & 660' FWL	7/22/78	12/20/78	6457'
Chaves	King Res.	#1 Phillips	16-9S-26E	660' FNL & 1980' FEL	7/7/69	8/27/69	6204'
Chaves	Marathon	#1 Dallas	23-9S-26E	660' FSL & 660' FWL	2/20/69	3/22/69	6380'
Chaves	Pennzoil	#1 Allied St.	33-9S-26E	1980' FNL & 1980' FEL	10/31/73	11/28/73	6200'
Chaves	Continental	#1-19 L.T. White	19-9S-28E	1980' FSL & 1980' FEL	4/16/56	6/20/56	7493'
Chaves	Continental	#1-27 L.T. White	27-9S-28E	1780' FNL & 660' FWL	8/30/56	11/28/56	7095'
Chaves	Dekalb	#1 J.P. White	31-9S-28E	660' FSL & 660' FWL	7/17/51	9/30/51	7463'
Chaves	Yates	#1 Sinkhole "NR" St.	8-10S-26E	1980' FNL & 1980' FEL	5/6/80	8/21/80	5200'
Chaves	Lowe	#1 Humble	20-10S-26E	660' FSL & 660' FEL	9/19/69	10/17/69	5895'
Chaves	Lowe	#1 Mercury	27-10S-26E	1980' FNL & 660' FWL	5/20/69	6/17/69	6124'
Chaves	Avalanche	#1 White	12-10S-27E	660' FNL & 1980' FEL	12/22/65	1/18/66	6850'
Chaves	Sage	#2 Copelan	31-10S-27E	660' FNL & 660' FEL	2/23/78	1/22/79	6930'
Chaves	British Amer.	#1 White	19-10S-28E	1980' FNL & 1980' FWL	8/25/52	11/2/52	7351'
Chaves	Dekalb	#1 J.P. White	35-10S-28E	1980' FSL & 660' FWL	7/6/43	2/8/44	7515'
Chaves	Whittenberg Avalanche	#1 L.E. Ranch	7-10S-29E	1980' FSL & 2310' FEL	10/6/62	11/20/62	8327'
Chaves	DeKalb	#1 J.P. White	7-10S-29E	1980' FSL & 1980' FEL	7/19/50	12/15/50	8735'

WELL NAME	LOCATION	FOOTAGE	SPUD	COMPLETION	TOTAL DEPTH
#1 Montgomery	2-8S-27E	660' FSL & 1980' FWL	8/5/71	11/4/71	6675'
#1-119 State	17-8S-27E	1980' FSL & 1980' FWL	4/12/57	5/29/57	7022'
#1 N. Salisbury	6-8S-29E	1980' FNL & 1880' FWL	10/3/59	11/27/59	7390'
#1 Boyle	11-9S-20E	2033' FNL & 2016' FEL	2/5/55	5/21/55	3562'
#1 Kitchens	6-9S-26E	1980' FSL & 1980' FWL	11/6/67	12/4/67	5755'
#1 Smith St.	14-9S-26E	1980' FSL & 660' FWL	7/22/78	12/20/78	6457'
#1 Phillips	16-9S-26E	660' FNL & 1980' FEL	7/7/69	8/27/69	6204'
#1 Dallas	23-9S-26E	660' FSL & 660' FWL	2/20/69	3/22/69	6380'
#1 Allied St.	33-9S-26E	1980' FNL & 1980' FEL	10/31/73	11/28/73	6200'
#1-19 L.T. White	19-9S-28E	1980' FSL & 1980' FEL	4/16/56	6/20/56	7493'
#1-27 L.T. White	27-9S-28E	1780' FNL & 660' FWL	8/30/56	11/28/56	7095'
#1 J.P. White	31-9S-28E	660' FSL & 660' FWL	7/17/51	9/30/51	7463'
#1 Sinkhole "NR" St.	8-10S-26E	1980' FNL & 1980' FEL	5/6/80	8/21/80	5200'
#1 Humble	20-10S-26E	660' FSL & 660' FEL	9/19/69	10/17/69	5895'
#1 Mercury	27-10S-26E	1980' FNL & 660' FWL	5/20/69	6/17/69	6124'
#1 White	12-10S-27E	660' FNL & 1980' FEL	12/22/65	1/18/66	6850'
#2 Copelan	31-10S-27E	660' FNL & 660' FEL	2/23/78	1/22/79	6930'
#1 White	19-10S-28E	1980' FNL & 1980' FWL	8/25/52	11/2/52	7351'
#1 J.P. White	35-10S-28E	1980' FSL & 660' FWL	7/6/43	2/8/44	7515'
#1 L.E. Ranch	7-10S-29E	1980' FSL & 2310' FEL	10/6/62	11/20/62	8327'
#1 J.P. White	7-10S-29E	1980' FSL & 1980' FEL	7/19/50	12/15/50	8735'

COUNTY	OPERATOR	WELL NAME	LOCATION	FOOTAGE	SPUD	COMPLETION	T
Chaves	J. P. White	#1 L.E. Ranch	7-10S-29E	2305' FNL & 1651' FEL	1/30/62	2/17/62	
Chaves	Aztec	#1 Pecos State	36-11S-25E	1980' FSL & 1980' FEL	8/14/72	9/22/72	
Chaves	Hanson	#1 Richfield	13-11S-26E	1980' FNL & 1980' FEL	6/15/64	6/26/64	
Chaves	Delaware-Apache	#1 U.S. Phillips	22-11S-26E	1980' FSL & 660' FEL	3/3/69	3/21/69	
Chaves	Shenandoah	#1 Federal "T"	23-11S-26E	660' FSL & 1980' FEL	9/27/72	10/22/72	
Chaves	Richfield	#2 Comanche	24-11S-26E	1980' FNL & 660' FEL	4/14/48	10/20/48	
Chaves	Kewanne	#1 Dekalb	25-11S-26E	735' FSL & 660' FWL	3/11/53	3/25/53	
Chaves	Hanson	#1 Comanche	26-11S-26E	1980' FNL & 660' FWL	1/15/63	2/20/63	
Chaves	Texas	#1 State "AM"	13-11S-27E	1980' FNL & 1980' FWL	8/29/50	11/16/50	
Chaves	Dekalb	#1 Coll	18-11S-27E	1980' FSL & 1980' FEL	1/30/49	12/4/49	
Chaves	Honolulu	#1 Hinkle	24-11S-27E	660' FNL & 1980' FWL	3/14/50	3/25/50	
Chaves	Secan	#1 Rutledge	25-11S-27E	330' FNL & 660' FEL	4/1/73	10/15/73	
Chaves	Secan	#1 Levick-St.	26-11S-27E	660' FNL & 1650' FWL	2/20/73	3/19/73	
Chaves	Secan	#1 State	26-11S-27E	1980' FNL & 1980' FEL	8/15/72	1/2/73	
Chaves	Union	#1 State	27-11S-27E	1980' FSL & 1980' FWL	6/26/49	9/6/49	
Lincoln	Stanolind	#1 Picacho	10-12S-18E	660' FNL & 760' FWL	1/1/45	7/16/45	
Chaves	Franklin	#1 Orchard	22-12S-25E	660' FNL & 1980' FWL	12/10/50	2/4/51	
Chaves	Atlantic	#1 Morrison	10-12S-26E	660' FNL & 660' FEL	5/3/68	5/28/68	
Chaves	Supron	#1 Amoco St.	16-12S-26E	1980' FSL & 1980' FEL	5/31/79	7/1/79	
Chaves	Cities Ser.	#1-A Stone	20-12S-26E	2080' FNL & 560' FWL	5/30/66	7/13/66	
Chaves	Humble	#1-U State	10-12S-27E	660' FSL & 1980' FEL	5/6/48	8/23/48	
Chaves	Gibson	#1 Humble St.	12-12S-27E	660' FSL & 660' FWL	6/4/52	8/19/52	

ATOR	WELL NAME	LOCATION	FOOTAGE	SPUD	COMPLETION	TOTAL DEPTH
. White	#1 L.E. Ranch	7-10S-29E	2305' FNL & 1651' FEL	1/30/62	2/17/62	8637'
c	#1 Pecos State	36-11S-25E	1980' FSL & 1980' FEL	8/14/72	9/22/72	5808'
on	#1 Richfield	13-11S-26E	1980' FNL & 1980' FEL	6/15/64	6/26/64	6129'
ware-Apache	#1 U.S. Phillips	22-11S-26E	1980' FSL & 660' FEL	3/3/69	3/21/69	6040'
andoah	#1 Federal "T"	23-11S-26E	660' FSL & 1980' FEL	9/27/72	10/22/72	6121'
field	#2 Comanche	24-11S-26E	1980' FNL & 660' FEL	4/14/48	10/20/48	6330'
nne	#1 Dekalb	25-11S-26E	735' FSL & 660' FWL	3/11/53	3/25/53	6278'
on	#1 Comanche	26-11S-26E	1980' FNL & 660' FWL	1/15/63	2/20/63	6175'
s	#1 State "AM"	13-11S-27E	1980' FNL & 1980' FWL	8/29/50	11/16/50	6617'
lb	#1 Coll	18-11S-27E	1980' FSL & 1980' FEL	1/30/49	12/4/49	6630'
lulu	#1 Hinkle	24-11S-27E	660' FNL & 1980' FWL	3/14/50	3/25/50	7315'
n	#1 Rutledge	25-11S-27E	330' FNL & 660' FEL	4/1/73	10/15/73	7000'
n	#1 Levick-St.	26-11S-27E	660' FNL & 1650' FWL	2/20/73	3/19/73	7700'
n	#1 State	26-11S-27E	1980' FNL & 1980' FEL	8/15/72	1/2/73	7000'
	#1 State	27-11S-27E	1980' FSL & 1980' FWL	6/26/49	9/6/49	7582'
lind	#1 Picacho	10-12S-18E	660' FNL & 760' FWL	1/1/45	7/16/45	2843
lin	#1 Orchard	22-12S-25E	660' FNL & 1980' FWL	12/10/50	2/4/51	5828'
tic	#1 Morrison	10-12S-26E	660' FNL & 660' FEL	5/3/68	5/28/68	6370'
n	#1 Amoco St.	16-12S-26E	1980' FSL & 1980' FEL	5/31/79	7/1/79	6210'
s Ser.	#1-A Stone	20-12S-26E	2080' FNL & 560' FWL	5/30/66	7/13/66	6014'
e	#1-U State	10-12S-27E	660' FSL & 1980' FEL	5/6/48	8/23/48	7851'
n	#1 Humble St.	12-12S-27E	660' FSL & 660' FWL	6/4/52	8/19/52	8020'

EXHIBIT 11
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COUNTY	OPERATOR	WELL NAME	LOCATION	FOOTAGE	SPUD	COMPLETION	TOTAL DEPT
Chaves	Delta Drlg.	#1 Clayton	8-13S-25E	660' FNL & 660' FWL	1/20/62	2/16/62	5500'
Chaves	Hamon	#1 Wilson	26-13S-26E	1780' FSL & 1980' FEL	12/23/75	1/26/76	7915'
Chaves	Magnolia	#1 Turney	23-14S-22E	660' FNL & 660' FWL	9/12/48	10/29/48	5342'
Chaves	Delaware-Apache	#1 Sun Fed.	22-14S-24E	660' FNL & 1980' FEL	4/28/69	5/29/69	6181'
Chaves	Land	#1 Garner	23-14S-25E	330' FNL & 330' FWL	11/3/75	2/15/76	4377'
Chaves	Franklin	#1 Cruz Fed.	31-14S-25E	660' NFL & 660' FWL	9/26/68	10/22/68	6754'
Chaves	Continental	#1 Langford	2-14S-26E	660' FSL & 1980' FEL	7/5/47	10/10/47	8099'
Chaves	Shenandoah	#1 Utterback	12-14S-26E	1980' FNL & 660' FWL	11/5/72	12/12/72	7000'
Chaves	Shenandoah	#1 Rhodes	23-14S-26E	660' FSL & 1980' FWL	10/5/72	10/30/72	7225'
Chaves	Magnolia	#1 Brown	27-14S-26E	1980' FNL & 660' FEL	6/29/56	10/12/56	8389'
Chaves	Sunray	#1-5 N.M. Fed.	11-14S-27E	660' FNL & 660' FEL	3/3/62	4/13/62	8691'
Chaves	Humble	#1 Gorman	30-15S-22E	660' FNL & 660' FEL	9/11/48	11/29/48	5849'
Chaves	Holmes	#1 Moats	4-15S-25E	1980' FNL & 1980' FWL	12/26/65	1/16/66	6621'
Chaves	Magnolia	#1 Pearson	23-15S-25E	660' FNL & 1980' FEL	3/25/59	6/9/59	7722'
Chaves	Blackford	#1 Roberts	10-15S-26E	660' FSL & 660' FEL	5/31/54	8/18/54	3440'
Chaves	Yates	#1 Riverbend "HR"	33-15S-26E	660' FSL & 1980' FEL	4/1/77	10/21/77	8500'
Chaves	Read & Stevens	#1 Sanders-St.	36-15S-26E	660' FSL & 1980' FWL	5/24/77	7/2/77	8295'

WELL NAME	LOCATION	FOOTAGE	SPUD	COMPLETION	TOTAL DEPTH
#1 Clayton	8-13S-25E	660' FNL & 660' FWL	1/20/62	2/16/62	5500'
#1 Wilson	26-13S-26E	1780' FSL & 1980' FEL	12/23/75	1/26/76	7915'
#1 Turney	23-14S-22E	660' FNL & 660' FWL	9/12/48	10/29/48	5342'
#1 Sun Fed.	22-14S-24E	660' FNL & 1980' FEL	4/28/69	5/29/69	6181'
#1 Garner	23-14S-25E	330' FNL & 330' FWL	11/3/75	2/15/76	4377'
#1 Cruz Fed.	31-14S-25E	660' NFL & 660' FWL	9/26/68	10/22/68	6754'
#1 Langford	2-14S-26E	660' FSL & 1980' FEL	7/5/47	10/10/47	8099'
#1 Utterback	12-14S-26E	1980' FNL & 660' FWL	11/5/72	12/12/72	7000'
#1 Rhodes	23-14S-26E	660' FSL & 1980' FWL	10/5/72	10/30/72	7225'
#1 Brown	27-14S-26E	1980' FNL & 660' FEL	6/29/56	10/12/56	8389'
#1-5 N.M. Fed.	11-14S-27E	660' FNL & 660' FEL	3/3/62	4/13/62	8691'
#1 Gorman	30-15S-22E	660' FNL & 660' FEL	9/11/48	11/29/48	5849'
#1 Moats	4-15S-25E	1980' FNL & 1980' FWL	12/26/65	1/16/66	6621'
#1 Pearson	23-15S-25E	660' FNL & 1980' FEL	3/25/59	6/9/59	7722'
#1 Roberts	10-15S-26E	660' FSL & 660' FEL	5/31/54	8/18/54	3440'
#1 Riverbend "HR"	33-15S-26E	660' FSL & 1980' FEL	4/1/77	10/21/77	8500'
#1 Sanders-St.	36-15S-26E	660' FSL & 1980' FWL	5/24/77	7/2/77	8295'

PECOS SLOPE

ABO SANDSTONE TIGHT GAS PLAY

IN SOUTHEAST NEW MEXICO

WELL NAME S,T,R Tract #	SPUD/COMP. DATE	TD/COMP. DEPTH	DHP/DEPTH (GRADIENT)	NATURAL FLOW RATE	FIRST TREATMENT TYPE & DATE	FLOW RATE AFTER 1ST TREATMENT	SECOND TREATMENT TYPE & DATE	FLOW RATE AFTER 2ND TREATMENT	DATE ON LINE INIT. PROD. RATE
BOYD OPERATING CO.									
Blackmore Federal #1 20-9S-26E 39	10-6-79 12-10-79	5700 4150-4210	1126	Swab dry with blow of gas	750g Acid	F 175 MCFPD	RAC 10000g	175 MCFPD	3-10-80 132 MCFPD
MCCLELLAN OIL CORP.									
"JJ" Federal No. 1 1-10S-25E 41	4-18-79 5-16-79	4510 3948-4496	1016	Not Available	1500g Acid	Weak blow gas	FRAC 70000g	2040 MCFPD	3-01-80 636 MCFPD
"MM" Federal No. 1 31-9s-26E 40	8-22-79 9-19-79	4730 4436-4468 4730 4174-4202	1082	Not Available	3000g Acid 1500g Acid	TSTM Swab & Flow 40-50 MCFPD	FRAC 70000g FRAC 100000g	253 MCFPD 1622 MCFPD	3-03-80 787 MCFPD
"PJ" Federal No. 1 No. 1 6-9S-26E 37	4-24-80 5-30-80	4700 4334-4514	1128	Not Available	2500g Acid	Potential well	None	2075 MCFPD	8-25-70 900 MCFPD
Penjack Federal No. 1 6-10S-26E 43	10-20-78 2-03-79	5570 4314-4334 5570 4089-4151	1058	Not Available Not Available	2000g Acid	Swab Flow 50 MCFPD	FRAC 100000g	1703 MCFPD	3-01-80 765 MCFPD
Tolmac State No. 1 36-9S-25E 35	2-04-79 4-16-79	4550 4257?-4272 4550 4034-4052	1074	Not Available Not Available	2000g Acid 9000g Acid	Swab with weak blow weak blow	FRAC 100000g FRAC 175000g	1034 MCFPD 833 MCFPD	3-01-80 292 MCFPD
POOL, FRED DRILLING									
Grynberg Com. Federal No. 1 13-6S-24E 13	6-3-80	5035 3778-3795	Not Available	Not Available	2500G Acid	Not Available	Pending	Not Available	Not On Line
Corn No. 1-24 24-5E-24E 7	1-16-80 2-29-80	4475 3822-3836 4475 3946-3860	1109	Not Available	3000g Acid	Not Available	FRAC 25000g	Not Available	7/28/80 229 MCFPD
Corn No. 2-24 24-5S-24E 6	4-20-80 6-28-80	5328 3706-3714 5328 3850-3866	1116	Not Available	1500g Acid 1500g Acid	10# 125 MCFPD	FRAC All PERFS 20000g	1317 MCFPD	8/15/80 62 MCFPD
MESA PETROLEUM CO.									
Acme No. 1 29-8S-26E 33	4-25-80 8-09-80	4980 4634-4652	1065	Swab dry with 2' flare	1000g Acid	30# 35 MCFPD	FRAC 25000g	95# 1/2 chk 700 MCFPD	Not On Line
Bestwall No. 1 29-9S-25E 39	4-5-80 5-09-80	4100 3346-3864	699	Swab dry	10000g Acid	Swab with gas on swab runs only.	FRAC 25600g	10# 20/64 chk 120 MCFPD	Not On Line
Rock Federal #1 7-8S-23E 30	10-16-79 2-16-80	4008 3355-3363 4008 3921-3970	---	100# 3/8ck 350MCFPD Swab dry with trace of gas	1000g Acid 3500g Acid	250# 850 MCFPD 0# 181 MCFPD	FRAC 25000g	750 MCFPD	Not On Line
Rock Federal #2 7-8S-23E 29	4-18-80 4-25-80	3500 2810-2819	1046	Swab dry	10000g Acid	TSTM	FRAC 15000g	10-20? 150-100 MCFPD	Not On Line
Rock Federal #5 18-8S-23E 31	7-26-80 8-11-80	3500 2878-2889 3500 2092-3007 3500 3208-3335 3500 3333-3351	Not Available	Swab dry	6000g Acid	115# 1/4" chk 180 MCFPD	FRAC 50000g	454 1/2 chk 300 MCFPD	Not On Line
Savage Federal No. 1 4-7S-25E 23	3-27-80 7-28-80	5102 3918-3954 5102 3600-3656	Not Available	Swab with 2-3' Flare 30# 32/64 CK 250 MCFPD	4000g Acid 4000g Acid	120# 1/2" CHK 750 MCFPD 100# 1/2" CHK 700 MCFPD	FRAC 40000g FRAC 40000g	625# 1/2" CHK 2000 MCFPD 375# 1# CHK 2000 MCFPD	Not On Line
Stancel Federal No. 1 23-5S-24E 5	5-10-80 7-12-80	5260 3913-3968 5260 3726-3912	Not Available	Swab Dry Swab Dry	3000g Acid 2500g Acid	100# 1/2" CHK 630 MCFPD 680# 8/64" CHK 2000MCFPD	FRAC 30000g FRAC 30000g	360# 1/2" CHK 1000 MCFPD 130# 1/2" CHK 800 MCFPD	Not On Line
Stancel Federal No. 2 22-5S-24E 4	8-23-80 9-10-80	4300 3710-3720	Not Available	Swab Dry	3000g Acid	20# 400MCFPD	FRAC 30000g	235# 300 MCFPD	Not On Line

EXHIBIT 10

WELL NAME S,T,R Tract #	SPUD/COMP. DATE	TD/COMP. DEPTH	PBD/DEPTH (GRADIENT)	NATURAL FLOW RATE	FIRST TREATMENT TYPE & DATE	FLOW RATE AFTER 1ST TREATMENT	SECOND TREATMENT TYPE & DATE	FLOW RATE AFTER 2ND TREATMENT	DATE ON LINE INIT. PROD. RATE
YATES PETROLEUM CORP.									
COTTONWOOD RANCH FEDERAL #1	8-1-80 9-12-80	4125 4053-4053	905 4051	15# 1/8" Choke	8-11-80 2000g Acid and Nitrogen	75# 3/8" Choke	8-29-80 FRAC 20000g Gell. Water, 20	500# 1/2" Choke	NOT ON LINE
25-7s-25e 27			(.246)	10 MCFPD		312 MCFPD	Tons CO2 & 50000# Sand	3212 MCFPD	
COTTONWOOD RANCH HK STATE #1	11-19-79 12-19-79	5318 3509-3024	1123 3815	NOT AVAILABLE	12-17-79 FRAC 20000g Gel.Wtr.2000g Acid 6000 CO2 60000# Sand	303# 1/2" Choke	NO TREATMENT	NA	7-11-80
36-6s-25e 18			(.294)			1963 MCFPD			400 MCFPD
DURGAN LT FEDERAL #1-Y	10-7-79 11-15-79	4120 3876-3884	1135 3880	MODERATE FLOW	11-8-79 1000g Acid	10# 1/8" Choke	11-13-79 FRAC 21000g Gelled Wtr.	250# 1/2" Choke	7-11-80
3-8s-25e 32			(.293)			8 MCFPD	63000g CO2 40000# Sand	1650 MCFPD	325 MCFPD
ERICKSON KY STATE #1	8-22-79 11-10-79	4775 4238-4253	1148 4240	MODERATE FLOW	10-24-79 2750g Acid	TSTM	11-2-79 FRAC 35000# Sand	105# 1/4" Choke	3-12-80
2-10s-25e 42			(.270)				29000g Gelled Water 10000g CO2	175 MCFPD	
FEDERAL BY #2	4-9-79 5-12-79	4970 3972-3930	1173 3376	NOT AVAILABLE	5-8-79 1500g Acid	200# 1/4" CHK 200 MCFPD	5-10-79 Frac	700#cf	5-25-79 ELPT
33-7s-25e 28		4970 3510-3560	(.303)		5-12-79 Acid & Frac	350# 1/2" CHK 2000 MCFPD			125 MCFPD ON FOR TM 8-7-80
FEDERAL IY #1	1-19-78 3-11-78	5132 4810-4822	1144 4815	NOT AVAILABLE	3-2-78 1000g Acid	10# 1/2" Choke	3-8-78 FRAC 16200g Gelled Water	60# 1/2" Choke	2-25-80
3-9s-25e 36			(.238)			146 MCFPD	17500# Sand	460 MCFPD	
FIVE MILE DRAW LX FEDERAL #1	10-27-79 7-3-80	5150 3816-3818 3826-3836	NOT AVAILABLE	MODERATE FLOW	6-29-80 1500g Acid and Nitrogen	65# 1/2" Choke	6-24-80 FRAC 17000g Gell. Wtr. 38605# Sand and CO2	300# 1/2" Choke	7-20-80
34-6s-25e 44						407 MCFPD		1960 MCFPD	370 MCFPD
GLOBE MT FEDERAL #1	1-30-80 2-24-80	4260 3758-3772	1131 3765	NOT AVAILABLE	2-14-80 1000g Acid	50# 1/8" Choke	2-19-80 FRAC 40000g Gell. Wtr. 2000g	215# 1/2" Choke	7-17-80
1-5s-24e 2			(.300)			220 MCFPD	Acid 80000# Sand	1440 MCFPD	440 MCFPD
GODFREY AP FEDERAL #1	12-30-79 2-18-80	4647 4012-4022	1142 4005	NOT AVAILABLE	2-14-80 1000g Acid	130# 5/8" Choke	2-23-80 FRAC 20000g gelled water 46320#	395# 1/2" Choke	7-14-80
10-7s-25e 26			(.285)			1430 MCFPD	Sand & CO2	2450 MCFPD	400 MCFPD
GRYNBERG LZ STATE #1	10-23-79 11-29-79	5096 3910-3946	1149 3928	NOT AVAILABLE	11-21-79 1000g Acid	113# 1/8" Choke	11-27-79 FRAC 41000g Gelled Wtr. &	243# 1/2" Choke	7-14-80
36-5s-24e 10			(.293)			425 MCFPD	CO2 75000# Sand	1000 MCFPD	540 MCFPD
GYP RO FEDERAL #1	2-12-80 3-6-80	5200 3770-3780	1129 3775	NOT AVAILABLE	3-4-80 Sand Frac & Acid	240# 1/2" Choke	NO TREATMENT	NA	7-14-80
35-5s-24e 0			(.299)			1600 MCFPD			505 MCFPD
HAIR MT FEDERAL #1	5-23-80 6-27-80	5200 4024-4030	1087 4027	MODERATE FLOW	6-20-80 1500g Acid	85# 1/2" Choke	6-25-80 FRAC 36000# Sand 20000g	160# 1/2" Choke	NOT ON LINE
9-7s-25e 25			(.270)			625 MCFPD	Gelled Water	1100 MCFPD	
HILLTOP RO STATE #1	5-6-80 6-20-80	5220 3950-3961	1077 3960	MODERATE FLOW	6-12-80 500g Acid	125# 1/8" Choke	6-17-80 FRAC 20000g Gell. Wtr. 50000#	40# 1/2" Choke	NOT ON LINE
7-7s-25e 24			(.272)			49 MCFPD	Sand and CO2	457 MCFPD	
IWANOWSKI ICY FEDERAL #1	2-8-80 6-19-80	5523 3304-3414	1014 3403	TSTM	4-8-80 1000g Acid and Nitrogen	TSTM	5-2-80 FRAC 20000g Gell. Wtr. 50000#	1600# 3/8" Choke	NOT ON LINE
34-3s-24e 14			(.291)				Sand	395 MCFPD	
MCCLELLAN RO FED. #1	1-12-80 2-20-80	4670 3930-3960	1146 3935	TSTM	2-18-80 FRAC 27150g Gell. Wrt. Acid &	670# 1/2" Choke	NO TREATMENT	NA	7-17-80
31-6s-25e 12			(.290)		CO2 60000# Sand	4200 MCFPD			695 MCFPD
[illegible] #1	Re-entry 4-23-77 5-6-77	6371 4701-4702	1146 4773	335# 1/4" Choke	5-21-77 2500g Acid & Nitrogen	TSTM AVAILABLE	5-25-77 FRAC 15000g Gell. Wtr. & CO2	340# 1/2" Choke	7-20-80
36			(.240)	521 MCFPD			17500# Sand	2040 MCFPD	
[illegible]	4-21-80 6-17-80	4050 3335-3340	983 3340	MODERATE FLOW	5-22-80 1000g Acid and Nitrogen	TSTM	5-29-80 FRAC 20000g Gell. Wtr. 50000# Sand	310# 1/4" Choke	NOT ON LINE
[illegible]			(.288)					460 MCFPD	

