STATE OF NEW MEXICO

ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION DIVISION FOR THE PURPOSE OF CONSIDERING:

APPLICATION OF MARATHON OIL COMPANY FOR A WATERFLOOD PROJECT, LEA COUNTY, NEW MEXICO

CASE NO. 10269

REPORTER'S TRANSCRIPT OF PROCEEDINGS

EXAMINER HEARING

BEFORE: MICHAEL E. STOGNER, Hearing Examiner

March 21, 1991
11:00 a.m.
Santa Fe, New Mexico

This matter came on for hearing before the Oil Conservation Division on March 21, 1991, at 11:00 a.m. at Oil Conservation Division Conference Room, State Land Office Building, 310 Old Santa Fe Trail, Santa Fe, New Mexico, before Paula Wegeforth, Certified Court Reporter No. 264, for the State of New Mexico.

FOR: OIL CONSERVATION DIVISION

BY: PAULA WEGEFORTH
Certified Court Reporter
CSR No. 264

I N D E X

March 21, 1991
Examiner Hearing

CASE NO. 10269

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E X H I B I T S

A P P E A R A N C E S

FOR THE DIVISION:	ROBERT G. STOVALL, ESQ. General Counsel Oil Conservation Commission State Land Office Building 310 Old Santa Fe Trail Santa Fe, New Mexico 87501
FOR THE APPLICANT:	KELLAHIN, KELLAHIN & AUBREY Attorneys at Law BY: W. THOMAS KELLAHIN, ESQ. 117 North Guadalupe Street Santa Fe, New Mexico 87501
FOR ARCO OIL AND GAS COMPANY:	CAMPBELL & BLACK, P.A. Attorneys at Law BY: WILLIAM F. CARR, ESQ. Santa Fe, New Mexico 87501

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EXAMINER STOGNER: Call next case 10269, which is the application of Marathon Oil Company for a waterflood project and oil unorthodox injection well locations, Lea County, New Mexico.

Call for appearances.

MR. KELLAHIN: Mr. Examiner, I'm Tom Kellahin of the Santa Fe law firm of Kellahin, Kellahin & Aubrey appearing in association with Mr. Tom ~Laurey, an attorney with Marathon Oil Company, on behalf of the applicant, and we have two witnesses to be sworn.

EXAMINER STOGNER: Any additional appearances?

MR. CARR: May it please the examiner, my name is William F. Carr with the law firm Campbell & Black, P.A., of Santa Fe. I represent Arco Oil and Gas Company. I do not intend to call a witness.

EXAMINER STOGNER: Subsequent to this case being advertised, it was called to my attention that an additional area needed to be included, being the west half of Section 15.

Also, the injection interval will be changed to reflect 9,500 -- approximately 9,500 feet to -- 3,500 feet to 3,850 feet, and that will be readvertised for the April 18th, 1991, hearing, if -- I believe we'll be able to get everything through today.

Are there any other changes, Mr. Kellahin?

MR. KELLAHIN: Not that I'm aware of at this point, Mr. Examiner.

EXAMINER STOGNER: Thank you, Mr. Kellahin. You may proceed.

Oh, first I guess we need to swear the witnesses. Would you please stand?

(The witnesses were duly sworn.)

EXAMINER STOGNER: You may be seated.

Mr. Kellahin.

MR. KELLAHIN: Mr. Examiner, at this time I'd like to call Mr. Eric Carlson. Mr. Carlson is a geologist with Marathon.

ERIC D. CARLSON,

the Witness herein, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q. Mr. Carlson, for the record, would you please state your name and occupation?

A. My name is Eric D. Carlson. I'm a petroleum development geologist for Marathon Oil Company.

Q. On prior occasions have you testified as a geologist before the Oil Conservation Division, Mr. Carlson?

A. Yes, sir.

Q. And pursuant to your employment as a geologist, have you made a study of the geologic facts surrounding the McDonald State Lease Waterflood Project in Lea County, New Mexico?

A. Yes, sir.

Q. Have you completed that study at this point?

A. Yes.

Q. Based upon that study, have you been able to reach certain geologic conclusions about the feasibility of this particular lease area for a waterflood project?

A. Yes. This would be a near ideal place to put a waterflood in the Queen.

MR. KELLAHIN: At this time, Mr. Examiner, I would tender Mr. Carlson as an expert petroleum geologist.

EXAMINER STOGNER: Mr. Carlson is so qualified.

Q. (By Kellahin) Mr. Carlson, let me direct your attention, sir, to what we have marked as Exhibit No. 1.

MR. KELLAHIN: For your information, Mr. Stogner, we have given you an extra copy of an index map. It is unmarked. It will appear in a smaller size scale in the C-108 package. It's Exhibit 8 later on in the hearing.

I thought it might be useful to have that as a locator map for you while we look at Mr. Carlson's geology.

The first exhibit he has is a structure map on top of the Queen, and it's Exhibit No. 1.

EXAMINER STOGNER: Before we get started, I noticed there were several people that just came in. For you-all's benefit, we're going to hear the Marathon case, which we're on now, and the next case, 10270, which is the Oryx case, and then we're going to take a lunch, and we're going to reconvene here at one o'clock. So if anybody has any interest in any other case, you may take off for lunch.

I'm sorry, Mr. Kellahin. You may proceed.

Q. (By Kellahin) Mr. Carlson, would you identify in a general way the acreage that is to be subject to the Queen waterflood?

A. The acreage is located in Lea County about five or so miles southwest of the City of Eunice in Township 22 south, Range 36 east. The acreage is in Section 16.

Q. In addition, it would include in that same lease the acreage in the west half of Section 15 as well?

A. Yes.

Q. When we talk about the Queen, we are in fact talking about which pool?

A. We're talking about the South Eunice Pool.

Q. That's specifically identified as the South Eunice Seven Rivers Queen Pool, is it not?

A. Yes.

Q. To aid you in your geologic analysis of the feasibility of the waterflood of the Queen formation, did

you prepare a structure map?

