STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

IN THE MATTER OF: THE HEARING CALLED BY THE OIL CONSERVATION COMMISSION TO CONSIDER:	)	
APPLICATION OF BIRD CREEK RESOURCES FOR SPECIAL POOL RULES, EDDY COUNTY, NEW MEXICO.	)	CASE NO. 10226

REPORTER'S TRANSCRIPT OF PROCEEDINGS

COMMISSION HEARING

BEFORE: WILLIAM J. LeMAY, Chairman
WILLIAM WEISS, Commissioner
JAMI BAILEY, Commissioner

June 12, 1991
9:07 a.m.
Santa Fe, New Mexico

This matter came on for hearing before the Oil Conservation Commission on June 12, 1991, at 9:07 a.m. at Morgan Hall, State Land Office Building, 310 Old Santa Fe Trail, Santa Fe, New Mexico, before Susan G. Ptacek, a Certified Court Reporter No. 124, State of New Mexico.

FOR: OIL CONSERVATION DIVISION

BY: SUSAN G. PTACEK
Certified Court Reporter
CCR No. 124

I N D E X

June 12, 1991
Commissioner Hearing
Case No. 10226

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A P P E A R A N C E S

FOR THE DIVISION: ROBERT G. STOVALL, ESQ.
General Counsel
Oil Conservation Division
State Land Office Building
Santa Fe, New Mexico 87504

* * *

COMMISSIONER LEMAY: Case 10226.

MR. STOVALL: Application of Bird Creek Resources for special pool rules, Eddy County, New Mexico. Applicant requests that this case be continued to the August 29 commission hearing.

COMMISSIONER LEMAY: Without objection case 10226 will be continued to August 29 commission hearing.

(Whereupon, the hearing was concluded at the approximate hour of 9:08 a.m.)

* * *

STATE OF NEW MEXICO)
) ss.
COUNTY OF SANTA FE)

REPORTER'S CERTIFICATE

I, Susan G. Ptacek, a Certified Court Reporter and Notary Public, do HEREBY CERTIFY that I stenographically reported the proceedings before the Oil Conservation Division, and that the foregoing is a true, complete and accurate transcript of the proceedings of said hearing as appears from my stenographic notes so taken and transcribed under my personal supervision.

I FURTHER CERTIFY that I am not related to nor employed by any of the parties hereto, and have no interest in the outcome thereof.

DATED at Santa Fe, New Mexico, this 19th day of July, 1991.

Susan G. Ptacek

SUSAN G. PTACEK
Certified Court Reporter
Notary Public

My Commission Expires:
December 10, 1993

STATE OF NEW MEXICO   COUNTY OF SANTA FE

OIL CONSERVATION DIVISION

EXAMINER HEARING

Cases: 10226

AUGUST 29, 1991

BE IT REMEMBERED, that on the 29th day of August, 1991, the following cases came on for hearing. This hearing was taken at the Oil Conservation Division conference room, State Land Office Building, Santa Fe, New Mexico commencing at 1:34 p.m.

A P P E A R A N C E S

OIL CONSERVATION COMMISSION:

WILLIAM J. LEMAY, Chairman
WILLIAM WEISS, Commissioner
GARY CARLSON, Commissioner Designee

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BY: WILLIAM F. CARR

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CHAIRMAN LEMAY: Case number 10226. The application of Bird Creek Resources for special pool rules, Eddy County, New Mexico. The appearances in case 10226?

MR. CARR: May I please the Commission, my name is William F. Carr of the Law firm of Campbell, Carr, Berge and Sheridan of Santa Fe. I represent Bird Creek Resources and I have two witnesses.

CHAIRMAN LEMAY: Thank you Mr. Carr.

MR. KELLAHIN: Mr. Chairman, I'm Tom Kellahin of the Santa Fe law firm of Kellahin, Kellahin and Aubrey appearing on behalf of Oryx Energy Company. We are in opposition to the applicant. I have three witnesses to be sworn.

CHAIRMAN LEMAY: Will the witnesses please stand and raise your right hand. I'm sorry. Excuse me. Another appearance in the case.

MR. KULSETH: May it please the Commission, my name is John Kulseth with the law firm of Hinkle, Cox, Eaton, Coffield and Hensley in Santa Fe appearing on behalf of R.B. Operating Company, Ramco-Myl, 1987 Limited Partnership, R.C. Bennett, and we have no witnesses.

CHAIRMAN LEMAY: Will you be giving a statement, or just participating in cross-examination?

MR. KULSETH: Just appearing I'm told.

CHAIRMAN LEMAY: Just appearing.

MR. KULSETH: Yes, sir.

CHAIRMAN LEMAY: Without witnesses.

MR. KULSETH: Yes, sir.

CHAIRMAN LEMAY: What's your last name again?

MR. KULSETH: It's spelled K-u-l-s-e-t-h.

CHAIRMAN LEMAY: Kulseth.

MR. KULSETH: Yes, sir.

CHAIRMAN LEMAY: And you're with Cox-Eaton, and you're representing who again?

MR. KULSETH: R.B. Operating Company, Ramco-Myl --

CHAIRMAN LEMAY: How do you spell that?

MR. KULSETH: R-a-m-c-o - M-y-l, 1987 Limited Partnership, and R.C. Bennett, B-e-n-n-e-t-t.

CHAIRMAN LEMAY: Thank you. We just needed to get those for the appearance. Are there any other appearances in the case?

(No response.)

CHAIRMAN LEMAY: Okay. Will the witnesses please stand and raise your right-hand?

(Witnesses Sworn.)

CHAIRMAN LEMAY: You may proceed, Mr. Carr.

MR. CARR: May it please the Commission, unlike Mr. Stovall I can't resist the temptation for an opening, but my opening will be extremely brief.

Bird Creek Resources is before you this afternoon requesting special pool rules for the East Loving Delaware pool including a provision for a special gas/oil ratio of 5,000 to one.

The reason for this request is simple. We are currently being substantially restricted under state-wide rules with the 2,000 to one gas/oil ratio.

I will call two witnesses, two engineers. One will show you that this is a type reservoir that what we have in this reservoir are a number of separate sand lenses or stringers to a very limited extent. The wells have high GOR's, and increasing the gas/oil ratio should not result in drainage between tracts.

We have also commissioned a study by T. Scott Hickman & Associates from Midland who will represent a witness that will demonstrate that the higher GOR's will not produce recovery in the reservoir but in fact will result in more efficient production from the reserves in the East Loving Delaware pool.

CHAIRMAN LEMAY: Thank you, Mr. Carr.

MR. KELLAHIN: Mr. Carr surprised me by being so brief in his comments.

May it please the Commission, on behalf of Oryx Energy Company Company, back in February of this year, I appeared with my witnesses in opposition to Bird Creek's request, which when presented to Examiner Catanach based on the evidence presented to him, he has denied Bird Creek's request to increase the gas/oil ratio in this Delaware oil pool.

Our evidence and testimony today will sustain, we believe, the appropriate order that Mr. Catanach entered, and we will ask you again to affirm his decision. This is a waste case. A pure and simple waste case.

Bird Creek seeks to increase the gas/oil ratio in the statewide 2,000 to one to the 5,000 to one level, not because it will increase ultimate oil recovery from the reservoir, but simply because it will accelerate the oil that they want to recover from the pool.

Examiner Catanach denied that applicat

presentation. We would ask that you await a final determination of any of the facts until you've heard our witnesses respond and rebut the conclusions expressed by the Bird Creek witnesses.

The pool is in an active state of development on its 40-acre oil spacing. The evidence will demonstrate to you that there is a structural factor, a structural component to the reservoir that is of importance. That is an issue that is in dispute.

We attach significance to structure in this reservoir; they do not. We attach a significance to the fact that there are high gas/oil ratio wells in obstruction to the low gas/oil ratio wells. And it will be our evidence that those wells are in pressure communication, one with another. And contrary to Mr. Carr's representation of his proof, we will show in fact that wells affect other wells within the pool.

Because of that affect, it is necessary to control the gas withdrawal rate from the reservoir. An issue and topic for you that we will address is whether this is a rate-sensitive reservoir. We conclude that it is, and we will demonstrate that it does. The rate sensitivity has an impact on ultimate oil recovery. It will it be our evidence that you have at risk in your decision today 763,000 barrels of oil that will ultimately not be recovered from this reservoir if you grant this application.

We ask you to pay attention to the data that the witnesses are utilizing upon which they will base their conclusions. Since the last hearing we have generated new data, rate sensitivity tests from our well, which demonstrate with field data that we are rate sensitive as to the oil component of the production. That means that at higher rates we are wasting reservoir gas by producing more gas per barrel of oil than we can at the 2,000 to one gas/oil ratio.

You're going to be presented not only with conventional engineering information, calculations, and data, but each side will present to you reservoir simulation. We would ask that you examine how each of those simulators in the data, where the parameters are that are of variance between the two presentations, and which one in your opinion more accurately and realistically portrays the reservoir. It is our contention and belief that we more accurately project what will happen in this reservoir.

At issue is whether or not there is vertical communication in the reservoir. This is a complex reservoir, it is very intricate. We have a geologist that we will present to you as our third witness, and he will show you the structure map his isopachs and cross sections.

Principally you have four continuous sand bodies that hold the gas in the reservoir, and that gas is in solution with the oil. This is an oil reservoir. And it's our engineering conclusions that the gas that is being produced is coming out of solution with the oil. It is also our contention and proof that you have no separate gas-only gas stringers in this reservoir.

There will be a question about whether or not there is vertical communication among these four oil stringers or oil sand zone members of the Delaware. It is our contention and proof that there is vertical communication by which either by fracture when the wells were completed or naturally these zones are in communication, and we must account that they are in fact not separate.

The three witnesses I'll present to you first of all is Ms. Bonnie Wilson. Ms. Wilson is a reservoir engineer, and she also has expertise in reservoir simulation. She has presented her modeling work to you in other hearings before this Commission, and she has come back to present her case to you today as she did before Examiner Catanach.

Mr. Bob Sidlowe is my geologist. He will present is geologic interpretations of the reservoir and his various geologic displays. In addition, I'll present to you Mr. Gregg Jacobson. He's a petroleum engineer and has done some eventual calculations with regards to the effect that one well has on the other within this reservoir.

It is our belief that we hope the evidence will demonstrate to you as it does to us that this is a rate-sensitive reservoir. That you cannot permanently or even on a temporary basis increase the gas/oil ratio. By doing so, you put at risk and you will waste some 763,000 barrels of oil that could otherwise be recovered.

CHAIRMAN LEMAY: Mr. Kellahin, is it your intention -- the both of you -- to introduce the records of the previous case or not?

MR. KELLAHIN: It is not my intention.

MR. CARR: Nor is it mine.

May it please the Commission, at this time we would call Mr. Brad Burks.

DIRECT EXAMINATION

BY MR. CARR:

Q Would you state your full name for the record, please?

A Brad Burks, B-u-r-k-s.

Q Mr. Burks, where do you reside?

A I reside in Tulsa, Oklahoma.

Q By whom are you employed and in what capacity?

A I am employed by B.K. Energy, a consulting firm that provides engineering and geological services to our client today, Bird Creek Resources, Inc., also of Tulsa, Oklahoma.

Q Have you previously testified before the Oil Conservation Commission?

A Yes, I have.

Q And were your credentials at the time of that testimony as a petroleum engineer accepted and made a matter of record?

A Yes, sir.

Q Are you a registered petroleum engineer?

A Yes, sir, in the state of Oklahoma.

Q Are you familiar with the application filed in this case on behalf of Bird Creek Resources?

A Yes, I am.

Q Are you familiar with the East Loving Delaware pool?

A Yes.

MR. CARR: Are the witness's qualifications acceptable?

CHAIRMAN LEMAY: His qualifications are acceptable.

BY MR. CARR:

Q Mr. Burks, would you briefly state what Bird Creek seeks with this application?

A Bird Creek seeks the promulgation of special pool rules. We are seeking the increased GOR from 2,000 to 5,000.

Q And why are you seeking this change?

A We are seeking this change for the reason of gas allowables. We have 10 wells on our leases that are currently curtailed, or that are currently curtailed due to the limited GOR of 2,000.

Q Are other operators in the pool likewise curtailed by the gas/oil ratio for this pool?

A Numerous other operators, yes.

Q Have you prepared certain exhibits for presentation here today?

A Yes, sir.

Q Let's go to the one that has been marked Bird Creek Exhibit Number 1. I'd ask you to first identify that, and then review for the Commission what this shows.

A Bird Creek's Exhibit Number 1 is a lease ownership map of the Township 23 south, 28 east, Eddy County. It is approximately 20 miles south of the City of Carlsbad. The East Loving Delaware field is highlighted within the orange striping. All Delaware wells are platted within that orange highlighted area.

By well count within the orange highlight, R.B. Operating is the largest producer, again by well count. Bird Creek Resources, which is denoted as BCR on the map, is the next largest, followed by Pogo, BTA, Oryx, Amoco, and Parker & Parsons.

There are four one-well owners in the field scattered about. R.B. Operating, again being the largest, typically is in the east half of the field. From north to south then you see Pogo wells and then Oryx and then BTA. And then going on south, Bird Creek Resources typically in the center of the field, Amoco, and Parker & Parsons on the south end.

Q When was this field discovered?

A The field was discovered by R.B. Operating in section 23 in 1987. In 1988 they drilled an off-set to that well. It also was successful. And then in 1989 Bird Creek drilled its first well, which was the third well in the field, and that was Carrasco 14, number one, which is denoted by the red arrow.

Q What is the significance of that particular well?

A Again, that well being our oldest well, we have the most production data. We have a large command of bottomhole pressure data. We have a PVT analysis on that well. We have basically the most history of our wells on that well. That is why it is so denoted. That well, because of its extensive history was utilized in the modeling program to determine a most efficient rate for the increased GOR.

Q Is the increased ownership of this pool also indicated on Exhibit Number 1?

A Yes, sir, it is. In the upper portion of each property is the operator's name. Again, BCR is the abbreviation for Bird Creek, and RB is the abbreviation for R.B. Operating. At the bottom of each acreage is the lease name.

Q Let's go down to now to Exhibit Number 2. Could you identify that, please.

A Exhibit Number 2 is a sample type log from our well, RGA Number 3.

Q Why did you select this particular well?

A I selected this particular well due to also the amount of data I have on this well. This well typically is in the center of the field. It is located in the southwest by southwest, 14. Along with open-hole logs we also cut a core and the core lab provided an analysis of that core.

Q Let's go to the second page, and I'd ask you to just explain what this shows.

A The second page of Exhibit 2 is the resistivity section of the open-hole log across the East Loving Delaware pay. This pay is situated at the base of the Brushy Canyon sand, right on top of the Bone Spring. The Delaware can be grouped into three sands, the Brushy Canyon being the bottom one-third of the sand and the East Loving Delaware field is at the base of Delaware.

The resistivity log as you see here is marked with four sands separating from each other. These separations were made for the purpose of modeling. Shales separated each sand, so we felt like each sand was heterogeneous to the next one. Those are labeled M1, M2, L1, and L2 over on the right-hand column. And you can see the top of the Bone Spring limestone beneath L2.

Q Let's go to the next page please.

A The next page is the corresponding porosity log across that same interval. The perforations of the pay are also marked in the footage column. And, again, the separate sands, M1, M2, L1, and L2 are the four that we have subdivided our pay are denoted.

Q Which of these zones are the primary producing zones in the reservoir?

A M1 typically tends to be the strongest producer, followed by L1, although those are usually thicker than the M2 and the L2. The M2 and L2 typically tend to be lower porosities than the M1 and L1.

Q Let's go to the last two pages of this exhibit. Would you identify those for the Commission?

A The last two pages are the print from the graphical presentation of the core lab out of Midland which just provides, again, a graphical presentation which can be correlated with the open-hole log of the core properties. These are just basic properties of the core. Core porosity, core permeability, which is to error, and also water saturations and oil saturations.

Q Where are those set forth, on the last page?

A Yes, sir, on the last page. The other is just a cover page to that report.

Q Let's go on to Exhibit Number 3, the isopach. Would you review this please?

A Exhibit 3?

Q Yes.

A Exhibit 3, again, is the same lease ownership map that you saw earlier of 23 south, 28 east. This isopach is a growth sand or -- excuse me, a net sand isopach. All four individual sand stringers, the M1, M2, L1 and L2. So this is a total net isopach. The porosity mapped here is all porosity greater than a 10 percent of above-hole logs.

Q Why did you select 10 percent?

A 10 percent typically was Bird Creek's cutoff in developing the field. It was also an approximate cutoff used in the modeling studies done by T. Scott Hickman & Associates.

Q What does this exhibit show?

A This exhibit just shows the layout of the sand as we now know it. Typically Bird Creek wells lie in the center, again of the field. Most wells have at least 50 to 60 feet of pay. Majority of the wells have at least 60 feet of pay. Some wells have upwards to 80 feet of pay.

Q In your opinion what is the status of the development of this field at this time?

A The field is in a slow state of development at this time. Pogo has just recently completed a well as has Oryx. Oryx has one location left. Pogo has approximately one location left. Bird Creek Resources has a few locations, we feel, on the north end and on the south end, which we have yet to drill.

R.B. Operating apparently due to pay thickness has finaled their drilling at least for the rest of the year, so we don't feel that the field will be extended considerably past what it has been. Most of the development that you've seen here occurred in the period 1989 through 1991.

