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PUBLIC HEARING
STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

Pecos Hall, 1st Floor, Wendell Chino Building
1220 S. Saint Francis Drive
Santa Fe, New Mexico

TRANSCRIPT OF PROCEEDINGS
April 22, 2025
VOLUME XIII

HEARD BEFORE:

HEARING OFFICER RIPLEY HARWOOD

COMMISSION MEMBERS:

GERASIMOS ROZATOS, Chair

BAYLEN LAMKIN, Member

DR. WILLIAM AMPOMAH, Member

COUNSEL TO THE COMMISSION:

MR. ZACHARY SHANDLER, ESQ.

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1 (On the record at 9:00 a.m.)

2 TRANSCRIPT OF PROCEEDINGS

3 CHAIR ROZATOS: Good morning, everybody. My
4 name is Gerasimos Rozatos. I am the acting director
5 for the Oil Conservation Division. I am also the
6 acting chair for the Oil Conservation Commission.
7 Today is April the 22nd. We are in our continuation
8 for the consolidated cases by Goodnight Midstream and
9 Empire New Mexico. This is a hearing that we are
10 continuing, an evidentiary hearing. This is for Case
11 Numbers 24123, 23614 through 17, Case Number 23775,
12 and also Case Number 24018 through 24020, and 24025.

13 Before I transfer it over to the hearing
14 officer, Mr. Hearing Officer, I wanted to bring up a
15 scheduling issue that we're going to have for Friday.
16 We do need to finish kind of early. I and the actual
17 other two commissioners do have to be done by
18 3:00 p.m., so if we could wrap it up by 2:45 on
19 Friday.

20 At the pace we're going, we're going to
21 need that third week that we had planned in May. So
22 obviously things will probably go out through to
23 then. So if we can make sure that we're done by 2:45
24 on Friday, that we can accommodate Commissioner
25 Ampomah, Acting Commissioner Lamkin and my schedule

1 as well.

2 HEARING OFFICER HARWOOD: All right.
3 Perfect. Chairman Rozatos, I'll be sure to set the
4 duck for 2:45.

5 CHAIR ROZATOS: Excellent. I appreciate
6 that.

7 The other thing that I wanted to mention
8 and this kind of what I reiterated yesterday, and I
9 have reiterated this multiple times in this setting,
10 things are getting heated, people, and we need
11 decorum. Whether it's witness responding to
12 attorneys, attorneys responding to witnesses, witness
13 responding commissioners, commissioners responding to
14 the witness, we need decorum in here.

15 The Hearing Officer is purposely set
16 here to make sure that things are functioning
17 appropriately. We need to give him all due respect.
18 If there are objections, we stop dead in our tracks.
19 Do not try to answer. Let the objection be heard,
20 let the objection be ruled upon, then a statement can
21 be made. This is normal etiquette. If this was a
22 district court, some of these shenanigans would not
23 have been accepted, and we all know this.

24 So, witnesses, make sure that you're
25 following with decorum. Attorneys, make sure you

1 have the decorum and respect for the hearing officer.
2 And everybody make sure that this is a respectful
3 setting.

4 I have said this multiple times and I'm
5 actually kind of getting tired of saying it. So
6 please make sure that you're following through with
7 this. This is for everybody. This disrespect is not
8 going to be tolerated. So please make sure that you
9 continue it.

10 And if I have to shut it down, we will
11 shut it down for the day. But it will be because of
12 your guys' respect. So please make sure that you're
13 following through with this.

14 I'm off my soapbox. Mr. Hearing
15 Officer, I transfer it over back to you.

16 HEARING OFFICER HARWOOD: I'll try and --
17 you know, I know some of this is inadvertent. It
18 happens when witnesses understand what the question
19 is going to be, and lawyers want to ignore the answer
20 and move on to the next question. So I understand
21 how that works. It's not always intentional. So
22 I'll try and keep a closer eye out for that.

23 Before we proceed, let me just make sure
24 we have a court reporter online and we're on the
25 record.

1 CHAIR ROZATOS: Mr. Hearing Officer, I just
2 wanted to add, Mr. Shandler also will be joining via
3 us via Teams today and for the rest of the week.