A. Yes, I did.

Q. Is that what we are looking at as Exhibit No. 1?

A. Yes, sir.

Q. Describe what conclusions you reach from an examination of the structure on top of the Queen, Mr. Carlson, in aiding your ultimate conclusion about the feasibility of the waterflood project.

A. We find, looking at the Exhibit No. 1, that the structure across the lease is almost flat. We see a maximum two-degree dip only across the area to be water-flooded, so we conclude that structure will not have a large impact on this waterflood.

Q. Let's turn now, sir, to Exhibit No. 2. I direct your attention first of all to the locator map. Show us the line of cross section that you've used for the wells in the display.

A. In Exhibit 2 the line of cross section runs north to south, from left to right, from Section 4 in Township 22 south, Range 36 east, to a log from our lease in Section 16 to Section 20 and then on down to Section 34 of the same township.

Q. When we look at any one of the logs on the cross section that you choose to utilize, show us what is the top of the pool and what is the base of the pool.

A. The top of the pool is defined as 100 feet above the top of the Queen formation, so if I were to direct your attention to the Sun Della Boren No. 4, Section 20 -- it's the third one on the cross section -- we'll see that you can just barely make out that the top of the pool is at the top of the log.

The base of the pool is the top of the Grayburg formation, which is also shown on the cross section at the base of these logs.

Q. On your locator map you have shaded in different colors certain areas on the locator map.

A. Yes.

Q. What's that significance?

A. These different colors show other floods of this pool that have been done so far. We have Marathon's flood shown there. In the southeast corner of the township adjacent and to the west of the Marathon flood is an Arco-operated flood. To the northwest of the Arco flood, the Conoco flood. Marathon's proposed flood will be in yellow in Section 16, and then the Chevron flood in red.

And the important thing to note is that for all intents and purposes these floods are all in the same type of Queen sands. They are all pretty much along what we'd call as geologists "depositional strike."

Q. Have the other flood projects been successful in

their attempts to introduce water into the Queen formation to aid in secondary recovery?

A. Yes.

Q. Specifically when you look at the log on the Marathon McDonald State 129 well, describe for us the anticipated Queen members, if you will, that will be exposed to the flood.

You have separated them out into two?

A. Yes, sir. I have separated them into the Upper Queen and Lower Queen sands. We chose the 129 log as the type log because it is one with an open-hole, gamma-ray neutron-density log so that we can take a look and see the various lithologies.

First of all, the Upper Queen sand package located below the top of the Queen -- we find that this cross section -- in fact, it's datum is the base of the Upper Queen sands. We -- this is a time line, if you will, stratigraphic time line, and so we can take a look at this, hang it on this time line and get a look for the depositional types for these sands.

What we find with the Upper Queen sand, as we look across this eight-mile swath, is that the Upper Queen sand is very continuous. And you'll see, for instance, that the Upper Queen sand -- the characteristics has a rather high gamma-ray response due to the fact that it is a

dirty sand, and we also see that it has a neutron-density porosity in excess of 12 percent.

So we can look -- and we can look within the zone marked "Floodable Upper Queen Sand," and we see, especially on the 129, looking south, especially to the Della Boren No. 4, and on to the 77, that for the most part this is a continuous, single, depositional event.

If we look at the Lower Queen sands, on the other hand, this is a package of less continuous sands. We see several dolomite breaks between these sands, and so they are slightly less continuous than the Upper Queen sand.

Q. Describe for us whether or not in your opinion the base of the pool, being the top of the Grayburg, serves as an useful base for the flood interval that would be subject to the secondary recovery project.

A. I believe it's a useful base. However, we have no plans to inject in the Penrose at this time.

Q. When we look at the base of the Queen, then, the balance of the pool going down, what is the next productive formation of hydrocarbons as we move below the base of the Queen within Section 16 in the west half of 15?

A. The next productive formation is the strawn portion of Langley D Field located -- the very southwest tip of Section 16 probably extends into that pool.

So that is 9,000 feet measured depth, so you're looking at approximately a mile below this injection program.

Q. Is there any hydrocarbon production in the Grayburg within the area to be exposed by the waterflood?

A. No.

Q. Is that formation hydrocarbon-bearing, or does it contain other fluids?

A. Within Section 16 that formation is not hydrocarbon-bearing.

Q. When we look at the top, then, of the flood, you are proposing to use a top of the Queen as the top interval, then, within the pool that's exposed to the waterflood?

A. Yes, sir.

Q. When we go above the top of the Queen, what is the next formation we find that's going to be productive of hydrocarbons?

A. The lower Seven Rivers formation is part of the Jalmat Pool, which produces gas.

MR. KELLAHIN: We'll get to a later display, Mr. Examiner, that deals with the Jalmat Gas wells that are in the immediate area.

Q. (By Kellahin) Let me turn your attention now, Mr. Carlson, to Exhibit No. 3. Identify and describe

Exhibit 3 for us, Mr. Carlson.

A. Exhibit No. 3 is a net sand map for the Upper Queen sand. We call it the floodable pay map. This represents the thickness of Upper Queen sand which is contiguous and therefore will be floodable. It's one event, and what this map shows us is in a three-dimensional perspective what we've already seen on the cross section.

The Upper Queen sand, a single, depositional event, is a series of tidal ridges that are oriented more or less east-west. The sand is continuous across the lease, and we are in a depositional setting that is a shallow shelf depositional setting. The actual coastline at this time was located three miles to the east. And in that coastline you can see beaches that are oriented north-south, but here we're westward of the coastline in the Permian Sea. We're in very shallow water, and we see the effect of the tides as Permian time moving us an east-west orientation to this sand bar.