Q Mr. Burks, I'd like to briefly discuss with you the geology of the field and I'd like you to refer to what has been marked as Bird Creek Exhibit Number 4.

Could you identify the first two pages on this exhibit?

A The first two pages of Exhibit Number 4 is a strip of an open-hole log from a recent well that we drilled and completed called the Burkham Number 1. The log head in here indicates it is a conventional dual lateral log or resistivity log running across the section.

Page 2, though, is an abnormal presentation not typically done out in the field. This presentation is a high resolution pass with a resistivity log. The interval you see here around 6100 feet is near the base of the M1 sand, which we again feel is the more prolific of the four sands.

By looking at the second page on this log we -- with a high resolution we can delineate the sand shale stringers. I have drawn a small diagram down around 6100 foot. The log divisions are two feet. And what this log is showing you, the MSFL, which is the shallow resistivity device, run in the high resolution mode can pick up down through several inches -- down to the resolution of several inches, individual sands and the corresponding shales that lie between the sand.

Q So what we have here is a log showing a portion of the M1 zone; we're not looking at the separate zones here.

A No, this is just the base of the M1, typically the bottom 20 feet or 40 feet of the M1.

Q What you're showing on the dark lines on the right are the shale stringers in the area that represents sands.

A That's correct. The sandstones having low resistivity due to the highly saturated brine within the formation. The shales being higher resistivity; therefore, the curve moving to the right.

Q Let's go down to the next page.

A I might point out I'm just looking at the solid curve of the three resistivity curves. The shallow and deep dual lateral log curves cannot measure this type of resolution, so therefore are useless in this type of presentation.

Q Let's go to the third page of this exhibit.

A The third page is the same high resolution pass on two wells. The left-hand presentation is again the Burkham Number 1, which we just looked at. Again, we're looking at the base of the M1 and the upper portion of the M2 sand. Next to it to the right is in a direct offset or diagonal offset to Pardue Number 1.

Bird Creek drilled both of these wells recently. We ran a high resolution pass across the zones to see if we could determine what sands, if any, would correlate from well to well.

We feel that based on running these logs on high resolution paths, the only thing that we can correlate are some of the shale stringers. The sand stringers are difficult to correlate as to which one is which. I might point out a 6120 on the Burkham Number 1.

There is a shale there, which is the base at the M1. That shale shows up in a marker number one, as can be seen by the gamma ray strip and also the resistivity log. Any small thin shales above or below that large shale though are not corelative or correlatable from well to well.

Q Mr. Burks, how far apart are the Burkham Number 1 and the Pardue Number 1 wells?

A Being diagonal and one crowding the other they are 1800 feet apart, which is a little more than a standard 1320 foot separation.

Q Let's go to the next page, and I'd ask you to identify what this is.

A The next page is a log heading for another tool that we've been using to picture and make an attempt to picture the sands. It is a bore hole imaging tool performed by Schlumberger called FMS. It uses a different process to determine the picture of each sand. What we see on the next page then is its image of the M1 sand in our Pardue Martin well, which is another recent completion.

What you see here are four stripes from top to bottom. Those four stripes are basically a picture of a well bore looking at four different directions. For example, one stripe is looking due north. The next stripe is looking due west. The next stripe is looking south. And then the next or last looking west.

From that the imaging appears as opposite colors. Shale is light; sand is dark. So the individual sand stringers are showing up here anywhere from one foot thick to no more than two, two and a half foot thick. The corresponding shales that lie above each sand is on the order of inches to feet.

Q Mr. Burks could you identify what we have marked as Exhibit 4(a)?

A Yes, I can. Exhibit 4(a) is a section, a representative sample of the M1 sand out of the RGA Number 3, whose type log we looked at earlier.

What that demonstrates, that depth interval is at 6123 in the RGA 3. What that demonstrates is the black shale at the base of that piece overlayed by a sandstone, well sorted, that begins to grade back to shale near the top. That is an example of the thinness of each individual sand and how each one is separated from its neighbor, its vertical neighbor by a shale stringer.

Q How much of this particular well did you actually core?

A On the RGA 3 we cored the entire pay sections, M1, M2, L1 and L2.

Q Is this a true representation of the core as it passed through these individual zones in the Brushy Canyon?

A Yes, it is.

Q Let's go on to the next page in your Exhibit Number 4, which is simply a text, and I would ask you to identify what this is.

A This is a one-page excerpt from an atlas from major Permian basin reservoirs published by the University of Texas. It is just a one-page description of the formation and characteristics of the Delaware sandstone. I might point out a couple of sentences out of that.

The first sentence of the second paragraph basically says, "Reservoirs are well-sorted, very fine-grained sandstone interbedded with laminated and burrowed silt stone, organically rich shale and some limestone." We do see those characteristics on that core. "The reservoir sandstone bodies were deposited by broad and internal braided channels."

One more sentence that I'd

sandstone bodies, reflecting the bedded nature of the channel-fill sandstone facies."

Q Now, Mr. Burks, is this a text a work that you as a petroleum engineer would rely on in evaluating reservoirs?

A Both petroleum engineers and geologists, yes.

Q The next page in this exhibit is what?

A The next page is also an excerpt that was attached to this article. I've included it for the sole purpose of showing the cross section with relationship of the Delaware, which is denoted as Bell Canyon, Cherry Canyon, and Brushy Canyon. What its relationship is with the Capitan limestone reef at that time. The Delaware sandstone, again, being a basin sandstone.

Q Let's go to the next and last page in this exhibit. Is this also an excerpt of the same --

A Yes, it is. It is from the same article. This is a block diagram of what the Delaware or how the Delaware was deposited, again, being broad channels -- sandstone channels feeding off of a reef or cuts in a reef.

I have taken that block diagram and drawn a small square down there called Square A. And I have enlarged that Square A to the far right-hand side showing the characteristic of the sands lying in there.

Again, by definition of the article, they are thin, lenticular sands, braided, which would imply that being that they are rather limited in extent and are not in pressure communication under virgin reservoir conditions with overlying and underlying sands.

Q All right. Mr. Burks, let's go to Exhibit Number 5. Can you identify that?

A Exhibit 5 is a tabular presentation of information on every well in the field as of August 15th of this year.

Q Okay. Let's just go through this. Review for the Commission what you are presenting in a tabular form.

A Starting on the left-hand side, I've chosen to put the well name or the lease name and the well number, the operator of that well, its location and its proration unit, the unit number, and section in 23 south, 28 east. This is in order by section number; therefore, I started with the section three and through the last page I finally end up at section 34.

The completion date is derived from the

Commission form C-105, which is available at the Artesia Commission Office, and is also available in Commission files here in Santa Fe. The initial potential is also derived from that form C-105 which is the completion form.

The last group of production data here is current production. This current production is a three-month averaging of C-115 production filed by each operator. The origin of the C-115's was the Artesia office.

Q Why did you use a three-month average?

A A three-month average was used to smooth out irregularities that often occur in production data. I felt a three-month average was indicative of the well's current performance.

Q Now, the last column is API Gravity. Why did you include that?

A I included that just to denote that the fluid from every well in the East Loving Delaware field is homogeneous to each other running in the range of 41 to 43 degrees API. That's a high gravity crude, highly parafinnic. Very high.

Q Now, you have included in this exhibit information on all the wells in the pool. Is that correct?

A Yes, sir, I have.

Q And what does this tabular information tell you?

A This tabular information just gives one a feel for what production is at initial potential and what currently throughout the fields can be, compared with Exhibit 1 which I presented earlier.

What can be deduced from looking at the initial potential versus current production is that GOR's typically have increased over the rough life of the reservoir from a GOR of about 1,000 per well on initial potential to GOR's of around 2- to 3,000 at this time.

Average production per day for the whole field, again with these -- using these numbers is 4900 barrels of oil per day, 3200 barrels of water per day, and 16,000 MCFD. That results in a GOR currently field wide of 3300, well above the GOR limitation of 2,000.

Q Mr. Burks, let's go to the last two pages in this exhibit. Second to the last is entitled a Daily Production Plat. What does this show?

A This Daily Production Plat is, again, the three-month average of the most current production that's available on C-115's. It is in the form of barrels of oil per day-barrels of water per day-MCFPD. It is done on a per-well basis just to give a feel of production in a plat form.

Q And this is just another way of presenting the same information that is contained on the preceding table.

A Yes, sir, it is.

I might add by looking at this that one can tell that there is no logical explanation to where or why GOR's are so located, why high GOR's are scattered. There are high GOR's in the north end of the field, there are high GOR's on the south end as well as the west to the east.

Q Let's go to the last page of the Exhibit. What is that?

A This is the GOR plat based on the previous page. This GOR also comes off the tabular data, and, again, shows the disparity of GOR throughout the field. No predictable area having any high or any low GOR.

Q Now, Mr. Burks, some of the wells are being production restricted --

A Yes, sir.

Q -- by the gas/oil ratio.

A Right.

Q Whereabouts are those generally in this field?

A Those typically are the south half of section 10, the east half -- south half, I'm sorry, south half of section 11, all of section 14, the east half of section 15, and the north half of section 23. Those areas typically have had and continue to have oil production rates curtailed to meet the allowable rate of 284 MCFD, which is the GOR 2,000.

Q Based on this geological presentation and this information, do you have an opinion as to whether or not the sands in the reservoir are in pressure communication with each other, location to location?

A As I mentioned earlier, the virgin reservoirs, each sand was separated from one another. And by each sand I mean zones M1, M2, L1 and L2 were not in communication with each other due to the thickness and impermeability of the shales between each one. I feel even with the ending of the single sands themselves, being a series of small lenticular channels separated by a few instances of shale, even some sands in M1 were not in communication with overlying and underlying sands.

At the time of completion though, operators in the well have typically tracked the well with half fraclinks going out at 100 feet. This has placed the zones in pressure communication with each other. A well typically after frac will produce and continue to produce until the abandonment of that well.

Q Do you see any evidence of vertical migration in this reservoir from any zones to, like, say, from the the L1 to the M1?

A I have not seen any evidence of that curve. We have had the feeling that, again, the zones are in pressure communication with each other once this sand fracture is in place. The wells, again as I said, are open to production at that time and continually produce until abandonment some time down the road. Which each sand and fluids, I don't feel that the sands would have any different pressure one versus the other. The pressures are homogeneous.

Q Let's go to your Exhibit Number 6. Would you explain to the Commission what this is designed to show?

A Exhibit Number 6 is the Lease Ownership Plat on the top page. On this plat I have drawn six traces. Each trace consists of four wells. What these are, each trace is a -- roughly a well bore diagram with the top of the M1 sand denoted.

I might ask you to turn to page 2, which is the first trace, C through C prime. C through C prime is a west to east, if you will, cross section starting at the Pogo well through Oryx into a BTA well. This denotes the top of the M1 sand, which is the top of all four sands. It shows what is sub CF is, which is indicated on the right-hand side or the left-hand side of the graph.

At the top is the lease name. At the bottom is current production, the three-month average. What can be deduced from looking at C through C prime is that structure plays no part or little part in the GOR or even the oil rates produced from each well which was provided earlier.

Q And the gas/oil ratio are on the bottom line of each of the well bores?

A Correct. Again, this is the same data that was provided in tabular form earlier.

I might have you notice that going across from left to right the GOR is running anywhere from less than 1,000 to over 3,000. In this example the highest GOR is off structure. That off structure well is also one of the better of these four wells, as far as oil rates are concerned. Traces.

Q Behind that you have a number of similar cross sections.

A Yes, sir, I do. The D through D prime exhibits the same characteristics. The structure plays little part in what produced GOR is. Although the off structure wells on the D through the D prime are lower oil producing wells, lower than allowable rates, they typically have the highest GOR in this case.

E through E prime is roughly a plat example with a large disparity of GOR. F through F prime is another example of where structure plays little part in what the GOR and the oil rates produced are. And G through G prime are typical.

Q They basically show the same information.

A They show the same information; that just because you have structure versus another well doesn't mean that you have or should have a higher GOR.

Q Now, Mr. Burks, let's go back to the first page of Exhibit Number 6. Referring to this page, could you just point out the location of the Oryx wells in this field?

A The Oryx wells in this field are in the east half of section 10.

Q How many wells do they operate?

A Oryx operates currently six wells. A 7th well has been drilled, a number 6, but it has not been potentialed yet. I believe it is waiting on the pump. There is also a gas well in there, which is a Morrow gas well.

Q Have you compared the producing histories of the Oryx wells with the other wells in this pool?

A Yes, I have.

Q And the result of that or part of that set forth on what you have marked as Exhibit Number 7?

A Yes, that's correct.

Q Let's go to that. First of all what is the source of the information you have displayed on Exhibit Number 7?

A Exhibit Number 7 is a production plat of production on a per-month basis versus time. This production was, again, derived from C-115 data.

Q Let's take a look at the first page of this exhibit, the Pardue Farms Number 1 well, and I'd ask you to review this exhibit for the Commission.

A Pardue Farms Number 1 is the first well that Oryx drilled and completed. It was completed in August of 1990, a little over a year ago. That well is in the southwest -- I'm sorry, southeast, southeast of section 10 or unit letter P. That well was drilled as a diagonal offset to the Teledyne Number 2, a Bird Creek well in the northwest, northwest of 14.

By looking at this production, one can deduce that the Pardue Farms Number 1 is capable of allowable rates. The units of oil, gas, and water production are on the left-hand side. 1,000 barrels per day, 10,000 barrels per day typical on the left-hand side.

I have drawn two lines here; one is a monthly oil allowable, which is 4320 barrels of oil per month, and the monthly gas allowable rate, 8640, based on that GOR 10,000. Immediately after completion, this well began to exceed the maximum oil allowable and has been there ever since, until June of this year where it is now at the oil allowable 4320.

Q What has the gas rate done?

A It's tough to predict what has happened with the gas rate. Above the gas rate and the GOR I have denoted the months that gas was flared, where there was no gas data filed on the C-115. When the well has had production, gas production reported, the gas rates have typically exceeded the monthly gas allowable.

Q Based on the month for which gas production has been reported, is this well over or underproduced?

A This well is overproduced; both oil and gas.

Q Now, can you tell how much gas actually has been produced from a well?

A I cannot based on the amount of gas that was flared.

Q All right. Let's go now to the second page of this exhibit. Would you identify this.

A Pardue Farms Number 3 is Oryx's request offset to their number one well.

Q Basically what does this exhibit show?

A This page shows that the well came on at near maximum oil allowable rates in November of 1990, and it has produced over that maximum allowable rate until about May of this year. This well is capable or was capable of maximum oil allowable rates. And, as I said, it has exceeded that.

The gas has typically been just beneath the monthly gas allowable when it has been recorded. I have denoted as likewise on this plat, the months where gas production was either vented or flared.

Q Let's go to the last page of this exhibit.

A Page 3 is the Lewis Estate Number 1, which is the north offset to their first well, Pardue Number 1.

Q Again, what does this show?

A This well came on in October of 1990. It came on higher than oil allowable rates. It shows that gas was either vented or flared for an extensive amount of time until this year when they began to sell gas.

At this point oil has dropped below the monthly allowable, so any overproduction on oil has been made up. Gas, though, is apparently increasing. This data is through June of 1991. I have platted GOR on all the plots as dots, and they typically are above the units for GOR, which are on the left-hand side of the plat. Standard cubic feet per barrel of oil ranged from 1,000 to 10,000.

Q Now, have you read the C-115's on Oryx's wells?

A Yes.

Q What do these forms tell you about the gas production from these wells?

A These forms tell me two things. One that Oryx has very good wells capable of exceeding oil allowables and gas allowables. That places them in a position to be similar to other wells in the field. Bird Creek wells, R.B. Operating wells, BTA wells, and Pogo wells that are capable of producing allowable oil rates.

The other thing that I can deduce from

looking at this is that one cannot derive sufficient conclusions from the Oryx data because of the limited amount that there is. Oil has been shown as sold. Gas has been either vented or flared with no volumes reported to the Commission.

Q When those volumes are not recorded, what impact would this have on, say, your ability to calculate gas/oil ratio?

A It is very difficult to report or even calculate a gas/oil ratio if you have no gas data or the data you have is questionable.

Q And if you could in fact read gas data, what would that do to the gas/oil ratios you have --

A It would show gas/oil ratios on three three Oryx wells exceeding the 2,000, and being closer to the 3- to 4,000 range, which is very similar to what we see in the other wells in the field.

Q What conclusions have you been able to reach from your study in this particular field?

A My conclusions are that it is a very complex reservoir. It is comprised of four major sands. That the sands within each sand such as the M1 sand, it is comprised of small, thin, and lenticular sands that can be seen on core, Exhibit 4(a).

I can also deduce that because of the

nature of these sands being thin, lenticular, that they do not cover -- each individual sand does not cover a large area; that typically, a sand in one 40-acre proration unit, a one foot of sand, say, is not present in another 40-acre unit.

Therefore, due to this geological deposition, and due to the fact core data indicates low porosity and low permeability, I feel that one well may indeed drain 40 acres, but would not drain any larger area than that.

Q Will Bird Creek call an additional engineering witness to discuss the simulation of work on this particular reservoir?

A Yes, we will.

Q Were Exhibits 1 through 7 and 4(a) either prepared by you or compiled by you?

A Yes.

MR. CARR: At this time we would move the admission of Bird Creek Exhibits 1 through 7 and 4(a).