WELL NAME S,T,R	SPUD/COMP. DATE	IP/COMP. INTVL	PBD/DEPTH (GRADIENT)	NATURAL FLOW RATE	FIRST TREATMENT TYPE & DATE	FLOW RATE AFTER 1ST TREATMENT	SECOND TREATMENT TYPE & DATE	FLOW RATE AFTER 2ND TREATMENT	DATE ON LINE CHOKE SIZE/TBG. PRES./PROD. RATE
SHERROFF NL STATE #1 2-5s-24e 3	4-5-80 4-25-80	4776 3634-3662	1130 3644 (.310)	.0# 1/8" Choke	1-23-80 3000g Acid	NOT 24/64" Choke 321 MCFPD	4-23-80 FRAC 50000# Sand 211260g Gell. Water	380# 3/4" Choke 5800 MCFPD	NOT ON LINE
SOUTH ALKALI LK FEDERAL #1 12-6s-25e 15	9-24-79	3714-3724 3812 3890-3926	1139 3719 (.306)	TSTM NOT AVAILABLE	9-14-79 FRAC 9-23-79 500g Acid	160# 9/16" Choke 1225 MCFPD NOT AVAILABLE	NONE	NOT AVAILABLE	7-13-80
TIGRAS UT FEDERAL #1 12-6s-25e 16	8-29-79 11-29-79	3144 3900-3930	1152 3930 (.209)	NO SHOW OF GAS OR OIL	10-11-79 1500g Acid	1050 3/64" Choke 39 MCFPD	10-16-79 FRAC 37000g Gell. Wtr. 74000# Sand	315# 1/2" Choke Small Mist Wtr. Periodically 2000 MCFPD	400 MCFPD 7-13-80
TIGRAS MI FEDERAL #2 3-7s-25e 22	8-25-80 10-2-80	3150 3958-3984	1122 3961 (.283)	WOULDN'T FLOW	9-19-80 2000g ACID and NITROGEN	207 1/4" CHOKE 48.6 MCFPD	9-30-80 FRAC 20000g GELLED WATER, 45250# SAND, and CO2	220# 1/2" CHOKE 1359 MCFPD	450 MCFPD NOT ON LINE
TECREA MD FEDERAL #2 13-6s-25e 17	6-19-80 7-26-80	5250 3961-3978	NOT AVAILABLE	77 1/8" Choke 7 MCFPD	7-17-80 2000g Acid, Nitrogen and Ball Sealers	30# 378". Choke 150 MCFPD	7-23-80 FRAC 40000g Gell. Wtr. 85000# Sand and CO2	615# 1/2" Choke 3860 MCFPD	NOT ON LINE

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NARRATIVE OF TESTIMONY TO THE
NEW MEXICO OIL CONSERVATION DIVISION
FOR DESIGNATION OF
PECOS SLOPE ABO TIGHT GAS PLAY
SOUTHEASTERN NEW MEXICO
AS A TIGHT GAS FORMATION

Ex 28

NOVEMBER 25, 1980

This testimony will be presented by John Jay Keesey, Vice-President and Manager of Engineering for Sipes, Williamson & Associates, Inc., Midland, Texas. Mr. Keesey has appeared before the New Mexico Oil Conservation Division on previous occasions and is a registered professional engineer in the State of Texas. A resume depicting Mr. Keesey's educational and professional experience is enclosed. Sipes, Williamson & Associates, Inc. is a petroleum consulting firm with offices in Midland and Houston, Texas. The firm has a background of experience since 1955 primarily in reservoir analyses, secondary and enhanced recovery studies, oil and gas reserve studies, annual reserve studies of publicly and privately owned companies, property evaluations, proration schedules, as well as other diversified services.

Exhibit 5 was presented by Mr. Joe Jeffers and is a structure map on top of the Abo. This exhibit additionally shows all of the wells, which were completed in the Abo formation as of October 31, 1980, and also serves as a reference for the engineering data to be presented. There were 43 wells completed or being completed in the Abo formation as of October 31, 1980. These wells are shown on Exhibit 5 by the gas well completion symbol and are also colored in orange. Each well has been assigned a map reference number which is referred to as Sipes, Williamson & Associates, Inc.'s (SW&A) tract number. This number appears next to each completed well. This number will also appear on the engineering exhibits to be submitted for easy reference purposes. A series of letters follow the tract number, which are keys to the engineering data that are available on specific wells. The letter "P" indicates that the well was producing as of October 31, 1980. The letter "A" indicates those wells for which core data are available. The

letter "B" indicates those wells for which production performance curves are included. The letter "C" indicates those wells for which prestimulation flow rate data are available. The letter "D" indicates those wells for which bottom-hole pressure build-up data were available for the calculation of reservoir permeability.

Exhibit 10 is a table presenting completion information on those wells which have been completed in the Abo formation. Information shown includes: Sipes, Williamson & Associates, Inc.'s tract number reference, well name, location, spud date, completion date, total depth, completion interval, initial bottom-hole pressure, flow rate data, stimulation data, date on line and initial producing rate.

The flow rate data mentioned above are presented for natural flow conditions; that is, prior to any stimulation. In addition, flow rate data obtained after the first and second stimulation treatments are also presented. Stimulation is required in order to obtain sustained commercial producing rates in this underpressured reservoir. The majority of wells were stimulated twice, with the first stimulation consisting of an acid treatment ranging generally from 500 to 4,000 gallons of acid. The second stimulation treatment normally consisted of a fracture treatment generally consisting of 20,000 to 40,000 gallons of jelled water and sand. It is noted that seven of the wells on Exhibit 10 were spudded prior to July 16, 1979 and therefore do not qualify for the tight gas sand classification under Section 107(b) of the Natural Gas Policy Act of 1978 (NGPA).

Exhibit 11 is a list of plugged and abandoned wells within the area of interest which have penetrated, or are believed to have penetrated, the Abo formation. A question of penetration exists on several wells where data are not complete or available. There are a total of 123 wells on this list. Several of these wells specifically have tested the Abo, while the remainder have simply penetrated the Abo formation during drilling to deeper depths. A high majority of these wells, if not all of them, were drilled with

rotary tools. No shows of hydrocarbons through the Abo section were recorded, which does not condemn the Abo formation for commercial gas production, but is indicative of the tight nature of the Abo formation.

The estimated average in situ gas permeability of the Abo sand section was calculated using two widely accepted industry standard methods. These methods include laboratory measurements of cored Abo sand sections and permeability calculations from bottom-hole pressure build-up data. It is the opinion of Sipes, Williamson & Associates, Inc. that these two methods provide the best estimate of the permeability to the gas and, although other methods may be accepted, the data with the highest quality were obtained pursuant to these methods.

The first method for obtaining the in situ gas permeability by core analysis requires permeability measurements of actual cored sections of Abo sand in the laboratory. Due to poor core recoveries and the increased expenses due to coring, only two wells were cored in the Abo sand. Routine core analyses data were obtained from these two cores. Exhibit 12 is a section of the log on the Thorpe "MI" Well No. 2, which shows the two intervals cored and highlights the Abo sand pay interval. Exhibit 13 is a log on the Papalote "OI" State No. 1 well, which also shows the section cored and the Abo sand pay interval. Exhibit 14 is a table listing the results of the routine core analyses on both wells. The data shown is for the Abo sand pay sections. The results of the routine core analyses on the Papalote "OI" State No. 1 reflect an average permeability of 0.048 millidarcies. The results of the routine core analyses on the Thorpe "MI" Well No. 2 reflect an average permeability of 0.074 millidarcies.

In addition to the above, special tests were run on samples from the Thorpe "MI" No. 2 to evaluate the effects of overburden pressure on the core samples and to determine a more nearly representative value for the in situ reservoir permeability. Routine core analyses are normally run with a confining or overburden

pressure of approximately 150 pounds. The overburden pressure within the formation is much greater and special tests are required in order to apply overburden pressure of that encountered at the depth of the reservoir. These special tests were run at an overburden pressure of 2,060 pounds. Exhibit 15 depicts the results of the special tests conducted on the Thorpe "MI" Well No. 2 core samples. These data reflect a marked decrease in the permeability for the tested samples under overburden, or in situ, conditions. The correlation depicted on Exhibit 15 can then be used to adjust the routine core permeability to in situ conditions for any other sample. This was done for all test intervals in the two wells tested and the results are shown in the last column of Exhibit 14. As noted, the average permeability for the pay section in the Papalote "OI" State No. 1 under in situ conditions was 0.0069 millidarcies, while the average in situ permeability for the Thorpe "MI" No. 2 was 0.0065 millidarcies. The average routine permeability and in situ permeability for both the Papalote "OI" State No. 1 and Thorpe "MI" No. 2 were determined to be 0.066 and 0.0066 millidarcies, respectively.

It is apparent from the above discussion that the available core data confirm that the Abo sand pay will have a permeability less than the allowed 0.1 millidarcies, under both routine and in situ test conditions.

The Thorpe "MI" Well No. 2 and the Papalote "OI" State No. 1 are both considered to be typical samples of the Abo formation. The Thorpe "MI" Well No. 2 was tested prior to stimulation and had no flow. After acidizing, the well flowed 48.6 MCF per day and, after a subsequent fracture stimulation, the well flowed 1,359 MCF per day. These data are shown on Exhibit 10. The Papalote "OI" State No. 1 is currently being completed and no specific test information is available; however, the core and log data reflect that this well is typical of the other Abo completions in the area of interest.

The second procedure for obtaining the in situ permeability is from bottom-hole pressure build-up data. These data were obtained on

four of the Abo completions. The pressure analysis method used to calculate the average permeability was the conventional Horner Plot technique. The equation to calculate the average permeability is:

Equation 1.

$$k, \text{ millidarcies} = \frac{162.6\ q\ \mu_i\ B_g}{m\ h}$$

The value for m is the slope of the straight-line portion of the Horner Plot of the bottom-hole pressure data. It is measured in psi per cycle.

The results of the bottom-hole pressure analyses on four wells are shown on Exhibit 16. This technique yielded average reservoir permeabilities ranging from a low of 0.01 to a high of 0.1188 millidarcies. The average permeability for the four wells was determined to be 0.0506 millidarcies. This average calculated permeability compares favorably to the permeability determined by the routine core analyses discussed above, but is lower than the in situ permeabilities determined by the core data method. The higher in situ permeabilities, determined by the bottom-hole pressure calculation method, are attributed to the fact that these four pressure build-up tests were taken after each of the wells was treated with acid.

Exhibit 17 is a tabulation of flow data obtained on Abo gas wells prior to stimulation. These data show that a large percentage of the Abo gas wells would not flow upon initial completion. Other wells had very low flow rates, or gas blows, that were too small to measure. Typically, these low flow rates, listed as too small to measure (TSTM), would be in the range of a few MCF of gas per day; and, in all cases, probably less than ten MCF of gas per day. Several wells had no flow rate data available, which is fairly common on tight gas sand wells as many operators will simply proceed with a planned stimulation treatment immediately upon perforating the well. As noted, several wells did have flow rates in the several hundreds of MCF of gas per day.

It should be noted that the flow rate data presented on Exhibit 17 were all conducted at unsteady state reservoir conditions. Test times varied from a number of hours to 24 hours, with two tests being conducted for a period of five days. However, in all cases, these tests are considered to be at nonstabilized conditions. In fact, due to the tight nature of the Abo reservoir, stabilized conditions on a typical well would not be obtained until a flow period of 4.8 years.

In view of the above, it was necessary to adjust the measured flow rates to pseudo-stabilized conditions against one atmosphere of back pressure. The method used employed a technique to estimate the value of the formation permeability (k), which then allowed the calculation of the radius of drainage (r_d), sometimes referred to as radius of investigation. The resulting radius of drainage was then used to recalculate the value of the reservoir permeability. This technique was followed through a series of calculations until the value of (r_d) converged. The final resulting radius of drainage value was then substituted into a flow equation to determine the stabilized flow rate in MCF per day at the test pressure. A second flow equation was then used to adjust the flow rate to one atmosphere or zero psi guage. The working equations utilized in this technique are as follows:

Equation 2.

Transient Radius of Drainage, feet = $r_d = \left[\frac{k\ t}{376\ \phi\ \mu_i\ C_{ti}}\right]^{1/2}$

Where:

q_g = Gas flow rate, MCFPD
T = Reservoir temperature, °R
μ_i = Gas viscosity, centipoise
z_i = Gas deviation factor, dimensionless
P_i = Initial reservoir pressure, psia
P_{wf} = Bottom-hole flowing pressure, psia
r_d = Radius of drainage, feet
r_w = Welbore radius, feet
s = Skin factor (assumed to be zero)
k = Reservoir permeability, md
t = Flow test time, t
ϕ = Porosity of pay sand, fraction
C_{ti} = Total system compressibility, psi $^{-1}$
h = Net formation thickness, feet

Equation 3.

$$\text{Permeability to gas, md} = k = \frac{1422 \times q_g \times T \times \mu_i \times Z_i}{(P_i^2 - P_{wf}^2)\, h} \ln \frac{r_d}{r_w} - 0.75 + s$$

The above equations are used to determine the theoretical value for r_d. This is done by estimating a value for "k" and substituting in Equation 2. The calculated r_d is then substituted in Equation 3 to determine a new value for "k." The procedure is iterated until convergence of r_d to a 10.00 percent difference is achieved. The resultant value for r_d is substituted in Equation 4 to yield a stabilized rate value, q_{gs}.

Equation 4.

$$q_{gs}, \text{ MCFPD} = q_g \frac{[\ln (r_d/r_w) - 0.75 + s]}{[\ln (r_e/r_w) - 0.75 + s]}$$

Where:

r_e = radius of drainage to outer boundary of well

The stabilized rate at one atmosphere is determined by:

Equation 5.

$$q_{gs_{(1 \text{ atm}),}} \text{ MCFPD} = q_{gs} \frac{(P_i - P_{wf_2})}{(P_i - P_{wf})}$$

Where:

P_{wf_2} = Bottom-hole flowing pressure at one atmosphere, psia

The average stabilized flow rate at one atmosphere of pressure for the 24 zones tested was determined to be 35 MCF per well per day, as noted on Exhibit 17. This stabilized flow rate is substantially below the allowed maximum daily flow rate of 105 MCF per well per day for the depth range of the 39 wells that have been completed in the Abo sand formation. As shown on Exhibit 10, the average depth top of the perforations for these 39 wells was 3,878 feet.

It is also noted that the average flow rate was 51 MCF per well per day, under unstabilized conditions, that is, under actual wellhead

test conditions. This rate is also substantially below the maximum allowed daily rate of 105 MCF per well per day. As noted earlier by Mr. Joe Jeffers, the average depth at the top of the Abo formation in the area of interest ranges from 1,900 feet to 4,500 feet. At the shallowest anticipated depth to the top of the Abo formation of 1,900 feet, the maximum allowed daily rate for a tight gas reservoir is 59 MCF per well per day under stablized conditions in one atmosphere. The flow rate data shown on Exhibit 17 indicate that the measured average flow rates under unstabilized and stabilized conditions for the Abo reservoir meet the criteria for the shallowest depth anticipated.

Exhibit 18 is a table showing the production data for those wells which were on production as of September 30, 1980. The average producing rate for the month of September 1980 is also shown. None of these wells has produced any type of hydrocarbon liquids and the Abo reservoir meets the tight gas reservoir criteria of producing less than five barrels of crude oil per day.

Production curves have also been submitted for eight of the Abo wells, which have been on production since the early portion of 1980. These curves generally show the type of gas production performance that is anticipated from tight gas reservoirs such as the Abo formation. Typically, the wells will begin producing at rates in the range of 10,000 MCF per month but will experience a rather severe decline in producing capacity in a relatively short period of time. The producing rates from these wells are expected to level off at some lower rate after a pseudo-steady-state condition is achieved. The time to reach the pseudo-steady-state condition will vary from well-to-well, but generally is expected to be around one and one-half years to two and one-half years. The high initial rate at the time that the well goes on stream is a result of the stimulation treatment which has increased the effective drainage area of the well bore. It is reiterated that all of the wells, for which production curves have been submitted, were stimulated during completion operations.

The classification of the Abo formation as a tight gas sand in the area of interest will not cause problems with respect to formation water sands. A typical casing problem involves the setting of conductor pipe at approximately 300 feet and circulating cement to the surface. In addition, an intermediate stream of casing will be set at 1,200 feet to 1,500 feet and either cemented to the surface or cemented to tie back into the control casing. A third stream of casing, which is the production casing, will be set at the total depth of the well and cemented with 1,000 to 1,100 sacks of cement, which should yield approximately 3,000 feet of cement above the total depth of the well and, in most cases, should tie back to the intermediate casing. In some areas, the conductive casing is not required to be set during drilling operations and the intermediate string at 1,200 feet to 1,500 feet is the first string of casing set. The application to drill and approval of casing programs are approved by the New Mexico Oil Conservation Division and the United States Geological Survey on federal lands.

In summary, it is the opinion of Sipes, Williamson & Associates, Inc. that the Abo gas formation in the area of interest meets all reservoir criteria for designation as a tight gas sand formation under Section 107(b) of the NGPA. The average reservoir pressure, determined by two standard methods, averaged less than the allowed 0.1 millidarcies. In addition, the average flow rate prior to stimulation was well below the maximum allowed daily rate of 105 MCF per well. The Abo reservoir is a dry gas reservoir and meets the criteria for allowed crude oil production.

Husky

Husky Oil Company

600 South Cherry Street
Denver, Colorado 80222
(303) 370-1300

April 8, 1981

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Federal Energy Regulatory Commission
Office of General Counsel
825 North Capitol Street, N.E.
Washington, D.C. 20426
Attn: Ms. Leslie Lawner

Dear Sirs:

RE: Docket No. RM79-76 (New Mexico-3)
NOTICE OF PROPOSED RULEMAKING
BY DIRECTOR OPPR

Husky Oil Company ("Husky") is active in oil and gas exploration, development and production. Husky currently has gas production in the State of New Mexico, including Chaves County.

Husky wishes to support the recommendation of the State of New Mexico Oil Conservation Division that the Abo Formation be designated as a tight formation under the Commission's final regulation, 18 CFR 271.703. Husky believes that such a designation will offer the needed economic stimulus for further natural gas exploration in this area. Husky further believes that the technology required to protect the environment is currently available.

Thank you for the opportunity to comment.

Sincerely,

Gretchen J. Scrivner
Manager, Natural Gas Supply

GJS:ss

cc: New Mexico Oil Conservation Division

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JOHN JAY KEESEY
VICE PRESIDENT AND MANAGER OF ENGINEERING

RESUME

John Jay Keesey is a vice president and the manager of engineering of Sipes, Williamson & Associates, Inc., a consulting engineering firm which maintains offices in Midland and in Houston, Texas and provides integrated engineering and management consulting services to clients in the United States and in Canada.

Prior to beginning consulting activities in 1973, Mr. Keesey worked for Amoco Production Company for ten and one-half years. His training and experience with Amoco centered in the Permian Basin area of West Texas and Southeastern New Mexico and included work in all phases of company activities, including drilling, primary operations, secondary recovery and special testing programs. His later assignments took him into supervisory positions over engineering sections concerned with the design, installation and operation of numerous secondary recovery projects in the West Texas area. In addition to supervising an engineering staff and his normal engineering duties, he served on engineering committees, has presented reports to property owners and has served as a company representative for the Texas - Mid-Continent Oil and Gas Association.

Mr. Keesey joined Sipes, Williamson & Associates, Inc. in June, 1973. Since then, he has been extensively involved in the evaluation of oil and gas reserves for property acquisition and sale, annual reserve studies and estate evaluations. Other responsibilities include waterflood feasibility studies, tertiary project supervision and consultation, geological investigations, gas-storage field studies and various equipment specification studies. He has also appeared as an expert witness at state regulatory commission hearings, including three on the Sawyer Canyon Field, Sutton County, Texas. April, 1977, he was made a vice president and the manager of engineering for Sipes, Williamson & Associates, Inc.'s Midland, Texas office.

Mr. Keesey received a bachelor of science degree in mechanical engineering from Texas Technological University in 1962. While with Amoco Production Company, he attended their reservoir engineering school and coauthored a paper on well logging. He has been a member of the Society of Petroleum Engineers of AIME since 1962, was Chairman of the Society's Permian Basin Section in 1975-76, and is past chairman of the Society's Engineering Registration Committee. He has been a member of the Petroleum Technology Advisory Committee to Midland College for five years and has taught sophomore courses on Oil and Gas Property Evaluation. Mr. Keesey is a registered professional engineer.

Mr. Keesey

JOHN JAY KEESEY
VICE PRESIDENT AND MANAGER OF ENGINEERING

RESUME

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STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
DIVISION FOR THE PURPOSE OF
CONSIDERING:

CASE NO. 7093
Order No. R-6602

APPLICATION OF MESA PETROLEUM COMPANY
AND YATES PETROLEUM CORPORATION FOR
DESIGNATION OF A TIGHT FORMATION,
TORRANCE, GUADALUPE, DeBACA, LINCOLN,
AND CHAVES COUNTIES, NEW MEXICO.

ORDER OF THE DIVISION

BY THE DIVISION:

This cause came on for hearing at 9 a.m. on November 25, 1980, at Santa Fe, New Mexico, before Examiner Daniel S. Nutter.

NOW, on this 23rd day of February, 1981, the Division Director, having considered the testimony, the record, and the recommendations of the Examiner, and being fully advised in the premises,

FINDS:

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

(2) That, pursuant to Section 107 of the Natural Gas Policy Act of 1978, and CFR Section 271.703, applicants Mesa Petroleum Company and Yates Petroleum Corporation seek the designation as a "tight formation" of the Abo formation underlying the following described lands:

CHAVES COUNTY, NEW MEXICO

All of Township 3 South, Range 20 East, NMPM
All of Township 3 South, Range 27 East, NMPM
All of Township 4 South, Ranges 20 through 27 East, NMPM
All of Township 5 South, Ranges 20 through 27 East, NMPM
All of Township 6 South, Ranges 21 through 28 East, NMPM
All of Township 7 South, Ranges 21 through 28 East, NMPM
All of Township 8 South, Ranges 21 through 28 East, NMPM

CHAVES COUNTY, NEW MEXICO con'd

All of Township 9 South, Ranges 21 through 27 East, NMPM
All of Township 9 1/2 South, Range 24 East, NMPM
All of Township 10 South, Ranges 21 through 27 East, NMPM
All of Township 11 South, Ranges 21 through 25 East, NMPM
All of Township 12 South, Range 21 East, NMPM
All of Township 12 South, Range 21 1/2 East, NMPM
All of Township 12 South, Ranges 22 through 24 East, NMPM
All of Township 13 South, Ranges 21 through 23 East, NMPM
All of Township 14 South, Ranges 18 through 22 East, NMPM

DeBACA COUNTY, NEW MEXICO

All of Township 1 North, Ranges 20 through 27 East, NMPM
All of Township 2 North, Ranges 20 through 27 East, NMPM
All of Township 3 North, Ranges 20 through 27 East, NMPM
All of Township 4 North, Ranges 20 through 27 East, NMPM
All of Township 5 North, Ranges 24 through 26 East, NMPM
All of Township 6 North, Ranges 25 and 26 East, NMPM
All of Township 1 South, Ranges 20 through 27 East, NMPM
All of Township 2 South, Ranges 20 through 27 East, NMPM
All of Township 3 South, Ranges 21 through 26 East, NMPM

GUADALUPE COUNTY, NEW MEXICO

All of Township 2 North, Ranges 16 through 19 East, NMPM
All of Township 3 North, Ranges 16 through 19 East, NMPM
All of Township 4 North, Ranges 16 through 19 East, NMPM
All of Township 5 North, Ranges 16 through 23 East, NMPM
All of Township 6 North, Ranges 16 through 24 East, NMPM
All of Township 7 North, Ranges 16 through 26 East, NMPM

LINCOLN COUNTY, NEW MEXICO

All of Township 1 North, Ranges 16 through 19 East, NMPM
All of Township 1 South, Ranges 14 through 19 East, NMPM
All of Township 2 South, Ranges 14 through 19 East, NMPM
All of Township 3 South, Ranges 14 through 19 East, NMPM
All of Township 4 South, Ranges 14 through 19 East, NMPM
All of Township 5 South, Ranges 14 through 19 East, NMPM
All of Township 6 South, Ranges 14 through 20 East, NMPM
N/2 of Township 7 South, Range 14 East, NMPM
N/2 of Township 7 South, Range 15 East, NMPM
N/2 of Township 7 South, Range 16 East, NMPM
N/2 of Township 7 South, Range 17 East, NMPM

LINCOLN COUNTY, NEW MEXICO con'd

All of Township 7 South, Ranges 18 through 20 East, NMPM
All of Township 8 South, Ranges 18 through 20 East, NMPM
All of Township 9 South, Ranges 18 through 20 East, NMPM
All of Township 10 South, Ranges 18 through 20 East, NMPM
All of Township 11 South, Ranges 18 through 20 East, NMPM
All of Township 12 South, Ranges 18 through 20 East, NMPM
All of Township 13 South, Ranges 18 through 20 East, NMPM

TORRANCE COUNTY, NEW MEXICO

All of Township 1 North, Ranges 14 and 15 East, NMPM
All of Township 2 North, Ranges 14 and 15 East, NMPM
All of Township 3 North, Ranges 14 and 15 East, NMPM
All of Township 4 North, Ranges 14 and 15 East, NMPM
All of Township 5 North, Ranges 14 and 15 East, NMPM
All of Township 6 North, Ranges 14 and 15 East, NMPM
All of Township 7 North, Ranges 14 and 15 East, NMPM

containing some 5,760,000 acres, more or less.