Q. Have you examined the logs of the wells that will be involved in the Section 16, west half 15, waterflood project?

A. Yes, I have.

Q. Are you able to conclude, Mr. Carlson, that based upon your log correlation of those wells that you have a sand member that has sufficient continuity from well

to well to give you the ability to flood that formation?

A. Yes. This Upper Queen sand is sufficiently continuous to flood adequately.

Q. Let's direct your attention now to the Lower Queen sand, and in doing so let me ask to you identify and describe Exhibit 4.

A. Exhibit No. 4 is a summed net sand map for the several stringers as defined in the Lower Queen sands as defined in the exhibit that was the cross section, Exhibit No. 2.

So in Exhibit No. 4 we once again see a three-dimensional view of the sum net sand. What we find is that when we start looking at the several events that form the Lower Queen sand, the influence of structure starts playing a larger role when you sum each of these sands up. For instance, looking in the section of -- the center of Section 16, we see well No. 10 is 13 net feet of Lower Queen sand. But if you look approximately 1,500 feet northwest of that, you will see the well No. 1 east saw 44 feet.

Now, the No. 10 well only saw a couple sands that were clean enough that we could actually sum them into this display, whereas the well to the northwest saw six or seven sands. This is because, due to the pathimetry of the time as a result of this structure, we were able to pawn

sands in front of that structure on the seaward side.

Even this notwithstanding, we see that there is continuity across this lease in the Lower Queen sands. We can't find a specific single member that would be present in every well, but there are always some members present in each well. So we feel that once again, if we get to a tight enough spacing, we can effectively flood this interval as well.

Q. Let me direct your attention now to Exhibit No. 5, Mr. Carlson.

Let's go back and talk about the geologic relationship of the Queen oil wells and the Jalmat gas wells before the Queen oil wells. For example, let's take this log as a type log, if you will, and tell us what well you've taken it from.

A. This well is located from the McDonald State Well 15, which is located in the northwest quarter of the southwest quarter of Section 15. It is adjacent to Section 16.

Q. This is Arco's Jalmat gas well for which they've expressed concern to us as a company about the waterflood project?

A. Yes, sir. And what we have here is for you a lithologic description from a core. This well was a core test, so we were able to recover the rock back in 1930.

When the well was drilled, it was cored.

So we look at this and we see first of all the top of the Queen formation located at approximately 3,715 feet. We see once again below that the floodable Upper Queen and the Lower Queen sands, and if you look at the lithologic description, you see they are predominantly sandy members.

If you look above the Queen 100 feet, we see the top of the South Eunice Pool. This is not a stratigraphic time line, but rather defined by statute.

Above that we see several sands in the Lower Seven Rivers formation that are productive of gas in the Jalmat Pool.

Q. Let's take a moment and find, then, where would be the approximate perforations in the Arco Jalmat gas well in the Lower Seven Rivers?

Do they currently produce any of these gas zones?

A. Yes, they do. They produce from the zone located approximately 3,490 feet deep.

Q. Have they attempted to complete in or produce any gas stringers above the top of the pool, the South Eunice Queen Pool, but below the current perforations?

A. I believe Mr. Bush would be better able to answer that question.

Q. Let me ask you this question: If we're attempting to confine flood fluids to the top of the Queen and avoid potential impact on any of the Jalmat gas stringers, whether currently produced or not, in the Arco well, geologically can we maintain that separation?

A. Yes. If we look in the interval between the top of the Queen and the top of the South Eunice Pool, we see that in addition to the dolomite, which is impermeable, there are several shales as well described in that core, and so we believe that there is a very effective seal between the top of the Queen and the South Eunice Pool.

Q. Geologically, could we propogate fractures even above the top of the Queen and keep ourselves away from interfering with the Jalmat gas pool?

A. It would be extremely unlikely to propogate a fracture 80 or 90 or 100 feet from the top of the Queen into the South Eunice Pool because we have changes in lithology. The dolomite, the sand and the shale all have different properties, so it's unlikely that a fracture would propagate that high.

Q. Are you satisfied as a geologist that there is adequate vertical separation and isolation of the proposed flood interval from any hydrocarbon-bearing interval above or below the flood interval?

A. Yes.

Q. Have you also determined whether or not there is any hydrologic connection or geologic faulting, other features that might communicate the flood formation with any fresh-water sands?

A. Yes. There is no faulting in the immediate area.

MR. KELLAHIN: That concludes my examination of Mr. Carlson. We move the introduction of his Exhibits 1 through 5.

EXAMINER STOGNER: Exhibits 1 through 5 will be admitted into evidence.

(Whereupon Applicant's Exhibits 1 through 5 were admitted into evidence.)

EXAMINATION

BY EXAMINER STOGNER:

Q. As I look at your Exhibit No. 2 -- I want to make sure I got the interval right -- the squiggly line designating, I guess, the top of the Queen --

A. Yes, sir.

Q. -- that will be from that line to the Lower Queen sands interval? That's your proposed injection interval, or does it extend into that Lower Seven Rivers?

A. No. We're planning, sir, to confine at the present time our injection to the intervals marked "Floodable Uppeer Queen Sand" and "Lower Queen Sands" in

cross hatch on the exhibit.

Q. Now, on your proposed injection intervals in your proposed -- and you may not be the one to ask this question to. Well, I guess you are -- will these perforations be separated where indeed they will be going into the Upper Queen and to the Lower Queen?

And then you have a blank space between the two. I assume that's a shale zone.

A. Sir, if I may direct your attention to the McDonald State No. 129 log, you will see that the log is a density neutron log. The neutron porosity is on the left of the -- of -- excuse me. The gamma ray is on the left of the depth track. The neutron density is on the right.

And we can see from the spread, if you will, between the two curves, the separation of the neutron and density curves, that indeed the interval between the floodable Upper Queen and the Lower Queen sands is a dolomite. The -- most of the interval is not sand pay here. It's dolomite pay -- or, excuse me, is dolomite trap rock, not productive.