4 HEARING OFFICER HARWOOD: Thank you,
5 Mr. Rozatos.

6 Okay. I don't see a witness. Where is
7 our witness, Mr. Rankin?

8 MR. RANKIN: Mr. Hearing Officer, good
9 morning. Adam Rankin with Holland & Hart appearing
10 for Goodnight Midstream in this case.

11 As we broke for the day yesterday,
12 Dr. Davidson had completed his cross-examination by
13 the parties and the Commission. And the question was
14 whether or not Goodnight was going to bring him back
15 for redirect. And upon evaluating the questions
16 pending -- or that had been addressed, we decided not
17 to bring Dr. Davidson back for redirect.

18 So with that, Mr. Hearing Officer, we
19 would ask that he be excused.

20 HEARING OFFICER HARWOOD: Okay. I
21 appreciate that. I didn't mean to be flip yesterday
22 at the end of the day when I suggested that he had
23 said everything he possibly could have on the
24 subject. I think he has and did. So I appreciate
25 the judgment call. I do see him in the back, I see

1 your witness, Dr. Davidson, in the back of the room
2 now.

3 MR. RANKIN: He's here. On that point,
4 Mr. Hearing Officer, if the commissioners have any
5 additional questions for Dr. Davidson before we move
6 on, happy to allow them to ask additional questions
7 of Dr. Davidson.

8 One point of order that I do want to
9 just point out, Commissioner Lamkin did ask a
10 question about whether Dr. Davidson had additional
11 analyses reflecting his petrophysical interpretation.
12 I can just point those out to Commissioner Lamkin and
13 he can identify them in the record, if that's
14 acceptable.

15 Dr. Davidson did include additional
16 petrophysical analyses in his direct testimony,
17 attached as Exhibit B, and those are all the --
18 there's, I believe, a total of seven EMSU wells, and
19 one of Goodnight Midstream's injection wells within
20 the unit.

21 And then in his rebuttal testimony,
22 Exhibit D-7, has an additional saltwater disposal
23 well operated by Goodnight. So I think there's a
24 total of nine petrophysical analyses included in his
25 direct testimony and his rebuttal testimony.

1 HEARING OFFICER HARWOOD: Mr. Lamkin, is
2 that helpful to you?

3 COMMISSIONER LAMKIN: That is. Thank you
4 very much.

5 HEARING OFFICER HARWOOD: All right. To
6 follow up on Mr. Rankin's offer, do either of you
7 gentleman have additional questions or you, Chairman
8 Rozatos, for Dr. Davidson?

9 CHAIR ROZATOS: I'll start off. I do not.

10 COMMISSIONER AMPOMAH: No, I do not.

11 COMMISSIONER LAMKIN: I don't either.

12 HEARING OFFICER HARWOOD: Before we move on
13 to your next witness, overnight I was thinking about
14 this. And for the record, as well as for the benefit
15 of the parties, I want to -- it was late in the
16 afternoon, my brain was tired. I have to listen to
17 every question throughout the day. So toward the end
18 of the day, this issue came up with Dr. Davidson's
19 opinion in connection with Mr. Moander's
20 cross-examination.

21 And I just want for the record and for
22 the benefit of the parties, although you all are
23 sophisticated players, so this is more for the record
24 than anything else, but I wanted to make sure that my
25 ruling was clear on that. I did not actually grant

1 Mr. Moander's motion to exclude that testimony.

2 If that testimony were presented in a
3 court of law, it likely would have been excluded
4 because only expert witnesses can offer opinion
5 testimony. It's beside the point, really, that this
6 was an undisclosed opinion because this was a
7 question that was asked and answered.

8 But the point is, it was an opinion that
9 only an expert could offer, and Dr. Davidson
10 explained that he was not an expert in that subject
11 matter. So in a court of law, that testimony would
12 have been excluded and a jury would have been
13 instructed to disregard the testimony.