(3) That the Abo sandstone of Lower Permian age in the so-called "Pecos Slope" of Southeast New Mexico consists of a series of fluvial deposits derived from the Pedernal Uplift to the Northwest which were laid down as elongate lenticular sand bodies of irregular shape and areal extent interbedded with red and green shales.

(4) That the top of the Abo formation underlying the lands described in Finding No. (2) above ranges from an estimated 4500 feet above sea level to 500 feet below sea level, thus demonstrating a regional relief in said formation of some 5,000 feet, dipping from north-northwest to south-southeast in the area of interest.

(5) That the known thickness of the Abo formation in the aforesaid lands (as shown by the cross-sectional diagrams presented at the hearing) varies from some 350 feet to some 818 feet.

(6) That the depth to the top of the Abo formation in the aforesaid lands varies from approximately 1800 feet in the western portion to approximately 4500 feet in the east.

(7) That although the area encompassed by the lands described in Finding No. (2) above totals some 5,760,000 acres, more or less, only 123 wells have been drilled into or through

the Abo formation on said lands, and of these 44 were completed or being completed as gas wells in said formation as of October 31, 1980, and 79 had been plugged and abandoned.

(8) That although none of the aforesaid 44 wells is known to have encountered what could be termed as "good" natural in situ permeability or high reservoir pressures, some of said wells have, after massive stimulatory treatment, yielded gas on initial potential test in what appears to be commercial quantities, while others continue to produce at low rates even after stimulation. Four have not yet been perforated nor tested.

(9) That considering all of the variables in reservoir rock characteristics, structural position, reservoir thickness, depth from surface, and producing characteristics encountered in the applied-for lands as interpolated from the 123 wells which have been drilled, it is apparent that from the available information, due to the sparsity of wells drilled, it would be difficult, if not impossible to arrive at a definitive interpretation which could be applied to said lands as a whole, and to arrive at a determination as to whether the Abo formation underlying all of the lands described in Finding No. (2) above should be recommended as a tight formation.

(10) That considering all such variables and the aforesaid difficulty of making a definitive interpretation, it is reasonable and proper in this case to consider for recommendation only that portion of the applied-for lands where sufficient wells have been drilled and sufficient information is available, and to eliminate the remainder of the lands from further consideration at this time.

(11) That a reasonable line of demarcation is the line that separates Township 1 South from Township 2 South, so that consideration may be given only to those lands lying south of said line, and the line that separates Range 21 East, NMPM, from Range 22 East, NMPM, so that consideration may be given only to those lands lying east of said line, except that in Township 12 South, the line separating the lands to be considered from the lands to be eliminated would be the line separating Range 21 1/2 East, NMPM, from Range 22 East, NMPM.

(12) That no recommendation for designation as a tight formation of the Abo sandstone lying north and west of the above-described lines of demarcation should be made at this time.

(13) That the following findings refer only to that portion of those lands described in Finding No. (2) above which lie south and east of the above-described lines of demarcation and which shall be referred to hereinafter as the "area."

(14) That the Abo formation underlies all of the area under consideration; that said formation comprises a sandstone consisting of very fine-grained sandstone to siltstone containing subangular to subrounded silt-sized grains of quartz, feldspar, and mica, cemented with calcite and argillaceous material.

(15) That the top of the formation in the area may be found at depths ranging from about 2800 feet to 4500 feet, while the thickness of the formation in the area may vary from approximately 535 feet to 818 feet.

(16) That a total of some 98 wells have been drilled to or through the Abo formation in the area, and of these, some 44 have been or are being completed to produce gas from said formation.

(17) That of the 44 wells in the area which have been or are being completed to produce from the Abo formation, 39 have actually been perforated in the Abo. Of these, tests were conducted prior to stimulation on only 20 wells with a total of 24 individual zone tests being conducted.

(18) That of the 24 zone tests conducted, 18 were swabbed dry or could not be made to flow or flowed gas TSTM (too small to measure), while six flowed gas at rates varying from seven MCF per day to 521 MCF per day.

(19) That the average rate of flow from the 24 zones tested prior to stimulation (including those which swabbed dry, which could not be made to flow, and which flowed gas TSTM) was 51 MCF of gas per day.

(20) That the aforesaid average rate of flow of 51 MCF of gas per day, when corrected to stabilized conditions at one atmosphere of pressure, equals 35 MCF of gas per day.

(21) That the average depth to the top of the formation in the aforesaid 39 wells is 3878 feet, and the maximum stabilized production rate for wells of this depth set forth in 18 C.F.R. Section 271.703 (c)(2)(B) is 105 MCF per day.

(22) That of the 39 wells in the area which have been perforated in the Abo formation, none was capable of sustained commercial production without substantial reservoir stimulation to enhance the poor natural permeability of the Abo sandstone.

(23) That the stimulation required to produce a commercial flow of gas from Abo wells in the area often consists of two separate treatments, the first consisting of an acid treatment of from 500 to 4,000 gallons of acid, and the second consisting of a fracture treatment with from 20,000 to 40,000 gallons of jelled water and sand.

(24) That only two wells (both of which are considered typical) have been cored in the Abo sandstone in the area, and routine core analysis of said wells indicated a permeability in the Abo of 0.048 and 0.074 millidarcies, respectively, for said wells, or an average routine permeability of 0.061 millidarcies.

(25) That said routine permeability for the aforesaid two wells, when corrected for the overburden pressure of some 2060 pounds, indicate an *in situ* Abo permeability for the two wells of 0.0069 millidarcies and 0.0065 millidarcies, respectively, or an average *in situ* permeability of 0.0067 millidarcies.

(26) That the *in situ* permeability of the Abo formation underlying the area, as calculated from bottom-hole pressure build-up data on four wells in the area, ranges from a low of 0.01 millidarcies to a high of 0.12 millidarcies, and averages 0.051 millidarcies; however these pressure build-up tests were conducted after each of the wells had been treated with acid and probably yielded higher *in situ* permeability values than are truly representative of the formation.

(27) That of the 39 wells in the area which have been perforated in the Abo formation, none has produced more than a trace of liquid hydrocarbons.

(28) That the data available from the aforesaid 39 wells indicate that the Abo formation in the area meets all the criteria set forth in 18 C.F.R. Section 271.703(c)(2)(A), (B), (C), and (D), viz:

(A) the estimated average *in situ* permeability throughout the pay section is expected to be less than 0.1 millidarcy;

(B) the stabilized production rate, against atmospheric pressure, of wells completed for production in the formation, without stimulation, is not expected to exceed 105 MCF per day (the average depth to the top of the formation is 3878 feet);

(C) no well drilled into the formation is expected to produce more than five barrels of crude oil per day; and

(D) the Division has not authorized the formation or any portion thereof to be developed by infill drilling.

(29) That there are certain fresh water sands existent in the area, and these are usually encountered at depths ranging from 300 to 400 feet and from 800 to 900 feet.

(30) That the usually required casing and cementing programs for oil and gas wells in the area require surface casing to be set below the uppermost of said water sands with cement circulated to the surface and a string of intermediate casing to be set anywhere from 1200 to 1500 feet with cement circulated to the surface. Production casing is usually set at total depth and cemented back to the intermediate casing.

(31) That the above-described casing and cementing programs for oil and gas wells drilled in the area are in conformance with existing State and Federal regulations and will assure that development of the Abo formation in the area will not adversely affect the fresh water aquifers (during both hydraulic fracturing and waste disposal operations) that are or are expected to be used as a domestic or agricultural water supply.

(32) That the Abo formation underlying the lands described in Exhibit "A" attached hereto and made a part hereof should be recommended to the Federal Energy Regulatory Commission for designation as a tight formation.

IT IS THEREFORE ORDERED:

(1) That it be and hereby is recommended to the Federal Energy Regulatory Commission pursuant to Section 107 of the Natural Gas Policy Act of 1978, and 18 C.F.R. Section 271.703, that the Abo formation underlying approximately 1,536,000 acres,

more or less, in Chaves and DeBaca Counties, New Mexico, as described in Exhibit "A" attached hereto and made a part hereof, be designated as a tight formation.

(2) That no recommendation is made as to those lands described in Finding No. (2) of this Order which are not included in Exhibit "A" attached hereto.

(3) 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 the day and year hereinabove designated.

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION

JOE D. RAMEY
Director

S E A L

dr/

EXHIBIT "A"
ORDER NO. R-6602

DeBACA COUNTY, NEW MEXICO

All of Township 2 South, Ranges 22 through 27 East, NMPM
All of Township 3 South, Ranges 22 through 26 East, NMPM

CHAVES COUNTY, NEW MEXICO

All of Township 3 South, Range 27 East, NMPM
All of Township 4 South, Ranges 22 through 27 East, NMPM
All of Township 5 South, Ranges 22 through 27 East, NMPM
All of Township 6 South, Ranges 22 through 28 East, NMPM
All of Township 7 South, Ranges 22 through 28 East, NMPM
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All of Township 9 1/2 South, Range 24 East, NMPM
All of Township 10 South, Ranges 22 through 27 East, NMPM
All of Township 11 South, Ranges 22 through 25 East, NMPM
All of Township 12 South, Ranges 22 through 24 East, NMPM
All of Township 13 South, Ranges 22 and 23 East, NMPM
All of Township 14 South, Range 22 East, NMPM

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

BRUCE KING
GOVERNOR

LARRY KEHOE
SECRETARY

POST OFFICE BOX 2088
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO 87501
(505) 827-2434

March 6, 1981

Federal Energy Regulatory Comm.
Department of Energy
825 North Capitol Street, N.E.
Washington, D. C. 20426

Attention: Mr. Howard Kilchrist

Dear Mr. Kilchrist:

Enclosed is a tight formation recommendation for the Commission's consideration which I am sending to you for your handling. Let me know if additional information is required.

Very truly yours,

ERNEST L. PADILLA
General Counsel

ELP/dr

enc.

cc: Hinkle, Cox, Eaton, Coffield
and Hensley
Roswell, New Mexico

Campbell and Black, P.A.
Santa Fe, New Mexico

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

NGPA SECTION 107 TIGHT FORMATION RECOMMENDATION	)	
STATE OF NEW MEXICO OIL CONSERVATION DIVISION OF THE ENERGY AND MINERALS DEPARTMENT	)	Docket No. _____

RECOMMENDATION FOR TIGHT
FORMATION DESIGNATION UNDER
SECTION 107 OF THE NGPA.

Mesa Petroleum Company and Yates Petroleum Corporation (Mesa and Yates), pursuant to Section 107 of the Natural Gas Policy Act, 18 CFR §271.703 of the FERC regulations, and the Special Rules and Procedures for Tight Formation Designations under Section 107 of the Natural Gas Policy Act of 1978 of the Oil Conservation Division, petitioned the Oil Conservation Division for tight formation designation of a portion of the Abo formation in Chaves, DeBaca, Guadalupe, Lincoln and Torrance Counties, New Mexico.

After notice and hearing on the application of Mesa and Yates, the Oil Conservation Division hereby recommends designation of a portion of the Abo formation in DeBaca and Chaves Counties, New Mexico, as recommended in Exhibit A (being Oil Conservation Division Order No. R-6602) attached hereto and incorporated by reference. Additionally, the Oil Conservation Division, submits herewith Exhibits B and C, attached hereto and incorporated herein by reference, which are supporting data required under 18 CFR §271.703(c)(3) of the FERC regulations and United States Geological Survey ratification of this recommendation, respectively.

Respectfully submitted,

ERNEST L. PADILLA
Attorney for the
Oil Conservation Division

VERIFICATION

STATE OF NEW MEXICO)
)ss.
COUNTY OF SANTA FE)

ERNEST L. PADILLA, being first duly sworn, on oath, states that he is an attorney for the Oil Conservation Division of the Energy and Minerals Department of the State of New Mexico; that he has executed the foregoing document with full power and authority to do so; and that the matters and facts set forth therein are true to the best of his information, knowledge and belief.

Ernest L. Padilla
ERNEST L. PADILLA

Subscribed and sworn to before me, this 9th day of March, 1981.

Diana Richardson
NOTARY PUBLIC

My Commission Expires:
Oct. 28, 1981

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a copy of the foregoing Recommendation to the law firms of Hinkle, Cox, Eaton, Coffield and Hensley, and Campbell and Black, P.A., Attorneys for Mesa Petroleum Company and Yates Petroleum Corporation, in accordance with the requirements of Section 1.17 of the Rules of Practice and Procedure.

Dated this 9th day of March, 1981.

Ernest L. Padilla
ERNEST L. PADILLA

United States Department of the Interior
GEOLOGICAL SURVEY
South Central Region
P. O. Box 26124
Albuquerque, New Mexico 87125

RECEIVED
MAR 09 1981
OIL CONSERVATION DIVISION
SANTA FE

MAR 05 1981

Mr. Ernest L. Padilla
Oil Conservation Division
State of New Mexico
P. O. Box 2088
Santa Fe, New Mexico 87501

Dear Mr. Padilla:

This jurisdictional agency concurs in the recommendation of the State of New Mexico, Case No. 7093, Order No. R-6602, dated February 23, 1981, that the described lands in subject order in Chaves and De Baca Counties, New Mexico, be designated as a Section 107 tight formation.

Request this concurrence be included with the recommendation submitted to the Federal Energy Regulatory Commission.

Sincerely yours,

Gene F. Daniel
Deputy Conservation Manager,
Oil and Gas

United States Department of the Interior
GEOLOGICAL SURVEY
South Central Region
P. O. Box 26124
Albuquerque, New Mexico 87125

RECEIVED
MAR 09 1981
OIL CONSERVATION DIVISION
SANTA FE

MAR 05 1981

Mr. Ernest L. Padilla
Oil Conservation Division
State of New Mexico
P. O. Box 2088
Santa Fe, New Mexico 87501

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Request this concurrence be included with the recommendation submitted to the Federal Energy Regulatory Commission.

Sincerely yours,

Gene F. Daniel
Deputy Conservation Manager,
Oil and Gas

ROUGH

dr/

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
DIVISION FOR THE PURPOSE OF
CONSIDERING:

CASE NO. 7093

Order No. R-6602

APPLICATION OF MESA PETROLEUM COMPANY
AND YATES PETROLEUM CORPORATION FOR
DESIGNATION OF A TIGHT FORMATION,
TORRANCE, GUADALUPE, DeBACA, LINCOLN,
AND CHAVES COUNTIES, NEW MEXICO.

ORDER OF THE DIVISION

BY THE DIVISION:

This cause came on for hearing at 9 a.m. on November 25, 19 80, at Santa Fe, New Mexico, before Examiner Daniel S. Nutter.

NOW, on this _____ day of February, 19 81, the Division Director, having considered the testimony, the record, and the recommendations of the Examiner, and being fully advised in the premises,

FINDS:

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

(2) That, pursuant to Section 107 of the Natural Gas Policy Act of 1978, and CFR Section 271.703, applicants Mesa Petroleum Company and Yates Petroleum Corporation seek the designation as a "tight formation" of the Abo formation underlying the following described lands:

CHAVES COUNTY, NEW MEXICO

All of Township 3 South, Range 20 East, NMPM

All of Township 3 South, Range 27 East, NMPM

All of Township 4 South, Ranges 20 through 27 East, NMPM

All of Township 5 South, Ranges 20 through 27 East, NMPM

All of Township 6 South, Ranges 21 through 28 East, NMPM

All of Township 7 South, Ranges 21 through 28 East, NMPM

All of Township 8 South, Ranges 21 through 28 East, NMPM

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All of Township 10 South, Ranges 21 through 27 East, NMPM

All of Township 11 South, Ranges 21 through 25 East, NMPM

All of Township 12 South, Range 21 East, NMPM

All of Township 12 South, Range 21 1/2 East, NMPM

All of Township 12 South, Ranges 22 through 24 East, NMPM

All of Township 13 South, Ranges 21 through 23 East, NMPM

All of Township 14 South, Ranges 18 through 22 East, NMPM

DeBACA COUNTY, NEW MEXICO

All of Township 1 North, Ranges 20 through 27 East, NMPM

All of Township 2 North, Ranges 20 through 27 East, NMPM

All of Township 3 North, Ranges 20 through 27 East, NMPM

All of Township 4 North, Ranges 20 through 27 East, NMPM

All of Township 5 North, Ranges 24 through 26 East, NMPM

All of Township 6 North, Ranges 25 and 26 East, NMPM

All of Township 1 South, Ranges 20 through 27 East, NMPM

All of Township 2 South, Ranges 20 through 27 East, NMPM

All of Township 3 South, Ranges 21 through 26 East, NMPM

GUADALUPE COUNTY, NEW MEXICO

All of Township 2 North, Ranges 16 through 19 East, NMPM
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All of Township 6 North, Ranges 16 through 24 East, NMPM
All of Township 7 North, Ranges 16 through 26 East, NMPM

LINCOLN COUNTY, NEW MEXICO

All of Township 1 North, Ranges 16 through 19 East, NMPM
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TORRANCE COUNTY, NEW MEXICO

All of Township 1 North, Ranges 14 and 15 East, NMPM
All of Township 2 North, Ranges 14 and 15 East, NMPM
All of Township 3 North, Ranges 14 and 15 East, NMPM
All of Township 4 North, Ranges 14 and 15 East, NMPM

TORRANCE COUNTY, NEW MEXICO con'd

All of Township 5 North, Ranges 14 and 15 East, NMPM

All of Township 6 North, Ranges 14 and 15 East, NMPM

All of Township 7 North, Ranges 14 and 15 East, NMPM

containing some 5,760,000 acres, more or less.

(3) That the Abo sandstone of Lower Permian age in the so-called "Pecos Slope" of Southeast New Mexico consists of a series of fluvial deposits derived from the Pedernal Uplift to the Northwest which were laid down as elongate lenticular sand bodies of irregular shape and areal extent interbedded with red and green shales.

(4) That the top of the Abo formation underlying the ~~area~~ lands described in Finding No. (2) above ranges from an estimated 4500 feet above sea level to 500 feet below sea level, thus demonstrating a regional relief in said formation of some 5,000 feet, dipping from north-northwest to south-southeast in the area of interest.

(5) That the known thickness of the Abo formation in the ~~area of interest~~ aforesaid lands (as shown by the cross-sectional diagrams presented at the hearing) varies from some 350 feet to some 818 feet.

(6) That the depth to the top of the Abo formation in the ~~area of interest~~ aforesaid lands varies from approximately 1800 feet in the western portion to approximately 4500 feet in the east.

(7) That although the area encompassed by the lands described in Finding No. (2) above totals some 5,760,000 acres, more or less, only ~~160~~ 122 wells ~~in the area~~ on said lands, have been drilled into or through the Abo formation, and of these 43 were completed or being completed as gas wells in said formation as of October 31, 1980, and ~~123~~ 79 had been plugged and abandoned.

123
44

(8) That although none of the aforesaid 43 wells is known to have encountered what could be termed as "good" natural in situ permeability or high reservoir pressures, some of said wells have, after massive stimulatory treatment, yielded gas on initial potential test in what appears to be commercial quantities, while these continue to produce at low rates even after stimulation. Four ~~have~~ not yet been perforated nor tested.

(9) That considering all of the variables in reservoir rock characteristics, structural position, reservoir thickness, depth from surface, and producing characteristics encountered in the ~~area of interest~~ applied-for lands as interpolated from the ~~166~~ 122 wells which have been drilled, ~~in the area,~~ it is apparent that from the available information, ~~that correlation~~ due to the sparsity of wells drilled, ~~makes~~ it would be difficult, if not impossible to arrive at a definitive interpretation ~~of the data~~ which could be applied to ~~the area~~ said lands as a whole, and to arrive at a determination as to whether the Abo formation underlying all of the lands described in Finding No. (2) above should be ~~xxx~~ recommended as a tight formation.

(10) That considering all such variables and the aforesaid difficulty of making a definitive interpretation, it is reasonable and proper in this case to consider for recommendation only that portion of the ~~requested area~~ applied-for lands where sufficient wells have been drilled and sufficient information is available, and to eliminate the remainder of the lands from further consideration at this time.

(11) That a reasonable line of demarcation is the line that separates Township 1 South from Township 2 South, so that consideration may be given only to those lands lying south of said line, and the line that separates Range 21 East, NMPM, from Range 22 East, NMPM, so that consideration may be given only to those lands lying east of said line, except that in Township 12 South, the line separating the lands to be considered from the lands to be eliminated would be the line separating Range 21 1/2 East, NMPM, from Range 22 East, NMPM.

(12) That no recommendation for designation as a tight formation of the Abo sandstone lying north and west of the above-described lines of demarcation should be made at this time.

(13) That the following findings refer only to that portion of those lands described in Finding No. (2) above which lie south and East of the above-described lines of demarcation and which shall be referred to hereinafter as the "area."

(14) That the Abo formation underlies all of the ~~lands~~ area under consideration; that said formation comprises a sandstone consisting of very fine-grained sandstone to siltstone containing subangular to subrounded silt-sized grains of quartz, feldspar, and mica, cemented with calcite and argillaceous material.

(15) That the top of the formation in the area may be found at depths ranging from about 2800 feet to 4500 feet, while the thickness of the formation in the area may vary from approximately 535 feet to 818 feet.

(16) That a total of some ~~137~~ 122 wells have been drilled to or through the Abo formation in the area, and of these, some ~~39~~ 44 have been or are being completed to produce gas from said formation.

90 90

(17) That of the ~~39~~ 44 wells in the area which have been or are being completed to produce from the Abo formation, 39 have actually been perforated in the Abo. Of these, tests were conducted prior to stimulation on only 20 wells with a total of 24 individual zone tests being conducted.

(18) That of the 24 zone tests conducted, 18 were swabbed dry or could not be made to flow or flowed gas TSTM (too small to measure), while six flowed gas at rates varying from seven MCF per day to 521 MCF per day.

(19) That the average rate of flow from the 24 zones tested prior to stimulation (including those which swabbed dry, which could not be made to flow, and which flowed gas TSTM) was 51 MCF of gas per day.

(20) That the aforesaid average rate of flow of 51 MCF of gas per day, when corrected to stabilized conditions at one atmosphere of pressure, equals 35 MCF of gas per day.

(21) That the average depth to the top of the formation in the aforesaid 39 wells is 3878 feet, and the maximum stabilized production rate for wells of this depth set forth in 18 C.F.R. Section 271.703 (c)(2)(B) is 105 MCF per day.

(22) That of the 39 wells in the area which have been ~~or~~ perforated in ~~are being completed to produce from~~ the Abo formation, none was capable of sustained commercial production without substantial reservoir stimulation to enhance the poor natural permeability of the Abo sandstone.

(23) That the stimulation required to produce a commercial flow of gas from Abo wells in the area often consists of two separate treatments, the first consisting of an acid treatment of from 500 to 4,000 gallons of acid, and the second consisting of a fracture treatment with from 20,000 to 40,000 gallons of jelled water and sand.

(24) That only two wells (both of which are considered typical) have been cored in the Abo sandstone in the area, and routine core analysis of said wells indicated a permeability in the Abo of 0.048 and 0.074 millidarcies, respectively, for said wells, or an average routine permeability of 0.061 millidarcies.

(25) That said routine permeability for the aforesaid two wells, when corrected for the overburden pressure of some 2060 pounds, indicate an in situ Abo permeability for the two wells of 0.0069 millidarcies and 0.0065 millidarcies, respectively, or an average in situ permeability of 0.0067 millidarcies.

(26) That the in situ permeability of the Abo formation underlying the area, as calculated from bottom-hole pressure build-up data ~~indicates~~ on four wells in the area, ~~is~~ ranges from a low of 0.01 millidarcies to a high of 0.12 millidarcies, and averages 0.051 millidarcies; however these pressure ~~build~~ build-up tests were conducted after each of the wells had been treated with acid and probably yielded

(22) That of the 39 wells in the area which have been ~~or~~ perforated in ~~are being completed to produce from~~ the Abo formation, none was capable of sustained commercial production without substantial reservoir stimulation to enhance the poor natural permeability of the Abo sandstone.

(23) That the stimulation required to produce a commercial flow of gas from Abo wells in the area often consists of two separate treatments, the first consisting of an acid treatment of from 500 to 4,000 gallons of acid, and the second consisting of a fracture treatment with from 20,000 to 40,000 gallons of jelled water and sand.