Q. But even so, in both the upper and the lower, are you going after a few stringers?

A. Well, the upper sand -- once again, we believe that we are going after that sand that is continuous in a vertical sense or contiguous, as we'd say, and so we think

the Upper Queen sand is basically one sand through there. Okay?

The Lower Queen sands, on the other hand, is a series of stringers.

Q. Can I see these stringers, or are they --

A. Yes, sir.

Q. On the Exhibit No. 2?

A. Yes, sir. The Lower Queen sand -- once again, the sands in here are -- typical for the Queen sands, are relatively high-gamma-ray response, and a neutron density excursion -- for the most part in the No. 129 well the neutron density reading of those sands is in excess of 15 percent.

And the facies in between it is a dolomite. These dolomite facies show a density reading approximately a minus -- oh, it looks like about a minus six percent dolomite reading and about a positive four percent neutron reading, giving us a cross-plot porosity of near zero porosity for the dolomite facies between these sands.

Q. Generally how many sand stringers are we talking about in the lower?

A. I've mapped those separately. They vary between approximately three and seven on the lease.

Q. When they extend into seven of these stringers, do you see them in the thicker part, or is it widespread

throughout the whole interval?

I'm looking at your Exhibit No. 4.

A. No. 4? Generally speaking, where there is more net sand, summed net sand, there are more stringers. I have all these maps available, or I can submit them later, to show you the number of sands mapped -- the map of the number sands. I call it a "pay continuity map."

Q. I don't think that will be necessary at this time. I was just trying to get a little more in-depth detail, but I don't think we really need to go into that much detail with exhibits. In fact, I'm through with that question, anyway. We'll go on to something else now.

The information on Exhibit No. 5 -- that was your core?

A. Yes, sir.

Q. This well was cored when? In 1930, you say?

A. Yes, sir.

Q. Was that original Ohio Oil Company oil?

A. Yes, sir.

Q. That's the reason you've still got the log. The cores, I assume.

When I look at the core in the Lower Queen sands again -- I'll get off of this, I promise -- how many of these sand stringers do we see in here?

A. I would have to refer to my map and exhibit,

but -- to be exactly sure, but it looks like there are probably three in this particular one. There's undoubtedly a stringer from 37 -- looks like about 77 to 3,794, maybe. And then there's probably a stringer right around 3,800 that the core describer, Mr. Kaney at the time, said, "Well, the interval between 3,795 and 3,806, that's mostly dolomite, but a little sand. So there is probably a little stringer in there."

And then from 3,808 to 3,818 there's another stringer there, so my best guess at this time would be that that's three sand stringers in that well.

Q. How does the deposition of the Lower Queen differ from the Upper Queen?

You said the Upper Queen laid offshore about three miles at one point in your testimony. What are we looking at in the Lower Queen?

A. As far as we can tell, the Lower Queen was also about three miles offshore, and the difference is probably just a -- the amount of sand that was present in the system at the time.

Of course the top of the Queen is now recognized across southeast New Mexico as an unconformity that's due to a sea-level low stand. So we're looking at just prior to that sea-level low stand, these would have been deposited during sea level still stands, so we're looking

at systems that would have had variable amounts of potentially wind-blown sand into the system, depending on minor climatic fluctuations during that sea-level high stand.

So there wouldn't have been much of a change of environment. The only difference might have been the availability of sand into the system to give you different thicknesses of sands.

Q. How about the grains between the upper and the lower?

A. The grains all show the typical Queen assemblage of fine-grain sands between 62 and 125 microns in combination with silts between 37 microns and 62 microns, pretty much -- some people call it a siltstone because of that high silt content. We like to think of it as a fine-grained sand with a large silt fraction.

EXAMINER STOGNER: I have no other questions of this witness at this time, Mr. Kellahin.

MR. KELLAHIN: Let me follow up on one point, Mr. Examiner.

EXAMINER STOGNER: Okay.

RE-DIRECT EXAMINATION

BY MR. KELLAHIN:

Q. We specifically discussed the Arco Jalmat Gas Well No. 15 and our proposal to not inject fluids above the

top of the Queen in proximity to that gas well, but as we move away from that gas well, are there hydrocarbon potential oil stringers in the pool above the top of the Queen and below the top of the pool as identified?

A. There is hydrocarbon potential in the Lower Seven Rivers formation in -- that is above the top of the Queen. I draw your attention particularly to, once again, either -- well, let's look at Exhibit 5, and we'll see at 3,680 there is a clastic, if you will, between these dolomite members. This is a pretty darn silty sand here, the Lower Seven Rivers A.

I could show you on another log, for instance, on the Exhibit No. 2, that that sand actually develops on our lease into a potentially produceable hydrocarbon-bearing sand.

Q. While the Queen may represent your primary flood target, are you also seeking in this application the flexibility to include those stringers in the Seven Rivers that remain confined to your pool as part of your approval of the waterflood project area?

A. Yes.

Q. So when we look at this core, you would be seeking approval -- well, I'm sorry. That's not a good example.

We need to find the footage interval on the type

well that shows us the 3,500 feet down to 3,850 or something approximately like that?

A. Yes, sir. If I could bring your attention again to Exhibit No. 2, the McDonald State No. 129, the second well from the left, we can actually see in the faint strawn at -- let's see -- 3,662 feet measured depth, the Lower Seven Rivers A sand, if we look at it, we'll see a neutron-density porosity -- it looks to be approximately 12 percent. We'll see a high-gamma-ray excursion in that interval -- looks to be approximately six feet of sand in that interval. This is an example.

Q. So you're seeking authority from the examiner to include those intervals in the Lower Seven Rivers above the top of the Queen but still remaining confined to the South Eunice Pool for potential inclusion into the waterflood project?

A. Yes, sir.

MR. KELLAHIN: That completes my examination of Mr. Carlson.