CHAIRMAN LEMAY: Without objection 1 through 7 and 4(a) will be admitted.

MR. CARR: That concludes my direct examination of Mr. Burks.

CHAIRMAN LEMAY: Mr. Kellahin?

MR. KELLAHIN: Thank you, Mr. Chairman.

CROSS EXAMINATION

BY MR. KELLAHIN:

Q Mr. Burks, is there any engineering basis for picking 5,000 to one gas/oil ratio as opposed to some other ratio for the pool?

A Yes, sir, there is.

Q What is it?

A In the early life of our wells, we started off near a GOR of 2,000. It took just a few months' production before we began to exceed the GOR of 2,000. When one projected, maintained oil production at an allowable rate on the 10 allowable wells that we have, the GOR began to follow a trend that started an upward climb.

Based on the two oldest wells in the field, which are R.B. Operating wells, I platted the production of those wells. Again, those are in section 23. A plat of those wells indicated the GOR increased from a low 2,000 to nearly 4,000, and then leveled off and came back down as oil rates began to drop below the oil allowable limitation.

Q Have you determined whether or not the maximum gas/oil ratio for the pool -- for the life of the pool will be ceiling that 5,000 to one gas/oil ratio?

A Could you say that again?
Q Yes, sir. Is 5,000 to one gas/oil ratio going to be as high as you need in the pool?
A Yes, sir, based on the data that we saw on the older R.B. Operating wells, which came on in '87 and '88, we feel that 5,000 should serve our purpose.
At some point in the life of the allowable wells, they will drop off that allowable rate. At that time the gas/oil ratio we expect will start to drop off of that 5,000 but remain rather high in the 4- to 5,000 range throughout the life of the reservoir.
Q At 5,000 to one your daily gas rate is 710 MCF a day?
A Yes, but the 5,000 GOR is not useful once the oil rates begin to drop off or once the gas rates begin to drop off the 710 MCFD.
Q How long is the 710 gas rate useful for the wells in the pool?
A I could not answer that at this time. Our modeling exhibits will show --
Q At the February hearing you requested a temporary period of 12 months for the 5,000 to one gas/oil ratio.
A Correct.

Q   Is that still your request?

A   Yes, sir, 12-month trial period.

Q   What do you intend to have that you do not now have in terms of information at the end of the 12-month period?

A   Production data based on the higher GOR rates for the numerous wells that are currently curtailed.

Q   Is it still your testimony as it was back in February that at 5,000 to one gas/oil ratio you are simply reducing your reserves faster than you would at 2,000 to one gas/oil ratio?

A   They would be produced a little faster. Along with that statement I also said at the 5,000 -- excuse me, staying at the 2,000 would enable some operators to crowd other operators' leases and drain them while the one -- the first operator was held at an allowable gas rate.

Q   For purposes of your production, increasing the gas/oil ratio from 2,000 to one to 5,000 to one would be a rate of acceleration of production for your wells, would it not?

A   Yes, sir, it would. Increased oil rate; increased gas rate.

Q   It does not demonstrate to you as a reservoir engineer that increasing the gas/oil ratio is going to increase ultimate oil recovery from your wells?

A I mean to leave that answer to our next engineer.

Q In February it was your testimony that it would not. Is that not true?

A Rephrase that again, please.

Q In February it was your testimony that simply increasing the gas/oil ratio was not going to increase ultimate oil recovery for your wells.

A Would not significantly change ultimate recovery.

Q Can you quantify what you mean by significant?

A In the range of a few percent.

Q What percent to recovery of original oil in place do you anticipate for this reservoir?

A Based on modeling studies that we have done we are seeing recovery of approximately -- ultimate recovery of approximately 11 percent of original oil in place. That's an approximate number.

Q And your testimony in February, you were estimating a range of 20 to 25 percent --

A Yes, sir.

Q -- recovery of ultimate oil in place?

A Yes, sir.

Q What has caused you to change that opinion?

A First off, reservoir modeling has adjusted my opinion of that. Second off, we have had wells drilled off structure off near the edge of the field. When you apply the 20 percent recovery factor which we have used in the past based on volume metrics, we were coming up with hundreds of thousands of barrels of oil. But the wells near the edge of the field were not exhibiting that characteristic on production decline. They were exhibiting ultimate reserves of, say, 80- to 100,000 barrels of oil per well. So obviously recovery is dropped based on those two findings.

Q In February you presented us with a structure map on top of the C member.

A Which we now call M1 for the purpose of modeling, yes.

Q So the letter C translates to M1 when we get to the modeling?

A Yes, sir.

Q You didn't present a structure map today.

A One will be presented. I did not present it.

Q Did you prepare your own structure map?
A Yes, sir, I did.
Q And is that the structure map you used at the February hearing?
A It is very similar. The changes that have been made are an acquisition of additional logs in the field, an additional drilling peformed by Bird Creek Resources.
Q Mr. Burks, are you familiar with Delaware Production in other pools besides this pool?
A Yes, sir, I am. I began my employment out of college in '83 with Texaco, Incorporated. Texaco had numerous Delaware fields of which several I'll be glad to name for you. I was placed over those fields as a reservoir and production engineer in charge of enhancing production and maintaining it on a consistent basis.
Q Have you utilized the device of water flooding any of those Delaware pools to enhance oil and water recovery from those --
A Yes, two floods Texaco had I have had responsibility of.
Q And in your assessment as a reservoir engineer was water flooding feasible for those Delaware pools?

A It was feasible in one Delaware pool; it was not in the other. The formation had permeability. The one that was not had permeability variations that were not predictable at the start of the initiation of the flood, so recovery was poor.

Q Describe for me your interpretation of the reservoir in terms of the drive mechanism and where this gas is coming from that is being produced by the high gas/oil ratio price.

A The drive mechanism appears to be a solution gas drive reservoir. The gas is being liberated off of oil that is in place and also oil moving up the well bore to the surface, the liberation of gas due to the pressure drop.

Q Do you have engineering calculations to support your conclusion that the wells that you have examined are not draining over 40 acres?

A No, sir, I do not have those with me. My professional opinion says that they should not drain more than 40 acres. I have testified before the Commission Examiner over the past two years that I do not feel that it exceeds 40 acres. I have presented testimony in the past with calculations as to why.

Q But you chose not to present those calculations to support that conclusion for today's hearing.

A Our reservoir engineer will provide data on that.

Q What do you estimate to be the ultimate oil recovery from your wells?

A Percent of oil in place?

Q Either as a percent of oil in place or ultimate oil in terms of barrels.

A As a total for Bird Creek Resources' operated leases is what you're saying. Right? I can state again the average number that we are going with is approximately 11 percent of original oil in place.

Bird Creek is continuing to drill approximately once every three months, drill a new well trying to expand the reservoir. I have not done an updated reservoir calculation or reserve calculation for Bird Creek Resource-operated wells.

I have been doing some decline analyses of the total production from the field, which indicates total field recoveries based on current production.

Q What is your best estimate of a per-well recovery for your wells at the pool?

A It's too varied to give you an answer at this time. I have a well in section 14 that indicate 250,000 barrels of oil. I have wells that we have drilled out on the edge of a reservoir that indicate no more than 40,000 barrels of oil.

Q Do you have any pressure information by which we could prepare pressures among or between wells in the pool?

A Yes, I do.

Q You've chosen not to present the pressure information to the Commission today?

A Our reservoir engineer will present the data that we have. We have those numbers with us.

Q Is there an explanation within the reservoir and the distribution of the hydrocarbons within these sand members so that we could by selectively perforating these wells reduce the gas/oil ratio that is being produced by some of these wells?

A I don't feel that there is any method available where one could selectively perforate different sand members. I'm saying individual sand stringers; that the production of gas is based on several parameters. Each of the four sands that we have identified has different properties or parameters that control the oil and gas production produced from those individual sands.

Q Are the operators within the pool generally attempting to complete in each one of those sand members?

A Yes, they are. And in my discussion with operators in the field, there are primarily two methods of completing a well, and in all four sand members.

Q Yes.

A If all four sand members are so present. Some wells don't have the M2 and the L2 due to their thin nature. Most wells typically, though, have the M1 and L1 because of their thick nature.

The two methods of completion are: the Bird Creek method has been perforated with sand that has porosity and adequate separation on the resistivity logs. The other method which has been practiced by Pogo, BTA, and R.B. Operating is to perforate in the middle, say, 20 or 30 holes in the middle of the 100-foot interval and then apply a sand fracture using a technique called Limited Entry, which is at high rates and high pressures. Therefore, what you end up with in theory, and they have proven it, that you can perforate the middle of a zone 20 or 30 feet and with high enough rates on the frac job, open a higher 60 or 80-foot interval.

Q Is there a water component in the reservoir that affects the rate?

A   Is there a water component --

Q   You do not see a water drive or --

A   I do not see a water drive. On wells that I have analyzed including Bird Creek wells, we do not see presence of a water drive.

Q   What is the range of the permeability that you see in the reservoir?

A   In RGA Number 3, C ranges anywhere from zero, of course, which was the shales, to three millidarcies, sometimes some small sand stringers approach 40 to 50. The geometric average of our RGA Number 3 was determined to be 0.7 millidarcies by core lab. So there are a few one-foot sand stringers with high permeability of, say, on the order of three to ten millidarcies, but the majority average is .7 millidarcies. That's a very tight reservoir.

Q   What other ranges of porosity do you find in the reservoir?

A   Using a 10 percent cutoff, that's one number you're looking for. The other porosities, I have seen some as high as 18 percent. In our wells, typically the highest porosity we see is 16 or 17, giving an average of about 14 in Bird Creek wells.

Q   Is there a substantial difference and result if you use 12 percent as versus 10 percent porsity level?

A You're only talking about roughly 1 percent difference in those two porosities.

MR. KELLAHIN: Thank you.

CHAIRMAN LEMAY: No additional questions of the witness? Commissioner Weiss?

CROSS EXAMINATION

BY MR. WEISS:

Q The core there, do you think that's a representative of the stringers?

A Yes, sir, it was. The sole purpose was just bringing that piece, again, it was representative. And flying on the airplane, it was a little heavy to bring a four or five foot core.

Q Do you think that there are gas stringers in that zone?

A I don't think there are gas stringers that are just 100 percent saturated with gas. I feel the stringers are saturated with oil.

Q So I guess that was the attorney's interpretation of your earlier statements that there are gas stringers.

A At that time our observation was that there were gas stringers. Data that we have been able to tabulate from other operators, core data, plus doing some, oh, some correlations, we have determined that what I felt were gas stringers are oil stringers, but are either oil wet or the relative permeabilities to gas is so much higher than the oil, there is a preferential flow to gas. So from the surface it would appear as a gas stringer, but at the bottom --

Q But you don't --

A I don't feel that there is a 100 percent saturated gas stringer. All I said back then, my last testimony in February was that I feel there are stringers giving up 100 percent gas, and I still feel that way, but they are not 100 percent gas saturated.

Q I think you mentioned that -- I wasn't sure when you said something about drainage affecting other wells, but yet it only affected 40 acres. You were concerned about offsets draining oil from -- your wells get -- what one well only drains 40 acres, I didn't get that.

A I'll give you an example. On Exhibit 1, which is the lease ownership plat with the orange outline on it. In the northeast quarter of section 15 there are two Bird Creek wells, a Chavez, and a Siebert. In the northeast quarter of section 15 there is a Chavez Number 1 and a Siebert Number 1.

South of the Chavez is a well drilled by

R.C. Bennett called the Kidd Number 1. This is an orthodox location, but he has crowded Bird Creek properties. In that instance if he drains 40 acres he drains part of our 40 acres under the Chavez and the Siebert, and that's where I felt there could be offset drainage, where at orthodox locations, but still crowding the lease line at 330, 330.

MR. WEISS: I have no others questions. Thank you.

CROSS EXAMINATION

BY CHAIRMAN LEMAY:

Q Mr. Burks, your experience in the Texaco fields, have they been in the Ramsey sand, or have you had some experience with sand below the Ramsey?

A I've had experience in all sands. As far as water flooding they have typically been the Ramsey sands. For example, Mesa Delaware. Those are the Delaware floods I'm familiar with Brushy Canyon sandstone reservoirs such as the Lusk Delaware, which is north of halfway bar. It's been shut down.

Q Are you familiar with any water floods with sands below the ranch? Have there been any to your knowledge?

A There has been one Brushy Canyon flood, down south of the border into Texas. I can't recall the name of that. I don't know what the success of that is. Our next witness has some experience in that.

Q The only other thing is the log you showed. Is that what they referred to as the microwave log or micro-oven log? There was one that came out for a while that had terminology like that, that differentiated the various sands. The FMS log.

A The FMS has a bore hole imaging tool. Schlumberger also has a tool, which is called an enhanced promulgation tool. It will also delineate those sands, the thickness of those sands due to its high resolution capabilities.

Q It will do the same thing as the FMS log?

A It's presentation would be like the high resolution resistivity logs that I showed on the Burkham Number 1. That's what its presentation would look like. Just showing you low resistivities indicating sand stringers, high resistivities indicating the shales in between the stringers. That's what the EPT presentation shows.

The FMS is, again, a bore hole imaging log through computation, again, draws a picture of what you're seeing, giving contrasting colors. The copy you have is in black and white. Those are actually colors.

Q I guess what I was trying to get at, is this EPT log, my memory is that they used to use that also for staying away from zones within a sand that produce high waters?

A Right.

Q Is there some resolution that can differentiate those high waters within a sand?

A On an EPT, yes.

Q Is there any concentration of those that you've been able to ascertain within the field, or is that a random occurrence?

A It's just a random occurrence within the field. Throughout this field. I assume this answers your question I've never been able to predict where our next oil production well will be.

Q Does the water have greater probability than any of the other four sands, or is that again random?

A In my opinion based on looking at our Bird Creek logs and RB logs and other logs in the field in performing my isopach map and structure map, the L1 sand typically tends to be a wetter sand.

Pogo has recently opened a well in just the L1 and has very high water rates that have previously not been seen in the field before.

So the L1 in my opinion is probably the wettest of the four sands.

Q One more question. Your isopach map that looks like you've got 50 feet of net sand here without production limits necessarily being defined. Have you got a cut-off on what it takes to make a commercial well as far as number of feet over 10 percent?

A Well, what would be a better answer to your question would be a feet times H isopach map where I multiply porosity times thickness. Because what we've seen on the edge of the field in some places, we've got 60 feet of pay but 11 percent porosity. And we're right next to our cutoff. But just because you've got 60 feet at 11 percent porosity doesn't mean you've got much of a well. That's an 830 barrel per day well.

Q So has it been your experience that the marginal nature of the field is a function of the side sands getting thinner and tighter and that being a function of maybe some having more water or something of that nature?

A Yes, sir. Typically, yes.

CHAIRMAN LEMAY: I have no further questions.

MR. CARR: At this time we would call Mr.

Vanorsdale.

DIRECT EXAMINATION

BY MR. CARR:

Q State your name for the record, please.

A Charles Vanorsdale.

Q Where do you reside?

A Midland, Texas.

Q By whom are you employed?

A I'm employed by T. Scott Hickman & Associates, a consulting firm.

Q And what is your relationship to Bird Creek Resources?

A We were retained to perform an independent evaluation of the field to silmply address the topic of oil recovery sensitivity to gas withdrawal rates.

Q Have you previously testified before this Commission?

A No, I have not.

Q Can you briefly review your educational background?

A Yes. I received a Bachelor of Science degree in petroleum engineering from the University of Tulsa in 1979, and a Master's degree in management from the University of Tulsa in 1984. I'm a registered professional engineer in the states of

Oklahoma, Texas, and New Mexico.

Upon graduation I went to work for Getty Oil Company. After having worked for Getty I went to work for a consulting firm in Tulsa, Kepplinger & Associates. Subsequent to that I did consulting work on my own, and then was hired by one of my clients to serve as manager of engineering for a small independent in Tulsa. And then most recently before I moved down to Midland to go to work for Mr. Hickman, I worked as director of technical services for another small independent in Tulsa.

Q How long have you been with Mr. Hickman?

A A little over a year.

Q Are you familiar with the application filed in this case by Bird Creek?

A Yes, I am.

Q Have you made a study of the East Loving Delaware pool?

MR. CARR: We would tender Mr. Vanorsdale as an expert witness and petroleum engineer.

CHAIRMAN LEMAY: His qualifications are accepted.

BY MR. CARR:

Q Mr. Vanorsdale, what were you asked to do, part of your assignment, from Bird Creek?

A We were asked to take a look at the data on the wells within the field for purposes of preparing a simulation study, a model to predict what the recoveries would -- how the recoveries would vary according to the gas withdrawal rates.

Q What data have you had available to you in terms of the study you've been attempting to make?

A We have been provided with a log production data, core analysis, special core analysis, pressure test data, anything and everything that was available and the companies felt that they could release without violating any confidentiality agreements. I must admit that we did receive data from Oryx, Pogo, Bird Creek, and R.B. Operating and Amoco.

Q Have you prepared certain exhibits with presentation here today?

A Yes.

Q Could you identify what has been marked as Bird Creek Exhibit Number 8?

A Yes. This is a base map which I have prepared. This shows three cross sections which I have prepared in my beginning stages of this study primarily to help me characterize the reservoir and identify the zones.

Q Now, we have on this map traces for three cross sections. Is that correct?

A That's correct.

Q How many cross sections do you propose to present here today?