(24) That only two wells (both of which are considered typical) have been cored in the Abo sandstone in the area, and routine core analysis of said wells indicated a permeability in the Abo of 0.048 and 0.074 millidarcies, respectively, for said wells, or an average routine permeability of 0.061 millidarcies.

(25) That said routine permeability for the aforesaid two wells, when corrected for the overburden pressure of some 2060 pounds, indicate an in situ Abo permeability for the two wells of 0.0069 millidarcies and 0.0065 millidarcies, respectively, or an average in situ permeability of 0.0067 millidarcies.

(26) That the in situ permeability of the Abo formation underlying the area, as calculated from bottom-hole pressure build-up data ~~indicates~~ on four wells in the area, ~~is~~ ranges from a low of 0.01 millidarcies to a high of 0.12 millidarcies, and averages 0.051 millidarcies; however these pressure ~~build~~ build-up tests were conducted after each of the wells had been treated with acid and probably yielded higher in situ permeability values than are truly representative of the formation.

(27) That of the 39 wells in the area which have been ~~are being completed to produce from~~ perforated in the Abo formation, none has produced ~~any type~~ more than a trace of liquid hydrocarbons.

(28) That the data available from the aforesaid 39 wells indicate that the Abo formation in the area meets all the criteria set forth in 18 C.F.R. Section 271.703 (c)(2)(A), (B),

(A) the estimated average in situ permeability throughout the pay section is expected to be less than 0.1 millidarcy;

(B) the stabilized production rate, against atmospheric pressure, of wells completed for production in the formation, without stimulation, is not expected to exceed 105 MCF per day (the average depth to the top of the formation is 3878 feet);

(C) no well drilled into the formation is expected to produce more than five barrels of crude oil per day; and

(D) the Division has not authorized the formation or any portion thereof to be developed by infill drilling.

(29) That there are certain fresh water sands existent in the area, and these are usually encountered at depths ranging from 300 to 400 feet and from 800 to 900 feet.

(30) That the usually required casing and cementing programs for oil and gas wells in the area require surface casing to be set below the uppermost of said water sands with cement circulated to the surface and a string of intermediate casing to be set anywhere from 1200 to 1500 feet with cement circulated to the surface. Production casing is usually set at total depth and cemented back to the intermediate casing.

(31) That the above-described casing and cementing programs for oil and gas wells drilled in the area are in conformance with existing State and Federal regulations and will assure that development of the Abo formation in the area will not adversely affect the fresh water aquifers (during both hydraulic fracturing and waste disposal operations) that are or are expected to be used as a domestic or agricultural water supply.

(32) That the Abo formation underlying the lands described in Exhibit "A" attached hereto and made a part hereof should be recommended to the Federal Energy Regulatory Commission for designation as a tight formation.

IT IS THEREFORE ORDERED:

(1) That it be and hereby is recommended to the Federal ~~Regulatory-Energy~~ Energy Regulatory Commission pursuant to Section 107 of the Natural Gas Policy Act of 1978, and 18 C.F.R. Section 271.703, that the Abo formation underlying approximately 1,536,000 acres, more or less, in Chaves and DeBaca Counties, New Mexico, as described in Exhibit "A" attached hereto and made a part hereof, be designated as a tight formation.

(2) That no recommendation is made as to those lands described in Finding No. (2) of this Order which are not included in Exhibit "A" attached hereto.

(3) 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 the day and year hereinabove designated.

EXHIBIT "A"
ORDER NO. R-6602

DE BACA COUNTY, NEW MEXICO

All of Township 2 South, Range 22 through 27 East, NMPM

All of Township 3 South, Ranges 22 through 26 East, NMPM

CHAVES COUNTY, NEW MEXICO

All of Township 3 South, Range 27 East, NMPM

All of Township 4 South, Ranges 22 through 27 East, NMPM

All of Township 5 South, Ranges 22 through 27 East, NMPM

All of Township 6 South, Ranges 22 through 28 East, NMPM

All of Township 7 South, Ranges 22 through 28 East, NMPM

All of Township 8 South, Ranges 22 through 28 East, NMPM

All of Township 9 South, Ranges 22 through 27 East, NMPM

All of Township 9 1/2 South, Range 24 East, NMPM

All of Township 10 South, Ranges 22 through 27 East, NMPM

All of Township 11 South, Ranges 22 through 25 East, NMPM

All of Township 12 South, Ranges 22 through 24 East, NMPM

All of Township 13 South, Ranges 22 and 23 East, NMPM

All of Township 14 South, Range 22 East, NMPM

ABG READY GA TOT

WU HB HOBBS

AYA077(1341)(4-027881S329)PD 11/24/80 1341

ICS IPMMTZZ CSP

5056223770 TDMT ROSWELL NM 46 11-24 0141P EST

PMS JOE D RAMEY [redacted]

NEW MEXICO OIL CONSERVATION COMMISSION PO BOX 2045

HOBBS NM 88240

REFERENCE CASE NUMBER 7093 DOCKET NUMBER 3080

READ AND STEVENS INC IS IN SUPPORT OF CAPTIONED HEARING FOR HIGHER GAS PRICES. IN ORDER TO MAKE IT ECONOMICALLY FEASIBLE TO DEVELOP THE ACREAGE COVERED UNDER THIS HEARING. WE BELIEVE THIS HIGHER PRICE WILL BE NECESSARY YOURS TRULY

JOE WIGLEY READ AND STEVENS INC

NNNN

Telegram western union

WU AGENT SANA

WU MOD ABO

346

AYB147(1627)(4-045330S329)PD 11/24/80 1626

ICS IPMBNGZ CSP

2143637380 TDBN DALLAS TX 25 11-24 0426P EST

PMS OIL CONSERVATION DIV, ATTN JOE RAMEY RPT DLY MGM, DLR

STATE LAND OFFICE BUREAU

SANTA FE NM

AS INTEREST OWNER IN THE ABO AREA WE ARE IN FULL SUPPORT OF MESA AND YATES APPLICATION FOR TIGHT GAS FORMATION (DOCUMENT #39-80, CASE #7893)

N J HARVEY JR

PO BOX 12785

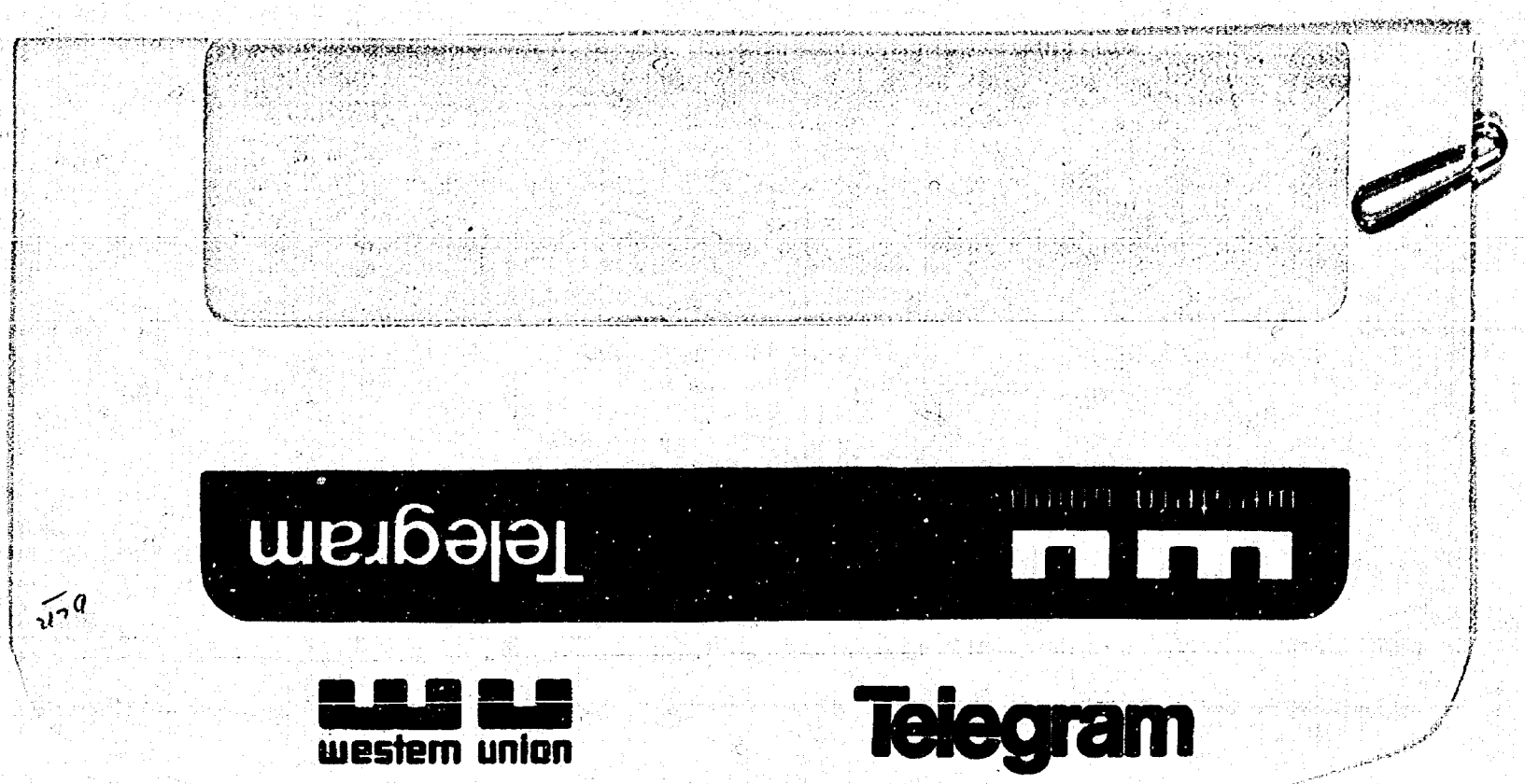
DALLAS TX 75225

NNNN

Telegram western union

WU AGENT SANA

WU AGENT SANA


Telegram
western union
Telegram

FLAG-REDFERN OIL CO BJ
PO BOX 2280
MIDLAND TX 79702

RECEIVED
NOV 25 1980
OIL CONSERVATION DIVISION

western union Mailgram

4-053677S329 11/24/80 ICS IPMBNGZ CSP ABQA
9156835184 MGM TDBN MIDLAND TX 54 11-24 0547P EST

JOE RANEY
DEPARTMENT OF ENERGY AND MINERAL OIL
CONSERVATION DIVISION BOX 2088
SANTA FE NM 87501

FLAG-REDFERN OIL COMPANY SUPPORTS THE APPLICATION OF YATES PETROLEUM CORPORATION IN CASE 7093 DOCKET 3980 FOR THE DESIGNATION OF THE ABO FORMATION AS TIGHT SAND RESERVOIR UNDER THE NGPA REGULATIONS.
BYRON H GREAVES, VICE PRESIDENT FLAG-REDFERN OIL COMPANY

1748 EST

MGMCOMP MGM

TO REPLY BY MAILGRAM, SEE REVERSE SIDE FOR WESTERN UNION'S TOLL - FREE PHONE NUMBERS

EAGLE EXPLORATION SBW
BOX 2526
AMARILLO TX 79105

western union **Mailgram**

4-056884S329 11/24/80 ICS IPMBNGZ CSP ABQA
8063730779 MGM TDBN AMARILLO TX SI 11-24 0631P EST

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NOV 25 1980
OIL CONSERVATION DIVISION
SANTA FE

OIL CONSERVATION COMMISSION
PO BOX 2088
SANTA FE NM 87501

AS AN OPERATOR ACTIVE IN THE ABO GAS AREA OF CHAVES COUNTY WE ARE MOST ANXIOUS FOR POSITIVE ACTION CONCERNING THE PRICING OF GAS FROM THE FORMATION. MORE PARTICULARLY WE HOPE YOU WILL GIVE APPROVAL IN DOCKET NUMBER 3980, CASE NUMBER 7093. SINCERELY
S. B. WHITTENBURG PRESIDENT PLAINS RADIO BROADCASTING CO.

2119 EST

MGMCOMP MGM

5241 (R1/78)

TO REPLY BY MAILGRAM, SEE REVERSE SIDE FOR WESTERN UNION'S TOLL - FREE PHONE NUMBERS

FRED POOL DRILLING CO JOHN KLEE
BOX 1300
ROSWELL NM 88201

western union **Mailgram**

4-034102S329003 11/24/80 ICS IPMMTZZ CSP ABQA
2 5056238202 MGM TDMT ROSWELL NM 11-24 0239P EST

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NOV 25 1980
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SANTA FE

OIL CONSERVATION COMMISSION ATTN JOE RAMEY
PO BOX 2088
SANTA FE NM 87501

THIS IS A CONFIRMATION COPY OF A PREVIOUSLY PHONE-DELIVERED TELEGRAM

FRED POOL DRILLING COMPANY IS IN SUPPORT OF DOCKET 3980 CASE 7093
TIGHT SAND PRICING
FRED POOL JR

1440 EST

MGMCOMP MGM

5241 (R1/78)

TO REPLY BY MAILGRAM, SEE REVERSE SIDE FOR WESTERN UNION'S TOLL - FREE PHONE NUMBERS

LEWIS C. COX, JR.
PAUL W. EATON, JR.
CONRAD E. COFFIELD
HAROLD L. HENSLEY, JR.
STUART D. SHANOR
C. D. MARTIN
PAUL J. KELLY, JR.
JAMES H. BOZARTH
DOUGLAS L. LUNSFORD
PAUL M. BOHANNON

ERNEST R. FINNEY, JR.*
J. DOUGLAS FOSTER
K. DOUGLAS PERRIN
C. RAY ALLEN*
JACQUELINE W. ALLEN*
T. CALDER EZZELL, JR.
WILLIAM B. BURFORD*
JOHN S. NELSON
RICHARD E. OLSON
PHILLIP T. BREWER*

LAW OFFICES
HINKLE, COX, EATON, COFFIELD & HENSLEY
600 HINKLE BUILDING
POST OFFICE BOX 10
ROSWELL, NEW MEXICO 88201
(505) 622-6510

OF COUNSEL
CLARENCE E. HINKLE
ROBERT A. STONE*

W. E. BONDURANT, JR. (1914-1973)

MIDLAND, TEXAS OFFICE
1000 FIRST NATIONAL BANK TOWER
(915) 683-4691

AMARILLO, TEXAS OFFICE
1701 AMERICAN NATIONAL BANK BUILDING
(806) 372-5569

*LICENSED IN TEXAS ONLY

November 25, 1980

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DEC 02 1980
OIL CONSERVATION DIVISION
SANTA FE

Mr. Ernest Padilla
General Counsel
Energy and Minerals Department
P. O. Box 2088
Santa Fe, New Mexico 87501

Dear Ernie:

For inclusion in the case record for docket 7093, I enclose statements from Elk Oil Company.

Very truly yours,

Harold

Harold L. Hensley, Jr.

HLH:lb
encl.

xc: Mr. Joe Jeffers

JOSEPH J. KELLY
PRESIDENT

ELK OIL COMPANY
BOX 310
ROSWELL, NEW MEXICO 88201
(505) 623-3190

J. MICHAEL KELLY
VICE PRESIDENT

RECEIVED
DEC 02 1980
OIL CONSERVATION DIVISION
SANTA FE

November 24, 1980

Energy and Minerals Department
Oil Conservation Division
P. O. Box 2088
Santa Fe, New Mexico 87501

Gentlemen:

STATEMENT:

Elk Oil Company hereby endorses the application of Mesa Petroleum Company and Yates Petroleum Corporation concerning the classification of tight sand gas reservoir under case number 7093.

Elk Oil has working interests in several wells as well as lease ownership in the area.

The tight sands incentive price is needed if Elk Oil and other operators are to fully develop the area in questions.

Yours very truly,

ELK OIL COMPANY

Joseph J. Kelly
President

JJK/rm

McClellan Oil Corporation

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DEC 02 1980
OIL CONSERVATION DIVISION
SANTA FE

November 24, 1980

New Mexico Oil Conservation Division
Post Office Box 2088
Santa Fe, New Mexico 87501

Re: Pecos Slope
Abo Sandstone Tight
Gas Play In Southeast
New Mexico

Gentlemen:

This letter is to concur with the prepared evidence to be presented at the Oil Conservation Division Hearing concerning the tight gas formation in the Pecos Slope Area of Southeastern New Mexico. I have personally reviewed the information to be presented in this testimony and feel it to be an accurate presentation of engineering and geological information presently available on wells drilled in this area. McClellan Oil Corporation has drilled eight Abo gas tests in the Pecos Slope area, completing five as producers and presently attempting to complete two.

I strongly urge that the Commission give favorable consideration to this designation of tight sand for the Abo formation inasmuch as I feel this price is going to be necessary if development of these tight sands in this area is going to continue.

Very truly yours,

Jack L. McClellan

Jack L. McClellan
President

Suite 1000 Security Bank Building — Drawer 730 — 505/622-3200 — Roswell, New Mexico 88201

CARL ENGWALL
GEOLOGICAL CONSULTANT
P. O. BOX 1782
ROSWELL, NEW MEXICO 88201

RECEIVED
DEC 02 1980
OIL CONSERVATION DIVISION
SANTA FE
PHONE: (505) 623-4541

November 24, 1980

Energy and Minerals Department
Oil Conservation Division
P. O. Box 2088
Santa Fe, New Mexico 87501

Gentlemen:

STATEMENT:

I, Carl Engwall, hereby endorse the application of Mesa Petroleum Company and Yates Petroleum Corporation concerning the classification of tight sand gas reservoir under case number 7093.

I have working interest in several wells as well as lease ownership in the area.

The tight sands incentive price is needed if operators are to fully develop the area in question.

Yours very truly,

Carl Engwall
CARL ENGWALL

CE/rm

Boyd Operating Company

P.O. BOX 1756
ROSWELL, NEW MEXICO 88201
TELEPHONE 505/623-6044

RECEIVED
DEC 02 1980
OIL CONSERVATION DIVISION
SANTA FE

November 24, 1980

Energy and Minerals Department
Oil Conservation Division
P. O. Box 2088
Santa Fe, New Mexico 87501

Re: Docket #3980
Case #7093

Gentlemen:

Gentlemen:

Boyd Operating Company hereby endorses the application of Mesa Petroleum Company and Yates Petroleum Corporation request for approval of Tight Gas Sands under Section 107 of the NGPA-1978 and 18-CFR Section 271. 701-705 scheduled to be heard November 25, 1980, under Case 7093.

Boyd Operating Company is the operator of a dual Abo-Wolfcamp well in this area. This designation of tight formation is needed for Boyd Operating Company and other operators to fully develop the potential production from gas reservoirs in this area.

Yours truly,

BOYD OPERATING COMPANY

T. M. Boyd
President

S. P. "Buzz" Johnson, III
414 South Main St.
Roswell, New Mexico 88201
(505) 622-6610

November 24, 1980

Investments & Ranching

Energy and Minerals Dept.
Oil Conservation Division
P. O. Box 2088
Santa Fe, NM 87501

Gentlemen:

STATEMENT

Johnson Enterprises Ltd. hereby endorses the application of Mesa Oil Company and Yates Petroleum Corporation concerning the classification of the tight sand gas reservoir under case #7093.

Johnson Enterprises has working interestsin several wells as well as lease ownership in this area.

The tight sand incentive price is needed if Johnson Enterprises and other operators are to fully develop the area in question.

Very truly yours,

S. P. Johnson III

S. P. Johnson III
General Partner

TOM BOYD DRILLING COMPANY, INC.
P. O. Box 1756 Roswell, New Mexico 88201 505/623-6800

RECEIVED
DEC 02 1980
OIL CONSERVATION DIVISION
SANTA FE

November 24, 1980

New Mexico Oil Conservation Commission
P. O. Box 2088
Santa Fe, New Mexico 87501

Re: Docket #3980
Case 7093

Gentlemen:

Tom Boyd Drilling Company, Inc. hereby endorses the application of Mesa Petroleum Company and Yates Petroleum Corporation request for approval of Tight Gas Sands under Section 107 of the NGPA-1978 and 18-CFR Section 271, 701-705 schedule to be heard November 25, 1980, under Case 7093.

Tom Boyd Drilling Company, Inc. has a working interest in several wells in this area and has additional lease ownership in this area.

Yours truly,

TOM BOYD DRILLING COMPANY, INC.

T. M. Boyd,
President

SOUTHWESTERN RESOURCES, INC.
P. O. Box 1756 Roswell, New Mexico 88201 505/623-6800

DEC 02 1980
OIL CONSERVATION DIVISION
SANTA FE

November 24, 1980

New Mexico Oil Conservation Commission
P. O. Box 2088
Santa Fe, New Mexico 87501

Re: Docket #3980
Case 7093

Gentlemen:

Southwestern Resources, Inc. hereby endorses the application of Mesa Petroleum Company and Yates Petroleum Corporation request for approval of Tight Gas Sands under Section 107 of the NGPA-1978 and 18-CFR Section 271, 701-705 Schedule to be heard November 25, 1980, under Case 7093.

Southwestern Resources, Inc. has a working interest in several wells in this area and has additional lease ownership in this area.

Yours truly,

SOUTHWESTERN RESOURCES, INC.

T. M. Boyd,
President

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

BRUCE KING
GOVERNOR

LARRY KEHOE
SECRETARY

POST OFFICE BOX 2088
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO 87501
(505) 827-2434

February 24, 1981

Mr. William F. Carr
Campbell, Byrd and Black
Attorneys at Law
Post Office Box 2208
Santa Fe, New Mexico

Re: CASE NO. 7093
ORDER NO. R-6602

Applicant:

Mesa Petroleum Company and
Yates Petroleum Corporation

Dear Sir:

Enclosed herewith are two copies of the above-referenced Division order recently entered in the subject case.

Yours very truly,

JOE D. RAMEY
Director

JDR/fd

Copy of order also sent to:

Hobbs OCD x
Artesia OCD x
Aztec OCD

Other Jamas Williams

RECEIVED
DEC 03 1980
OIL CONSERVATION DIVISION
SANTA FE

Midland

October 29, 1980

Narrative of Testimony to the New Mexico Oil Conservation Division hearing for Designation of the Abo Sandstone as a Tight Gas Sand in southeast New Mexico

The Geological testimony will be presented by Joseph W. Jeffers of Mesa Petroleum Co., Midland, Texas.

Joseph W. Jeffers is a Division Geologist for Mesa Petroleum Co. in the Permian Basin Division headquartered in Midland, Texas. Part of his responsibilities is the Abo gas play in New Mexico.

Prior to his association with Mesa Petroleum in 1973, Mr. Jeffers worked as District Geologist for Pubco Petroleum for four years. Prior to his association with Pubco in 1969 Mr. Jeffers was employed by Mobil Oil Corporation for 15 years as both exploration and development geologist with primary responsibilities the search for the development of hydrocarbons in Permian Basin of Texas and New Mexico.

Mr. Jeffers received a bachelor of science degree in geology from Southern Methodist University in 1954 and a master of science degree in geology in 1955 from the same institution.

Mr. Jeffers has been accepted as an expert witness on numerous occasions before the Oil Conservation Division of New Mexico.

Ex 27

NARRATIVE OF TESTIMONY TO THE
NEW MEXICO OIL CONSERVATION DIVISION
FOR DESIGNATION OF
PECOS SLOPE ABO TIGHT GAS PLAY
SOUTHEASTERN NEW MEXICO
AS A TIGHT GAS FORMATION

NOVEMBER 25, 1980

This testimony will be presented by John Jay Keesey, Vice-President and Manager of Engineering for Sipes, Williamson & Associates, Inc., Midland, Texas. Mr. Keesey has appeared before the New Mexico Oil Conservation Division on previous occasions and is a registered professional engineer in the State of Texas. A resume depicting Mr. Keesey's educational and professional experience is enclosed. Sipes, Williamson & Associates, Inc. is a petroleum consulting firm with offices in Midland and Houston, Texas. The firm has a background of experience since 1955 primarily in reservoir analyses, secondary and enhanced recovery studies, oil and gas reserve studies, annual reserve studies of publicly and privately owned companies, property evaluations, proration schedules, as well as other diversified services.

Exhibit 5 was presented by Mr. Joe Jeffers and is a structure map on top of the Abo. This exhibit additionally shows all of the wells, which were completed in the Abo formation as of October 31, 1980, and also serves as a reference for the engineering data to be presented. There were 43 wells completed or being completed in the Abo formation as of October 31, 1980. These wells are shown on Exhibit 5 by the gas well completion symbol and are also colored in orange. Each well has been assigned a map reference number which is referred to as Sipes, Williamson & Associates, Inc.'s (SW&A) tract number. This number appears next to each completed well. This number will also appear on the engineering exhibits to be submitted for easy reference purposes. A series of letters follow the tract number, which are keys to the engineering data that are available on specific wells. The letter "P" indicates that the well was producing as of October 31, 1980. The letter "A" indicates those wells for which core data are available. The

Ex 28

letter "B" indicates those wells for which production performance curves are included. The letter "C" indicates those wells for which prestimulation flow rate data are available. The letter "D" indicates those wells for which bottom-hole pressure build-up data were available for the calculation of reservoir permeability.

Exhibit 10 is a table presenting completion information on those wells which have been completed in the Abo formation. Information shown includes: Sipes, Williamson & Associates, Inc.'s tract number reference, well name, location, spud date, completion date, total depth, completion interval, initial bottom-hole pressure, flow rate data, stimulation data, date on line and initial producing rate.

The flow rate data mentioned above are presented for natural flow conditions; that is, prior to any stimulation. In addition, flow rate data obtained after the first and second stimulation treatments are also presented. Stimulation is required in order to obtain sustained commercial producing rates in this underpressured reservoir. The majority of wells were stimulated twice, with the first stimulation consisting of an acid treatment ranging generally from 500 to 4,000 gallons of acid. The second stimulation treatment normally consisted of a fracture treatment generally consisting of 20,000 to 40,000 gallons of jelled water and sand. It is noted that seven of the wells on Exhibit 10 were spudded prior to July 16, 1979 and therefore do not qualify for the tight gas sand classification under Section 107(b) of the Natural Gas Policy Act of 1978 (NGPA).