EXAMINER STOGNER: Thank you, Mr. Kellahin.

SCOTT BUSH,

the Witness herein, having been first duly sworn, was examined and testified as follows:

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DIRECT EXAMINATION

BY MR. KELLAHIN:

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

A. Scott Bush, reservoir engineer with Marathon Oil Company in Midland, Texas.

Q. Mr. Bush, on a prior occasion have you testified before the division as an engineer?

A. No, sir, I haven't.

Q. Summarize for us your educational background.

A. I graduated in May of 1982 with a bachelor of science degree in petroleum engineering from Marietta College. Upon graduation I began employment with Marathon as a reservoir engineer in their Shreveport office. I was there for approximately two years before transferring to the -- what's considered the Yates Engineering Group as a production engineer.

In 1989 I transferred down to what we consider our mid-continent region engineering as a reservoir engineer and have been there since that time.

Q. As part of your engineering duties for your company, have you made a study of the feasibility of water-flooding the McDonald State lease in the South Eunice Pool in Lea County, New Mexico?

A. Yes, sir, I have.

Q. Have you completed that study?

A. Yes, sir.

MR. KELLAHIN: We tender Mr. Bush as an expert petroleum engineer.

EXAMINER STOGNER: Mr. Bush is so qualified.

Q. (By Kellahin) Mr. Bush, I think it might be helpful to start off with the locator plat that shows the area involved, and let me share one of those with you.

One of your first responsibilities, I assume, was to determine whether or not this particular lease area could be subject to successful waterflood operations in this particular pool?

A. That's correct.

Q. At the time you began your study, how many producing wells remain producing out of this pool within the lease?

A. At this time we began our study of the area, we had approximately five wells that were currently producing.

Q. What was their total oil cumulative production on a daily basis?

A. At that time, approximately 20 barrels a day.

Q. Summarize for us the background of the pool in terms of its primary production.

A. The pool was -- within this area was originally developed beginning in 1930 with Ohio Oil Company's Well

No. -- McDonald's State account, well No. 1, and that is currently the Arco 15 well that has just previously been discussed.

Between 1930 and up to the present time, if I could refer to Exhibit 6, a production decline curve for the lease, you can see we didn't -- we do not have individual yearly production from 1930. However, this graph represents the decline in production over time to the present day. This graph represents production from 17 wells from the South Eunice Queen Pool within the lease at various times.

Q. In making your projections about the feasibility for secondary recovery operations for this lease, did you make a comparison to the ability of other operators to recover secondary oil from this pool for their projects?

A. Yes, sir.

Q. Where did you look?

A. Basically we used as our example the three waterfloods to the south: the Conoco, Arco and Marathon floods. Initially our review consisted of determining the primary production from our lease in the Section 16 area. This data revealed approximately 2.1 million barrels of oil recovered.

When we went in and did some volumetric work, we found this to be approximately ten percent of original oil

in place, which was very similar to that obtained in the three waterfloods currently on line.

Q. What is your best engineering judgment as to the level of secondary oil to be recovered from the lease area?

A. At the present time we're anticipating approximately 1.4 million barrels of oil recovery, and this equates to a rough estimate of a one-to-one secondary-to-primary ratio within the immediate area to be affected by the flood. This compares to a secondary-to-primary ratio of 1.0 that was found in the Marathon and Arco units and a secondary to primary of .9 which was found in the Conoco unit.

Q. In your opinion, is that substantial secondary oil reserves that can be recovered from this lease to an economic benefit for all the interest owners?

A. Yes, sir.

Q. Let me have you identify without describing in detail what is shown on Exhibit No. 7.

A. Exhibit 7 basically is a step-by-step analysis of the -- or a step by step of the analysis we undertook to determine the feasibility of water-flooding the subject acreage, beginning with our initial waterflood review, continuing on to our initial estimation of reserves, and then finally in Part C the optimization that we undertook to maximize profitability from our waterflood.

Also shown on Section D is the scope of the project, the work that we plan on doing in order to -- to initiate secondary recovery.

Q. Let's talk about the plan of operation to institute the waterflood, and again you might want to go back to the index display that shows the configuration of the producers and the injectors and shows the lease.

What's the plan of operation? What pattern will you utilize?

A. We'll be using the basic five-spot pattern. This will be -- the five-spot patterns will be 40-acre, five-spot patterns.

Q. When you look at the injector wells, are you going to convert any current well to injection, or will these be newly drilled injection wells?

A. All injection wells will be new-drilled wells.

Q. From Mr. Carlson's testimony it's apparent that geologically the waterflood project is not constrained to its lease boundaries. How will you as an engineer satisfy yourself that you do not have lease hydrocarbons being forced off the lease?

A. As shown -- what is not shown on the C-108 exhibit are the locations of our proposed producing wells. We plan on -- in addition to the wells that are shown on this plat, we also plan on drilling two wells to the north

of injectors 40 and 41, which will prevent the movement of oil off the lease to the north.

To the south we plan on re-entering well Nos. 4 and 7, currently shown as P and A wells.

Q. If Mr. Stogner is looking at the index map, he will see some squares.

A. Okay. I'm sorry.

Q. All right. If he's looking at the squares, those are the new producers that you're discussing now?

A. That's correct. That's correct. And then in addition, as I mentioned, 4 and 7 will be reactivated to producing status to prevent moving oil off of our lease to the south.

Q. The twelve injectors are shown as new-well injector wells? The new producers are identified with the open squares?

A. That's correct.

Q. The current producers shown will be continued to be used as producers?

A. Yes, sir.

Q. How will you satisfy yourself on the western boundary that you are not adversely impacting the correlative rights of any of the owners that do not share in your lease production?

A. The -- located to the west we will have Wells 1,

2, 3 and 4 which will be active producers. In addition, that entire section over there within the Queen Seven Rivers Pool is a one hundred percent Marathon acreage.