14 Of course, this is not a court of law,
15 and the rules of evidence do not technically and
16 strictly apply. They're just for guidance here. And
17 that's for a good reason. I mean, this particular
18 setting exemplifies the reason that there is a
19 relaxed standard. We're not here with a jury of
20 unsophisticated laypersons listening to sophisticated
21 experts where there's a risk of being misled. Not
22 that I'm suggesting that Dr. Davidson was in any way
23 attempting to do that. But the risk is not present
24 in a situation where you have sophisticated
25 fact-finders that are experts in their own right,

1 either in the a specific field or a closely related
2 field. The risk is simply not there.

3 So those were the bases for my decision
4 to not grant Mr. Moander's motion and simply allow
5 the Commission, under the guidance of Mr. Shandler,
6 to give that opinion such weight, if any, that they
7 thought it might deserve.

8 All right. Anyway, that said,
9 Mr. Rankin, who is your next witness?

10 MR. RANKIN: Mr. Hearing Officer, our next
11 witness I'd like to call to the stand is Mr. William
12 Knights.

13 HEARING OFFICER HARWOOD: I've seen you in
14 the back of the room for a long time, Mr. Knights.
15 Good to put a face to a name.

16 WILLIAM J. KNIGHTS,
17 having first been duly sworn, testified as follows:

18 DIRECT EXAMINATION

19 BY MR. RANKIN:

20 Q. Mr. Knights, will you please state your name
21 for the record.

22 A. William J. Knights.

23 Q. By whom are you employed?

24 A. Netherland, Sewell & Associates. And I'm
25 senior technical advisor, vice president.

1 Q. And what is your role in that capacity with
2 Netherland, Sewell?

3 A. Basically due diligence on financial
4 transactions, SEC reportings, signing reserve reports
5 and evaluating financial transactions.

6 Q. And you do that based on a geologic
7 analysis; is that right?

8 A. Yes. I'm primarily a geologist, but I've
9 been there 35 years and worked with engineers closely
10 for that entire time.

11 Q. Have you testified before the Commission?

12 A. No, I have not.

13 Q. Are you seeking to be qualified as an expert
14 in petroleum geology?

15 A. I don't like to -- yes, I think so.

16 Q. Okay. And is your curriculum vitae, your
17 resume, attached as Appendix A to direct written
18 testimony?

19 A. Yes, it is.

20 Q. Because you haven't yet testified before the
21 Commission, Mr. Knights, and just to give a little
22 background for the Commission to understand your
23 experience, will you just give a brief summary of your
24 education first.

25 A. A master's degree in geology from Texas

1 Christian University in Fort Worth. And basically
2 experience in the industry since 1983.

3 Q. So I'll move on to your experience now. So
4 when did you obtain your master degree from TCU?

5 A. 1983.

6 Q. So with respect specifically to your
7 experience around the Central Basin Platform and the
8 Permian Basin, if you would, just give us a brief
9 summary of your experience as a petroleum geologist;
10 in particular, as it relates to conducting geologic
11 evaluations and reserve assessments for fields in and
12 around the Central Basin Platform.

13 A. I think the largest project I've worked on
14 was the Altura acquisition, which was the acquisition
15 of BP and Shell's CO2 projects in the Central Basin
16 Platform at Title 23 fields, including the Hobbs
17 North, South, Seminole, Wasson, Goldsmith. I think
18 those were mentioned in this hearing. Then 18 other
19 fields.

20 Q. All around the Central Basin Platform?

21 A. All in the Central Basin Platform and CO2
22 projects.

23 Q. And what exactly were you tasked with doing
24 as part of your job responsibility?

25 A. It was basically due diligence, screening

1 the oil in place, recovery factors, things that go
2 into the reservoir model, things that influence the
3 financial transaction. A lot of it had to do with
4 depth volumes curve, where the oil in place is, and
5 reviewing the geologic inputs to the models.

6 Q. So do you have experience evaluating ROZ
7 projects?

8 A. Every oil project I have has a component of
9 ROZ.

10 Q. And as to this case, what were you asked to
11 do in this case?

12 A. Review the geology, specifically relating to
13 oil in place. And then also the communication between
14 the injection zone and the shallower reservoirs.

15 Q. And as part of that assessment, were you
16 asked to evaluate whether or not there's any potential
17 communication between Goodnight's injection disposal
18 zone and the overlying zones within the EMSU?