Exhibit 11 is a list of plugged and abandoned wells within the area of interest which have penetrated, or are believed to have penetrated, the Abo formation. A question of penetration exists on several wells where data are not complete or available. There are a total of 123 wells on this list. Several of these wells specifically have tested the Abo, while the remainder have simply penetrated the Abo formation during drilling to deeper depths. A high majority of these wells, if not all of them, were drilled with

rotary tools. No shows of hydrocarbons through the Abo section were recorded, which does not condemn the Abo formation for commercial gas production, but is indicative of the tight nature of the Abo formation.

The estimated average in situ gas permeability of the Abo sand section was calculated using two widely accepted industry standard methods. These methods include laboratory measurements of cored Abo sand sections and permeability calculations from bottom-hole pressure build-up data. It is the opinion of Sipes, Williamson & Associates, Inc. that these two methods provide the best estimate of the permeability to the gas and, although other methods may be accepted, the data with the highest quality were obtained pursuant to these methods.

The first method for obtaining the in situ gas permeability by core analysis requires permeability measurements of actual cored sections of Abo sand in the laboratory. Due to poor core recoveries and the increased expenses due to coring, only two wells were cored in the Abo sand. Routine core analyses data were obtained from these two cores. Exhibit 12 is a section of the log on the Thorpe "MI" Well No. 2, which shows the two intervals cored and highlights the Abo sand pay interval. Exhibit 13 is a log on the Papalote "OI" State No. 1 well, which also shows the section cored and the Abo sand pay interval. Exhibit 14 is a table listing the results of the routine core analyses on both wells. The data shown is for the Abo sand pay sections. The results of the routine core analyses on the Papalote "OI" State No. 1 reflect an average permeability of 0.048 millidarcies. The results of the routine core analyses on the Thorpe "MI" Well No. 2 reflect an average permeability of 0.074 millidarcies.

0.048
0.074
.122
.060

In addition to the above, special tests were run on samples from the Thorpe "MI" No. 2 to evaluate the effects of overburden pressure on the core samples and to determine a more nearly representative value for the in situ reservoir permeability. Routine core analyses are normally run with a confining or overburden

pressure of approximately 150 pounds. The overburden pressure within the formation is much greater and special tests are required in order to apply overburden pressure of that encountered at the depth of the reservoir. These special tests were run at an overburden pressure of 2,060 pounds. Exhibit 15 depicts the results of the special tests conducted on the Thorpe "MI" Well No. 2 core samples. These data reflect a marked decrease in the permeability for the tested samples under overburden, or in situ, conditions. The correlation depicted on Exhibit 15 can then be used to adjust the routine core permeability to in situ conditions for any other sample. This was done for all test intervals in the two wells tested and the results are shown in the last column of Exhibit 14. As noted, the average permeability for the pay section in the Papalote "OI" State No. 1 under in situ conditions was 0.0069 millidarcies, while the average in situ permeability for the Thorpe "MI" No. 2 was 0.0065 millidarcies. The average routine permeability and in situ permeability for both the Papalote "OI" State No. 1 and Thorpe "MI" No. 2 were determined to be 0.066 and 0.0066 millidarcies, respectively.

routine perm 0.048

routine perm 0.074

It is apparent from the above discussion that the available core data confirm that the Abo sand pay will have a permeability less than the allowed 0.1 millidarcies, under both routine and in situ test conditions.

The Thorpe "MI" Well No. 2 and the Papalote "OI" State No. 1 are both considered to be typical samples of the Abo formation. The Thorpe "MI" Well No. 2 was tested prior to stimulation and had no flow. After acidizing, the well flowed 48.6 MCF per day and, after a subsequent fracture stimulation, the well flowed 1,359 MCF per day. These data are shown on Exhibit 10. The Papalote "OI" State No. 1 is currently being completed and no specific test information is available; however, the core and log data reflect that this well is typical of the other Abo completions in the area of interest.

The second procedure for obtaining the in situ permeability is from bottom-hole pressure build-up data. These data were obtained on

four of the Abo completions. The pressure analysis method used to calculate the average permeability was the conventional Horner Plot technique. The equation to calculate the average permeability is:

Equation 1.

$$k, \text{ millidarcies} = \frac{162.6\ q\ \mu_i\ B_g}{m\ h}$$

The value for m is the slope of the straight-line portion of the Horner Plot of the bottom-hole pressure data. It is measured in psi per cycle.

The results of the bottom-hole pressure analyses on four wells are shown on Exhibit 16. This technique yielded average reservoir permeabilities ranging from a low of 0.01 to a high of 0.1188 millidarcies. The average permeability for the four wells was determined to be 0.0506 millidarcies. This average calculated permeability compares favorably to the permeability determined by the routine core analyses discussed above, but is lower than the in situ permeabilities determined by the core data method. The higher in situ permeabilities, determined by the bottom-hole pressure calculation method, are attributed to the fact that these four pressure build-up tests were taken after each of the wells was treated with acid.

Exhibit 17 is a tabulation of flow data obtained on Abo gas wells prior to stimulation. These data show that a large percentage of the Abo gas wells would not flow upon initial completion. Other wells had very low flow rates, or gas blows, that were too small to measure. Typically, these low flow rates, listed as too small to measure (TSTM), would be in the range of a few MCF of gas per day; and, in all cases, probably less than ten MCF of gas per day. Several wells had no flow rate data available, which is fairly common on tight gas sand wells as many operators will simply proceed with a planned stimulation treatment immediately upon perforating the well. As noted, several wells did have flow rates in the several hundreds of MCF of gas per day.

It should be noted that the flow rate data presented on Exhibit 17 were all conducted at unsteady state reservoir conditions. Test times varied from a number of hours to 24 hours, with two tests being conducted for a period of five days. However, in all cases, these tests are considered to be at nonstabilized conditions. In fact, due to the tight nature of the Abo reservoir, stabilized conditions on a typical well would not be obtained until a flow period of 4.8 years.

In view of the above, it was necessary to adjust the measured flow rates to pseudo-stabilized conditions against one atmosphere of back pressure. The method used employed a technique to estimate the value of the formation permeability (k), which then allowed the calculation of the radius of drainage (r_d), sometimes referred to as radius of investigation. The resulting radius of drainage was then used to recalculate the value of the reservoir permeability. This technique was followed through a series of calculations until the value of (r_d) converged. The final resulting radius of drainage value was then substituted into a flow equation to determine the stabilized flow rate in MCF per day at the test pressure. A second flow equation was then used to adjust the flow rate to one atmosphere or zero psi guage. The working equations utilized in this technique are as follows:

Equation 2.

Transient Radius of Drainage, feet = $r_d = \left[\frac{k\ t}{376\ \phi\ \mu_i\ C_{ti}}\right]^{1/2}$

Where:

q_g = Gas flow rate, MCFPD
T = Reservoir temperature, °R
μ_i = Gas viscosity, centipoise
Z_i = Gas deviation factor, dimensionless
p_i = Initial reservoir pressure, psia
p_{wf} = Bottom-hole flowing pressure, psia
r_d = Radius of drainage, feet
r_w = Welbore radius, feet
s = Skin factor (assumed to be zero)
k = Reservoir permeability, md
t = Flow test time, t
ϕ = Porosity of pay sand, fraction
C_{ti} = Total system compressibility, psi $^{-1}$
h = Net formation thickness, feet

Equation 3.

$$\text{Permeability to gas, md} = k = \frac{1422 \times q_g \times T \times \mu_i \times Z_i}{(P_i^2 - P_{wf}^2)\, h} \ln \frac{r_d}{r_w} - 0.75 + s$$

The above equations are used to determine the theoretical value for r_d. This is done by estimating a value for "k" and substituting in Equation 2. The calculated r_d is then substituted in Equation 3 to determine a new value for "k." The procedure is iterated until convergence of r_d to a 10.00 percent difference is achieved. The resultant value for r_d is substituted in Equation 4 to yield a stabilized rate value, q_{gs}.

Equation 4.

$$q_{gs},\ \text{MCFPD} = q_g \frac{[\ln (r_d/r_w) - 0.75 + s]}{[\ln (r_e/r_w) - 0.75 + s]}$$

Where:

r_e = radius of drainage to outer boundary of well

The stabilized rate at one atmosphere is determined by:

Equation 5.

$$q_{gs_{(1\ atm)}},\ \text{MCFPD} = q_{gs} \frac{(P_i - P_{wf_2})}{(P_i - P_{wf})}$$

Where:

P_{wf_2} = Bottom-hole flowing pressure at one atmosphere, psia

The average stabilized flow rate at one atmosphere of pressure for the 24 zones tested was determined to be 35 MCF per well per day, as noted on Exhibit 17. This stabilized flow rate is substantially below the allowed maximum daily flow rate of 105 MCF per well per day for the depth range of the 39 wells that have been completed in the Abo sand formation. As shown on Exhibit 10, the average depth top of the perforations for these 39 wells was 3,878 feet.

It is also noted that the average flow rate was 51 MCF per well per day, under unstabilized conditions, that is, under actual wellhead

test conditions. This rate is also substantially below the maximum allowed daily rate of 105 MCF per well per day. As noted earlier by Mr. Joe Jeffers, the average depth at the top of the Abo formation in the area of interest ranges from 1,900 feet to 4,500 feet. At the shallowest anticipated depth to the top of the Abo formation of 1,900 feet, the maximum allowed daily rate for a tight gas reservoir is 59 MCF per well per day under stablized conditions in one atmosphere. The flow rate data shown on Exhibit 17 indicate that the measured average flow rates under unstabilized and stabilized conditions for the Abo reservoir meet the criteria for the shallowest depth anticipated.

Exhibit 18 is a table showing the production data for those wells which were on production as of September 30, 1980. The average producing rate for the month of September 1980 is also shown. None of these wells has produced any type of hydrocarbon liquids and the Abo reservoir meets the tight gas reservoir criteria of producing less than five barrels of crude oil per day.

Production curves have also been submitted for eight of the Abo wells, which have been on production since the early portion of 1980. These curves generally show the type of gas production performance that is anticipated from tight gas reservoirs such as the Abo formation. Typically, the wells will begin producing at rates in the range of 10,000 MCF per month but will experience a rather severe decline in producing capacity in a relatively short period of time. The producing rates from these wells are expected to level off at some lower rate after a pseudo-steady-state condition is achieved. The time to reach the pseudo-steady-state condition will vary from well-to-well, but generally is expected to be around one and one-half years to two and one-half years. The high initial rate at the time that the well goes on stream is a result of the stimulation treatment which has increased the effective drainage area of the well bore. It is reiterated that all of the wells, for which production curves have been submitted, were stimulated during completion operations.

The classification of the Abo formation as a tight gas sand in the area of interest will not cause problems with respect to formation water sands. A typical casing problem involves the setting of conductor pipe at approximately 300 feet and circulating cement to the surface. In addition, an intermediate stream of casing will be set at 1,200 feet to 1,500 feet and either cemented to the surface or cemented to tie back into the control casing. A third ~~stream~~ string of casing, which is the production casing, will be set at the total depth of the well and cemented with 1,000 to 1,100 sacks of cement, which should yield approximately 3,000 feet of cement above the total depth of the well and, in most cases, should tie back to the intermediate casing. In some areas, the conductive casing is not required to be set during drilling operations and the intermediate string at 1,200 feet to 1,500 feet is the first string of casing set. The application to drill and approval of casing programs are approved by the New Mexico Oil Conservation Division and the United States Geological Survey on federal lands.

In summary, it is the opinion of Sipes, Williamson & Associates, Inc. that the Abo gas formation in the area of interest meets all reservoir criteria for designation as a tight gas sand formation under Section 107(b) of the NGPA. The average reservoir pressure, determined by two standard methods, averaged less than the allowed 0.1 millidarcies. In addition, the average flow rate prior to stimulation was well below the maximum allowed daily rate of 105 MCF per well. The Abo reservoir is a dry gas reservoir and meets the criteria for allowed crude oil production.

EXHIBIT 19

FIELD	BITTER LAKES (ABO)
OPERATOR	BOYD OPERATING CO.
LEASE	BLAKEMORE FEDERAL
LOCATION OR RRC NO.	20-9S-26E
DIST.	☐ OIL ☐ GAS
COUNTY	CHAVES
STATE	N.M.
NO. WELLS	1
WELL NOS.	1
DATE PROD. BEGAN	3/80
ACRES	

MIDLAND SIPES, WILLIAMSON & ASSOCIATES, INC. HOUSTON

PLOTTED FROM CLIENT'S DATA

GAS PRODUCTION - MCF/MONTH

100 000
9
8
7
6
5
4
3
2
10 000
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6
5
4
3
2
1000
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8
7
6
5
4
3
2
100

Mar. June Sept. Dec.

19 80 | 19 81 | 19 82 | 19 83 | 19 84 | 19 85 | 19 86 | 19 87 | 19 88

SWA TR 39

EXHIBIT 20

FIELD	WILDCAT (ABO)
OPERATOR	McCLELLAN OIL CORP.
LEASE	J. J. FEDERAL
LOCATION OR RRC NO.	01-10S-25E
DIST.	☐ OIL ☐ GAS
COUNTY	CHAVES
STATE	N.M.
NO. WELLS	1
WELL NOS.	1
DATE PROD. BEGAN	2/80
ACRES	

SIPES, WILLIAMSON & ASSOCIATES, INC. MIDLAND HOUSTON

PLOTTED FROM CLIENT'S DATA

GAS PRODUCTION - MCF/MONTH

100 000
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Mar. June Sept. Dec.

19 80 | 19 81 | 19 82 | 19 83 | 19 84 | 19 85 | 19 86 | 19 87 | 19 88

SWA TR 41

EXHIBIT 21

FIELD:	WILDCAT (ABO)
OPERATOR:	McCLELLAN OIL CORP.
LEASE:	M. M. FEDERAL
LOCATION OR SEC. NO.:	31-9S-26E
DIST.:	☐ OIL ☐ GAS
COUNTY:	CHAVES
STATE:	N.M.
NO. WELLS:	1
WELL NOS.:	1
DATE PROD. BEGAN:	3/80
ACRES:	

SIPES, WILLIAMSON & ASSOCIATES, INC.
MIDLAND HOUSTON

PLOTTED FROM CLIENT'S DATA

GAS PRODUCTION - MCF/MONTH

100 000
10 000
1000
100

Mar. June Sept. Dec.

19 80 | 19 81 | 19 82 | 19 83 | 19 84 | 19 85 | 19 86 | 19 87 | 19 88

SWA TR 40

EXHIBIT 22

FIELD	WILDCAT (ABO)
OPERATOR	McCLELLAN OIL CORP.
LEASE	PENJACK
LOCATION OR RRC NO.	06-10S-26E
DIST.	☐ OIL ☐ GAS
COUNTY	CHAVES
STATE	N.M.
NO. WELLS	1
WELL NOS.	1
DATE PROD. BEGAN	2/80
ACRES	

SIPES, WILLIAMSON & ASSOCIATES, INC.
MIDLAND HOUSTON

PLOTTED FROM CLIENT'S DATA

GAS PRODUCTION - MCF/MONTH

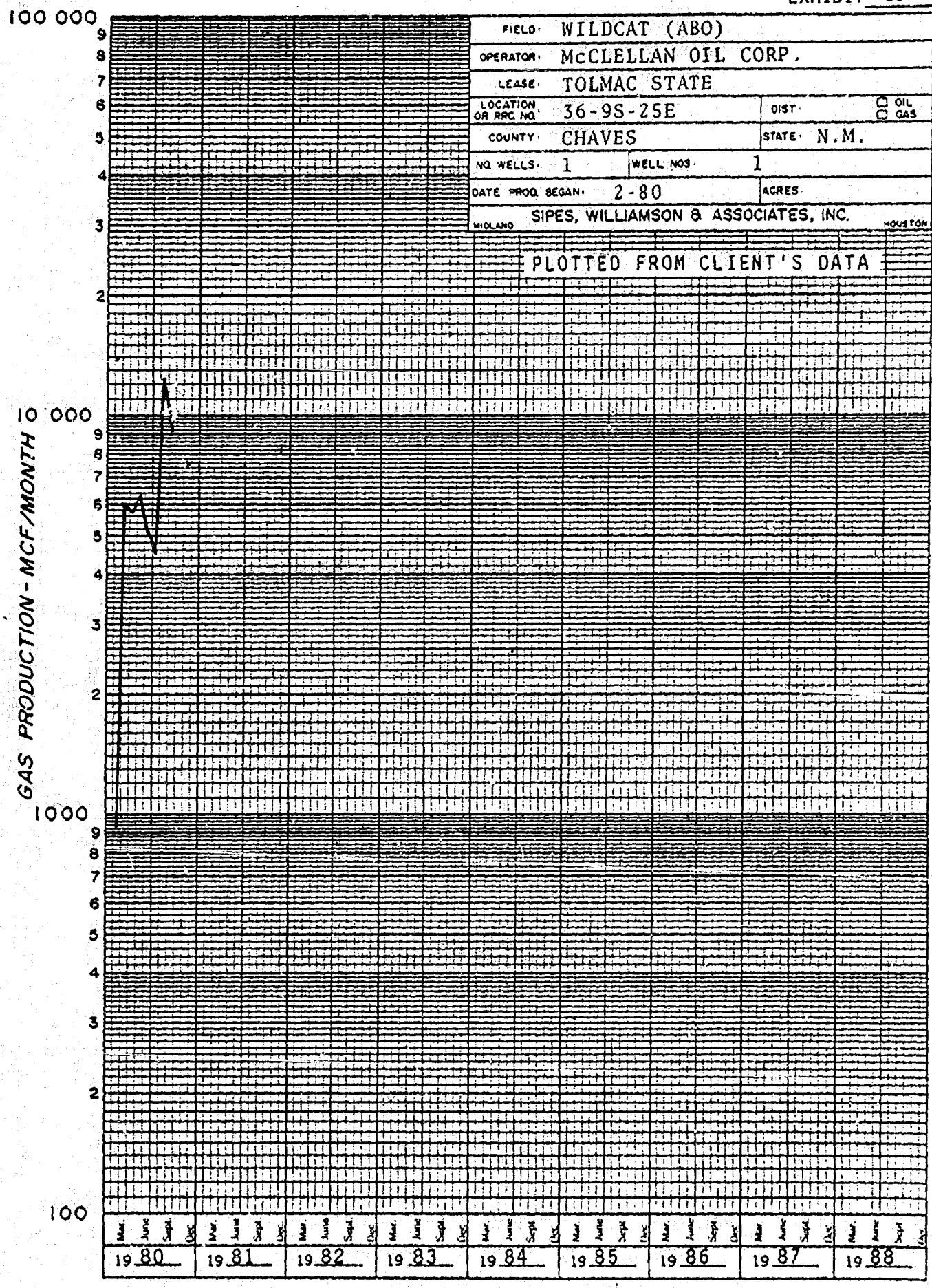
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Mar. June Sept. Dec.

19 80 | 19 81 | 19 82 | 19 83 | 19 84 | 19 85 | 19 86 | 19 87 | 19 88

SWA TR 43

EXHIBIT 23



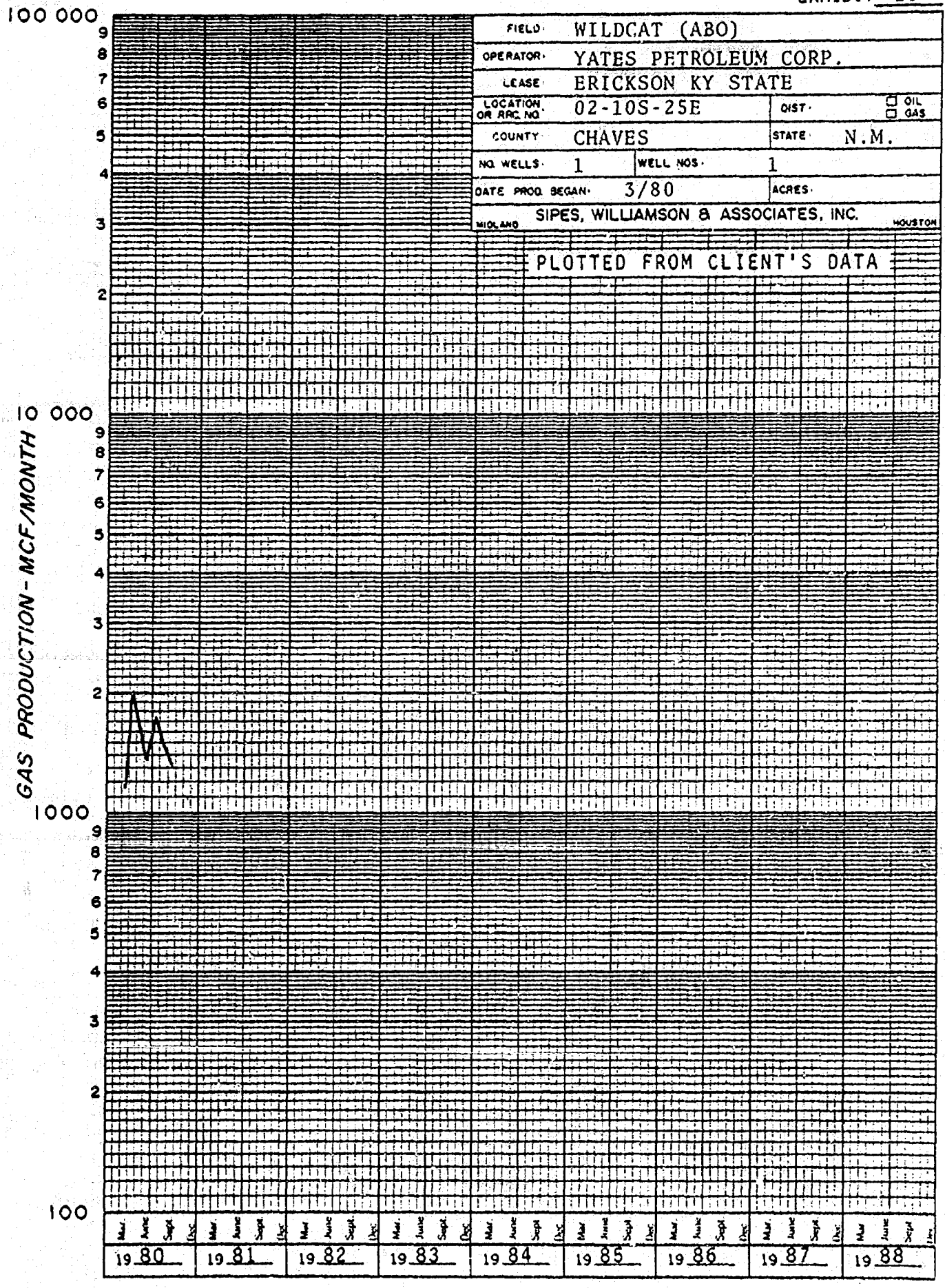
SWA TR 35

EXHIBIT 24

FIELD	WILDCAT (ABO)
OPERATOR	YATES PETROLEUM CORP.
LEASE	ERICKSON KY STATE
LOCATION OR RRC NO.	02-10S-25E
DIST.	☐ OIL ☐ GAS
COUNTY	CHAVES
STATE	N.M.
NO. WELLS	1
WELL NOS.	1
DATE PROD. BEGAN	3/80
ACRES	