A I'm only showing one, marked BE Prime.

Q Let's move from Exhibit 8 to Exhibit 9, which is that cross section. I'd ask you to review that for the Commission.

A This is a cross section running from the northwest part of the field to the southeast part of the field, generally going down structure.

Q Basically what does this show you?

A Primary purpose for this was to illustrate the continuity of the individual reservoirs M1 through L2. Also to indicate that each one of those sands does vary in thickness across the field.

One of the other purposes of preparing that cross section was to take a look at any relationship that may be obvious from a structure versus GOR standpoint.

Q Are the gas/oil ratios indicated on this exhibit?

A Yes, on these wells I have indicated the initial gas/oil ratios from the state tests and recent data taken from about two months ago, month and a half ago.

Q What does this information tell you?

A There is no relationship between structure and GOR histories.

Q All right. Let's move to Exhibit Number 10. Structure map. Would you review that for the Commission please?

A This is a structure map which I have prepared. I have been given structure maps by four of the operators in the field, which I then coalesced and updated with some new well information.

In addition to simply showing the structure of the field on top of the M1 sand, I've also highlighted four particular wells. The well which is surrounded by the diamond is the Carrasco 14-1, which was the well in my reservoir simulation.

The other three wells which are circled represent wells which I looked at the core analysis in some detail. Again, the core analysis was -- I looked at it in detail for the purposes of preparing that for my reservoir simulation.

Q In terms of preparing your reservoir simulation, could you explain to the Commission exactly how you went about this? What did you decide to do?

A First I needed to characterize the individual sands; find out what makes each one different if indeed they are different. So I had to take a look at relationships with regards to porosity and permeability with regard to the individual sands. Had to take a look at the wetability of each sand. Specifically whether or not one sand was more oil wet as opposed to water wet, which has a bearing on what fluids are being produced.

Generally speaking, just the overall quality of individual reservoirs from a log standpoint, a core standpoint, and the PVT standpoint, primarily.

Q And you had this made available to you?

A I had all this data available.

Q How did you decide to go about actually approaching the simulation?

A Could you be more specific?

Q How many wells did you use? What did you look at to structure this simulation?

A We tried to incorporate as many wells as possible in the simulation study. Not particularly highlight one particular area of the field.

Now, with regards to the core analysis, the three wells whihc I have selected here were selected simply because they represented the best core samples. In other words, there were more samples per sand in these three wells.

Also I was able to delineate the top and bottom of each one of those four sands, whereas in some other wells which I had the cores I was not able to do that; therefore, could not differentiate one sand from another.

Q What is the significance of the Carrasco 14 Number 1 well?

A The Carrasco 14-1 was selected for several reasons. It had log qualities which were fairly typical of most of the wells in the field with regards to porosity, resistivity, so on and so forth. It also had some extensive production and pressure history. This is one of the oldest wells in the field, as Mr. Burks has already mentioned.

The properties of this well, structurally I would place it essentially right in the middle of the field, and even from an aerial standpoint it is located essentially right in the middle of the field.

Q Mr. Vanorsdale, you selected the Carrasco 14 Number 1 well for what purpose?

A Well, primarily it had the most data available to it which would lend itself towards the simulation. We had pressure and adequate production data, what I would consider accurate production data to provide us with a reservoir model and match.

Q Is this what you picked as an average well?

A Yes.

Q Is this what you were basing your simulation on?

A Yes.

Q In your opinion, is basing a simulation on one well like this an appropriate way to make determinations about how the entire reservoir would perform?

A Yes, I believe so. This well has produced long enough to give us ideas what the reservoir character is like. I believe Mr. Burks has already mentioned this well is probably representative of all the wells in the field.

Q Let's go to Exhibit Number 11. Could you identify this for the Commission?

A Yes. One of the things that we need to take into consideration when we are looking at the wells is how reliable are the data in regards to estimating certain rock and fluid properties.

Exhibit Number 11 illustrates the relationship that was derived between the core porosity as relayed in core analysis reports prepared to the core permeability. There is a gold line that has been drawn through these points, the points representing the data from three individual wells.

Down at the lower right-hand corner is an equation which relates the permeability to the core porosity. Also within that box is an R squared, which represents the goodness of fit. And the closer that goodness and fit is, the better the relationship. 73 is a very good fit.

Q Let's go to the next graph on this exhibit. What does is that?

A Exhibit 11(a) represents a graph of core porosity versus log porosity. The purpose for developing this was to go to any well I selected which would have a log, and therefore log porosity, and then be able to relate that to a core porosity.

Now, in the event the well I was electing to study did not have a core analysis performed on it, I would be able to with these two exhibits develop a reasonable estimate as to what the average permeability would be for that particular sand.

I prepared these for each one of the four sands.

Q All right. Let's move on now to your

Exhibit Number 12. I'd ask you to identify that for the Commission and review it.

A Exhibit Number 12 represents on a per-sand basis, the results on average that I received from each of the cores that I studied in detail. They represent the geometric average permeability and the average porosity for each one of those four zones.

In addition to that, I have listed the Carrasco 14-1 and its porosity, and derive permeability from these relationships I have just shown on my Exhibits 11, and 11(a). It indicates the value of the Carrasco by zone as it relates to the values for the other three wells. You can see that the data for the Carrasco 14-1 falls within the range of the data for the other three wells.

Q So from the information on Exhibit Number 11 you were able to determine porosity and permeability from the Carrasco Number 1 as set out on Exhibit Number 12.

A Yes.

Q Let's go to Exhibit Number 13. What is that?

A Exhibit 13 represents the input data for simulation on the Carrasco 14-1. It also indicates at the bottom of the page the data which was finally used in the reservoir match on a per-sand basis.

Q Let's move to 14. What does this show?

A Exhibit Number 14 illustrates the actual model that I used at the Carrasco 14-1. Set up on a 40-acre gridblock. It is a seven by seven by seven grid, and the dimensions on the individual reservoirs are somewhat representative, but just the vertical scale has been exaggerated on this.

This also illustrates the modeling of the hydraulically fract area right around the well bore as shown by the very thin gridblock, which runs through the well in the center of the model.

Q In the center at the top of the model is a black dot. That indicates the well bore?

A Yes, that is the Carrasco 14-1 well bore.

Q And the narrow lines that come off of that represent a fract?

A Yes.

Q Why is it important to include the fracture in your model?

A Well, around the well bore of a hydraulically fracked well, if you do not account for fairly rapid changes in pressure and fluid distribution changes, you will not obtain an accurate history match. And the whole purpose of performing simulation is to be able to match actual production and pressure history in order to forecast that into the future. If you do not take into consideration the rapid changes that occur around the well bore, you will not be adequately forecasting the future.

Q All right. Let's move to the three graphs marked Exhibit 15. Would you identify those?

A Yes, the first one illustrates the match that I obtained from the simulation of the oil production rate versus time. The more spiked lines there represent the actual production data and the smoother fit represents my match. The actual production up through May of 1991 versus the projected match results were within 2 percent of the actual oil produced, which is an excellent fit.

Q Okay. The next page?

A The next page illustrates the reservoir pressure as matched by the simulation. Kind of hard to differentiate between the two. It matches very good. But I do have the actual match there. Probably a difference on the maximum of only about 40 pounds.

Q Finally the third page of this exhibit?

A The last and possibly the most important match was on gas/oil ratio. Gas/oil ratio here was matched adequately. As a matter of fact, the actual gas production versus the simulated gas production up through the end of May was also within 2 percent. So I feel very confident that the match I received from my simulation would be more than sufficient to project into the future.

Q And so with this kind of a match you have confidence that you can project how the reservoir perform in the future. Is that what you said?

A Yes.

Q Now, at this point in time in your work you have the reservoir properties in your simulator. Correct?

A Yes.

Q And you have performed a history match to evaluate how accurately you can project a performance. Is that correct?

A That's correct.

Q Then what did you do at that time?

A The next step was to impose limitations on the amount of gas involved to find out what the significance would be on the ultimate recovery under different GOR allows. Then I basically went into the simulator as it had been set up with the matched responses and then imposed different GOR allows.

Q Now, let's go to what has been marked as

Exhibit 16. Can you identify that, please?

A Exhibit 16 represents the amount of, the percentage of oil in place recovered as a function of the gas/oil ratio allowable. There is very little difference going from even a 1,000 to one gas/oil ratio up to a 5,000 to one gas/oil ratio.

Q How much of a decline as we go out to the 20 year reserves figure do you actually see?

A As you go from a 1,000 to one gas/oil ratio to a 5,000 to one gas/oil ratio, where those are reserved after 20 years of production, you go from 10.58 percent to 10.32 percent illustrating a difference of approximately point 26 percent of the gas/oil in place. In other words, less than three tenths of a percent.

Q Mr. Vanorsdale, you're showing less than three tenths of a percent recovery on this exhibit. Is that correct?

A That's correct.

Q Do you believe that what will occur in this reservoir is actually less ultimate recovery as a result of the high gas/oil ratio?

A Excuse me?

Q Will a higher gas/oil ratio actually in your opinion result in a smaller ultimate recovery of oil from this pool?

A Effectively not.

Q Why not?

A Basically the oil recovery seems to be insensitive to the gas/oil ratio.

Q Are there any other factors that will come to bear on this situation that actually can be recovered from this pool?

A One of the things that tends to be overlooked is the operational hazard. The wells out there are already experiencing difficulties with regards to paraffin, some corrosion, some scale, and so on and so forth.

It would be very unlikely that a well could continue for 20 years without some major problems. The implications there would be that you need to produce your oil as quickly as possible, otherwise you may not be able to produce your oil.

Q Do you have an opinion as to whether or not increasing the gas/oil ratio would result in a more efficient production from the -- in more efficient production from the reservoir?

A Yes, I believe that by increasing the gas/oil ratio you will more efficiently drain the reservoir in a more timely fashion. The possibility also exists that given the liklihood of operational risks; you may actually produce more oil by increasing your GOR allowable.

Q Now, if we look at this exhibit, what kind of a recovery factor do we see?

A The recovery factor here is on the order of about 10 and a half percent.

Q What does this tell you about the efficiency of the reservoir drive mechanism?

A For a solution gas drive reservoir, which this is, this is a very inefficient solution gas drive reservoir. The drive mechanism is not very effective.

Q In your study do you see any evidence of the formation of a gas cap?

A No.

Q In your opinion, could there be a gas cap forming in this reservoir?

A No, I don't believe so.

Q And why not?

A The permeabilities of the formations are very low in the first place. In the second place there is the evidence of laminated shale within the sands, which acts to some extent as vertical permeability barriers.

I did perform a simulation in which I

tilted the reservoir seven degrees to see what the impact would be on gas migration. Although there was some gas migration, the overall response was just a mirror image of what we see here, actually a lower recovery as a percent of oil in place.

Q Now, as a consulting petroleum engineer you've been called on to perform reservoir simulations on a number of reservoirs, I assume.

A That's correct.

Q Based on your experience, has there been sufficient information available to you to perform a simulation on this reservoir?

A Yes.

Q Have you taken a look at pressures in this reservoir?

A Yes, I have.

Q And what have you reviewed?

A I have been given essentially all of the pressure data that was available for the wells in the field either through gradient pressure surveys or build-up surveys. And I have taken that data where I felt it was adequate. I have platted it up versus time and converted all of the pressures to a common subC data, the purpose being there to illustrate that if wells were all in common reservoir with pressure communication, then the pressure should track with time regardless of when the well was completed. It should fall within a specific range.

MR. CARR: Now, may it please the Commission, the reason we have addressed this point is in response to cross examination by Mr. Kellahin. We do have an exhibit and a plat. We only have one copy. We'll mark it as Exhibit 18, and I presume there will be a brief break after this, and we can make copies available to Mr. Kellahin.

I'll be happy if he desires not to move its admission until he has a chance to see it, but it is in response to questions raised by him, and we're trying to get it out on the table, so if he has a witness that is fair game when it comes to cross-examination to that issue.

BY MR. CARR:

Q Mr. Vanorsdale, in your opinion, would approval of the application of the Bird Creek Resources result in the waste of hydrocarbons?

A No.

Q And why not?

A I believe that there will be very little difference overall in the amount of oil recovered by going from a 2,000 to 5,000 to one GOR, with the exception of the time factor involved. As has been brought out before, if you were to stay in low GOR's it's going to take you longer to recover the same amount of oil. In the process of doing that you run the risks of operational hazards to prevent the ultimate recovery of that oil.

Q In your opinion will there be a problem of rights of any interest owner in the pool which will be impaired by the granting of this application?

A No, I do not believe so.

Q Have you reviewed the Oryx operated wells as part of this investigation?

A Yes, I have.

Q Do you have an opinion to whether or not the conclusions you have just announced will apply to those as well as other wells in the pool?

A I believe they would.

Q Why is that?

A The Oryx wells, as has already been brought out, would more than likely behave just as all of the other wells in the field if we actually knew what the gas production had been. From a GOR standpoint, we have no feel as to how these wells are doing.

Inasmuch as they vented a considerable amount of their gas, I must admit that one of the reasons I would not choose any of the Oryx wells involved is because I didn't have sufficient data upon which to draw a map.

Q Do you believe that there is a situation or are situations in this reservoir where production of any well in the 5,000 to one GOR should have an adverse impact on the recovery of an off-setting well?

A No, I don't think so.

Q Were exhibits 1 through 16 prepared by you?

A Yes.

MR. CARR: At this time we would move the admission of Bird Creek Resources Exhibits 1 through 16.

CHAIRMAN LEMAY: Without objection, exhibits 1 through 16 will be entered into the record.

MR. CARR: I will mark the Pressure Versus Time Curve as 18 and move its admission at the end of cross.

And there is one last thing I'd like to do, Mr. Examiner. We have received some letters of support from other operators in the pool. And I'd like to just offer them to be included in the case file. They are letters from BTA, Teledyne, R.B. Operating, Harken, Hallwood, and Ray Wesco. They are all here.

That concludes my direct examination of Mr. Vanorsdale.

CHAIRMAN LEMAY: Mr. Kellahin?

MR. KELLAHIN: Mr. Chairman, we'll take exception to Exhibit 17. It's hearsay testimony, and I assume the Commission will do as it does usually with correspondence applied to a particular case; simply read it, put it in the case file, and it will not form a basis upon which to decide in this case.

MR. CARR: I would also like the record to reflect I did not move its admission, and suggest you do just that. Put it in the case file.

CHAIRMAN LEMAY: You're in agreement there.

CROSS EXAMINATION

BY MR. KELLAHIN:

Q Mr. Vanorsdale, if I understood you correctly, you have one well model upon which you have made your conclusions?

A Yes, that's correct.

Q And the well that you have matched, the history with your model is the Carrasco 14 Number 1 well?

A Yes.

Q Did you attempt to simulate the performance of two wells in the reservoir as opposed to a single well?

A Yes, I did.

Q With what result?

A I wasn't able to obtain a match.

Q You couldn't get a history match on the higher GOR well.

A I didn't have the time.

Q Did you attempt to simulate the performance of three wells in the reservoir?

A No, I did not.

Q How about four wells?

A No.

Q When we look at Exhibit Number -- let me ask you this about the model. We've got a one-well model. And in response to Mr. Carr's questions a while ago, you said you adjusted the model to put some structure in the model to see what would happen to the performance of the single well?

A Yes, I had took the model that I had and tilted it seven degrees.

Q If you don't have a second well to model in the simulation it's not going to be very useful to take a single well and simply tilt the structure of the model, is it?

A I think so because you can detect what the gas saturation migration is going to do from block to block.

Q When we look at your blocks, I think that is shown on Exhibit 14. Do you have a copy of that?

A Yes. Exhibit 14.

Q The M1 interval on the model is the top block?

A Yes.

Q In the model we'll assume within that block that there are no flow restrictions within that block. Right?

A No.

Q When you look at M1 and the shape and size of that block, are we using the same pressure within that block?

A Essentially, yes. We're talking about a vertical distance of about 48 feet. I don't think it would be practical to go to any smaller grid size in order to model pressure response in a vertical direction.

Q Mr. Burks has told us within the M1 block he has a lenticular reservoir that is separated by shale barriers?

A Yes.

Q By looking at the right block?
A That's probably present in most of these sands.
Q But you didn't attempt to model or assimilate the characteristics of that block by breaking it apart further into separate blocks.
A No. That would have even resulted in less gas migration had I inserted any vertical barriers.
Q When we look at the four blocks, does the computer simulation input any flow restrictions between the blocks?
A There were barriers within the blocks, yes, but I have enabled to crossflow around the --
Q Say that again. I'm sorry.
A I have established as is shown here on Exhibit 14 barriers between the sands themselves, but I have enabled in a simulation, flow, crossflow at the well bore.
Q I'm sorry, you have enabled the model to crossflow between the barriers?
A To permit fluid crossflow between the members at the well bore.
Q So these are not absolute barriers between the four blocks?
A No, and they shouldn't be considering that

the well has been fracked.

Q If I look at Exhibit 13, those are your input parameters for your simulation?

A Yes.

Q The original oil-in-place number for 40 acres, you've got 1949 stock tank barrels of oil?

A Yes.

Q Where does that number come from?

A That was derived from a simulation. The computer calculates the oil in place.

Q If I take Exhibit 16 then, and I take the original oil-in-place number --

A Okay.

Q -- and you have told me that at 2,000 to one gas/oil ratio I'm going to get 10.58 percent of the original oil in place out of that 40-acre tract?