19 A. Yes. That was part of my task.

20 Q. And have you conducted, therefore, a
21 geological study of the history of oil and water
22 production in and around the EMSU?

23 A. Yes, I have.

24 Q. And that would be both from the Grayburg and
25 San Andres formations?

1 A. Correct.

2 Q. Did your analysis also include the
3 determination of whether there's any potentially
4 economically recoverable hydrocarbons in an ROZ within
5 the EMSU?

6 A. Yes.

7 Q. What did you look at to come to your
8 opinions?

9 A. All the data provided by Empire, Goodnight,
10 and some individual research, as I always do, through
11 all the public data and literature.

12 Q. So you looked at data that was provided by
13 Empire as part of this case?

14 A. Yes.

15 Q. And data that was provided by Goodnight as
16 part of this case?

17 A. Correct.

18 Q. Did you also construct your own
19 investigation looking through public records?

20 A. Correct. Yes.

21 Q. And as a result of your analysis, did you
22 prepare a written direct rebuttal and surrebuttal
23 testimony and exhibits that are marked as Exhibit E
24 that provide your opinions and analyses?

25 A. Yes, I did.

1 Q. Now, before I go any further, you did
2 prepare a revised direct testimony that was filed with
3 the Commission, correct?

4 A. Yes, I did.

5 Q. Will you let us know what it was that you
6 revised in that direct testimony?

7 A. It was a mathematical error in the
8 calculation of hydrocarbon pore volume.

9 Q. And what was the error there?

10 A. The intervals were based on half foot, and I
11 summed them up instead of taking the .5 foot. So it
12 was a significant mathematical error that we
13 corrected.

14 Q. And in addition to the mathematical error
15 that you made in your direct testimony, was there
16 another revision that you made in your direct
17 testimony?

18 A. Yes. I changed a cutoff, which changed some
19 numbers to more reflect the 20 percent cutoff that
20 Melzer and Trentham defined as the ROZ.

21 Q. So originally you had used 30 percent as
22 your cutoff?

23 A. Yes.

24 Q. Can you explain why it is that you initially
25 used 30 percent and why you revised -- why you

1 originally used 30 percent and why you revised it to
2 20 percent?

3 A. Generally, I like to use a higher cutoff to
4 kind of get a higher quality rock, an idea of kind of
5 a sensitivity analysis. But then I realized that in
6 this setting, being more conforming to all the other
7 processes makes it easier to relate one oil in place
8 to the other.

9 Q. So that was based on the testimony of
10 Dr. Trentham and Mr. Melzer, correct?

11 A. Yes, correct.

12 Q. Now, you also prepared revised surrebuttal
13 testimony that was in response to Ops Geologic
14 rebuttal testimony that was filed with the Commission,
15 correct?

16 A. Correct.

17 Q. What were the revisions that you made on
18 that revised surrebuttal?

19 A. There's a 16,000-foot -- 16,000 number that
20 should have been 19,000. And so I updated that.

21 Q. That was the only correction you made to
22 that revised testimony?

23 A. Correct.

24 Q. Were there exhibits and figures included in
25 your revised direct rebuttal and revised surrebuttal

1 testimony prepared by you and compiled on your
2 direction and supervision?

3 A. Yes.

4 Q. Any additional corrections or changes to the
5 testimony, figures or exhibits that were filed with
6 the Commission?

7 A. No.

8 Q. Do you adopt the testimony in the
9 self-affirmed direct written rebuttal and revised
10 surrebuttal testimony that's marked as Exhibit E as
11 your sworn testimony?

12 A. Yes, I do.

13 MR. RANKIN: Mr. Hearing Officer, I would
14 tender Mr. Knights as an expert witness in petroleum
15 geology.

16 HEARING OFFICER HARWOOD: Any objection from
17 Empire?

18 MR. WEHMEYER: Without objection.

19 HEARING OFFICER HARWOOD: OCD?

20 MR. MOANDER: No objection.

21 HEARING OFFICER HARWOOD: Rice?

22 MR. BECK: No objection.

23 HEARING OFFICER HARWOOD: Pilot?

24 MR. SUAZO: No objection.

25 HEARING OFFICER HARWOOD: He'll be so

1 recognized.