Q. When you look at the location of the injectors on the western boundary, what will you do to satisfy yourself that you're not prematurely adversely affecting hydrocarbon production by another operator with your injector well?

A. We currently have under review for our management lease line injection agreements on water injection wells No. 37 and 43, and once we have approval and once we get those in the correct -- in the form that we are satisfied with, we will be getting those out to Conoco and Wiser Oil Company for their review and approval.

Q. There is a 40-acre tract -- is it Maxwell?

A. Yes, sir.

Q. The Maxwell tract that is shown on the display being in the --

A. North.

Q. Yes, the northeast of the northwest, that 40-acre tract?

A. Yes, sir.

Q. Describe that tract for us.

Who's the operator?

A. That is a Marathon-operated tract that is owned

one hundred percent by Marathon Oil.

Q. When we look at the McDonald lease, which comprises substantially the rest of Section 16 and the west half of 15, who is the operator and working interest owner for that lease?

A. That is also Marathon Oil, and that is a one-hundred-percent-Marathon-operated lease.

Q. Do you see any inequities in establishing the injector in proximity to the Maxwell lease?

A. No, sir.

Q. In fact, the Maxwell lease royalty owners will benefit by that injector as well as the McDonald royalty lease owners, right?

A. Yes, sir.

Q. When we go to the subject of the Jalmat gas well --

A. Yes.

Q. -- let's look at the Jalmat gas well which is shown as the Arco Well 15 in the southwest quarter of Section 15.

A. That's correct.

Q. Arco has expressed to you their concern about the utilization of which injectors in proximity to their Jalmat gas well?

A. They have expressed concern on Wells 33, 34, and

also Well No. 40.

Q. Identify for the examiner their other Jalmat gas well in that section.

A. Their other Jalmat gas well is located in Section 15 in the northwest quarter. That's Well No. 23.

Q. Have Marathon and Arco reached a letter agreement satisfactory to both companies for the utilization of those injectors so that they don't serve as a source of interference with the Jalmat gas wells?

A. Yes, sir, we have.

Q. Without going into great detail, summarize for the examiner what your proposal is to avoid interference with the Jalmat gas well.

A. Our basic proposal will be that in Wells 33, 34 and 40 we will limit our injection interval to the Queen formation. We will not perforate the Lower Seven Rivers, and we believe that that should insure that we will not put -- we will in no way harm their Jalmat gas wells inadvertently.

Q. In addition, at the time those injectors are completed and tested for injection, will you run any tests to satisfy yourself that you're not propagating fractures up into the Jalmat gas pool?

A. Yes, sir. We plan on running step-rate tests, injectivity profiles and cement -- we will also run CBLs to

determine the extent of cement behind pipe to insure that we're not going to be putting any water up into the Jalmat.

MR. KELLAHIN: Mr. Examiner, we propose to submit to you a draft order that specifically addresses the solution that Arco and Marathon propose for your approval with regards to those three injectors.

EXAMINER STOGNER: And those being No. 40, 34 and 33; is that correct?

THE WITNESS: Yes, sir.

MR. KELLAHIN: Yes, sir.

EXAMINER STOGNER: Thank you, Mr. Kellahin.

Q. (By Kellahin) Let's turn now to the subject of the C-108 that's identified as Exhibit No. 8, Mr. Bush, and within Exhibit 8, then, I have numbered each of the individual pages. Let me have you turn, first of all, to page 2.

How have you demonstrated to the examiner the half-mile radius of review?

A. We took -- it is shown here as a dashed line around the Section 16 area.

Q. You simply squared it off, if you will?

A. Yes, sir. We squared off the half-mile radiuses around each injector.

Q. When we look at that area of review, did you examine any plugged and abandoned wells and all producing

wells to determine their integrity?

A. Yes, sir, I did.

Q. In making your review, how many plugged and abandoned wells did you find within that area?

A. Two.

Q. Of the producing wells, have you provided a tabulation to the examiner of all that well bore data?

A. Yes, sir, I have. It's attached.

Q. You have twelve injectors proposed. Did you give the examiner a type example of a schematic showing the method for completion of the well?

A. Yes, sir, and that is shown on page 7 of the exhibit.

Q. All right. Let's turn back to page 6, first of all.

A. Okay.

Q. Does page 6 list all the proposed injectors and their actual footage locations?

A. Yes, sir, it does.

Q. Then we get to page 7. Describe for us -- I assume this is to be a generic display for all twelve?

A. Yes, sir.

Q. Describe for us the typical example and then give us instances where you might have variations.

A. The basic well configuration will include

setting a conductor string and also the proposed surface casing. The surface casing will be set below the Ogalala, as identified from discussions we've had with the state engineering office in Roswell, to be at 216 feet.

As you can see, our proposed surface casing will be approximately 450 feet with cement circulating to the surface. Our production casing will also have cement circulated to the surface set at at a TD of approximately 3,900 feet, which will be through the bottom of the Queen interval.

We will then come in and complete the well with perforations within the Queen intervals identified by Mr. Carlson previously.

Q. Your actual perforated interval may vary within this general range of 3,500 feet to 3,850?

A. Yes, sir, that's correct.

Q. But if the examiner approves that as an interval, then, to be utilized in the waterflood, is that broad enough to include all the potential perforations you'll need for the success of your project?

A. Yes, sir, we believe it is.

Q. What else?

A. We will run in with our injection tubing, which will be -- we will inject below a packer. We will monitor the back side for communication and possible leaks, and at

that point we will commence injection into the well.

Q. What is to be the source of the water for injection?

A. Our current plans are to use water supplied by the Jal -- Texaco's Jal water supply system, which is Capitan Reef water. This water is also being used within the Arco, Marathon and Conoco units to the south as makeup water.

Once --

Q. Are you aware of any of those operators having difficulty with the compatibility of that source water with the formation?