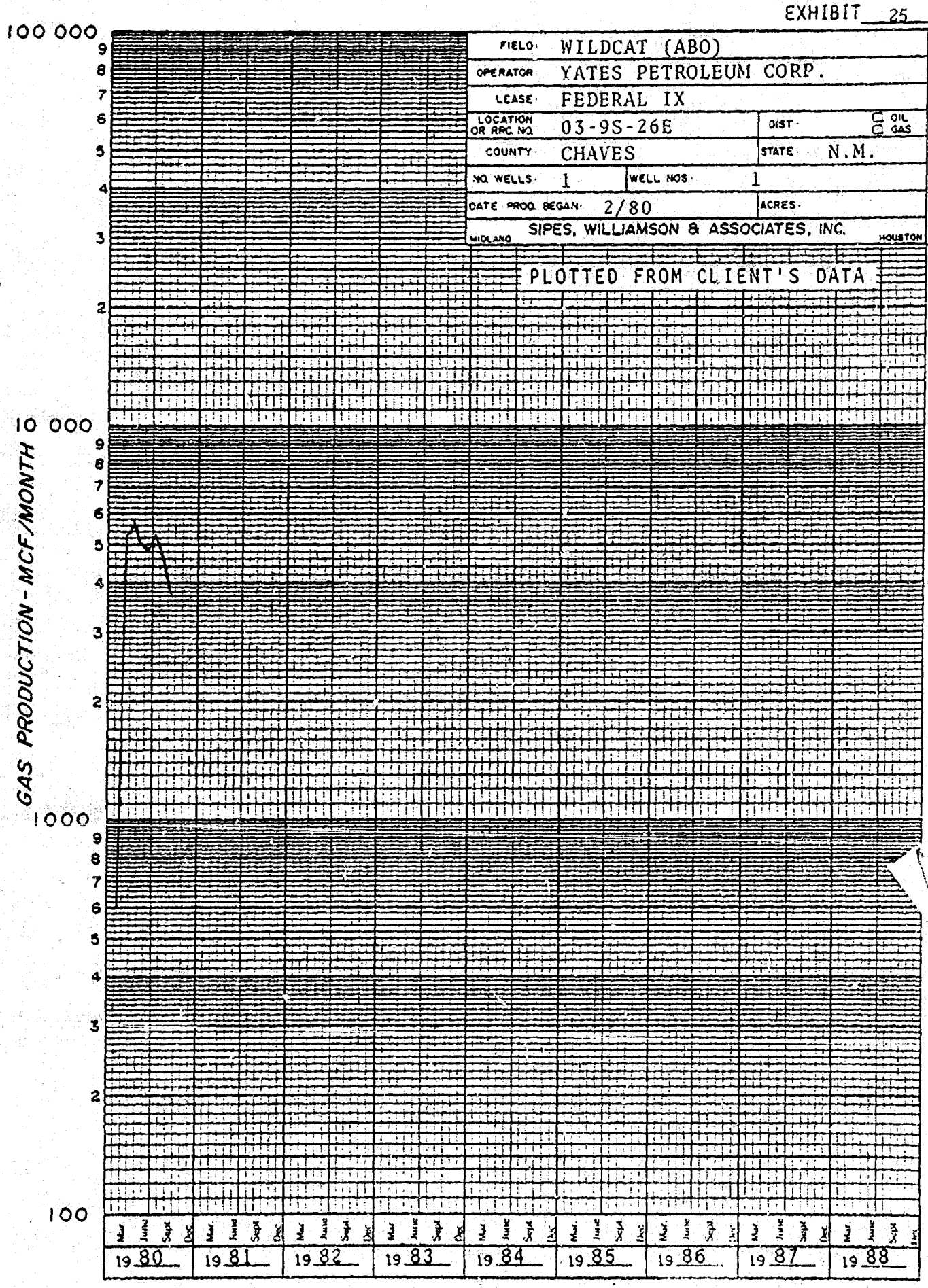
SIPES, WILLIAMSON & ASSOCIATES, INC.
MIDLAND HOUSTON

PLOTTED FROM CLIENT'S DATA



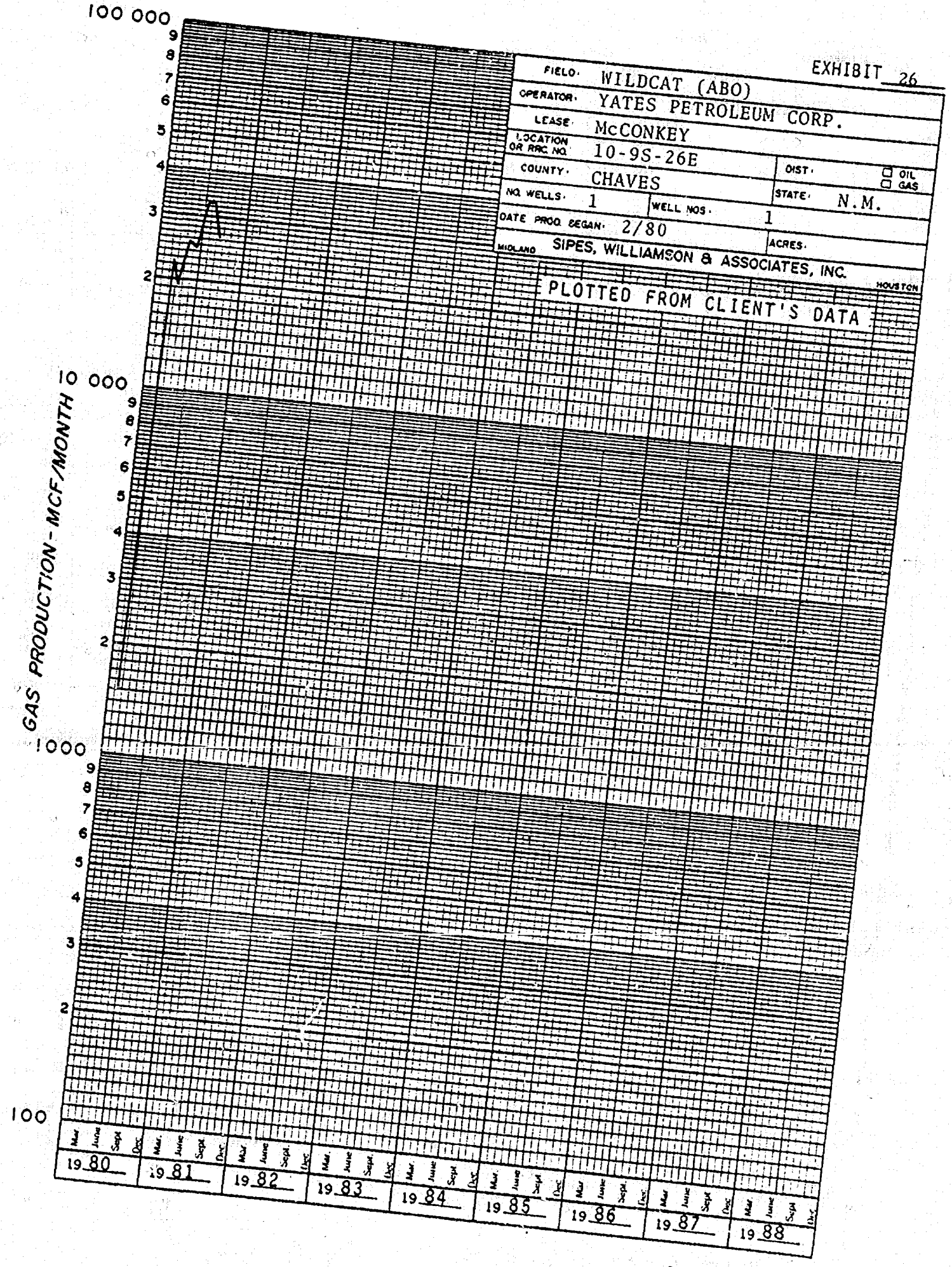
SWA TR 42

EXHIBIT 25



SWA TR 36

EXHIBIT 26



SWA TR 38

PECOS SLOPE
ABO TIGHT GAS PLAY
SOUTHEASTERN NEW MEXICO

TABULATION OF PRODUCTION DATA

SW&A TRACT NUMBER	OPERATOR / WELL NAME	SEPTEMBER 1980 PRODUCTION RATE* LIQUIDS, BBLPM	SEPTEMBER 1980 PRODUCTION RATE* GAS, MCFPM	CUMULATIVE PRODUCTION AS OF SEPTEMBER 30, 1980* LIQUIDS, BBL	CUMULATIVE PRODUCTION AS OF SEPTEMBER 30, 1980* GAS, MCF
	BOYD OPERATING COMPANY				
39	• BLAKEMORE FEDERAL NO. 1	0	1,374	0	20,757
	McCLELLAN OIL CORPORATION				
41	• "PJ" FEDERAL NO. 1	0	1,185	0	20,091
40	• "MM" FEDERAL NO. 1	0	3,453	0	43,013
37	"PJ" FEDERAL NO. 1	0	16,497	0	23,023
43	• PENJACK FEDERAL NO. 1	0	2,359	0	35,337
35	• TOLMAC STATE NO. 1	0	9,172	0	49,214
	POOL, FRED DRILLING COMPANY				
7	CORN NO. 1-24	0	6,875	0	6,875
6	CORN NO. 2-24	0	1,847	0	1,847
	YATES PETROLEUM CORPORATION				
18	COTTONWOOD RANCH "MK" STATE NO. 1	0	10,978	0	32,246
32	DUNCAN "LH" FEDERAL NO. 1-Y	0	11,829	0	28,114
42	• ERICKSON "KY" STATE NO. 1	0	1,318	0	10,687
28	FEDERAL "HY" NO. 2	0	3,894	0	5,677
36	• FEDERAL "IX" NO. 1	0	3,799	0	35,286
44	FIVE MILE DRAW "LX" FEDERAL NO. 1	0	11,888	0	30,977
2	GLOBE "MN" FEDERAL NO. 1	0	15,391	0	38,291
26	GODFREY "MP" FEDERAL NO. 1	0	19,785	0	43,110
10	GRYNBERG "LZ" STATE NO. 1	0	21,590	0	48,365
9	GYP "MO" FEDERAL NO. 1	0	20,330	0	48,931
12	McCLELLAN "MB" FEDERAL NO. 1	0	28,275	0	60,155

Gas & Hc Yates wells
only Oil & Gas Average amount
& GOR's & condensate.

• wells for which production data is plotted.

EXHIBIT 18
PAGE 1 OF 2

PECOS SLOPE
ABO TIGHT GAS PLAY
SOUTHEASTERN NEW MEXICO

TABULATION OF PRODUCTION DATA

SW&A TRACT NUMBER	OPERATOR / WELL NAME	SEPTEMBER 1980 PRODUCTION RATE* LIQUIDS, BBLPM	SEPTEMBER 1980 PRODUCTION RATE* GAS, MCFPM	CUMULATIVE PRODUCTION AS OF SEPTEMBER 30, 1980* LIQUIDS, BBL	CUMULATIVE PRODUCTION AS OF SEPTEMBER 30, 1980* GAS, MCF
	YATES PETROLEUM CORPORATION				
38	McCONKEY NO. 1	0	26,615	0	185,765
3	SHERNOFF "NL" STATE NO. 1	0	13,870	0	19,410
15	SOUTH ALKALI "LK" FEDERAL NO. 1	0	14,360	0	33,271
17	TECKLA "MD" FEDERAL NO. 2	0	13,724	0	13,724
16	THOMAS "LN" FEDERAL NO. 1	0	20,771	0	48,013

*Based on production data provided by client.

PECOS SLOPE AND PORTIONS OF
SOUTHEASTERN , NEW MEXICO

SYSTEM	SERIES	ROCK UNIT	LITHOLOGY
PERMIAN	OCHOAN	RUSTLER	
		SALADO	
	GUADALUPIAN	TANSILL	
		YATES	
		SEVEN RIVERS	
		QUEEN	
		GRAYBURG	
		SAN ANDRES	
	LEONARDIAN	"GLORIETA"	
		UPPER YESO	
		DRINKARD	
		LOWER YESO	
	Abo →		
	WOLFCAMPIAN	HUECO	
PENNSYLVANIAN	VIRGILIAN	CISCO	
	MISSOURIAN	CANYON	
	DESMOINESIAN	STRAWN	
	ATOKAN	" ATOKA"	
	MORROWAN	"MORROW"	
MISSISSIPPIAN	CHESTERAN	"CHESTER"	
	MERAMECIAN OSAGIAN KINDERHOOKIAN	MISSISSIPPIAN LIME	
DEVONIAN		WOODFORD	
SILURIAN		"UNDIFFERENTIATED SILURIAN"	
ORDOVICIAN		MONTOYA	
		SIMPSON	
		ELLENBURGER	
PRECAMBRIAN		UNNAMED	

PECOS SLOPE
ABO TIGHT GAS PLAY
SOUTHEASTERN , NEW MEXICO

GENERALIZED

STRATIGRAPHIC SECTION

EXHIBIT #3

PECOS SLOPE

ABO SANDSTONE TIGHT GAS PLAY

IN SOUTHEAST NEW MEXICO

GEOGRAPHICAL AND GEOLOGICAL DESCRIPTION

Geographically, the tight Abo sandstone gas play is located in southeast New Mexico and covers portions of Guadalupe, DeBaca, Torrance, Lincoln and Chaves Counties. The northern boundary of the filing area lies just south of Santa Rosa and the southern boundary is southwest of Roswell. The village of Vaughn is near the western boundary and Fort Sumner lies just within the eastern boundary. The area described will hereinafter be referred to as the Pecos Slope. (Refer to Exhibits #1 & #2)

The Lower Permian Abo sandstones of the Pecos Slope were deposited by a series of fluvial systems which derived their sediments from the Pedernal Uplift to the northwest. The Abo sandstones were deposited as elongate lenticular sand bodies on a low relief, fluvial plain. Individual sandstone bodies are irregularly shaped, limited in areal extent and are interbedded with red and green shales.

Gas production has been established in the low permeability sandstones of the Abo "red bed" section. The poor reservoir properties of the Abo sandstones vary both across the Pecos Slope and within individual sandstone bodies.

EXHIBITS 1 & 2: Area Map & Political Subdivision Description

This 1" = APPROXIMATELY 8 miles scale map shows parts of seven counties in Southeast New Mexico with the location of the major cities and towns.

The heavy line on the southeast marks the approximate extent of the Abo sandstones to the southeast.

The remainder of the map has indicated presence of Abo sandstones which will be discussed with the Cross-Section exhibits to follow.

The area of the application for tight Abo sandstones is shown by the outline on Exhibit #1 and is described by township and range in Exhibit #2.

EXHIBIT 3: Generalized Stratigraphic Section

The stratigraphic section is presented to show the location of the Abo section in geologic time and to indicate general lithology of the Abo section on the Pecos Slope. All rock units and Series shown are not present over the entire area of the Pecos Slope. The stratigraphic section is a compilation of industry accepted stratigraphic sections to fit the Pecos Slope.

EXHIBIT #4: Lithologic Description

This report is presented to show the Abo sandstone is a very fine-grained sandstone to siltstone. It consists of subangular to subrounded silt-sized grains of quartz, feldspar and mica, cemented with calcite and agrillaceous material.

EXHIBIT 5: Structure Map - Top of Abo

This map is on a scale of 1" = 8000'. It shows the same area as the Map Exhibit #1. The wells currently completed as Abo gas wells are colored orange. The fields outlined on the map show their name and producing formation. All of the wells that penetrate the Abo are indicated by black dry hole symbols or are circled or are shown by large completed gas well symbols. The cross-section traces are indciated by letter symbol and heavy lines. Control (data) point wells are lettered to correspond to the type of engineering data available (shown in the legend). In addition, the map shows the outline of the area of the application shown on Exhibit #1 and described in Exhibit #2.

The Abo structure map was prepared to illustrate the structural relief of the Abo sandstones across the Pecos Slope. Structure appears to be important only with respect to drilling depth to penetrate the sandstone lenses and channels in the Abo. The map is contoured on top of the Abo formation. The 100' contour interval indicates the general east dip with overall relief in excess of 5,500 feet across the area filed for tight Abo sandstone. Surface elevations range from 4,000 feet to the east to approximately 6,500 feet to the west. The drilling depth to the top of the Abo varies from approximately 4,500 feet to the east to 1,800 feet to the west.

CROSS SECTIONS

The cross sections which comprise the following exhibits were designed to show the presence of Abo sandstones over the entire Pecos Slope area. In addition wells that are completed from the Abo have completion data described at bottom of the log.

EXHIBIT 6: Regional Cross Section A-A'

Exhibit 6 is a generally North-South trending stratigraphic cross-section. This section is hung stratigraphically on the top of the Abo formation. It shows an increase in the total Abo section from north to south. In addition it shows numerous individual sand bodies within the Abo.

The cross-section is not designed to show structure but the logs indicate depth to the top of the sand inverval at well A-1 in Guadalupe County to be 2,682 feet while at well A-3 in DeBaca County it is 3,440 feet. The Abo section is approximately 640' thick in the north and 815' thick in the south. This, and the following cross-sections, show the variations, the unpredictable nature and the lack of continuity of the sandstone lenses and channels from well to well.

EXHIBIT 7: Regional Cross Section B-B'

Exhibit 7 is a generally West-East stratigraphic cross-section. The section is hung stratigraphically on the top of the Abo formation. It shows the wedge of the Abo thickening to the east and thinning to the west toward the source area for the Abo rocks. The thickness of the Abo varies from 780' in well B-3 to an estimated thickness of 400' to 500' in well B-1. Well B-1 had a show of flammable gas in sandstone at approximately 1,825 feet near the top of the Abo while drilling with cable tools.

EXHIBIT 8: Regional Cross Section C-C'

Exhibit 8 is a generally West-East stratigraphic cross-section. The section is hung stratigraphically on the top of the Abo formation. This section, like Sections A-A' & B-B',

shows the numerous individual sand bodies within the Abo zone. The depth to the top of the Abo in well C-1 is 1,900 feet in Lincoln County while, at well C-4 in Chaves County, it is 4,405 feet. The wedge shape of the Abo is well demonstrated on this section. The Abo is approximately 340 feet thick to the west and 685 feet thick to the east.

The Abo section in well C-1 rests on granite wash, which is assumed to be Wolfcamp in age, which in turn rests on a Quartz Diorite basement.

Well C-2 production tested a show of gas (described on the cross-section) from an Abo sandstone.

EXHIBIT 9: Regional Cross Section D-D'

Exhibit 9 is a generally North-South stratigraphic cross-section hung stratigraphically on the top of the Abo formation. This section ties Sections A-A', B-B' and C-C' and demonstrates the numerous individual sand bodies within the Abo formation. In addition, the completed gas wells from the Abo have the completions and production treatments partially described at the respective wells.

CONCLUSIONS:

The area filed for Abo tight sand designation on the Pecos Slope includes portions of five counties in Southeast New Mexico. Over this area the Abo formation exhibits remarkably similar lithologic and stratigraphic characteristics. The individual sandstones present in the Abo formation as exhibited on the cross-sections, are erratic and discontinuous.

The Abo sandstones were deposited in a fluvial system which has all the unpredictability and variation of this type deposition. Reservoir quality within the sand zones, as well as within the individual sandstone bodies, is unpredictable due to variations in clay content, cementing and grain size. The lithologic characteristics tend to make the Abo sandstone a relatively poor reservoir which is difficult to produce without stimulation.

SUE UMSHLER - USGS - ALBUQUERQUE CALLED
CAN't MAKE IT TO HEARING ON TIGHT SANDS

THEY HAVE NO MAJOR OBJECTIONS BUT FEEL THAT
THE DATA SUBMITTED DOES NOT SUBSTANTIATE ACREAGE

THEY WONDER IF THERE IS SEISMIC INFORMATION
TO BACK THIS.

NOVEMBER 25, 1980 8:00 a.m.

LAW OFFICES
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1000 FIRST NATIONAL BANK TOWER
(915) 683-4691

AMARILLO, TEXAS OFFICE
1701 AMERICAN NATIONAL BANK BUILDING
(806) 372-5569

*LICENSED IN TEXAS ONLY

November 10, 1980

RECEIVED
NOV 12 1980
OIL CONSERVATION DIVISION
SANTA FE

(HAND DELIVERED)

Mr. Ernie Padilla
Oil Conservation Division
P. O. Box 2088
Santa Fe, New Mexico 87501

Re: Mesa Petroleum-NGPA Tight Sand
Application Hearing

Dear Mr. Padilla:

Enclosed please find Exhibits 1 through 26, together with narrative discussions, to be offered by Mesa Petroleum in the above captioned matter.

Very truly yours,

HINKLE, COX, EATON, COFFIELD & HENSLEY

Paul M. Bohannon

PMB:mh
Encl.
cc: U.S.G.S.
Mesa Petroleum

Memo

From

ERNEST L. PADILLA
GENERAL COUNSEL

To Florene:

Set this for
Nov. 25

Application

OIL CONSERVATION DIVISION SANTA FE

IN THE OIL CONSERVATION DIVISION

ENERGY AND MINERALS DEPARTMENT

STATE OF NEW MEXICO

RECEIVED
OCT 20 1980
OIL CONSERVATION DIVISION
SANTA FE

IN THE MATTER OF THE APPLICATION OF MESA PETROLEUM COMPANY AND YATES PETROLEUM CORPORATION FOR DESIGNATION OF A TIGHT FORMATION IN CHAVES, DE BACA, GUADALUPE, LINCOLN AND TORRANCE COUNTIES, NEW MEXICO)

Date of Filing:

Case 7093

APPLICATION FOR DESIGNATION OF TIGHT FORMATION

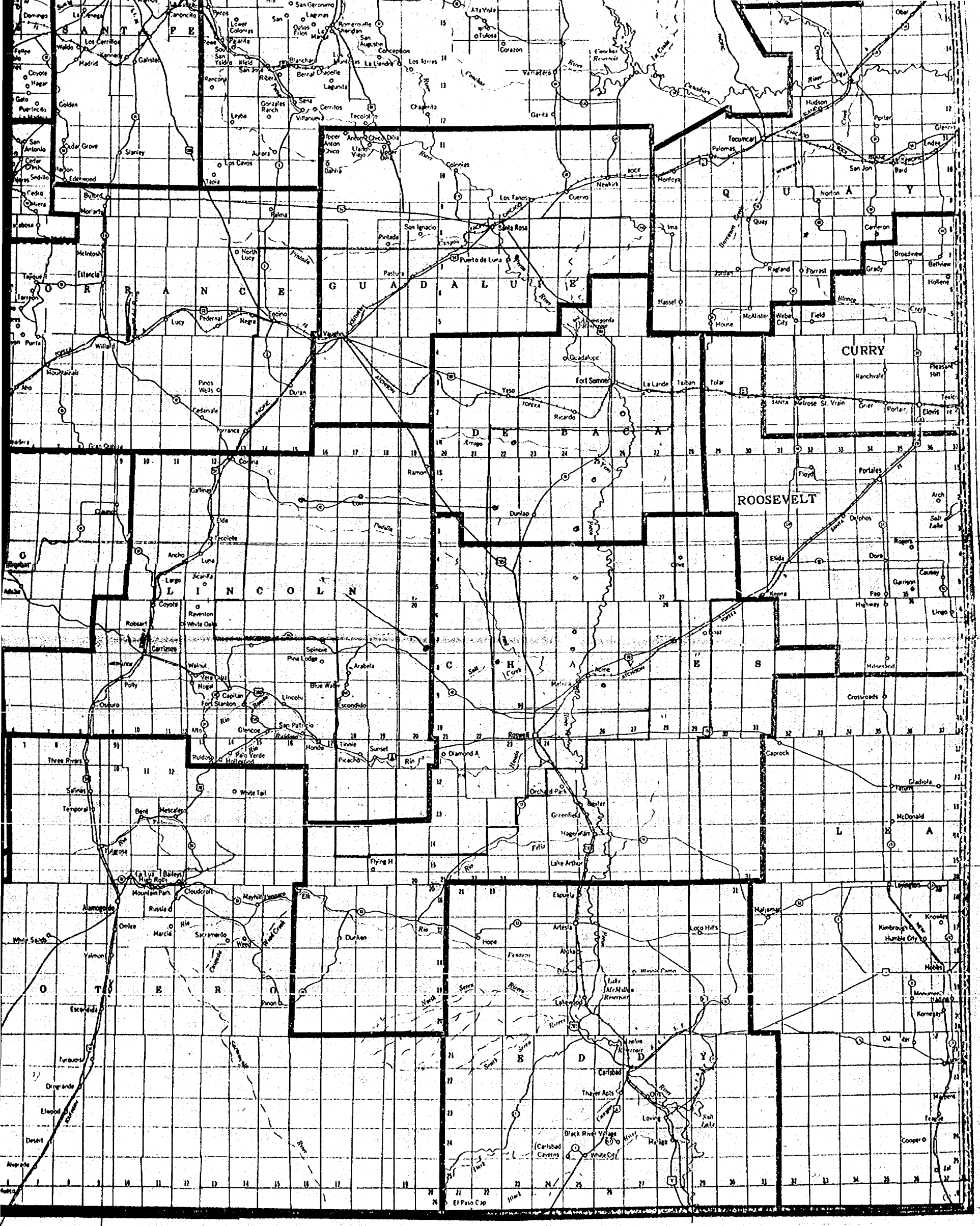
COME NOW Mesa Petroleum Company and Yates Petroleum Corporation, pursuant to Order R-6388 of the New Mexico Oil Conservation Division, and state:

1. Applicants are the owners of interests in the Abo formation underlying portions of the lands described in Exhibit "A" attached hereto and made a part hereof.

2. If productive sands are encountered, the Abo formation underlying the lands described in Exhibit "A" is expected to have an estimated average in situ gas permeability throughout the pay section of less than 0.1 millidarcy.

3. The average depth to the top of the Abo formation is 3800 feet. The stabilized production rate, either at atmospheric pressure or calculated against atmospheric pressure, of wells completed for production in the formation, without stimulation, is not expected to exceed 105 MCF of gas per day.

4. No well drilled into the Abo formation underlying the lands described in Exhibit "A" is expected to produce more than five barrels of crude oil per day prior to application of stimulation techniques or processes.



DISTRICT FOUR COUNTIES

WHEREFORE, Applicants pray that the New Mexico Oil Conservation Division enter its order recommending to the Federal Energy Regulatory Commission that, pursuant to 18 CFR §271.701, the Abo formation underlying the lands described in Exhibit "A" be designated as a tight formation, together with such other and further relief as the Division may deem just and proper.

HINKLE, COX, EATON, COFFIELD & HENSLEY

By _____
Attorneys for Mesa Petroleum Company
and Yates Petroleum Corporation

EXHIBIT "A"

CHAVES COUNTY

All of the following described Real Properties:

Township 3 South, Range 20 East, N.M.P.M.
Township 3 South, Range 27 East, N.M.P.M.

Township 4 South, Range 20 East, N.M.P.M.
Township 4 South, Range 21 East, N.M.P.M.
Township 4 South, Range 22 East, N.M.P.M.
Township 4 South, Range 23 East, N.M.P.M.
Township 4 South, Range 24 East, N.M.P.M.
Township 4 South, Range 25 East, N.M.P.M.
Township 4 South, Range 26 East, N.M.P.M.
Township 4 South, Range 27 East, N.M.P.M.

Township 5 South, Range 20 East, N.M.P.M.
Township 5 South, Range 21 East, N.M.P.M.
Township 5 South, Range 22 East, N.M.P.M.
Township 5 South, Range 23 East, N.M.P.M.
Township 5 South, Range 24 East, N.M.P.M.
Township 5 South, Range 25 East, N.M.P.M.
Township 5 South, Range 26 East, N.M.P.M.
Township 5 South, Range 27 East, N.M.P.M.

Township 6 South, Range 21 East, N.M.P.M.
Township 6 South, Range 22 East, N.M.P.M.
Township 6 South, Range 23 East, N.M.P.M.
Township 6 South, Range 24 East, N.M.P.M.
Township 6 South, Range 25 East, N.M.P.M.
Township 6 South, Range 26 East, N.M.P.M.
Township 6 South, Range 27 East, N.M.P.M.
Township 6 South, Range 28 East, N.M.P.M.