A Yes.

Q So if I make that calculation, come up with, what, 208,000?

A Should be about 200,000 barrels of oil. This well has already produced approximately 90,000 barrels of oil.

Q And then if we move out to the 5,000 to one gas/oil ratio, the percentage of recovery drops to 10.32 percent?

A Yes.

Q And if we take 10.32 percent of the oil in place, it's going to get us what, maybe 195,000?

A Yes, I think probably on the order between five- and 7,000 barrels.

Q So somewhere between five- and 7,000 bears of oil are going to be left in the reservoir per 40-acre tract based upon your simulation, and if we change the gas/oil ratio from 2,000 to one to 5,000 to one?

A Using a simplified assumption that the well will continue to produce for 20 years.

Q How many 40-acre tracts are currently producing?

A I don't know.

Q Let me ask you to turn to Exhibits 15, Mr. Vanorsdale.

I'm sorry. I've gotten ahead of myself. There was one question on 13 on reservoir simulation input. We talked about the oil in place. When we look about the individual reservoir data down in the bottom portion of the display and we look at the columns --

A Yes.

Q -- look over at column L1. And last row of that column is an initial solution gas/oil ratio.

A Yes.

Q You get 875. And that's, what, gas/oil ratio -- solution gas/oil ratio for that zone?

A Yes.

Q Why is that substantially different than the other three which are identical?

A That is a function of several different things. For one thing, that may very well represent a bubble point pressure for that particular reservoir. So that would not necessarily be alarming.

Another thing, in a history match there are several variables which are exactly that. There is some degree of leeway. I could possibly have obtained a similar match with a slight adjustment of that value. Possibly in a higher direction. The same may be true of the other solutions of the gas/oil ratio.

Q To get a history match on the Carrasco 14-1 well that satisfied you, what are the parameters that you're adjusting to make that match?

A Primarily relatively permeability data. That is oil and water relative permeability, and oil and gas relative permeability.

Q Can you tell us what the final relative permeability was used in order to get a match that satisfied you?

A Well, it would have to be presented in tabular form because it varies as a function of the oil saturation.

Q Let's turn to the match if we look on Exhibit 15. The first part of the match is, you're trying to get the simulation to match oil production?

A Yes, that's correct.

Q That's what's on the first page here.

A Yes.

Q The simulation is identified by the arrow that says match, and that is the line that remains flat. And then by the beginning of 1991 starts to decline?

A That's correct.

Q And the actual is the jagged peak display portion of the exhibit.

A Yes, sir.

Q Where did you get the actual production in oil upon which to history match your model?

A That was provided by R.B. Operating and Bird Creek.

Q Can we turn to page 2? What are you matching on this page?

A This is a reservoir pressure. And this has been converted to a subC datum of 3100 feet.

Q And in the last page you're trying to also match the gas/oil ratio that is calculated based upon the production from the well?

A Yes, that's correct.

Q Does it make a substantial difference in your conclusion if the oil production that you're matching has been curtailed and what you're matching is curtailed oil production?

A No, not really.

Q Curtailed oil production in order to satisfy you that the gas or the oil allowable would be a volume less than the performance abilities of the well, would it not?

A Yes.

Q So what you are projecting if this production is matching curtailed production reported from the well, is simply that, curtailed production.

A Until it reaches a point at which it can no longer meet that curtailed amount, which is what is illustrated at the beginning of 1991. That represents a position within the reservoir energy that the well could no longer meet that allowable.

Q Where on page 1 of Exhibit 15 do you show what the allowable level is for the well?

A Exhibit 15?
Q Uh-huh.
A The allowable would represent that flat line.
Q When you simulate the performance of the well, did you input a maximum rate that represented the maximum allowable for that well using a 2,000 to one gas/oil ratio?
A Are you talking about a gas allowable, or the oil -- are you talking about the 142 barrels per day or --
Q No, I'm talking about the 284. That's the controlling number. Is it not?
A It's supposed to be, yes. But for this match, this well went above that gas/oil ratio, so I hadn't compensated for that in order to accurately represent what was going on in the reservoir.
Q I'm sorry. It's still not clear to me what you have matched with the simulation.
A Okay. I have restricted the oil production rate. But because they exceeded the GOR of 2,000 to one, which as I understand is on a temporary basis all right as long as over the year's period of time it's cleared up, I went ahead and had no restrictions on that GOR. If you were to -- as a matter of fact, I

did this in the initial run -- if you were to impose a GOR of 2,000 to one, the match wouldn't have been as good.

Q Looking at your model in summary, we have a one-well simulation of the performance of this single well in the pool. Right?

A Yes.

Q And you have not taken account of structure in making that model. It's neutral as to structure.

A I wouldn't say that; the models that I have prepared. One of them was at a seven degree dip.

Q I understand. But the actual conclusions that are represented on Exhibit 16 assume no structural component in the calculations.

A That's true.

Q It also assumes there is no free gas movement within the structure?

A It doesn't assume that. That's the results of the simulation.

MR. KELLAHIN: Thank you.

CHAIRMAN LEMAY: Additional questions of the witness?

MR. CARR: May it please the Commission, at this time I would like to have the witness identify Exhibit 18, and then move its admission.

BY MR. CARR:

Q Mr. Vanorsdale, could you identify for the record what has been marked as Bird Creek Exhibit 18?

A Yes, Exhibit 18 illustrates the typical initial bottomhole pressure data for wells as they come on line. So in that regard I'm comparing pressure versus time.

In a reservoir that was in complete communication, in other words, there is a depletion effect to some extent on all wells, the reservoir pressure would decline whether or not a particular location was actually in the process of being produced. So that when you drill a well there, there has been some depletion in the reservoir; therefore, the reservoir pressure at that location would be very similar to reservoir pressure in the other wells that have been produced for a period of time.

If there is some discrepancy in that, that would indicate there is not communication.

Q This is the plat that shows the absence of that discrepancy?

A Yes.

Q Was this exhibit prepared by you?

A Yes, it was.

MR. CARR: I move the admission of Bird

Creek Exhibit 18.

CHAIRMAN LEMAY: Without objection 18 will be entered into the record.

MR. CARR: That concludes my examination of this witness.

CHAIRMAN LEMAY: Any cross on Exhibit 18?

MR. KELLAHIN: No, sir.

CHAIRMAN LEMAY: Additional questions of the witness? Mr. Weiss?

CROSS EXAMINATION

BY MR. WEISS:

Q Could you have gotten the same match without -- with the grid without any blocks in it? Just a box?

A No. You need quite a few grids in order to actual simulate the pressure and fluid in distribution within the reservoir. I first started to model this with fewer grids and wasn't coming up with very good match. You really need to have as many small grids as possible in order to represent that distribution through the reservoir.

Q The problem was when you had fewer grids was matching what?

A Matching everything.

Q The production didn't match. Looks to me like you could with just a box.

A You have very abrupt changes in pressure fluid saturations as you go from one block to another when the blocks are very large. When you have many small blocks there is very little change within each one. So it more accurately represents flow of pressure of fluids within the reservoir.

Q Well, what we see here, this could be done with one block.

A No.

MR. KELLAHIN: That was Exhibit 15, Mr. Weiss, is that correct?

MR. WEISS: Yes, it was.

BY MR. WEISS:

Q And the reservoir pressures were measured -- how were they measured? There is a lot of fluctuation in tight reservoirs. Did you attempt to calculate D bar or is this the pressure?

A For the static gradients they were run -- most of the static gradients run for a period of seven days. So seven days is an adequate period of time within which to obtain a reasonable reservoir pressure even in a tight formation. We also had seven-day build-up tests as well as static gradient tests.

COMMISSIONER WEISS: No further questions.

CHAIRMAN LEMAY: Any other questions?

(No response.)

CHAIRMAN LEMAY: You may be excused. Does that conclude your --

MR. CARR: That concludes our presentation.

CHAIRMAN LEMAY: Let's take a 15-minute break.

(Recess taken.)

MR. KELLAHIN: Mr. Chairman, I would like to call as my first witness Ms. Bonnie Wilson.

DIRECT EXAMINATION

BY MS. KELLAHIN:

Q Ms. Wilson, for the record, would you please state your name and occupation?

A Bonnie Wilson. I'm a reservoir engineer for Oryx Energy.

Q Have you on prior occasions testified before the Oil Conservation Division and the Commission as a reservoir engineer?

A Yes, I have.

Q And did you testify before examiner Catanach back in February in a hearing in this case?

A Yes, I did.

Q In preparing for your testimony today, have you modeled the performance of wells in the East

Loving Delaware pool in Eddy County, New Mexico?

A Yes, I have.

Q Have you updated your information since the last hearing so that your information is accurate and current?

A Yes.

Q In addition, has Oryx run well sensitivity tests on their production to determine whether or not in actual well bore conditions there would be escalating gas/oil ratios at higher producing GOR?

A Yes. We ran such a test on Pardue Farms Number 1.

MR. KELLAHIN: We Tender Ms. Wilson as an expert reservoir engineer.

CHAIRMAN LEMAY: Her qualifications are acceptable.

THE WITNESS: Thank you.

BY MR. KELLAHIN:

Q What is your conclusion, Ms. Wilson, about the appropriate gas/oil ratio for this pool?

A At this point in time I believe that the 2,000 to one are allowable. It may not be the optimum, but I think it is sufficient to produce the most oil recovery that we can from the field.

Q What is the most optimum gas/oil ratio for the pool?

A It would be very low. Maybe even less than 1,000, but you reach a point of economic returns where if you can't sell oil or gas from your wells by holding back your rates, then you can't drill your wells, so it becomes a balance between economics and loss of reserves.

Q Are those equities balanced at the statewide 2,000 to one gas/oil ratio that's been the gas/oil ratio for this pool from inception of its first production until now?

A Yes.

Q What in your opinion occurs if the Commission adopts a gas/oil ratio as the applicant requests and places it at 5,000 to one?

A Changing the GOR allowable to 5,000 would change the New Mexico gas rate to 710 MCF, and this would allow wells of high GOR's to produce high gas rates and it would result in depletion of reservoir energy and a loss of recovery.

Q Have you estimated what the ultimate loss in oil recovery is on a pool-wide basis if we go from 2,000 to one to 5,000 to one gas/oil ratio?

A My estimate of the loss in primary recovery is 763,000 barrels of oil. That's roughly at $20 a barrel. That's worth about 15 million dollars.

Q You've studied this reservoir and its performance and production for a considerable period of time. Describe for us in a conclusion statement how this well -- how the wells in the pool are operating and the character and description of the reservoir.

A We have GOR's across the field that vary from 900 to over 10,000. That's the problem; these varying GOR's. There are specific reasons why the wells produce at different GOR's.

The large amount of gas in this high GOR wells is coming from somewhere, and in this reservoir it's gas that has been resolved from this solution. I think we all agree it's a very complex reservoir.

There are four distinct sands. Anywhere from two to four of those sands are in the individual wells. Some only -- some wells only have two sands, some wells have three or four. All the wells have been fractured in the field.

So now all of these sands even if they were separate are now in communication, well beyond the well bore. If our fractlinks are correct, we have propped fracts with infinite conductivity.

I believe that this reservoir is in

pressure communication between all of these sands. I believe initially the reservoir was very near its bubble point. It may have been slightly above of or slightly below.

There may have been a few very small initial gas caps that may not have been maybe to what I believe to be secondary gas caps or localized gas caps.

The way I view this reservoir is I view it like a maze. There is a lot of dead-end alleys, but they are all in pressure communication. It just might take quite a while for that communication to show up.

I believe that the high GOR's are a function of three factors: permeability, depletion, and reservoir structure.

Q When you look at a description of the reservoir and look at these four main sand members of the primary producing interval and pool, there are indications of shale between those members, are there not?

A Yes.

Q Within each sand member there are also occasional indications of shale. Are there not?

A I don't see shale barriers or indications of shale within sand members.

Q Within a given sand member, do you as a reservoir engineer conclude that that sand member is anything other than pressure communicated within that sand member itself?

A Vertically within the sand members, yes, I believe that within a sand member that that sand member is in pressure communication.

Q And among the four individual sand members, what do you conclude about the communication among those four members?

A Since we have propped fractures that communicate the sands, they're on pressure communication also.

Q Describe for us the method that you chose to go about simulation of the performance of the reservoir so that you could accurately forecast what would be the ultimate impact if the gas/oil ratio was changed from 2,000 to 5,000 to one.

A I built a simulator that included four wells in a structural position; a high GOR well structure, a low GOR well structure, two different wells so I could model what would be gas migration to the higher structure position.

Q Why did you not choose to do what Mr. Vanorsdale did, and that is to take a single well such as the Carrasco 14-1 and model the performance of that single well?

A You can't investigate where the depletion of the reservoir energy is going to do, but between two wells with one well model, you need at least two wells.

Q If you were to take a single well model and put some structure into the model, what would that tell you about the ultimate recoveries from the single well?

A Very little. You need a well-up structure to produce at a higher GOR to produce the higher GOR energy.

Q The model you have selected includes four wells?

A Yes.

Q Describe for us the kinds of characteristics that caused you to select each of the wells that went into the model. Is there a structural relationship to each of those four wells?

A I chose a high structural well, two wells that were medium structure, and then the lower structure well. The high well would have high producing GOR and the lower well would have a lower producing GOR.

Q Let's turn to what is marked as Exhibit Number 1. Does this represent your work product?

A Yes.

Q What are your conclusions based upon your reservoir simulation using the four-well model?

A I refer you to the back page, first to look at Conclusions, page 9.

Q Okay.

A These show the six model forecasts that I made; two at 1,000 GOR, two at a limited GOR of 2,000, two at a GOR of 5,000. I ran the forecasts two different ways. The top curve shows what happens when you lay the wells flat and incorporate no dip and you don't consider the fact that there may have been gas cap wells obstructure. The lower curve, which I will show with a history match, shows what happens to your recovery, how drastically your recovery is decreased when you do add dip and you do consider high GOR wells.

Q Do you have a copy of Mr. Vanorsdale's conclusion summary display?

A Yes.

Q That shows his ultimate projection. When we look at your top line, and that's the assumption of no dip and no gas cap, how does that compare to Mr.

Vanorsdale's conclusions?

A I believe they are quite similar. I'm showing that if you don't consider dip or a gas cap, then you reduce your recovery from 12.8 percent to 12.6 percent, which is basically negligible over the life of the field. That's what Mr. Vanorsdale stated about his estimates. You can see his reserves quite flat too; little measurable difference from the 2,000 to the 5,000.

Q When we look under the assumption of no dip and no gas cap, there is still a change in ultimate gas recovery between the 2,000 to one and the 5,000 to one. The 5,000 to one gas/oil ratio will get you less ultimate oil recovery?

A Yes, it will be less.

Q Why have you chosen to input a dip and a gas cap into the simulation of the reservoir?

A First of all, I drilled wells out there that have very high initial GOR's. Some wells when they were drilled have GOR's of 7,000 initially. And then the secondary is the fact that there is a degree of dip to this reservoir. There is a structural. We've mapped it and I've included it in the model.

Q In your opinion, which is the simulation method that most accurately reflects the actual conditions of the reservoir and the performance of the wells in the reservoir?

A The four-well model including dip and the gas cap would more accurately represent what is going on in the rest of them.

Q Using that forecast at 2,000 to one gas/oil ratio, what is your percentage of ultimate oil recovery?

A At 2,000 to one is 12.2 percent of oil in place.

Q When we look at the 5,000 and one gas/oil ratio, what is your percentage of oil in place recovery?

A At 5,000 to one it is 10.8 percent recovery of your oil in place. That's an 11 percent reduction. So you've lost 11 percent of your primary production from your well.

Q Have you determined what in your opinion is the original oil-in-place number?

A Yes.

Q When you take that oil-in-place number and run the calculation, what is the ultimate oil left in the reservoir that will not be recovered if we increase the gas/oil ratio as the ultimate request? That's the 7,000 --

A 663,000, yes.

Q Let's go back then to the beginning of page 1 of Exhibit 1 and have you take us through each of the displays and demonstrate to us how you have tailored the model to fit the history of the performance of the wells that you have chosen. And the reliability and confidence that you have that you can now accurately forecast the performance of the pool with this model.

A Page 1 simply shows my model grid. Each black dot shows one of your four wells. There are four wells there. Each well has 40 acres of drainage assigned to it. Each well is five layers thick, an average thickness of 50 feet across the field. And there's one degree of dip in a mile.

Q One degree of dip per mile is it?

A Yes. One degree of dip.

Q And that's the structural component?

A Yes.

Q What is the significance of the shaded area?

A This shows the area that you have in the model built in as an initial gas cap. It's a small volume, but I was unable to get GOR's as high as these structural wells were making without inserting a small gas cap.

Q What is your field evidence available to you to demonstrate in your opinion that there was an initial gas cap in the reservoir?

A I will show the high GOR wells that show the high -- their productive characteristics.

Q Page 2 is the reservoir simulation input data?

A Yes. There are three pieces of data that you need in your simulator; one is your reservoir geometry, the other is your rock properties, and then the third one is your fluid properties. These are a listing of the rock and fluid properties. I used 16 percent porosity average, 15 feet. Irreducible water saturations of 26 to 30 percent, and these are based on actual relative permeability data.

We ran oil, gas, and oil/ Water level permeability data, and I input that data directly into this model and did not change it.