A. No, sir, I'm not.

Q. Are they having any operational difficulties with their injector wells?

A. Not that I'm aware of.

Q. Any variations in this type example, then, among the twelve wells as you've proposed now?

A. Approximately the only difference would be in the three wells we've previously discussed, which will be limited at all times to the Queen.

Q. Let's turn to the plugged and abandoned wells schematic. The first one is this McDonald State AC No. 1, 4 Well, in Section 16?

A. Yes, sir, it is.

EXAMINER STOGNER: Which page, Mr. Kellahin?

MR. KELLAHIN: I have page 8.

EXAMINER STOGNER: Okay.

Q. (By Kellahin) Are you satisfied that that well is properly plugged and abandoned, Mr. Bush?

A. Yes, sir, I am.

Q. Let's turn now to page 9, and that's the McDonald State No. 7 Well in Unit O of Section 16?

A. Yes, sir.

Q. Are you also satisfied that that well is properly plugged and abandoned?

A. Yes, sir, I am.

Q. Let's turn now to your tabulation of the information for the producer wells that either produce from or penetrate through the proposed flood interval.

In making your examination of the area of review, other than the Jalmat gas wells that you've already discussed, do you see any potential problems for the waterflood with any of these other producing wells?

A. No, sir, I don't.

Q. You said yesterday, in looking at the area of review in reviewing the tabulation, that there is in fact one example that requires further explanation to satisfy the examiner that you have isolation between the flood formation and the producing formation in that well. I

think it was the Conoco No. 14 well.

A. Yes, sir. That would be the Conoco State E No. 14.

Q. Where is that well located?

A. That's in Section 17 in the northeast -- or, excuse me, the southeast quarter of the section.

EXAMINER STOGNER: What page are you on, Mr. Kellahin?

MR. KELLAHIN: I don't have a specific page.

THE WITNESS: I believe that's page 14.

EXAMINER STOGNER: 14, and we're talking about the Conoco --

THE WITNESS: State E 14 in the lower --

EXAMINER STOGNER: The one on the bottom?

THE WITNESS: Yes, sir.

Q. (By Kellahin) It's the last entry on the page?

A. Yes.

Q. Looking at that tabulation and having found it on the display, what's your concern about the tabulated information?

A. When we first went in -- and we calculated our cement top within this well using a formula of assuming class C cement with a 50 percent safety factor in there, and when we calculated the top of that cement, we obtained a depth of 3,537 feet to the top of cement.

If you look in certain wells to the east, you

would find that it is potential that that could be on the borderline between the Jalmat and the top of the Seven Rivers Queen Pool. Upon review of the log of Well No. 14, however, it's found that the top of the Seven Rivers Queen Pool is located approximately 30 feet below the top of that calculated cement top.

Q. Mr. Bush, let me show you what's marked as Exhibit No. 10. Is that a copy of the log to which you've just made reference?

A. Yes, sir, it is.

Q. Turn to the second page, then, and describe again for the examiner what has satisfied you that this is not a problem well.

A. As you can see from the log, the top of the Queen has been identified as approximately 3,661 feet.

Q. That's penciled in here?

A. Yes, sir.

Q. It says -- I'm sorry, 3,561?

A. Excuse me, 3661. And that's the top of the Queen formation.

Q. Oh, all right. I'm with you. Go ahead.

A. As defining the Seven Rivers Queen Pool, the top of the pool extends a hundred feet above the top of the Queen to a depth of 3,561 as marked on the log at that depth.

Q. Okay. Where is your cement going to be?

A. Approximately 3,537. And as you can see, we have approximately 23 feet or so above the top of the Seven Rivers Queen Pool.

Q. Have you satisfied yourself, then, that there will be adequate separation between the Conoco well and the waterflood project?

A. Yes, sir, because in addition to the cement we will also have two producing wells between this well and offset injectors.

Q. What does that tell you?

A. That any fluid that might be moving through the Seven Rivers at that point will be produced out of those two wells.

Q. Other than those, have you found any other problem wells within the area of review?

A. No, sir, I haven't.

Q. Have you either calculated or shown measured tops for the cement for each of the wells?

A. Yes, sir, I have.

Q. Do you see any amendments or corrections to make to that portion of the display?

A. No, I don't.

Q. You said earlier that you had contacted the Roswell office of the state engineers to determine the

information they had available for fresh-water sources.

A. That's correct.

Q. Have you shown on the index map what their files report to be the location of fresh-water wells?

A. Yes, sir, we have.

Q. How are those shown?

A. Those would be shown as water injection well symbols with open -- as you can see, one in Section 16, in the northeast section there.

Q. In Unit B of 16 there's a fresh-water well?

A. Yes. And then also down in Section 22, that would be Unit I, I believe.

Q. Okay. Were those the only two that you found?

A. Yes, sir.

Q. What is the deepest reported producing zone for a fresh-water well in this area?

A. 216 feet, and that would be the Ogalala.

Q. Have you satisfied yourself that all of the wells to be included in the waterflood project have adequate cement from the surface down through the lowest known producing fresh-water sand to isolate those wells from the fresh water?

A. Yes, sir, I have.

Q. Do you have water samples for the wells?

A. Yes, we do.

Q. Are those shown?

A. Those would be shown on page 19. The North Ranch water well would be the well located in Section 16. The South Ranch water well would be the one located in Section 22.

Q. What are the water analyses we see on pages 17 and 18?

A. Page 17 is a sample of produced water taken from the lease, from one of our heater treaters. The sample No. 2, raw water, is the anticipated injection water, the Jal water supply system, obtained from Texaco.

Turning over to page 18, you can see mixing samples that we had Morton Water Lab do for us to insure that we weren't going to have any compatibility problems with these waters.

And we mixed them on three different ratios, and based on these results and the results that we have seen within our own unit, we don't feel that there's going to be any compatibility problems with these two waters.