2 MR. RANKIN: Mr. Hearing Officer, I, at this
3 time, move the admission of Mr. Knights' revised
4 direct testimony, his rebuttal testimony and revised
5 surrebuttal testimony and his attached exhibits and
6 figures that are all marked as Exhibit E.

7 HEARING OFFICER HARWOOD: Any objection
8 Empire?

9 MR. WEHMEYER: Without objection.

10 HEARING OFFICER HARWOOD: OCD?

11 MR. MOANDER: No objection.

12 HEARING OFFICER HARWOOD: Rice?

13 MR. BECK: No objection.

14 HEARING OFFICER HARWOOD: Pilot?

15 MR. SUAZO: No objection.

16 HEARING OFFICER HARWOOD: They'll be
17 admitted.

18 (Admitted: Goodnight Midstream
19 Exhibit E.)

20 BY MR. RANKIN:

21 Q. Mr. Knights, have you been present for or
22 did you listen to the summary testimony, the
23 cross-examination, redirect testimony provided by all
24 the witnesses that were presented during the first and
25 second week of the testimony in this proceeding?

1 A. Yes.

2 Q. And you were here for the testimony
3 yesterday, correct?

4 A. Correct.

5 Q. And did you prepare a summary of slides
6 reflecting your up-to-date opinions based upon
7 observing the testimony, the questions and the
8 redirect, over the course of this proceeding?

9 A. Yes.

10 Q. Okay. So I'll go ahead and share my screen,
11 Mr. Knights. And we'll walk through your slides.
12 I'll ask you a question to prompt, and if you would
13 just explain at high level the key takeaways of how
14 each of these slides reflect your summary opinions for
15 the benefit of the Commission.

16 So this first slide, Number 1, if you
17 would just explain what the star is on why this is
18 significant in terms of your overall analysis.

19 A. It's kind of a big picture of the San Andres
20 and Grayburg fields in the Central Basin Platform in
21 New Mexico. And basically shows that south of the
22 EMSU, there's very little production.

23 Q. And the yellow star indicates where the EMSU
24 is located?

25 A. Correct.

1 Q. How does this next slide here reflect on
2 the previous slide? And explain what this shows with
3 respect to the San Andres.

4 A. Well, the way the oil got into the
5 San Andres is typically industry standard, coming from
6 the Wolfcamp. So it's very complicated migration
7 pathways as the oil migrates into the San Andres and
8 Grayburg and the rest of Central Basin Platform.

9 The thing that's important about this is
10 that each of these occurrences is unique and very
11 difficult to use any one field as an analogy for
12 another directly.

13 Q. And this next slide, if you would just
14 explain how this particular slide reflects upon what
15 you just stated about, in your opinion, the unique
16 nature of each of these San Andres accumulations?

17 A. Since this trial does emphasize the
18 San Andres, I just broke out the fields that were
19 San Andres in the public data, showing those fields.
20 Basically showing that the east flank of the Central
21 Basin Platform has a high concentration of oil fields
22 that have an indication of that as a major migration
23 pathway and much fewer fields on the west flank where
24 the EMSU is located, showing that that was less of a
25 major migration pathway.

1 MR. RANKIN: Mr. Hearing Officer, I'm
2 hearing some backgrounds noise. It's distracting me
3 and it maybe distracting Mr. Knights and others.
4 Maybe we can figure out where that's coming from
5 before we go further.

6 (Pause in the proceedings.)

7 BY MR. RANKIN:

8 Q. So, Mr. Knights, I apologize because I was
9 being distracted by the sounds of that reverberation
10 or echo.

11 But maybe just quickly summarize what
12 you just said for my benefit, explain, if not anybody
13 else's. But explain how this slide is relevant to
14 what you just discussed about unique accumulations in
15 the San Andres across the basin.

16 A. This is restricted to the San Andres, and it
17 basically shows that the eastern part of the Central
18 Basin Platform is a major migration pathway, with all
19 the fields developed and a tremendous amount of oil.