The oil properties, PVT data is included as Exhibit A, I believe.

Q We'll come to that. The PVT data used in the simulation is attached to Exhibit 8 that's in the exhibit package?

A Yes. There's a summary of that PVT data here on the left side of the package.

Q Let's turn then to page 3 of Exhibit 1 and have you identify what you have described initially.

A Page 3 and page 4 are my history matches. I've history-matched two different cross sections across this field. You can see that the Teledyne Number 2, which is on the left-hand side, is a high GOR well. The plat on top is the gas/oil ratio, and the plat on the bottom is the oil production.

Q You're applying the same methodology that Mr. Vanorsdale did when he was matching gas/oil ratios and production.

A Yes. When you have a model, you check the accuracy of your model. You first compare your predictions, your early time predictions to the data to see how accurate your model is forecasting compared to your data. And from there you forecast it out further.

I have some GOR maps that will show you these cross sections and why I chose these wells. I built the model generically. I was not trying to absolutely history-match any individual distinct well. I was trying to model a process that I hoped to show on this independent GOR map what is occurring.

Q Let's take a moment so that we can compare the location of your wells on the cross section of Exhibit 3, to those on one of your other displays. And perhaps it's best to go to Exhibit Number 3 to do that.

A Yes.

Q Let's do that for a moment. Let's go to Exhibit 3 and have you identify and describe for me what that is.

A There are four distinct layers in this reservoir. This is only the top layer; one of four. It is an isopach map showing porosity greater than 14 percent, but it is probably the majority. Definitely more than half the production is coming from this layer, so that's why I chose to look at this layer.

Q This layer that you've marked "A Sand" corresponds to what nomenclature used by Bird Creek in their presentation?

A Corresponds to the M1 sand that Bird Creek used in their presentation.

Q Describe what you've done.

A We platted GOR's under this map. And every well that was producing has a GOR underneath it. Now, the only ones that I have colored are wells that have more than 10 feet of pay in the sand. If they have less than 10 feet of pay, I assume that the major production for that well was coming from another sand. So the ones I've colored are the ones that show greater than 10 feet from the upper sand. That's why I've colored all of the dots.

What I have outlined are the three different areas of the field. These three different areas roughly correspond to three thicks in this sand. One sand in the south, there are two thicks that appear to be connected in the middle, and one thick in the north.

The area in the south has all very high GOR wells. The red dots indicate the GOR is greater than 4,000. It is an area that has been opened, and is less productive. Most of those wells are not allowable wells, and they seem have high GOR's. They are also the oldest part of the field. I believe the fact that they are older and less productive means they are tighter. That is why these wells have a higher GOR.

The area that I'm trying to history-match in my model is closer to the middle area of the field. In general you see yellow dots which indicate low GOR to the right, blue dots towards the middle, and red dots to the northwest indicating a higher GOR.

So you can see how the GOR is grading

across this area. Now, it's not perfect. It's an extremely complex reservoir, and there are three other sands here that have to be included, but I'm trying to understand the structural relationship and why certain wells have higher GOR's than other wells.

Q The color code at the bottom of the display shows the range of the gas/oil ratios used to identify those wells?

A Yes.

Q Is there a significant structural component that's related to the gas/oil ratio?

A Yes, if you go to the Exhibit Number 4, I've taken the same areas and the same dots. I've laid them over on a structure map.

If you look at the middle area, in general the wells with the higher GOR's are shown high on the structure.

Q When we return now to page 3 of Exhibit 1, the wells on this page 3 with the wells on page 4 are going to correspond to the line of wells connected on the structure map that is shown on Exhibits 3 and 4?

A Yes. If you look at section 14, there are two cross sections shown on section 14. One goes from the Teledyne Number 2 to the Teledyne Number 1 to the Carrasco 14 Number 2 to the Carrasco 14 Number 3.

That's page 3 of the model output. And in the other exhibit it goes from the width of the tract RGA to the Reid.

But those are the wells that I'm showing a history match against. Again, I was not trying to absolutely match specifically an exact well. If I went to that much detail to match a single well, then I would no longer have something that was representative of a reservoir. I wanted something that was generic enough that it would be representative of in general what the reservoir was doing.

Q Your line of cross section for the wells in which you matched is perpendicular to the structure. Is it not?

A Yes.

Q So you've taken into account in the modeling the actual structure within this portion of the pod of the reservoir?

A Yes.

Q What does the match tell you? Are you satisfied with the match?

A I think it's reliable. It's not excellent, but I think it's going to give you a lot of results that tell me that my model is working sufficiently enough for me to forecast and believe in my results.

If I look specifically at the Teledyne Number 2, my GOR's match pretty well on that well. My oil rights are a little lower. But if you look at the next cross section, the width of Number 1, its GOR is up around 10,000. I'm falling a little bit short on that well, but my oil production looks pretty good.

So if I would fix the oil production for Teledyne Number 2, then I ruin the match on the Witt Number 1. Again, I'm trying to average what I'm seeing in various wells rather than picking out a specific well.

Q Within the context of trying to determine the difference, if any, between 2,000 and to 5,000 gas/oil ratio, are you satisfied that you have sufficient history on these wells in which to make a reliable forecast of the magnitude of difference in recoveries if we change the gas/oil ratio?

A Yes.

Q Identify and describe then the second cross section on page 4.

A The second cross section is just from the Witt to the fracture of the RGA3.

Q I think you have satisfied yourself that you have sufficient history in which to accurately match your simulation. Have you attempted to adjust parameters to accurately reflect the heterogeneous character of the reservoir?

A No. In history matching, the only thing that I altered during the history matching was that production began in this field in 1987, and most of these wells didn't begin production at that point, so I produced the model for relatively about a year to allow for a depletion of the reservoir prior to these wells coming on. So I had to add the gas cap and the only -- I played with the permeability a little bit. I settled on three millidarcies, which appears to match pretty well.

Q My point is, you have selected reservoir parameters that are specific to reservoir data.

A Yes.

Q Does it matter in your simulation that in the early producing life of some of the Oryx wells there may be a question about whether or not we have accurately reported all the gas production from those wells?

A I don't have any Oryx wells in these two cross sections, so it would not be related.

Q When we get to page 5, the display says, Upper Well Model Forecast. What does make mean?

A Once you have obtained the correct history match, then the forecaster is rematched. These are 17-year forecasts. The next four pages are forecasts for the four wells.

In the upper left-hand corner, you have oil production. In the upper right-hand corner it shows the gas production. In the lower left-hand corner I have platted cumulative oil production. And in the lower right-hand corner we have reservoir pressure.

Q What is the conclusion?

A There are two things that are very important to notice and compare about the upper well and the next well beneath it. I think what is most important -- I'm looking at the lower left-hand corner -- the cumulative oil production. You can see that the red curve is the 5,000 to one GOR curve, and you can see that is showing a cumulative production slightly more than that light blue curve, which is the 2,000 to one GOR production.

So an upper well, a high GOR well in the five- to 10,000 range is going to very slightly benefit from raising this allowable.

The next point to make is in the upper right-hand corner, you can see that, again, the red curve shows the 5,000 GOR well. You can see that this well increases up to 710 MCF of gas per day where it goes flat for about two years, and then it can no longer produce that maximum rate of 710 MCF gas per day after that.

You can see the blue curve shows how many years -- the light blue curve shows how many years that well would limit at the maximum rate of 284 if you retained the 2,000 to one GOR.

Q This well in the upper portion of the structure in the reservoir then receives some short time small benefit from increasing the gas/oil ratio?

A Yes, but it's at the detriment of the next three lower wells, and that's what the next three curves show, the next three pages.

Q Show us that. What is the detrimental effect then on the other three wells lower in the model?

A On page 6 in the lower left-hand corner the red curve shows that that well would produce 100,000 barrels of oil that would raise the GOR limit to 5,000.

The light blue curve shows that that well would produce over 125,000 barrels of oil if we leave the GOR limit at 2,000. That's more than 25,000 barrels of oil production for this well. If you look at the upper right-hand corner, you can see that this well never benefits from a 5,000 to one GOR. It can never produce 710 CFM of gas per day.

The further away that you get from these high GOR wells as you move down structure, this becomes less severe, the further away you get. But if you're neighboring one of these wells, the pressure depletion is going to affect you this much.

Q Page 7.

A Page 7 you can see that the difference between the red and the light blue curve in the lower left-hand corner is showing less of a loss, but it still is a significant loss in recovering. And you can see in the upper right-hand corner that, again, this well never benefits from a maximum gas rate of 710 CFM of gas per day.

Q Finally, the last well at the lowest structural point.

A It is still being harmed even though it is much less of a harmful situation from the lowest wells.

Q Apart from reservoir simulation, have you done any conventional material balance calculations?

A Before I began the simulator I actually did a material balance to help me understand how the well is working. That is Exhibit Number 2.

Q What is the purpose of this particular of this material balance calculation? What are you trying to find out?

A This is the material balance calculation for a solution gas drive reservoir. The second page shows the results of that.

Q Can you take a material balance calculation and determine recovery factors as a function of cumulative GOR?

A The recovery factor is inversely proportional for a GOR for a solution gas drive reservoir. I have put the specific PVT data into this formula so I can plat the actual curve for this reservoir, and that's what is shown on the second page.

You can see that as GOR's go up, your recovery factors go down. Now, we can't control the actual GOR that a single well produces at. And this is important because it explains the difference between the two models. If you look at one well, you cannot change the GOR of that one well. Your rock properties control that. Your PVT controls that. Your reservoir geometry controls that single well.

But if you look at an entire field and not just a single well, and you have high gas rates updip and high oil rates downdip, by limiting how much energy you pull out updip, how much gas you pull out updip and pulling out more oil downdip, you can shift your field GOR down this curve, and you can actually increase your recovery.

Q Let's go to the Exhibit Number 3 again.

Having explained to us on three the area that you have simulated within the reservoir, go on and complete your explanation and discussion about this isopach.

First of all, looking at the three areas, relate the three areas to us in terms of thickness.

A The three areas represent the three thicknesses in the reservoir that I see in this top layer of sand.

Q Give us a description of each of the areas and how they are similar and dissimilar.

A The lower sand appears to be -- the lower thick appears to have wells that don't produce at high rates or as high of rates as the wells in the other two areas. And I'm interpreting this to believe that this part of the reservoir may be tighter in permeability.

The other two areas seem to have wells that are similar in productivity characteristics. These are very good wells and these produce at high rates. And the other two areas seem to have very similar productive characteristics.

What is different different about them is their age and development. This innerarea has been developed first, and the northwest area is currently being developed. That's why I have the dotted line to the west. We don't know the extent of it yet, and we haven't drilled the highest updip wells in this area yet.

Q Do you find pressure communication between the two areas?

A In this sand there may or may not have been pressure communication, but you have to remember there are three or sands there, and we have fractured and propped at every well bore these sands. And even though this sand may not communicate from one well to another between these two areas, if you drop down to our C sand or what Burks was calling their lower 1 sand, then there is no permeability barrier between these two pods. So it would be a pressure communication now.

Q If we're looking at the A sand only and comparing the northwest pod to the central pod, right along that common boundary, if you look at the north pod you have low gas/oil ratio wells.

A Yes.

Q If you move to the right of the pod you have high gas/oil ratio wells. What is the explanation?

A Which wells?

Q The second pod is the center pod. Along the common boundary between the two pods. Are you with me?

A No.

Q All right. The first pod is the northeast -- I'm sorry the northwest pod.

A Okay.

Q Do you see that?

A Yes.

Q Along its southeastern boundary are some low gas/oil ratio wells.

A Okay.

Q Move across the boundary line that you've interpreted to the southeast and you're now in close proximity to high gas/oil wells.

A Right.

Q What is the explanation?

A That's what I'm trying to show here, is that there may be a permeability barrier in this upper sand or a flow barrier that is preventing gas migration at this point. But that doesn't mean that there is not pressure communication occurring through the lower zone. It means the gas has hit the cap; that it can't get past. Yet the pressure is communicated through the lower sands.

Q Let me have you turn now to Exhibit 4 which is the structure map again and have you complete your explanation about the structure map and the conclusions you derive from the structure map.

A Again, in the lower pod there doesn't seem to be a structural correlation. The wells there produce quite low rates and consistently high GOR.

In the center pod, I think that there is a distinct grading and GOR from downstructure to upstructure. The highest structural wells are the Witt, Teledyne -- and I can't remember the name on the other red well that shows the dot on it.

There are exceptions to this. Again, there are three other sands that I'm not looking at the structure of those first three sands or the permeability of the other three sands that may explain some of the anomalies, but I think in general it is a good correlation from low to high GOR's that match the structure within that area.

Now, within the area northwest, the new pod, those wells may not have been drilled long enough to start seeing this gradient, plus we certainly don't have -- haven't figured out the northwestern range yet. That's why I would be expecting to see our highest GOR wells there that haven't been drilled yet.

Q Let me ask you to turn to Exhibit 5.

That summarizes your conclusions about the magnitude of oil left in the reservoir if we increased the gas/oil ratio.

A Using my forecast, if I incorporated the dip and the gas cap. I predict that your recovery of oil in place would be 12.1 percent. And that corresponded to the 2,000 to one GOR allowable. By raising that GOR allowable to 5,000 to one, that would correspond to a recovery of 10.8. Applying those recoveries to a reservoir volume in the original oil in place results in 763,000 barrels potential loss for this field.

Q Ms. Wilson, can we temporary increase the gas/oil ratio to 5,000 to one for a 12-month period and if production demonstrates that said that's a mistake, can we return to the 2,000 to one gas/oil ratio and recapture then the ultimate oil recovery in the reservoir?

A No.

Q Why not?

A You're going to do your damage now. Your pressure depletion will have already occurred in the next year. By changing it now it will result in pressure depletion. If you want to change the field rules, you need to wait until the majority of your oil production has been produced and then change the field rules to allow for wells that are marginally economic to produce the higher GOR's.

Q Have you caused to be conducted on an Oryx well a rate sensitivity test to see what would happen in field conditions if you changed the gas/oil ratio on a specific well?

A I have indeed prepared number 6.

Q Identify the well and describe what was done to obtain the data.

A This is the Pardue Farms Number 1. These are the actual well tests on the field. We try to do them -- there are a few days missing. We find that if you don't flow the rates constant for a period of a week that you do not get stabilized rates. It's very difficult to get stabilized rates within that period because they are hitting and flowing. They flow slugs of gas. Slugs of oil and slugs of gas.

But you can see that in general where the oil production was higher, and that was in April, our GOR's averaged for that period in the 3500 GOR range and our oil production was 195 barrels of oil per day for that period. And then --

Q Is that a reliable average?

A Yes.

Q Using that period of time, are you satisfied as a reservoir engineer that you adequately flowed the wells to get a reliable indication of the performance of gas and the oil within that well?

A Yes.

Q Contrast that then to the August test.

A In August we were holding our rates back lower. For one reason, we wanted to see this lower rate to see what the GOR's were going to be doing. I started out with a high rate and moved to a lower rate to prevent any depletion that might be masking. If you look at it backwards and start at a lower rate and go to a high rate, a depletion can make your GOR's go up.

So you want to start at a high rate and move to a lower rate. That's why we did it at a high rate and then low rate. We averaged 123 barrels of oil per day. You can see how the GOR went down. It was 2,300 average.

So this indicates to me that there is rate sensitivity.

Q Have you looked at the production of any other well to see if it is sensitive as to rate and gas/oil ratios?

A The Teledyne Number 2 --

Q That's shown on Exhibit Number 7?

A Shown on Exhibit Number 7.

Q Describe the source of the data.

A This data came from the state records.

Q What have you tabulated?

A I've tabulated monthly oil and gas production in the average GOR for that month. The operator has been reducing those rates, producing at a lower rate to make up his own production. What I've tried to do is separate out what I saw as the two areas; the area of high oil rates, and the area of lower oil rates. And then I averaged the oil rates and the corresponding GOR's, and I saw that when I produced the 90 barrels of oil per day the GOR's were in excess of 6,000. And when they cut that oil rate in half, down to 55 barrels of oil per day, the GOR's dropped down to 3,000.

Q What is your conclusion?

A My conclusion, it is rate-sensitive to oil production rates.

MR. KELLAHIN: That concludes my examination of Ms. Wilson. We move the introduction of her exhibits, 1 through 7.

CHAIRMAN LEMAY: If there is no objection, Exhibits 1 through 7 will be entered into the record.

CROSS EXAMINATION

BY MR. CARR:

Q Ms. Wilson did I understand your testimony when you look at this reservoir do you see a homogeneous reservoir in all four zones, or do you see four separate zones in the reservoir?

A I see four separate zones.

Q And yet within each of those do you see any further separations and separation into separate lenses or stringers?

A I don't see any distinct separate lenses or stringers.

Q And you see communication vertically through how much of the structure?

A Vertically?

Q Yes.

A From my pressure build-up analysis -- I only have one -- I calculated a fracture half-length of 30 feet. 30 feet out into the reservoir on either side of my well bore we have a propped fract. 30 feet into the reservoir we do have a 30 foot fract that is infinite conductivity between these layers.

Mr. Burks has testified that his fracture half-lengths were over 100 feet. But he has 100 feet on some of his wells.

Q And is that infinite conductivity within that fracture?

A Yes.

Q That would in your opinion communicate the zones, one, two, three and four?

A Yes.