Q. Approximately what would be the surface limitation pressure if you abided by the division guideline of two-tenths pounds per foot of depth?

A. That would be an injection gradient of approximately 650 -- or, excuse me, .65 psi per foot or approximately 700 to to 750 pounds surface pressure.

Q. Your original application requested a surface pressure in excess of that volume, did it not, or that pressure?

A. Yes, sir, it did.

Q. And you at this point are not asking to have that exception?

A. No, sir. We believe that initially the .2 psi per foot based on our -- on the data available within the depleted wells, that the .2 psi per foot will be adequate for our initial injection records.

Q. Are you recommending or suggesting to the examiner the inclusion of administrative process to increase your pressure based on step-rate data?

A. Yes, sir, we are. We've seen within our Seven Rivers Queen unit an increase in pressure over time with the increase in reservoir pressure, and we fully expect to see this within our -- within our Section 16 area.

And for that reason we are requesting that we be allowed to run step-rate tests at various times to determine the optimum -- or to determine fracture -- parting pressures so that we can remain above the -- or, excuse me, below that and yet still maximize injection into our project.

MR. KELLAHIN: That concludes my examination of Mr. Bush.

Exhibit No. 9, Mr. Examiner, is the certificate of mailing. The addresses for all those parties are shown as an attachment to the C-108. They appear on pages 3 and 4 of Exhibit No. 8, and then the return receipt cards are attached to Exhibit No. 9.

We would at this time, Mr. Examiner, move the introduction of Exhibits 6 through 10.

EXAMINER STOGNER: Exhibits 6 through 10 will be admitted into evidence.

(Whereupon Applicant's Exhibits 6 through 10 were admitted into evidence.)

EXAMINATION

BY EXAMINER STOGNER:

Q. Mr. Bush, you mention that at this time Marathon is working for a lease line injection agreement with Wiser Oil and Conoco; is that correct?

A. Yes, sir.

Q. When do you expect that?

A. We hope to have that ready to be mailed by the end of this month.

EXAMINER STOGNER: Mr. Kellahin, do you see any problem about limiting authorization for injection in those two or -- yeah, those two particular wells, being 43 and 37, until such time as the injection lease line injector agreements are signed?

MR. KELLAHIN: No, sir. We would request that that be included in the order.

EXAMINER STOGNER: And you're going to provide me a rough draft?

MR. KELLAHIN: Yes, sir.

EXAMINER STOGNER: And you're going to include that in there? .

MR. KELLAHIN: Yes, sir.

Q. (By Examiner Stogner) Have you discussed with the state land office -- since this is state land and you've got a lease line injector between the Maxwell lease and the McDonald State lease, has that entered any conversations with the state Land Office?

A. We have -- as you can see by the attachment, we've forwarded a copy of the C-108 to the state.

We've also provided the state Land Office with a brief summary of the scope of our project as well as several of the isopach and structure -- the -- I believe we supplied the structure map as well as the two isopach maps, the upper and Lower Queen sections.

At this point we have not heard or received any correspondence from them in regard to the project. We mailed that out approximately, I believe it was, about a week after we sent out the C-108s.

Q. I'm still a little confused as far as the

injection interval. I guess I misinterpreted Mr. Carlson's testimony that this was going to be limited to the Queen anyway.

A. Okay.

Q. You want to elaborate?

A. Yes, sir. What we're requesting is the ability to inject water within the entire Seven Rivers Queen Pool. However, initially we're going to concentrate our efforts on the Queen formation because we believe that's where the bulk of the oil production lies.

Now, within Section -- now, within Wells 33, 34 and 40 we have the letter that says we will limit ourselves to the Queen. The reason we -- even though we don't intend to inject into the Seven Rivers initially, we do have some core data that suggests the Seven Rivers to be oil productive and to have flood potential. And once our flood is up and running at a later date, we fully intend to go in and do some Seven Rivers Queen test flooding to determine if there is any economic potential up there.

Q. In looking at pages 8 and 9 of your well data sheets of the two plugged and abandoned wells, was any of the 7-inch casing retrieved?

A. No, sir, it wasn't.

Q. In either one of them?

A. No, neither one.

Q. Have you done calculations on what top of cements would be for the 403 -- 600 sacks of cement behind the 7-inch?

A. No, sir, I hadn't because when we initially P-and-A'ed the wells we went in and perforated the 7-inch and circulated or -- and circulated cement behind pipe, I believe.

Q. At a depth of 3,615 in the No. 4?

A. That was at 950 -- or we perfed it at a thousand feet in No. 4 and then set a cast-iron retainer at 951 and then cemented with 200 sacks, getting returns to the surface.

EXAMINER STOGNER: I don't have any other questions of this witness, Mr. Kellahin.

Does anybody else have anything for this witness? If not, he may be excused.

Mr. Kellahin, do you have anything else further in this case?

MR. KELLAHIN: That concludes our presentation.

EXAMINER STOGNER: As was stated earlier, this case will be readvertised for the April 18th, 1991, hearing. I don't believe there will be any need for additional testimony at that time, and you will provide me by that time with a rough draft order; is that correct?

MR. KELLAHIN: Yes.

EXAMINER STOGNER: In that case, we will adjourn that particular case.

(The foregoing hearing was concluded at the approximate hour of 12:05 p.m.)

* * *

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 10269, heard by me on 21 March 1991.

Michael E. Stogner, Examiner
Oil Conservation Division

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

REPORTER'S CERTIFICATE

I, PAULA WEGEFORTH, a Certified Court Reporter and Notary Public, DO HEREBY CERTIFY that I stenographically reported these 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 hereof.

DATED at Santa Fe, New Mexico, this 9th day of April, 1991.

Paula Wegeforth

PAULA WEGEFORTH
Certified Court Reporter
CSR No. 264, Notary Public

My Commission Expires:
September 27, 1993