20 And that the western side of the Central
21 Basin Platform was a less major migration pathway for
22 oil.

23 Q. And you indicated here the location of the
24 EMSU with the red star, correct?

25 A. Correct.

1 Q. That's on the western margin of the Central
2 Basin Platform, correct?

3 A. Correct.

4 Q. Okay. Moving on to the next slide here, I
5 think this is sort of a general depiction of something
6 we've seen many times already. But if you would, just
7 at a very high level, explain how this relates to the
8 previous three slides we just discussed.

9 A. This is Trentham and Melzer's model on those
10 migration pathways that show the Artesia pathway on
11 the western flank of the Central Basin Platform and
12 additional migration pathways on the east, so that
13 migration of fluid from the west to the east and then
14 from the north to the south.

15 And the lower picture shows the actual
16 pathway of the Artesia extending down south, and even
17 in this diagram, going all the way to the end of the
18 eastern part of the Central Basin Platform in the
19 Yates Field.

20 Q. What does this tell you about the size and
21 interconnectedness of the San Andres across this large
22 region?

23 A. This implies that it's a very, very large
24 aquifer that has tremendous pathways for fluid
25 migration.

1 Q. And tell me, just so I understand, and for
2 the benefit of the Commission, structurally, as you go
3 south, what is the relationship structurally as you go
4 from the EMSU to the south along the migration pathway
5 or that interconnected pathway?

6 A. For the EMSU, it's probably on a structural
7 high, and it goes down as you go to the south. When
8 you go further south to the Yates it gets very
9 structurally high. And as you go to the west -- I
10 mean, to the east, it also goes downdip.

11 Q. Now, zooming in a little bit here, explain
12 what this shows with respect to the specific
13 accumulations of oil in the San Andres within the --
14 across the Central Basin Platform and with the
15 significance of this chart that you've got here.

16 A. So on the far left, I have the EMSU in
17 yellow is the Grayburg production. So that's where
18 all the production is. The yellow bars below that are
19 the water supply wells that are all in the deeper part
20 of the San Andres.

21 But I was trying to get a regional
22 picture of what the San Andres looks like from a
23 standpoint. So when you go to the north, to the south
24 Hobbs fields, the dark lines that are on these are the
25 top and base of the Grayburg from public data and just

1 kind of a quick analysis. And the colored ones are
2 producing intervals that have been perfed in that
3 field.

4 And so what you see as you move to the
5 north and to the west, that there's different
6 stratigraphic intervals that are charged with oil in
7 each of these relative to the public Grayburg tops,
8 but kind of pointing out that each of these
9 accumulations is probably unique migration pathways
10 and would be difficult to use as a direct analogy for
11 the EMSU.

12 Q. You said north to the west, but did you mean
13 north to the east?

14 A. North to the east. Apologize.

15 Q. And is this reflective in your opinion,
16 Mr. Knights, of the unique migration pathways within
17 and across the San Andres for oil?

18 A. Yes, it is.

19 Q. Looking at this next slide, I think you're
20 zooming in here to the EMSU unit itself. Would you
21 explain what this shows and how it relates to what you
22 were just discussing about the migration pathways
23 across the Central Basin Platform in the San Andres?

24 A. Correct. This was a diagram I made up early
25 in the analysis, just trying to get my bearing on

1 where things were.

2 The green wells on the left are the
3 water supply wells that produce no oil. And you can
4 see that the upper perf in the 458 is maybe at 500
5 feet. So just a quick look says that's pretty much an
6 aquifer.

7 The actual producing interval in the
8 EMSU has an original oil-water contact between
9 negative 325 or negative 350. On this diagram I put
10 350 as the producing oil-water contact, which is in my
11 testimony.

12 All the wells that penetrated below the
13 producing oil-water contact and tested oil are
14 highlighted on this. The other thing that's
15 highlighted on this in the red squares were our
16 original eight wells that we did petrophysical
17 analysis that Jim Davidson had for a time.

18 All the wells in orange on the right are
19 water disposal wells, indicating to me that everything
20 below negative 500 is an aquifer and used for either
21 water supply or water disposal.

22 And the other thing to mention on this
23 slide is, when I go through my analysis, there's a lot
24 of discussion about San Andres nomenclature. I never
25 want to get into that quagmire. So I just used -- by

1 oil-in-place analysis was based on TVD subsea depths,
2 and those -- the three intervals that I've identified.
3 The interval between 350 feet, the producing oil-water
4 contact, and the highest water supply well is at 500.
5 I called that interval a "potential ROZ."