Q So what you're saying is the vertical communication from -- I don't know what you call it, A, B, C and D, and we call them M1, M2, L1, L2 you're seeing a vertical communication throughout out that zone. Is that how I understand your testimony?

A Yes.

Q Now, when you were -- what you're talking about is basically the completion technique being employed by altering the reservoir; therefore, you've got one zone. Is that right? Or a zone that is in communication top to bottom.

A The completion technique has allowable pressure communication between all of these sand lenses.

Q We can go to Exhibit Number 1. This is the basic model that you've been working from. Is that correct?

A Yes.

Q And you are basing this on the assumption, again, that we have this vertical communication.

A Yes.

Q And as you have testified, to get the match that you needed, you inserted a gas cap.

A Yes.

Q Without that you couldn't get the match?

A That's correct.

Q You also made some other adjustments, did you not, in the input data to get the match?

A Varying permeability.

Q And what permeability did you use?

A I used a varying permeability between the layers; permeability between one layer, permeability between two and another layer, permeability of four and another layer, permeability of eight and another layer, permeability of 16 and another later.

I felt like the permeabilities varied

within the range of the core that I was looking at.

Q And even with the changes in permeability you couldn't get your match without the inclusion of the gas cap. Is that what you're telling us?

A That's correct.

Q Now, if we continued to model this model in the theory, it seems to me that what you would get is higher gas/oil ratio wells on the structure. Is that what you're trying to tell us?

A Yes.

Q Now, we go to the second page of this exhibit. We've got -- these are the input factors, is that right, into your model?

A Yes.

Q And you have used a porosity of 16 percent?

A Yes.

Q Where did you get that?

A From our geologist.

Q You relied on it. Do you know what that was based on?

A It's an average porosity from the logs. I assume, the logs that he had.

Q Do you know that?

A No. He'll be on the stand, and you can ask him.

Q Using that porosity, you got a net pay of 50 feet. Is that right?

A An average impact, 50 feet, yes.

Q If you had used a lower porosity you would have gotten more in terms of the --

A If I had used a lower porosity.

Q Then you would have gotten --

A Obtained a larger, yes.

Q Okay. Now, we've got the permeability factor down at the end of 3.2 millidarcies. Did you get that from your geologist?

A No, that was obtained from log data. That 3.2 millidarcies is the log average of the one, two, four, eight, and 16 millidarcies.

Q Did you use any core data or integrate any of that into this calculation?

A The core data that I used to obtain that range was from the RGA Number 3.

Q If we drop down, we have the oil properties. Are you assuming there is one type of oil in terms of its chemical makeup in all zones?

A Yes.

Q If that's the case, why are some of the lower zones wet? They are, are they not?

A Wet? We have capillary pressure effects and our relative permeability data indicates that different layers have certain capillary pressure properties that would allow larger or smaller transition zones, but the oil is all the same.

Q And you see no chemical change in the oil as you go from one zone to the other.

A No, I don't.

Q We get to the next page of your exhibit and we've got certain matches that you made to determine the reliability of the model.

A Yes.

Q And if I look at the match for the Teledyne Number 2, that's your match on the gas/oil ratio.

A You have to recall that I assume you're talking about the lower GOR points around 3,000.

Q Yes.

A I think this well is curtailed. Its rates were cut back to half of what it had before. And due to the rates of the reservoir, the GOR would fall.

Now, my forecast, and this is a forecast compared to actual data, did not cut back those rates. It kept producing that well at 90 barrels of oil per day rather than cutting it back to 45 barrels per day. So my model is going to show a GOR increasing.

Q You indicated you were satisfied with this match?

A Yes.

Q How accurate is it? Do you have a high degree of confidence with this kind of pressure or GOR?

A I have a very high degree of confidence. My management does, based on this data.

Q If we take a look at your forecast on these individuals that you come up with after the match you have shown in this exhibit.

A Yes.

Q Are you modeling just the individual zones here? What are we looking at when we look at the upper well? Are we looking at all the four zones?

A You're looking at all four.

Q So what you've done in each of these cases, you put all four zones together.

A Yes.

Q And we haven't individually broken down particular zones of the model.

A But I have the model built in the file. Layers of permeability, barriers between those layers. So there is some vertical -- not barriers, but vertical permeability is higher. And this gas is going to have to move up through the tighter permeability between those layers to get to the next layer. So there is a holdback. It's not a barrier, it's a dam. And the gas has to spill over the dam before it can get to the next layer.

Q Are you assuming the same properties in all four of those zones?

A Vertical permeability, yes.

Q But each of the zones has the same reservoir properties as you move up and down?

A Except for the absolute permeability in the XY direction.

Q And in your actual modeling have you included the fracture? Have you taken that into account?

A The way that I incorporated the fracture into the model was by increasing the permeability right around the well bore. Increasing the well index, the productivity of the well right around the well bore to account for the increased flow rather than building a fracture into the model.

Q Now, when we go to the -- let's go to Exhibit 3. Take a look at your isopach. Are we talking about all the zones here, or are we talking about just your A zone?

A Exhibit 3 is the isopach, or the A zone.

The field represents somewhere between 60 to 80 percent of the productive capacity of the wells.

Q So when we look at the gas well ratio shown on this map, are we looking at just one of the four zones?

A Yes.

Q You would agree with me that there are other zones that would impact these numbers.

A Yes.

Q And they are not as strong and perhaps not as significant now, but at another time we might see some change in the way the wells are performed?

A It's possible.

Q You've drawn these pods. What is the basis for the boundaries between these pods?

A In general, I looked at two things; production characteristics, and the geology. And I tried to make the productive characteristics and the geology merge. Oil is producing a certain way and there is a reason why, and I believe there is a geological reason why. So I try to make the areas of productive characteristics match the three different areas. It doesn't match exactly in all areas, but in general it matches.

Q And you've assumed some of the lines where the various pods led up against one another.

A Yes.

Q And you indicated there might be a flow barrier there. Did you see any evidence of a flow barrier?

A I think the evidence is the fact that you have a very high GOR well next to a very low GOR well. There is some reason why that's occurring.

Q What we have here, you would agree with me, is by mapping one zone you have low structural wells down to the south and the east.

A Yes.

Q And they have high GOR.

A Yes.

Q And then you have -- up at the northwest you have structurally high wells with low GOR.

A Yes.

Q And you agree we have a very complex reservoir here.

A Yes.

Q And if the flow barriers are wrong, it could be that there are other factors that explain the difference between the GOR.

A I think the GOR's are controlled by structure, permeability, and depletion. And I'm trying to resolve those three by drawing these three areas.

Q By drawing these three areas you can make this data fail where we have had to go to three separate pods to explain this complex system.

A I don't think you have explained the high GOR wells with the previous testimony that's been presented. I haven't seen an explanation of high GOR wells. That's what I'm trying to explain here with this map.

Q And you're seeing barriers here and you're seeing one homogeneous reservoir with these barriers to explain --

A I've seen vertical communication, and yet earlier across the fill I have seen some flow barriers. But, again, these flow barriers are probably individual sands so that there is pressure communication elsewhere. So there is pressure communication. It's like a maze. It's all in communication.

Q Do you see small lenticular sands of limited area to an extent?

A No.

Q So you don't see the reservoir as we have portrayed it?

A No.

Q Instead you're seeing these flow barriers as you have stated earlier.

A Yes.

Q When we look at your rate sensitivity test, these are basically -- they basically show rate acceleration in terms of what, the oil production? Is that what you start with?

A What are you looking at?

Q I'm looking at your Exhibit Number 6.

A Okay. What they are showing is if you produce the wells at higher rates, you're going to produce -- you have higher GOR's. You're going to deplete reservoir energy much faster.

Q It shows, however, that if you produce a higher rate you also produce your oil at a faster rate. Does it not?

A Well, yes.

Q And this Exhibit alone doesn't tell you everything.

A No.

MR. CARR: That's all I have.

CHAIRMAN LEMAY: Additional questions of the witness? Mr. Weiss?

CROSS EXAMINATION

BY MR. WEISS:

Q On the build-ups, were there any evidence that the reservoir is actually fractured?

A No. The build-up was dominated by the linear flow. We had do a flow analysis.

Q How long did the simulation take?

A The initial simulation I did four months ago for the previous hearing. I had started building it, but I really only spent about a week on it. Again, I spent about a week on this update since I got my -- we were planning on simulating, and so we had pulled relative permeability and PVT samples, and I got all the permeability data in.

Q That's not included in here, I presume.

A I can get that for you.

Q Do you think the rate sensitivity could be a result of gas coning.

A Gas coning. I haven't considered that option. The reservoir is timed. I haven't investigated it. I haven't investigated it. It could be a possibility.

MR. WEISS: That's all my questions. Thank you.

CHAIRMAN LEMAY: Mr. Kellahin?

MR. KELLAHIN: Just a point for

clarification.

REDIRECT EXAMINATION

BY MR. KELLAHIN:

Q Let's go back to 6 or 7. Either one. Let's use 6. Mr. Carr was asking you whether or not this was simply an indication of rate of acceleration.

Let me look at this display with you.

A Okay.

Q On the Pardue Farms Number 1 well, if you look at the average and we've got an oil per day rate of 195 barrels.

A Yes.

Q And it's going to take 693 MCF of gas for that quantity of oil. Right?

A Yes.

Q That's what you've averaged?

A Yes.

Q And you contrast that to the August sensitivity test. At which rate are you using more gas per barrel of oil to cover?

A Well, obviously at the higher oil rate you're using more gas per barrel of recovery. And you take that in conjunction with the material balance calculations, if you take this exhibit in conjunction with the material balance calculation, then you would assume that because you are using up more reservoir energy, then you would lower your recovery. You would have to take the two together to draw that conclusion.

Q Conversely, when you produce at a lower rate you're more efficiently utilizing the gas production that goes with the oil.

A Yes.

Q So this is not simply a rated acceleration is it?

A No, it would also result in a loss of recovery as well as acceleration.

Q At a higher rate we're wasting the gas drive.

A Yes.

MR. KELLAHIN: No further questions.

CHAIRMAN LEMAY: You may be excused. You may call your next witness.

MR. KELLAHIN: Mr. Chairman, I'd like to call Gregg Jacobson. Mr. Jacobson is a petroleum engineer.

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q Mr. Jacobson, would you state your name and occupation?

A Gregg Jacobson. I'm a reservoir engineer employed by Oryx Energy, Oklahoma City office.

Q Are you also a registered petroleum engineer?

A Registered professional engineer in the state of Texas.

Q Summarize for us your educational and employment experience.

A I graduated from Texas A&M University in '83 with a Bachelor of Science in petroleum engineering. Upon graduation I was employed by Sun Exploration and Production Company in their Abilene office. Since that time I've worked for Sun, which is now Oryx, in their Abilene office, the Midland regional office, as well as the Oklahoma City region. I've been responsible for properties in central Texas, west Texas, as well as New Mexico.

Q Describe for us your specific involvement in studying the East Loving Delaware pool of Eddy County, New Mexico.

A What I've tried to take a look at is beyond the straight technical scientific aspects. How can we best explain what is happening in the reservoir and why it's happening.

Q And based upon that study, have you reached certain conclusions about why and what is happening in the reservoir?

A Yes, sir I have.

MR. KELLAHIN: We tender Mr. Jacobson as an expert petroleum engineering.

CHAIRMAN LEMAY: His qualifications are accepted.

BY MR. KELLAHIN:

Q Mr. Jacobson, tell us what and why.

A If I can direct your attention to Exhibit 8. Exhibit 8 lists among other data, the initial reservoir pressures in two of the wells in the field. Initial pressure in the Carrasco 14-1 of 2892 PSI is very close to what we believe to be the original field line initial reservoir pressure of slightly over 2,000 PSI.

When we completed our Pardue Farms Number 1 nearly one year later, the initial pressure that we found in that well was only 2375 PSIG. Several hundred pounds less than the original reservoir pressure.

The Pardue Number 1 was a 40-acre offset producing wells to the south and to the east. This pressure completion indicates to us that drainage is at least greater than 40 acres, otherwise we would have been pressure depleted. And that the reservoir depletion in adjacent wells can and will affect the recovery in 40-acre offsets.

Q As a reservoir engineer can you take any comfort in Bird Creek's contention that we can increase the gas/oil ratio for the high gas/oil ratio wells and not affect the offsetting wells?

A No, sir. As I'll show later, by increasing the gas/oil ratio and producing wells you're basically doubling the reservoir voidage for the same amount of oil, and therefore it's an inefficient use of reservoir energy. The reservoir only has a certain amount of energy if it is a true solution gas drive reservoir. If we waste that energy by preferentially producing gas, we leave oil in the ground.

Q Mr. Burks has told us earlier today that he had thought this was a solution gas drive reservoir.

A That's correct.

Q And if it is, what do you do about the gas/oil ratio?

A In a true solution gas drive reservoir you will try to minimize the amount of free gas production in order to maintain reservoir pressure and maximize your ultimate recovery.

Q Have you tabulated where these wells that have the capacity to produce in excess of the gas rate that applies at 2,000 to one, that's a daily gas rate of 284 MCF a day.

A Yes. Exhibit 9 is a plat showing the location of the wells currently capable of producing in excess of 284 MCF per day. As Bird Creek previously testified, three of the Oryx operated wells are capable of producing in excess of that rate, but we feel that this would not be a prudent thing to do even though we are capable of producing that excess rate, because we would be preferentially producing gas. Because as we have shown from our step rate tests, producing oil at a higher rate results in excess evolution of the free gas, and results in an ineffecient use of the reservoir energy.

Also on this plat you can see that although there are a significant number of wells that are capable of producing in excess of 284 MCF per day, there are a significant number of wells that are not capable.

Also directing your attention back to our Exhibit 3, for these same wells that all are capable of producing excess volumes, the GOR on these particular wells varies from well to well, so the relative depletion in these wells will vary significantly as well.

Q Mr. Burks expressed a concern that if the high gas/oil ratio wells are gas curtailed that he is placed at a disadvantage in the reservoir to those wells that have lower gas/oil ratio. Do you agree with that?

A No, I don't. I think that reflects an attitude of we've got to get all of ours before the next guy offset to us produces his or produces some of ours. It indicates to me that he's concerned about drainage from well to well.

Q Let me direct your attention to Exhibit Number 10. You prepared that display?

A Yes, sir. Exhibit Number 10 is a calculation of the maximum reservoir voidage at an assumed pressure of 2,000 PSIA for both the current field rules, 2000 to one GOR limit, as as well as the 5,000 to one GOR limit. And the bottom line of the slide is that the total voidage for a top line of the well at 284 MCF per day is 373 reservoir barrels per day. By increasing the gas/oil ratio allowable to 5,000, which would result in a gas rate of 710 MCF per day, the total voidage is then increased to 741 barrels per day.

So for two similar wells offset from each other, they are both capable of producing top allowable oil rates, 142 barrels a day. The one well with the high gas/oil ratio would basically be depleting the reservoir twice as fast as the adjacent well.

And the GOR is a function as we've seen of structure, of relative permeability of the rock characteristics, as well as the relative rate of completion; therefore, allowing excessive GOR's is going to hurt some wells and help some others.

From our exhibits we can demonstrate that the wells are affected by offset depletion; that the rate of depletion has increased substantially with higher GOR's, and that the GOR is a function itself of the producing oil rate.

From our step rate tests, as you produce at a higher oil rate your gas/oil ratio increases; therefore, you're producing at a less efficient rate. And with all this data we can conclude that increasing the gas allowable will result in an inefficient use of the reservoir energy and will result in significant volumes of oil left behind in the reservoir.

Q What's your reservoir explanation to the proximity in relationship of the high gas/oil ratio to the low gas/oil ratio wells?

A In what area of the field?

Q Well, in any area that you choose.

A Well, like I said earlier, the gas/oil ratio is certainly -- we've seen that it is a function of structure or can be demonstrated to be a function of structure, but it's also -- it is affected by the relative permeability characteristics within that well as well as the quality of the stimulation within that well.

In discussions with operators within the field, they've noted to us that some of the higher GOR wells are wells that had a less effective stimulation.

Q Mr. Burks was critical of the way we had accounted for and recorded the gas production on certain of your wells and pool. Have you also gone back and looked at the data concerning those wells and how that production was reported?

A There's no doubt that we did have a problem. We were not selling our gas, and we had a flare permit. As far as I'm aware, we did report volumes to the state. I'm not sure that those volumes weren't reflected in the C-115's, but as far as I know we did report volumes.

The subsequent step rate test that we took, we performed that test after we had the wells hooked up. So it wasn't during a period of flaring; it was a periods of gas sales. So the flaring, period, doesn't affect any of the data that we have presented here today.

Q Let me direct your attention to Bird Creek's Exhibit 18. They had some pressure data that they were showing.

A Bird Creek's Exhibit 18 was presented as the initial reservoir pressure in several of those wells. And the point was made that because of the dissimilarity or the distribuition of pressure across the field, that these wells couldn't be in pressure communication.

Well, theoretically, the only way for all the wells to lay along the lines drawn for the Carrasco 14-1 would be if the reservoir had virtually infinite permeability. And we have already discussed and it's been testified to that this is a relatively tight reservoir; you wouldn't expect to see pressure distribution to be equal across the field at any one given time.

One interesting point in relation back to our Exhibit 3 where we have the three little pods, well, the wells on Exhibit 18 that have the lower reservoir pressure are in the lower pod that we projected as being more depleted. And this pressure data sports that.