Township 7 South, Range 21 East, N.M.P.M.
Township 7 South, Range 22 East, N.M.P.M.
Township 7 South, Range 23 East, N.M.P.M.
Township 7 South, Range 24 East, N.M.P.M.
Township 7 South, Range 25 East, N.M.P.M.
Township 7 South, Range 26 East, N.M.P.M.
Township 7 South, Range 27 East, N.M.P.M.
Township 7 South, Range 28 East, N.M.P.M.

Township 8 South, Range 21 East, N.M.P.M.
Township 8 South, Range 22 East, N.M.P.M.
Township 8 South, Range 23 East, N.M.P.M.
Township 8 South, Range 24 East, N.M.P.M.
Township 8 South, Range 25 East, N.M.P.M.
Township 8 South, Range 26 East, N.M.P.M.
Township 8 South, Range 27 East, N.M.P.M.
Township 8 South, Range 28 East, N.M.P.M.

Township 9 South, Range 21 East, N.M.P.M.
Township 9 South, Range 22 East, N.M.P.M.
Township 9 South, Range 23 East, N.M.P.M.
Township 9 South, Range 24 East, N.M.P.M.
Township 9 South, Range 25 East, N.M.P.M.
Township 9 South, Range 26 East, N.M.P.M.
Township 9 South, Range 27 East, N.M.P.M.

Township 9½ South, Range 24 East, N.M.P.M.

Township 10 South, Range 21 East, N.M.P.M.
Township 10 South, Range 22 East, N.M.P.M.
Township 10 South, Range 23 East, N.M.P.M.
Township 10 South, Range 24 East, N.M.P.M.
Township 10 South, Range 25 East, N.M.P.M.
Township 10 South, Range 26 East, N.M.P.M.
Township 10 South, Range 27 East, N.M.P.M.
Township 11 South, Range 21 East, N.M.P.M.
Township 11 South, Range 22 East, N.M.P.M.
Township 11 South, Range 23 East, N.M.P.M.
Township 11 South, Range 24 East, N.M.P.M.
Township 11 South, Range 25 East, N.M.P.M.

Township 12 South, Range 21 East, N.M.P.M.
Township 12 South, Range 21½ East, N.M.P.M.
Township 12 South, Range 22 East, N.M.P.M.
Township 12 South, Range 23 East, N.M.P.M.
Township 12 South, Range 24 East, N.M.P.M.

Township 13 South, Range 21 East, N.M.P.M.
Township 13 South, Range 22 East, N.M.P.M.
Township 13 South, Range 23 East, N.M.P.M.

Township 14 South, Range 18 East, N.M.P.M.
Township 14 South, Range 19 East, N.M.P.M.
Township 14 South, Range 20 East, N.M.P.M.
Township 14 South, Range 21 East, N.M.P.M.
Township 14 South, Range 22 East, N.M.P.M.

DE BACA COUNTY

All of the following described Real Properties:

Township 1 North, Range 20 East, N.M.P.M.
Township 1 North, Range 21 East, N.M.P.M.
Township 1 North, Range 22 East, N.M.P.M.
Township 1 North, Range 23 East, N.M.P.M.
Township 1 North, Range 24 East, N.M.P.M.
Township 1 North, Range 25 East, N.M.P.M.
Township 1 North, Range 26 East, N.M.P.M.
Township 1 North, Range 27 East, N.M.P.M.

Township 2 North, Range 20 East, N.M.P.M.
Township 2 North, Range 21 East, N.M.P.M.
Township 2 North, Range 22 East, N.M.P.M.
Township 2 North, Range 23 East, N.M.P.M.
Township 2 North, Range 24 East, N.M.P.M.
Township 2 North, Range 25 East, N.M.P.M.
Township 2 North, Range 26 East, N.M.P.M.
Township 2 North, Range 27 East, N.M.P.M.

Township 3 North, Range 20 East, N.M.P.M.
Township 3 North, Range 21 East, N.M.P.M.
Township 3 North, Range 22 East, N.M.P.M.
Township 3 North, Range 23 East, N.M.P.M.
Township 3 North, Range 24 East, N.M.P.M.
Township 3 North, Range 25 East, N.M.P.M.
Township 3 North, Range 26 East, N.M.P.M.
Township 3 North, Range 27 East, N.M.P.M.

Township 4 North, Range 20 East, N.M.P.M.
Township 4 North, Range 21 East, N.M.P.M.
Township 4 North, Range 22 East, N.M.P.M.
Township 4 North, Range 23 East, N.M.P.M.
Township 4 North, Range 24 East, N.M.P.M.
Township 4 North, Range 25 East, N.M.P.M.
Township 4 North, Range 26 East, N.M.P.M.
Township 4 North, Range 27 East, N.M.P.M.

Township 5 North, Range 24 East, N.M.P.M.
Township 5 North, Range 25 East, N.M.P.M.
Township 5 North, Range 26 East, N.M.P.M.

Township 6 North, Range 25 East, N.M.P.M.
Township 6 North, Range 26 East, N.M.P.M.

Township 1 South, Range 20 East, N.M.P.M.
Township 1 South, Range 21 East, N.M.P.M.
Township 1 South, Range 22 East, N.M.P.M.
Township 1 South, Range 23 East, N.M.P.M.
Township 1 South, Range 24 East, N.M.P.M.
Township 1 South, Range 25 East, N.M.P.M.
Township 1 South, Range 26 East, N.M.P.M.
Township 1 South, Range 27 East, N.M.P.M.

Township 2 South, Range 20 East, N.M.P.M.
Township 2 South, Range 21 East, N.M.P.M.
Township 2 South, Range 22 East, N.M.P.M.
Township 2 South, Range 23 East, N.M.P.M.
Township 2 South, Range 24 East, N.M.P.M.
Township 2 South, Range 25 East, N.M.P.M.
Township 2 South, Range 26 East, N.M.P.M.
Township 2 South, Range 27 East, N.M.P.M.

Township 3 South, Range 21 East, N.M.P.M.
Township 3 South, Range 22 East, N.M.P.M.

Township 3 South, Range 23 East, N.M.P.M.
Township 3 South, Range 24 East, N.M.P.M.
Township 3 South, Range 25 East, N.M.P.M.
Township 3 South, Range 26 East, N.M.P.M.

GUADALUPE COUNTY

All of the following described Real Properties:

Township 2 North, Range 16 East, N.M.P.M.
Township 2 North, Range 17 East, N.M.P.M.
Township 2 North, Range 18 East, N.M.P.M.
Township 2 North, Range 19 East, N.M.P.M.

Township 3 North, Range 16 East, N.M.P.M.
Township 3 North, Range 17 East, N.M.P.M.
Township 3 North, Range 18 East, N.M.P.M.
Township 3 North, Range 19 East, N.M.P.M.

Township 4 North, Range 16 East, N.M.P.M.
Township 4 North, Range 17 East, N.M.P.M.
Township 4 North, Range 18 East, N.M.P.M.
Township 4 North, Range 19 East, N.M.P.M.

Township 5 North, Range 16 East, N.M.P.M.
Township 5 North, Range 17 East, N.M.P.M.
Township 5 North, Range 18 East, N.M.P.M.
Township 5 North, Range 19 East, N.M.P.M.
Township 5 North, Range 20 East, N.M.P.M.
Township 5 North, Range 21 East, N.M.P.M.
Township 5 North, Range 22 East, N.M.P.M.
Township 5 North, Range 23 East, N.M.P.M.

Township 6 North, Range 16 East, N.M.P.M.
Township 6 North, Range 17 East, N.M.P.M.
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Township 6 North, Range 19 East, N.M.P.M.
Township 6 North, Range 20 East, N.M.P.M.
Township 6 North, Range 21 East, N.M.P.M.
Township 6 North, Range 22 East, N.M.P.M.
Township 6 North, Range 23 East, N.M.P.M.
Township 6 North, Range 24 East, N.M.P.M.

Township 7 North, Range 16 East, N.M.P.M.
Township 7 North, Range 17 East, N.M.P.M.
Township 7 North, Range 18 East, N.M.P.M.
Township 7 North, Range 19 East, N.M.P.M.
Township 7 North, Range 20 East, N.M.P.M.
Township 7 North, Range 21 East, N.M.P.M.
Township 7 North, Range 22 East, N.M.P.M.
Township 7 North, Range 23 East, N.M.P.M.
Township 7 North, Range 24 East, N.M.P.M.
Township 7 North, Range 25 East, N.M.P.M.
Township 7 North, Range 26 East, N.M.P.M.

LINCOLN COUNTY

All of the following described Real Properties:

Township 1 North, Range 16 East, N.M.P.M.
Township 1 North, Range 17 East, N.M.P.M.
Township 1 North, Range 18 East, N.M.P.M.
Township 1 North, Range 19 East, N.M.P.M.

Township 1 South, Range 14 East, N.M.P.M.
Township 1 South, Range 15 East, N.M.P.M.
Township 1 South, Range 16 East, N.M.P.M.
Township 1 South, Range 17 East, N.M.P.M.
Township 1 South, Range 18 East, N.M.P.M.
Township 1 South, Range 19 East, N.M.P.M.

Township 2 South, Range 14 East, N.M.P.M.
Township 2 South, Range 15 East, N.M.P.M.
Township 2 South, Range 16 East, N.M.P.M.
Township 2 South, Range 17 East, N.M.P.M.
Township 2 South, Range 18 East, N.M.P.M.
Township 2 South, Range 19 East, N.M.P.M.

Township 3 South, Range 14 East, N.M.P.M.
Township 3 South, Range 15 East, N.M.P.M.
Township 3 South, Range 16 East, N.M.P.M.
Township 3 South, Range 17 East, N.M.P.M.
Township 3 South, Range 18 East, N.M.P.M.
Township 3 South, Range 19 East, N.M.P.M.

Township 4 South, Range 14 East, N.M.P.M.
Township 4 South, Range 15 East, N.M.P.M.
Township 4 South, Range 16 East, N.M.P.M.
Township 4 South, Range 17 East, N.M.P.M.
Township 4 South, Range 18 East, N.M.P.M.
Township 4 South, Range 19 East, N.M.P.M.

Township 5 South, Range 14 East, N.M.P.M.
Township 5 South, Range 15 East, N.M.P.M.
Township 5 South, Range 16 East, N.M.P.M.
Township 5 South, Range 17 East, N.M.P.M.
Township 5 South, Range 18 East, N.M.P.M.
Township 5 South, Range 19 East, N.M.P.M.

Township 6 South, Range 14 East, N.M.P.M.
Township 6 South, Range 15 East, N.M.P.M.
Township 6 South, Range 16 East, N.M.P.M.
Township 6 South, Range 17 East, N.M.P.M.
Township 6 South, Range 18 East, N.M.P.M.
Township 6 South, Range 19 East, N.M.P.M.
Township 6 South, Range 20 East, N.M.P.M.

Township 7 South, N½ Range 14 East, N.M.P.M.
Township 7 South, N½ Range 15 East, N.M.P.M.

PECOS SLOPE
ABO SANDSTONE TIGHT GAS PLAY
IN SOUTHEAST NEW MEXICO
GEOGRAPHICAL DESCRIPTION

CHAVES COUNTY

All of the following described Real Properties:

Township 3 South, Range 20 East, N.M.P.M.
Township 3 South, Range 27 East, N.M.P.M.

Township 4 South, Range 20 East, N.M.P.M.
Township 4 South, Range 21 East, N.M.P.M.
Township 4 South, Range 22 East, N.M.P.M.
Township 4 South, Range 23 East, N.M.P.M.
Township 4 South, Range 24 East, N.M.P.M.
Township 4 South, Range 25 East, N.M.P.M.
Township 4 South, Range 26 East, N.M.P.M.
Township 4 South, Range 27 East, N.M.P.M.

Township 5 South, Range 20 East, N.M.P.M.
Township 5 South, Range 21 East, N.M.P.M.
Township 5 South, Range 22 East, N.M.P.M.
Township 5 South, Range 23 East, N.M.P.M.
Township 5 South, Range 24 East, N.M.P.M.
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Township 6 South, Range 21 East, N.M.P.M.
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Township 6 South, Range 27 East, N.M.P.M.
Township 6 South, Range 28 East, N.M.P.M.

Township 7 South, Range 21 East, N.M.P.M.
Township 7 South, Range 22 East, N.M.P.M.
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Township 7 South, Range 27 East, N.M.P.M.
Township 7 South, Range 28 East, N.M.P.M.

Township 8 South, Range 21 East, N.M.P.M.
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Township 8 South, Range 23 East, N.M.P.M.
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Township 8 South, Range 26 East, N.M.P.M.
Township 8 South, Range 27 East, N.M.P.M.
Township 8 South, Range 28 East, N.M.P.M.

Township 9 South, Range 21 East, N.M.P.M.
Township 9 South, Range 22 East, N.M.P.M.
Township 9 South, Range 23 East, N.M.P.M.
Township 9 South, Range 24 East, N.M.P.M.
Township 9 South, Range 25 East, N.M.P.M.
Township 9 South, Range 26 East, N.M.P.M.
Township 9 South, Range 27 East, N.M.P.M.

Township 9½ South, Range 24 East, N.M.P.M.

Township 10 South, Range 21 East, N.M.P.M.
Township 10 South, Range 22 East, N.M.P.M.
Township 10 South, Range 23 East, N.M.P.M.
Township 10 South, Range 24 East, N.M.P.M.
Township 10 South, Range 25 East, N.M.P.M.
Township 10 South, Range 26 East, N.M.P.M.
Township 10 South, Range 27 East, N.M.P.M.

EXHIBIT # 2

Township 11 South, Range 21 East, N.M.P.M.
Township 11 South, Range 22 East, N.M.P.M.
Township 11 South, Range 23 East, N.M.P.M.
Township 11 South, Range 24 East, N.M.P.M.
Township 11 South, Range 25 East, N.M.P.M.

Township 12 South, Range 21 East, N.M.P.M.
Township 12 South, Range 21½ East, N.M.P.M.
Township 12 South, Range 22 East, N.M.P.M.
Township 12 South, Range 23 East, N.M.P.M.
Township 12 South, Range 24 East, N.M.P.M.

Township 13 South, Range 21 East, N.M.P.M.
Township 13 South, Range 22 East, N.M.P.M.
Township 13 South, Range 23 East, N.M.P.M.

Township 14 South, Range 18 East, N.M.P.M.
Township 14 South, Range 19 East, N.M.P.M.
Township 14 South, Range 20 East, N.M.P.M.
Township 14 South, Range 21 East, N.M.P.M.
Township 14 South, Range 22 East, N.M.P.M.

DE BACA COUNTY

All of the following described Real Properties:

Township 1 North, Range 20 East, N.M.P.M.
Township 1 North, Range 21 East, N.M.P.M.
Township 1 North, Range 22 East, N.M.P.M.
Township 1 North, Range 23 East, N.M.P.M.
Township 1 North, Range 24 East, N.M.P.M.
Township 1 North, Range 25 East, N.M.P.M.
Township 1 North, Range 26 East, N.M.P.M.
Township 1 North, Range 27 East, N.M.P.M.

Township 2 North, Range 20 East, N.M.P.M.
Township 2 North, Range 21 East, N.M.P.M.
Township 2 North, Range 22 East, N.M.P.M.
Township 2 North, Range 23 East, N.M.P.M.
Township 2 North, Range 24 East, N.M.P.M.
Township 2 North, Range 25 East, N.M.P.M.
Township 2 North, Range 26 East, N.M.P.M.
Township 2 North, Range 27 East, N.M.P.M.

Township 3 North, Range 20 East, N.M.P.M.
Township 3 North, Range 21 East, N.M.P.M.
Township 3 North, Range 22 East, N.M.P.M.
Township 3 North, Range 23 East, N.M.P.M.
Township 3 North, Range 24 East, N.M.P.M.
Township 3 North, Range 25 East, N.M.P.M.
Township 3 North, Range 26 East, N.M.P.M.
Township 3 North, Range 27 East, N.M.P.M.

Township 4 North, Range 20 East, N.M.P.M.
Township 4 North, Range 21 East, N.M.P.M.
Township 4 North, Range 22 East, N.M.P.M.
Township 4 North, Range 23 East, N.M.P.M.
Township 4 North, Range 24 East, N.M.P.M.
Township 4 North, Range 25 East, N.M.P.M.
Township 4 North, Range 26 East, N.M.P.M.
Township 4 North, Range 27 East, N.M.P.M.

Township 5 North, Range 24 East, N.M.P.M.
Township 5 North, Range 25 East, N.M.P.M.
Township 5 North, Range 26 East, N.M.P.M.

Township 6 North, Range 25 East, N.M.P.M.
Township 6 North, Range 26 East, N.M.P.M.

Township 1 South, Range 20 East, N.M.P.M.
Township 1 South, Range 21 East, N.M.P.M.
Township 1 South, Range 22 East, N.M.P.M.
Township 1 South, Range 23 East, N.M.P.M.
Township 1 South, Range 24 East, N.M.P.M.
Township 1 South, Range 25 East, N.M.P.M.
Township 1 South, Range 26 East, N.M.P.M.
Township 1 South, Range 27 East, N.M.P.M.

Township 2 South, Range 20 East, N.M.P.M.
Township 2 South, Range 21 East, N.M.P.M.
Township 2 South, Range 22 East, N.M.P.M.
Township 2 South, Range 23 East, N.M.P.M.
Township 2 South, Range 24 East, N.M.P.M.
Township 2 South, Ramge 25 East, N.M.P.M.
Township 2 South, Range 26 East, N.M.P.M.
Township 2 South, Range 27 East, N.M.P.M.

Township 3 South, Range 21 East, N.M.P.M.
Township 3 South, Range 22 East, N.M.P.M.
Township 3 South, Range 23 East, N.M.P.M.
Township 3 South, Range 24 East, N.M.P.M.
Township 3 South, Range 25 East, N.M.P.M.
Township 3 South, Range 26 East, N.M.P.M.

GUADALUPE COUNTY

All of the following described Real Properties:

Township 2 North, Range 16 East, N.M.P.M.
Township 2 North, Range 17 East, N.M.P.M.
Township 2 North, Range 18 East, N.M.P.M.
Township 2 North, Range 19 East, N.M.P.M.

Township 3 North, Range 16 East, N.M.P.M.
Township 3 North, Range 17 East, N.M.P.M.
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Township 4 North, Range 16 East, N.M.P.M.
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Township 6 North, Range 22 East, N.M.P.M.
Township 6 North, Range 23 East, N.M.P.M.
Township 6 North, Range 24 East, N.M.P.M.

Township 7 North, Range 16 East, N.M.P.M.
Township 7 North, Range 17 East, N.M.P.M.
Township 7 North, Range 18 East, N.M.P.M.
Township 7 North, Range 19 East, N.M.P.M.
Township 7 North, Range 20 East, N.M.P.M.
Township 7 North, Range 21 East, N.M.P.M.
Township 7 North, Range 22 East, N.M.P.M.
Township 7 North, Range 23 East, N.M.P.M.
Township 7 North, Range 24 East, N.M.P.M.
Township 7 North, Range 25 East, N.M.P.M.
Township 7 North, Range 26 East, N.M.P.M.

LINCOLN COUNTY

All of the following described Real Properties:

Township 1 North, Range 16 East, N.M.P.M.
Township 1 North, Range 17 East, N.M.P.M.
Township 1 North, Range 18 East, N.M.P.M.
Township 1 North, Range 19 East, N.M.P.M.

Township 1 South, Range 14 East, N.M.P.M.
Township 1 South, Range 15 East, N.M.P.M.
Township 1 South, Range 16 East, N.M.P.M.
Township 1 South, Range 17 East, N.M.P.M.
Township 1 South, Range 18 East, N.M.P.M.
Township 1 South, Range 19 East, N.M.P.M.

Township 2 South, Range 14 East, N.M.P.M.
Township 2 South, Range 15 East, N.M.P.M.
Township 2 South, Range 16 East, N.M.P.M.
Township 2 South, Range 17 East, N.M.P.M.
Township 2 South, Range 18 East, N.M.P.M.
Township 2 South, Range 19 East, N.M.P.M.

Township 3 South, Range 14 East, N.M.P.M.
Township 3 South, Range 15 East, N.M.P.M.
Township 3 South, Range 16 East, N.M.P.M.
Township 3 South, Range 17 East, N.M.P.M.
Township 3 South, Range 18 East, N.M.P.M.
Township 3 South, Range 19 East, N.M.P.M.

Township 4 South, Range 14 East, N.M.P.M.
Township 4 South, Range 15 East, N.M.P.M.
Township 4 South, Range 16 East, N.M.P.M.
Township 4 South, Range 17 East, N.M.P.M.
Township 4 South, Range 18 East, N.M.P.M.
Township 4 South, Range 19 East, N.M.P.M.

Township 5 South, Range 14 East, N.M.P.M.
Township 5 South, Range 15 East, N.M.P.M.
Township 5 South, Range 16 East, N.M.P.M.
Township 5 South, Range 17 East, N.M.P.M.
Township 5 South, Range 18 East, N.M.P.M.
Township 5 South, Range 19 East, N.M.P.M.

Township 6 South, Range 14 East, N.M.P.M.
Township 6 South, Range 15 East, N.M.P.M.
Township 6 South, Range 16 East, N.M.P.M.
Township 6 South, Range 17 East, N.M.P.M.
Township 6 South, Range 18 East, N.M.P.M.
Township 6 South, Range 19 East, N.M.P.M.
Township 6 South, Range 20 East, N.M.P.M.

Township 7 South, N½ Range 14 East, N.M.P.M.
Township 7 South, N½ Range 15 East, N.M.P.M.
Township 7 South, N½ Range 16 East, N.M.P.M.
Township 7 South, N½ Range 17 East, N.M.P.M.
Township 7 South, Range 18 East, N.M.P.M.
Township 7 South, Range 19 East, N.M.P.M.
Township 7 South, Range 20 East, N.M.P.M.

Township 8 South, Range 18 East, N.M.P.M.
Township 8 South, Range 19 East, N.M.P.M.
Township 8 South, Range 20 East, N.M.P.M.

Township 9 South, Range 18 East, N.M.P.M.
Township 9 South, Range 19 East, N.M.P.M.
Township 9 South, Range 20 East, N.M.P.M.

Township 10 South, Range 18 East, N.M.P.M.
Township 10 South, Range 19 East, N.M.P.M.
Township 10 South, Range 20 East, N.M.P.M.

Township 11 South, Range 18 East, N.M.P.M.
Township 11 South, Range 19 East, N.M.P.M.
Township 11 South, Range 20 East, N.M.P.M.

Township 12 South, Range 18 East, N.M.P.M.
Township 12 South, Range 19 East, N.M.P.M.
Township 12 South, Range 20 East, N.M.P.M.

Township 13 South, Range 18 East, N.M.P.M.
Township 13 South, Range 19 East, N.M.P.M.
Township 13 South, Range 20 East, N.M.P.M.

TORRANCE COUNTY

All of the following described Real Properties:

Township 1 North, Range 14 East, N.M.P.M.
Township 1 North, Range 15 East, N.M.P.M.

Township 2 North, Range 14 East, N.M.P.M.
Township 2 North, Range 15 East, N.M.P.M.

Township 3 North, Range 14 East, N.M.P.M.
Township 3 North, Range 15 East, N.M.P.M.

Township 4 North, Range 14 East, N.M.P.M.
Township 4 North, Range 15 East, N.M.P.M.

Township 5 North, Range 14 East, N.M.P.M.
Township 5 North, Range 15 East, N.M.P.M.

Township 6 North, Range 14 East, N.M.P.M.
Township 6 North, Range 15 East, N.M.P.M.

Township 7 North, Range 14 East, N.M.P.M.
Township 7 North, Range 15 East, N.M.P.M.

CORE ANALYSIS

for

Yates Petroleum Thorpe MI Federal #2

Abo Formation 3947-3988 ft

Chaves County, New Mexico

Pecos Slope
Abo Tight Gas Play
Southeastern New Mexico
LITHOLOGIC DESCRIPTION
Exhibit #4

By: The Western Company
Research & Development
P.O. Box 186
Fort Worth, Texas 76101

THE WESTERN COMPANY
Research Center
P.O. Box 186
Fort Worth, Texas 76101

Date: October 31, 1980

X-RAY DIFFRACTION ANALYSIS NO. 5249

Operator:	Yates Petroleum	Date Sampled:	not specified
Well:	Thorpe MI Federal #2	Date Received:	October 27, 1980
Field:	not specified	Submitted By:	Jerry Jackson
Formation:	Abo	Source of Sample:	Well coring
Geologic Age:	Lower Permian	Additional Information:	- - -
County:	Chaves		
State:	New Mexico		
Depth:	see below		
BHT:	not specified		

Sample Identification	Mineral Percentages																			
	Quartz	Feldspar	Calcite	Dolomite	Siderite	Anhydrite	Gypsum	Pyrite	Barite	Kaolinite	Illite	Chlorite	Montmorillonite	Mixed Layer Illite/Mont.	Mixed Layer Chlorite/Mont.	Total		15% HCl Solubility (%)	15% HCl Soluble Iron Content (%)	
3947 ft	76	12	5	3				tr			1	3				100		9.0	1.29	
3960 ft	69	17	10	1				tr			1	2				100		23.5	1.19	
3988 ft	69	17	7	7				tr			tr	tr				100		25.0	0.34	

Comments: The samples are feldspathic, very fine-grained sandstones with non-expandable interstitial clay.

cc: Vithal Pai
Field Request File
Formation File

Analyst Thomas H. Barnes

Thomas H. Barnes

SEM Study #5249
Depth: 3960 feet
Date: 11-3-80

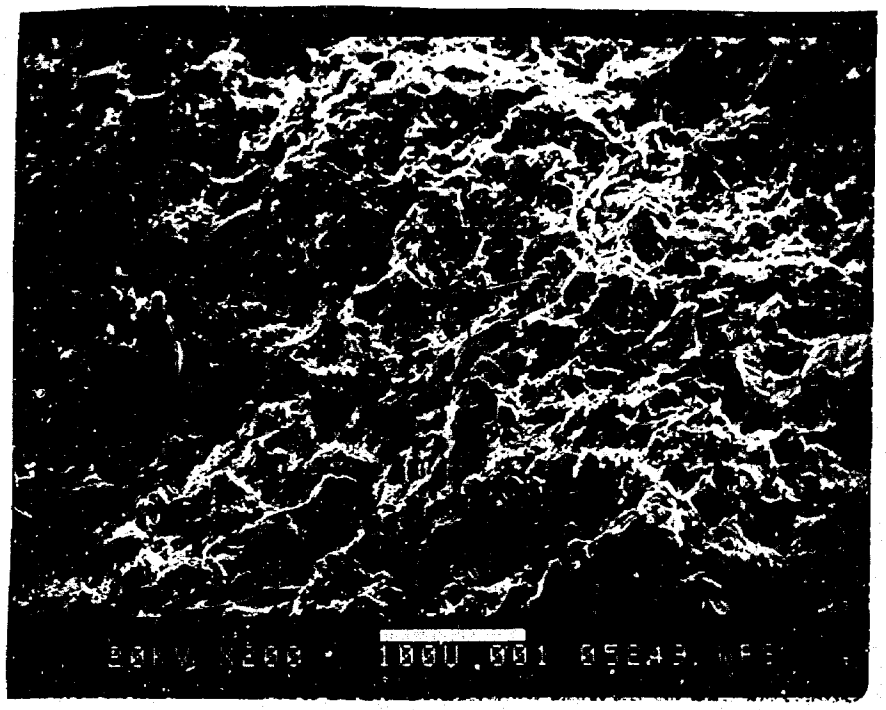


Fig. 1 - 200X - This general view of the sample shows an accumulation of coarse silt-sized crystals of quartz, feldspar, mica, and calcite cemented with a relatively large amount of chlorite clay.

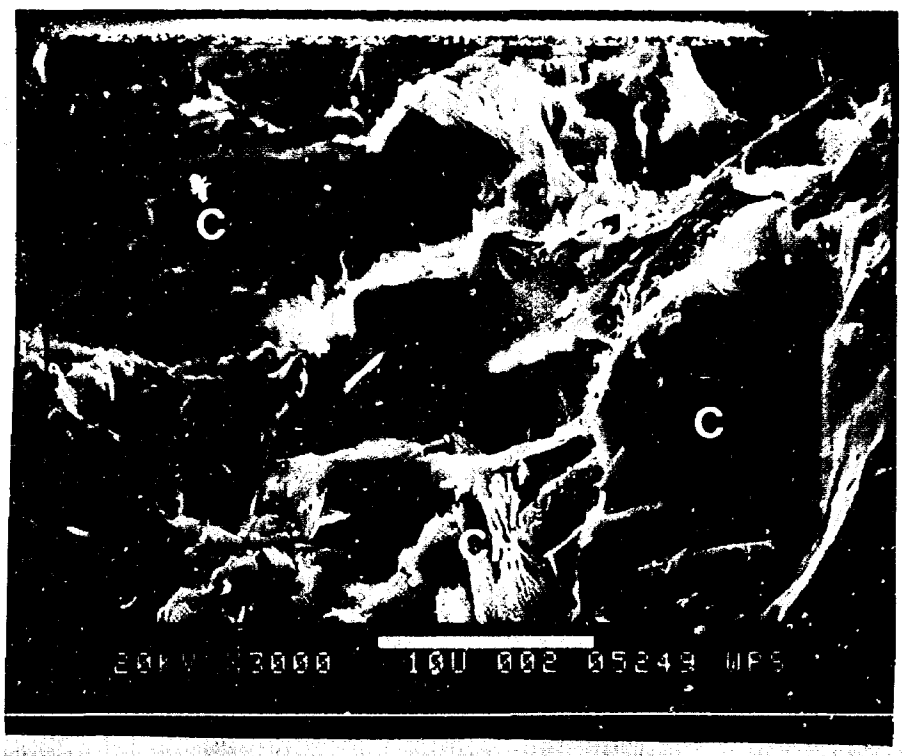


Fig. 2 - 3000X - A possible source of porosity which is shown in Figure #1 (in the square) is again presented in this image. The void is surrounded by calcite (labeled C) and chlorite clay (labeled Cl). Note that even this opening appears to have a bottom.

Analyst Jim Westbrook

SEM Study #5249
Depth: 3960 feet
Date: 11-3-80

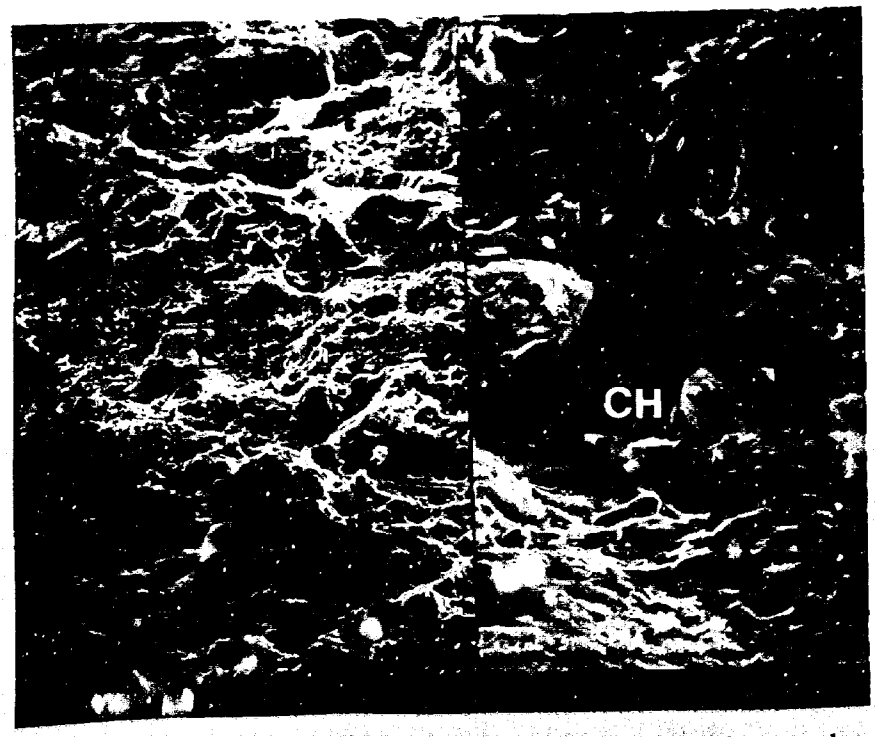


Fig. 3 - 200X (left) and 1500X (right) - This split image shows a potential pore space at two magnifications to show both its location (in the square) and contents. The image on the right shows it to contain chlorite clay (CH) and ilmenite (I). Ilmenite is $FeTiO_3$ and is shown to the left of center.

Analyst Jim Westbrook

PETROGRAPHIC STUDY

for

Yates Petroleum Thorpe MI Federal #2

Abo Formation 3947-3988 ft

Chaves County, New Mexico

By: Dr. John A. Breyer
Department of Geology
Texas Christian University
Fort Worth, Texas 76129
Consultant to the Western
Company

1. Sample number: 3960

The rock is a very fine-grained sandstone to siltstone. It consists of subangular to subrounded grains of quartz and feldspar set in calcite cement. Red, argillaceous matrix occurs between grains and as a replacement of feldspar. Diagenetic features includes quartz and feldspar overgrowths on detrital grains, replacement of feldspar by clay and calcite, and calcite cementation.

modal analysis:

component	%
quartz	31
feldspar	20
muscovite	1
argillaceous matrix	17
calcite cement	28
siliceous cement	1
void	2
	100

3960.
10/30/80

JB

8:30-9:50

① HBL						
CC	Φ	CC	UT 17-77 F	Argill mtx	Argill mtx	CC
m Φ	Φ OVG	CC	15-77 ↓ Φ	Φ	CC	muscovite
CC	Φ	Argill mtx	Argill mtx	Argill mtx	CC	Φ
Φ	Argill mtx	Argill mtx	Argill mtx	CC	Argill mtx	UT F → Argill
21 + 2 0-153 7%	21-71 VOID DISSOLVED GRAIN	CC	Argill mtx	CC	UT 15-51 F < CC REPL.	11	Φ
21-53 ↑ CC	19-73 ↓ Φ	T F W/ALT	UT F W/ALT	CC	16-51 1% ↑ CC	CC	CC
UT F	CC	19-51 UT F	CC	CC	Φ	CC	Argill mtx
UT F w/OVG	Argill mtx	17-51 ↑ UT F	CC replacing FWG:	CC	Argill mtx	CC	UT F
CC	Φ w/OVG	UT F W/ALT	Φ	Argill mtx	CC	F > CC ALT	Φ DET-SIEF.
Argill mtx	UT F	UT F 11	Φ	Φ w/ OVG	CC	CC	Φ

	Argill mtx	CC	18-52 UT F	Φ	20-71 Φ	19-52 UT F	Φ
? 17-70 un + n > qtz	Φ	Φ	20-52 ↑UT F	Argill mtx	19-70 ↓ Φ 2x	17-53 ↑UT F ∠ → Argill	Φ
	Argill mtx	Argill mtx	Φ	CC	CC	Φ DIST-SIEC	17-74 Φ
	UT F	11	muscovite	CC	CC	CC	15-74 ↓ Φ
Argill mtx is red - brn secondary and primary angular - subangular vfg - silt	UT F → Argill	11	UT F	Φ	Argill mtx	CC	CC
	Φ	Φ	Φ	Φ	Φ	Argill mtx	UT F
	16-77 Φ	CC	Φ	Φ	F → Argill	Φ	Φ
	15-75 ↓ F → CC	CC	UT F	CC	CC	CC	Φ
	Φ	UT F	CC	Φ	UT F	Φ	Φ
	UT F	Φ	Φ	UT F	VOID DISS. FWC ?	UT F → Argill	Argill mtx

M-52 lk ↑ UT F	Argill mtx	CC	Φ	argill mtx		
Φ	CC	14-73 UT F	CC	"		
Φ	CC	15-73 ↓ UT F	CC	CC		
					Φ	31%
Argill mtx	UT F → CC	Φ	Φ	UT F w/ OVG	F	20%
	CC	CC	CC	UT F → ARGILL	mainly UT	
					muddy lk	1%
Argill mtx	VOID oversize	Φ	Φ	UT F		
					argill mtx	17%
Φ	Argill mtx	Argill mtx	F → CC	Argill mtx		
					calcite CO_3	28%
					Φ OVG	1%
CC	CC	"	CC	"		
					VOID	2%
						100
Φ	CC	UT F → Argill	Φ	Φ		
15-52 CC	CC	Φ	Φ	CC		

PECOS SLOPE
ABO TIGHT GAS PLAY
SOUTHEASTERN NEW MEXICO

TABULATION OF CORE-DERIVED PERMEABILITY

SWEA TRACT NUMBER	WELL NAME Operator Location	SAMPLE NUMBER	CORE DEPTH, FEET	CORRELATIVE LOG DEPTH, FEET	MAXIMUM ROUTINE PERMEABILITY, md	CORRECTED IN SITU PERMEABILITY, md
45	PAPALOTE "OI" STATE NO. 1 Yates Petroleum Corporation Section 16, T-7-S, R-25-E	29	3,718-19	3,720-21	0.010	0.0033
		30	3,719-20	3,721-22	0.010	0.0033
		31	3,720-21	3,722-23	0.044	0.0070
		32	3,721-22	3,723-24	0.030	0.0058
		33	3,722-23	3,724-25	0.130	0.0120
		34	3,723-24	3,725-26	0.027	0.0053
		35	3,724-25	3,726-27	0.029	0.0057
		36	3,725-26	3,727-28	0.027	0.0055
		37	3,726-27	3,728-29	0.020	0.0047
		38	3,727-28	3,729-30	0.060	0.0081
		39	3,728-29	3,730-31	0.091	0.0100
		40	3,729-30	3,731-32	0.080	0.0095
		41	3,730-31	3,732-33	0.039	0.0065
		42	3,731-32	3,733-34	0.073	0.0090
	TOTAL				0.670	0.0959
	AVERAGE PERMEABILITY OF THE PAPALOTE "OI" STATE NO. 1				0.048	0.0069
22	THORPE "HI" NO. 2 Yates Petroleum Corporation Section 3, T-7-S, R-25-E	15	3,644-45	3,640-41	0.030	0.0058
		16	3,645-46	3,641-42	0.030	0.0058
		17	3,646-47	3,642-43	0.040	0.0066
		18	3,647-48	3,643-44	0.020	0.0047
		19	3,648-49	3,644-45	0.030	0.0053
		20	3,649-50	3,645-46	0.040	0.0066
		21	3,650-51	3,646-47	0.030	0.0058
		22	3,651-52	3,647-48	0.020	0.0047
		23	3,652-53	3,648-49	0.020	0.0047
		24	3,653-54	3,649-50	0.020	0.0047
		25	3,654-55	3,650-51	0.040	0.0066
		26	3,655-56	3,651-52	0.010	0.0033
		27	3,656-57	3,652-53	1.100	0.0360
		34	3,945-46	3,956-57	0.110	0.0110
		35	3,946-47	3,957-58	<0.010	<0.0033
		36	3,947-48	3,958-59	0.300	0.0170
		37	3,948-49	3,959-60	0.200	0.0150
		38	3,949-50	3,960-61	<0.010	<0.0033
		39	3,950-51	3,961-62	<0.010	<0.0033
		40	3,951-52	3,962-63	0.090	0.0100
		41	3,952-53	3,963-64	0.010	0.0033
		42	3,953-54	3,964-65	<0.010	<0.0033
		43	3,954-55	3,965-66	0.020	0.0047
		44	3,955-56	3,966-67	<0.010	<0.0033
		45	3,956-57	3,967-68	<0.010	<0.0033
		46	3,957-58	3,968-69	<0.010	<0.0033
		47	3,958-59	3,969-70	<0.010	<0.0033
		48	3,959-60	3,970-71	<0.010	<0.0033
		49	3,960-61	3,971-72	<0.010	<0.0033
		50	3,961-62	3,972-73	<0.010	<0.0033
		51	3,962-63	3,973-74	2.280	0.2017
	TOTAL				0.074	0.0065
	AVERAGE PERMEABILITY OF THE THORPE "HI" NO. 2				0.066	0.0066

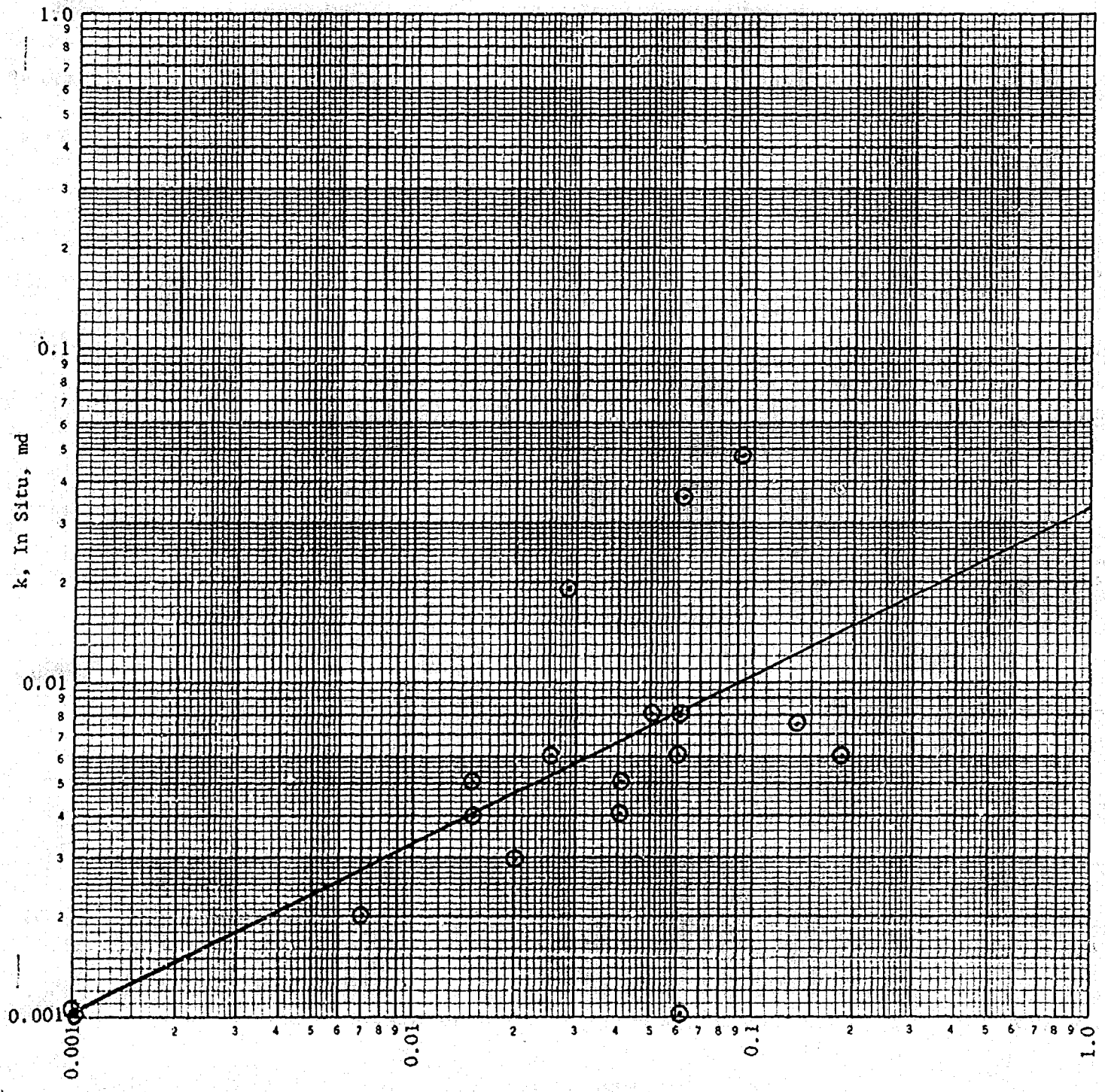
AVERAGE PERMEABILITY OF ALL WELLS

SIPES, WILLIAMSON & ASSOCIATES, INC.
1200 BLANKS BUILDING MIDLAND, TEXAS 79701
JOHN JAY KENSEY, P.E./CT/wps/vjv OCTOBER 30, 1980

EXHIBIT 14

PECOS SLOPE
ABO TIGHT GAS PLAY
SOUTHEASTERN NEW MEXICO
IN SITU GAS PERMEABILITY, millidarcies
versus
ROUTINE PERMEABILITY TO AIR, millidarcies

CORE DATA: THORPE "MI" NO. 2, SECTION 3, T7S-R25E
OPERATED BY YATES PETROLEUM CORPORATION



k, routine, md

EXHIBIT 15

PECOS SLOPE
ABO TIGHT GAS PLAY
SOUTHEASTERN NEW MEXICO

TABULATION OF AVERAGE PERMEABILITY DERIVED FROM BOTTOM-HOLE PRESSURE BUILD-UP DATA

SW&A TRACT NUMBER	NAME OF WELL OPERATOR	CALCULATED AVERAGE PERMEABILITY BASED ON BOTTOM-HOLE PRESSURE BUILD-UP DATA, md
33	ACME NO. 1 MESA PETROLEUM CO.	0.1188
29	KOCK FEDERAL NO. 2 MESA PETROLEUM CO.	0.0100
20	SELMAN DRAW "NS" STATE NO. 1 YATES PETROLEUM CORPORATION	0.0220
16	THOMAS "LN" FEDERAL NO. 1 YATES PETROLEUM CORPORATION	0.0516

Average "k," 4 wells = 0.0506 md

SIPES, WILLIAMSON & ASSOCIATES, INC.
1200 BLANKS BUILDING MIDLAND, TEXAS 79701
JOHN JAY KEESEY, P.E./CT/wps/vjv OCTOBER 30, 1980

EXHIBIT 16

PECOS SLOPE
ABO TIGHT GAS PLAY
SOUTHEASTERN NEW MEXICO

TABULATION OF FLOW RATES PRIOR TO STIMULATION

SU&A TRACT NUMBER	OPERATOR / WELL NAME	FLOW RATE PRIOR TO STIMULATION: TEST RATE, MCFPD	FLOW RATE PRIOR TO STIMULATION: CORRECTED TO STABILIZE CONDITIONS AT 1 ATMOSPHERE	COMPLETION INTERVAL, FEET: TOP	COMPLETION INTERVAL, FEET: BOTTOM	COMPLETION INTERVAL, FEET: AVERAGE
39	BOYD OPERATING COMPANY BLAKEMORE FEDERAL NO. 1	Swab Dry Swab Blow Gas	0 0	4,273 4,198	4,344 4,210	4,308 4,204
41	McCLELLAN OIL CORPORATION "JJ" FEDERAL NO. 1	No Test	-	4,448	4,456	4,452
40	"MM" FEDERAL NO. 1	No Test	-	4,174	4,468	4,321
37	"PJ" FEDERAL NO. 1	No Test	-	4,334	4,314	4,424
43	PEAJACK FEDERAL NO. 1	No Test	-	4,314	4,334	4,324
35	TOLMAC STATE NO. 1	No Test	-	4,034	4,272	4,153
33	MESA PETROLEUM COMPANY ACME NO. 1	TSTM*	0	4,634	4,652	4,643
34	BESTWELL NO. 1	Swab Dry	0	3,846	3,864	3,855
30	ROCK FEDERAL NO. 1	350 TSTM	230 0	3,355 2,923	3,363 3,020	3,359 2,972
29	ROCK FEDERAL NO. 2	Swab Dry	0	2,810	2,819	2,815
31	ROCK FEDERAL NO. 5	TSTM	0	2,876	3,351	3,114
22	SAVAGE FEDERAL NO. 1	Swab/Steady Gas TSTM 250	0 129	3,916 3,600	3,954 3,656	3,935 3,628
5	STANCEL FEDERAL NO. 1	80 Swab Dry	32 0	3,942 3,786	3,966 3,812	3,954 3,799
4	STANCEL FEDERAL NO. 2	Swab With No Recovery	0	3,710	3,830	3,770
13	POOL, FRED DRILLING COMPANY GAYNBERG COM. FEDERAL NO. 1	Not Available	-	3,776	3,796	3,787
7	CORN NO. 1-24	Not Available	-	3,822	3,860	3,841
6	CORN NO. 2-24	No Test	-	3,706	3,866	3,786
27	YATES PETROLEUM CORPORATION COFFMAN "NY" FEDERAL NO. 1	10	10**	4,048	4,053	4,051
18	COTTONWOOD RANCH "HX" STATE NO. 1	Not Available	-	3,809	3,824	3,817
32	DUNCAN "LH" FEDERAL NO. 1-Y	No Flow	0	3,876	3,884	3,880
42	ERICKSON "KY" STATE NO. 1	No Flow	0	4,238	4,258	4,248
28	FEDERAL "HY" NO. 2	Not Available	-	3,548	3,880	3,714
36	FEDERAL "IX" NO. 1	Not Available	-	4,810	4,822	4,816
44	FIVE MILE DRAW "LX" FEDERAL NO. 1	Not Available	-	3,816	3,836	3,826
2	GLOBE "HN" FEDERAL NO. 1	Not Available	-	3,758	3,772	3,765
26	GODFREY "HP" FEDERAL NO. 1	Not Available	-	4,012	4,022	4,017
10	GAYNBERG "LZ" STATE NO. 1	Not Available	-	3,910	3,946	3,928
9	GYP "HO" FEDERAL NO. 1	Not Available	-	3,770	3,780	3,775
25	HAHN "HH" FEDERAL NO. 1	Not Available	-	4,024	4,030	4,027

39 wells 8 11 19 21 24

EXHIBIT 17
PAGE 1 OF 2

PECOS SLOPE
ABO TIGHT GAS PLAY
SOUTHEASTERN NEW MEXICO

TABULATION OF FLOW RATES PRIOR TO STIMULATION

SWEA TRACT NUMBER	OPERATOR / WELL NAME	FLOW RATE PRIOR TO STIMULATION: TEST RATE, MCFPD	FLOW RATE PRIOR TO STIMULATION: CORRECTED TO STABILIZE CONDITIONS AT 1 ATMOSPHERE	COMPLETION INTERVAL, FEET: TOP	COMPLETION INTERVAL, FEET: BOTTOM	COMPLETION INTERVAL, FEET: AVERAGE
				128,097		
	YATES PETROLEUM CORPORATION					
24	HILLTOP "NQ" STATE NO. 1	Not Available	-	3,958	3,961	3,960
14	IWANOWSKI "MM" FEDERAL NO. 1	TSTM	0	3,404	3,414	3,409
12	McCLELLAN "MB" FEDERAL NO. 1	TSTM	0	3,930	3,960	3,945
38	McCONKEY NO. 1	521	431	4,764	4,782	4,773
20	SELLMAN DRAW "NS" STATE NO. 1	Not Available	-	3,335	3,346	3,341
3	SHERNOFF "NL" STATE NO. 1	0	0	3,630	3,662	3,646
15	SOUTH ALKALI "LK" FEDERAL NO. 1	TSTM	0	3,714	3,724	3,719
		Not Available	-	3,896	3,926	3,911
17	TECKLA "MD" FEDERAL NO. 2	7	7**	3,961	3,978	3,970
16	THOMAS "LN" FEDERAL NO. 1	No Show of Gas or Oil	0	3,968	3,990	3,979
22	THORPE "NI" FEDERAL NO. 2	Would Not Flow	0	3,958	3,964	3,961
	SUMMATION OF:					
	Flow Rates, MCFPD	1,218	639			
	Number of Zones Measured	24	24			
	Average Daily Flow Rate, MCFPD	51	35			
	Average Depth to the Tops of the Perforations		3,878			
	Allowed Maximum Daily Flow Rate, MCF per Section 107(b) of the Natural Gas Policy Act of 1978		105			

*TSTM - Gas Rate is too small to measure.

**Low Gas Rate - Adjustment for stability not material and not calculated.