The wells above the line; Urquidez 3, Urquidez 2, and the Federal 10-1 are all in our pod to the north which we felt was less depleted. And this pressure data supports that contention as well.

All the wells that we feel are in the middle pod, the Donaldson, the Carrasco 14-2, and the Carrasco 14-1 all have similar pressures as well. So in my mind this pressure data supports our interpretation of the three pods.

Q To expedite your testimony, Mr. Jacobson, I don't have Bird Creek's specific exhibits before me, but I'll ask you to go through their exhibit package and if there is any of their exhibits with regards to Mr. Burks' presentation that you would like to make specific rebuttal comments to, I'd like you to do that at this time.

A I've only got a few comments, particularly on Bird Creek's Exhibit 6, which is the package of structural information.

If you'll note on the first cross section, C to C prime, that for all the four wells, you've got listed an oil rate as well as a gas rate and the corresponding GOR, if you will note that the GOR is lower in the wells that are not producing greater than

284 MCF per day. In other words, the legal wells, the wells producing less than the maximum rate have the lower GOR, which seems to indicate to me a certain degree of rate sensitivity. The wells that are being blown down the quickest have the higher GOR.

In addition, the next subsequent cross section, D to D prime, all of these wells have much higher than the field average GOR, and all these wells are currently producing in excess of the current field allowable of 284 MCF.

So this data as well indicates to me that there is a degree of rate sensitivity that if you produce the wells at the higher gas rates you're going to get a much higher GOR. It's a much less efficient production method.

Q Anything else?

A No, sir,

MR. KELLAHIN: Mr. Chairman, we would move the introducton to Mr. Jacobson's Exhibits 8, 9, and 10.

CHAIRMAN LEMAY: Without objection, Exhibits 8, 9, and 10 will be entered. Mr. Carr?

CROSS EXAMINATION

BY MR. CARR:

Q Mr. Jacobson just a couple of questions.

If I look at your Exhibit 9, I believe you indicated that you found evidence of drainage in this reservoir because of the initial pressure in Pardue Farms Number 1 well.

A That's correct.

Q And it was lower than the initial pressure of some offsetting wells. And that it was drilled after some of these other wells had produced for some period of time.

A That's correct.

Q How long was the pressure build-up test on the Pardue Farm Number 1? Do you know?

A I believe it was 72 hours.

Q Do you know how long the pressure build-up test might have been on any of the offsetting wells?

A From the previous testimony they said that there had been pressures after seven days.

Q So if in a fact if you had a longer pressure build-up on the Pardue Farm Number 1, you might have actually encountered a higher pressure there. Is that possible?

A No, sir, we extrapolated the pressure and that's the number that's demonstrated there.

Q Now, if I -- so you believe that just the fact that because you a shorter test that gave you the initial pressure doesn't distort your conclusion.

A No, sir.

Q If we take your Exhibit 9 and compare that exhibit to, say, Exhibit Number 3 or 4 that was offered by Bonnie Wilson, she has indicated a flow barrier between pods between the northwest pod and the central pod. That actually runs between the Pardue Farms Number 1 and the 40-acre offset to the west and the 40-acre offset to the southwest. Does it not?

A Yes, it does, but not to the 40-acre offset to the immediate south.

Q So based on your evidence you're not concerned then about the potential drainage from the wells now to the east or toward the southeast.

A No, sir, that's not correct, because all the wells have been fractured. Each of the four layers are in pressure communication and can drain each other.

Q The 30-foot fractures on those well bores which have been continuously producing now may reach -- somehow communicate across the flow barrier that Ms. Wilson states?

A Not necessarily the flow barrier, no, sir. The individual pressure communications near the well bore. In one subsequent pressure point on Bird

Creek's Exhibit 18, if you platted our 2375 initial reservoir pressure in September of 1990, it falls almost exactly on Bird Creek's depletion line, which would indicate that it's a similar reservoir -- or it's in pressure communication. Excuse me.

MR. CARR: That's all.

CHAIRMAN LEMAY: Additional questions of the witness? Mr. Weiss?

MR. WEISS: No. I have no questions.

CHAIRMAN LEMAY: You may be excused. Thank you.

MR. KELLAHIN: Mr. Chairman, I'd like to call Mr. Bob Sidlowe. Mr. Sidlowe is a geologist with Oryx.

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q For the record, sir, would you please state your name and occupation?

A Robert Sidlowe with Oryx Energy. I'm a geologist.

Q Mr. Sidlowe, in February of this year did you testify before Examiner Catanach and make your geologic presentations to him in this case?

A Yes, I did.

Q Have you substantially altered, refined, or changed your presentation before Examiner Catanach in preparing your exhibits today?

A Nothing substantially has changed. I've updated my maps, et cetera.

MR. KELLAHIN: We tender Sidlowe as an expert in the petroleum field.

CHAIRMAN LEMAY: His qualifications are acceptable.

BY MR. KELLAHIN:

Q Let's turn to Exhibit 11, Mr. Sidlowe. Would you identify and describe what this is?

A Exhibit 11 is a structural map, Top of Brushy Canyon Pay Sand itself. Has a conture area of 20 feet. Covers the entire field. We see a basic dip in the southeast direction with some localized noses, structural highs trending in a northwest to southeast direction. Oryx Acres is colored there in yellow.

I also want to point out the cross section lines, B to B prime, north/south cross section, and a dip section, A to A prime, which we'll be referring to later.

And I also want to point out that the localized high there just southeast of Oryx Acres on Teledyne Number 2.

Q Let's have you identify and describe the cross section A to A prime. That is marked as Exhibit Number 12.

A These are colorful.

Q Yes, sir. What do they show us?

A Basically here it shows four different sand members divided by anywhere from four to six feet of shale. These shale breaks determine individual sand depositional vents. The very lowest was sand here and is discontinuous across the east-west dip section. It is only present in the Oryx Energy Pardue Farms Number 1.

You can see here that what I'm labeling A, B, C, and D from top to bottom, the A and C sands are the most prevalent. And together A and C account for 90 percent of the net pay in the area. And the A sand probably accounts for probably 70 percent of net pay. The A sand here is the prevalent one. We're looking at in it field.

Perforations are marked on the cross section. I also want to point out I'll be referring to this a little bit later. If you look at the difference on the porosity curves on the right between the Oryx Energy Pardue Farms Number 1 going to the Teledyne Number 2 and back to the Teledyne Number 1, you'll see a marked decrease in porosity in the Bird

Creek Teledyne Number 2. That corresponds to the thin which Ms. Wilson previously testified to.

Q Let's look at the north-south cross section. That's Exhibit 13.

A This is, again, is a rather large cross section. It does cover the entire field. Once again, you'll see four prevalent sands are continuous across the field, except for, again, that bottom most D sand. D sands are easy to correlate; go all the way across the field.

I agree with the geology that Mr. Burks previously testified about. The majority of these sands in the Delaware are probably deposited as channel-type sands. And that's indicative, if you look over on the far southern portion of the RB Oper Brantley Gas Com Number 1, you'll see a definite channel-type deposit with that cutting shown. That's the -- I guess, that's basically what I wanted to show in this cross section.

Q Have you individually mapped each of the four sand members and prepared an isopach?

A Yes, sir, I have. I tried to look at each sands we referred to.

Q Let's start with the lowest sand member first. That's Exhibit 14. That will be the D sand.

A D sand corresponds to the previously L2 sand. This the very first sand being deposited in the area. I have that mapped as a channel-type sand. This map is a channel-type sand, whether it's density currents turbidity-type currents. This is what you're looking at as far as the initial stages of the sedimentation in the area. This sand is a minor player in the overall picture in the net pay of the field.

Q Let's move up the to C sand, isopach, Exhibit 15. Identify and describe that display.

A This is an isopach net pay in the C sand. A little higher sedimentation rate. Again, a channel-type deposit. The contour over here is a five-foot. You can see how it continually goes basically in the north-south direction across the field. I show the sand pinching out to the west and also pinching out to the east. Shows a basic thickening towards the south.

Q Okay. And then finally as we move up into the top sand being investigated, is the isopach on A sand.

A Isopach on B sand.

Q On the B sand?

A Okay. You want to go right to the top?

Q I'm sorry. Did I miss one?

A Yes, sir. Exhibit Number --

Q 16 is the B sand.

A Right. This is, again, a very thin sand and a minor player in the field. I believe this is a -- represents the time of a very low sedimentation rate. This sand was deposited in this area, probably reworked with some kind of current.

Q Let's go to the A sand isopach. That's Exhibit 17.

A Okay. Exhibit 17 is an isopach of the uppermost A sand. M1. The contour over here is 10 foot. That shows some definite northeast to southwest trending thicks and thins as you will have the net porosity.

I want to point out the fact that the geology here as far as the possible flow barrier, the flow restriction to the various southeast corner on section 10, I believe this geology in the isopach of the A sand along with the structure not shown gives a reasonable explanation to the production characteristics we have seen in the field.

Q Let's have you summarize your major geologic conclusions with regards to your entire geologic investigation.

First of all, you have identified four sand members that contribute A in the pool.

A That's correct. Of the four major sands, two of those are roughly 90 percent of the net pay in the field, the A and C. I --

Q When you look at the A sand member, that contributes approximately what percentage of the net pay or porosity in the production?

A I estimated about 70 percent.

Q Are you able to map to your satisfaction the continuity of the A sand and the C sand?

A Yes, sir I can. I've also looked at one core in the area, and I do not see individual shale barriers within the A sand itself.

Q You don't see permeability barriers or shale barriers within the A or the C sand?

A No, sir, I don't.

Q What do you see?

A I see a very fine grain sandstone with disbursed shale intermittently. I believe that's pretty much what Bird Creek was referring to -- was shale layers. I can show you the piece of that core and relate to what I see. I forgot to bring it up here to the stand.

Q Certainly. Let me hand you the core sample that was used by Bird Creek in their presentation.

A I thought it was relatively interesting that they picked a zone to refer to their RGA Number 3, Exhibit Number 2.

The depth here is 6123. And according to the log of that well, this interval here that they are showing is not within the pay sands. It's taken within a very shalelike interval in that log from that well.

What I basically see here is a highly disbursed shale within this dirty sand that you can refer to on the log on RGA Number 3.

Q Within the A and C sand you see various porosity ranges?

A Yes, you do. You see various porosity and permeability changes. And that basically is a function of the amount of shale.

Q Are there any specific geologic conclusions or geologic evidence that Mr. Burks has relied upon that you wish rebut in your testimony at this point?

A Well, Mr. Burks' testimony seemed to refer to one-inch to two-inch thick sands that were deposited in the shale areas between. I have not seen that. Like I said, I believe the shale was disbursed throughout the sand. He referred in previous literature and included that in his exhibit. I believe what they're referring to in the literature is a very wide scale. When they talk about shale laminations, they are talking about the five and six-foot shale laminations, and not something that is millimeters thick.

Q In your geologic conclusions can you support the conclusions Ms. Wilson has made and Mr. Jacobson has made in the terms of sand continuity of the A sand member from well to well?

A Sure I can. I think the geologists supports the reservoir characteristics, the production characteristics we've seen, and I believe the continuity has been demonstrated clearly. And I believe the production from one well would be affected -- will be affecting the offsets of that well.

MR. KELLAHIN: That concludes my examination of Mr. Sidlowe. We move the introduction of his exhibits. I believe they are Exhibits 11 through 17.

CHAIRMAN LEMAY: If there are no objections they will be entered.

CROSS EXAMINATION

BY MR. CARR:

Q Mr. Sidlowe, very briefly.

When I look at your cross sections, what is the green designed to show?

A The green is designed to show the limits of the A sand.

Q As I look at this it goes across the reservoir, correct?

A Correct.

Q I don't see any barriers shown on this.

A No, not on the A sand. There is some flow restriction like I pointed out on the Teledyne Number 2.

Q But it is still a continuous sand bottom.

A I agree.

Q Now, when you were talking about this particular portion of the core, you were relating it to a -- what depth?

A Says 61.3. Maybe you can tell me which ones -- which is the top and which is the bottom.

Q It might all be within 61.3. Correct?

A Correct.

Q Were you relating it -- when you were explaining, you saw this wear in the sand row shales?

A I see this in a very, very dirty sand that is not included in either of these four.

Q You're looking at a log that displays this form?

A Yes, sir, I have that in front of me.

Q Are you aware that this was given at a core depth which is different from the log depth?

A It could quite possibly be that.

MR. CARR: That's all I have.

CHAIRMAN LEMAY: Additional questions of the witness?

(No response.)

CHAIRMAN LEMAY: Just a quick question.

CROSS EXAMINATION

BY CHAIRMAN LEMAY:

Q Did you run any samples on these sands at all, Mr. Sidlowe?

A I usually have mud loggers on this these wells. The samples are run by -- I've seen a few of them. It's a very fine sandstone. From my experience I always hate to call it a fine grain sand. It's pretty fine.

Q On completion, have you followed any of these wells after they have been completed in terms of productive characteristics?

A Yes, sir. Somewhat, sure. I'm always interested in what wells do.

Q Have you been on any of the wells at completion?

A No, not at completion. No.

Q You don't know if they produce a lot of freesand after treatment then, do you?

A No, sir I don't.

Q One other thing. That top sand, the A sand, have you got any geological model to run a environmental deposition on it?

A I believe it is the same channel-type deposit; however, I'm also assuming the later reworking of that sandstone was in the same basic direction we saw initialized in the B sand.

Q I think your cross sections show no limit to the sand.

A Okay. Yeah, the A sand, as far as the deposition of the A sand we have not found a limit to it. However, if you look on both the A and A prime cross section and the B and B prime cross section, you show a definite thinning of the entire Brushy Pay interval to the north and to the west. And you also see a decreased porosity in that same direction. So I think we are quickly approaching the field limits.

Q I guess my question really is, what is the trapping mechanism in this field in your estimation?

A I believe it's basically stratigraphic with some structural control.

Q Structural control meaning downdip --

A Some of the downdip wells seem to be more work productive. But I believe it is mostly stratigraphic with an updip permeability with a porosity pinchout.

Q But as yet the downdip limits, you could not define the trapping mechanism there?

A I have not yet defined the downdip limits of this field, no

CHAIRMAN LEMAY: Additional questions of the witness?

(No response.)

CHAIRMAN LEMAY: He maybe excused. Do you want to sum this up verbally?

MR. KELLAHIN: Let me add something Mr. Chairman. Mr. Weiss inquired about the capillary pressure tests and special corelative permeability test. We have that documentation. And subsequent to the hearing I'll mark these as Exhibits 19 and 20 to our presentation, and I'll hand you a set now and supplement the record. We're here at your pleasure.

I'll be happy to tell you what you already know. The hour is late; if you've had enough, I've had enough.

CHAIRMAN LEMAY: I would think the record could speak for statistics. However, we'll keep the record open for a couple of weeks.

MR. CARR: May it please the Commission, I think that would be an effective way to do this. I'd like to set a date because whatever date you set will be the date I will be --

CHAIRMAN LEMAY: Two weeks?

MR. CARR: We'll have a written summation for you.

CHAIRMAN LEMAY: The record will be kept open for two weeks.

MR. KELLAHIN: Thank you.

CHAIRMAN LEMAY: Any other additional questions?

MR. STOVALL: I believe there are other people present who may want to make a statement.

CHAIRMAN LEMAY: I was going to cover statements. That was the last item on my agenda here.

MR. FOSHAG: Mr. Chairman, my name is William Foshag.

CHAIRMAN LEMAY: Would you spell your name for the court reporter?

MR. FOSHAG: Sure. It's F-o-s-h-a-g.
I'm a reservoir engineer with Pogo. Pogo supports Bird Creek's application for special pool rules for the East Loving Delaware pool in Eddy County.

We believe the study by T. Scott Hickman & Associates petitioned by Pogo, Bird Creek, R.B. Operating Company, Oryx, and Amoco as presented here today by Bird Creek fairly represents the production we are currently seeing in the field as well as the production we anticipate if granted the special rules.

Based on the results of T. Scott Hickman & Associates' work, it is Pogo's opinion that increasing the GOR limits from 2,000 to 5,000 will not adversely affect oil or gas recovery in the East Loving Delaware pool.

Thank you.

CHAIRMAN LEMAY: Thank you very much, sir. Mr. Khalsa, do you want to say anything for the record?

MR. KHALSA: No, Mr. Chairman.

CHAIRMAN LEMAY: Any other statements for the record?

(No response.)

CHAIRMAN LEMAY: If not, we'll take this

case under advisement. Thank you, ladies and gentlemen.

(Hearing Concluded: 5:40 p.m.)

STATE OF NEW MEXICO)
COUNTY OF SANTA FE)

I, PATRICK M. MALONE, RPR-CP-CSR, and Notary Public, DO HEREBY CERTIFY that I did report in Stenographic shorthand the questions and answers set forth herein, and the foregoing is a true and correct transcription of the proceeding had upon the taking of this deposition.

I FURTHER CERTIFY that I am neither employed by nor related to any of the parties or attorneys in this case, and that I have no interest whatsoever in the final disposition of this case in any Court.

I FURTHER CERTIFY that I have retained the original copy of this deposition to seal and deliver to The Oil Conservation Division.

WITNESS MY HAND AND SEAL this 28th day of September, 1991.

Patrick M. Malone

Court Reporter & Notary Public
Certificate No. 412

My Commission expires 2/1/93