6 And the other big scoping picture is,
7 you know, of the 340, 380 million barrels of water
8 that have been produced below the oil-water contact.
9 There's only been 55 barrels of oil produced in all of
10 the tests. So that comes out to a water ratio of
11 99.99998 percent. So that kind of goes to my initial
12 look at the significance of the oil below the
13 oil-water contact. You know, first plunge direct
14 physical evidence, starting out with a very low
15 indication of any significance of oil.

16 Q. So just to be clear, everything below minus
17 350 is included on here that's tested?

18 A. Correct.

19 Q. And all of those tests have accumulated 55
20 barrels of oil?

21 A. Correct.

22 Q. And over 340 million barrels of water,
23 correct?

24 A. Correct.

25 Q. What's this next slide? And tell me a

1 little bit about what it shows and explain your
2 analysis here and how it relates to your opinion.

3 A. So one of the things on a due diligence that
4 you do is you look at any analyses provided and you
5 try to do a due diligence on does it make sense with
6 the actual physical data that you have.

7 I'm going to focus on just the Grayburg
8 interval, which is between negative 100 and negative
9 350, so that first green line. The three
10 petrophysical analyses here are the NuTech original,
11 the NuTech revised and NSAI's original oil in place.

12 Just to start out with, I looked at it
13 from a conventional basis. So I used a 40 percent oil
14 saturation cutoff for net pay, and I just took all the
15 data that was provided and said, okay, what is the net
16 pay? And the far column on the right is the oil net
17 pay. So the percentage of those net feet that net
18 that hurdle of 40 percent, porosity showed that in the
19 NuTech original, 69 percent of that would fit a
20 conventional oil.

21 So typically what you look for is a
22 relationship between that oil net pay and the
23 production. In NuTech's revised, they did not change
24 their methodology for the Grayburg. The reason
25 there's a number difference is because they had some

1 slight changes in their tops. And in the bottom, the
2 original NSAI model shows the same thing.

3 So if you look at the oil net pay, I
4 look at that 69 percent oil net pay, and that would
5 suggest that if everything was equal, they should have
6 a 69 percent oil cut in that area. The actual oil cut
7 in that area is 2 percent.

8 So one of the other significant things
9 about this is most of these wells in Jim's analysis
10 were done between 2002 and 2007. So this was probably
11 20 years after the water injection had occurred. So
12 the actual state of the reservoir at that time was
13 basically flushed from a waterflood with over 20
14 years, so it had a lot of fluid in there, a lot of oil
15 extracted, and the current oil cut was 2 percent.

16 So the petrophysical model concerned me
17 that these net pays in a water flush zone would
18 indicate that there's significantly high oil
19 saturations.

20 The revised has the same issue of very
21 high oil net pay versus the standard conventional
22 cutoffs. And when you looked at NSAI's original
23 thing, they also kind of overestimated the oil net pay
24 by this kind of ratio method with that. But they had
25 it down to 18 percent oil cut, and it was 2 percent.

1 So in all these cases, I don't see
2 anybody that has underestimated the oil that was in
3 place; all basically overestimating, some
4 dramatically.

5 Q. What is this analysis about the net pay in
6 the Grayburg in the producing zone, the main pay zone
7 of the EMSU, that NuTech's analyses show -- tell you
8 about the reliability of their analysis in the deeper
9 zones below minus 350 or below minus 500 feet?

10 A. Well, the concern is, if it doesn't relate
11 to the actual physical data that you have evidence for
12 when you're not calibrating to data, it's very
13 difficult to believe in its accuracy.

14 And the other thing about the original
15 NuTech model is that if you look down on the third
16 layer, which I've entitled a transition zone between
17 negative 500 and 700, that basically has a higher oil
18 net pay ratio than any of the zones above it.

19 So just looking at the oil net pay in
20 that interval, you would say that that is the best
21 zone to be producing from an oil-water contact. And
22 all of the tests that I have below the oil-water
23 contact suggests that there's very little, if any,
24 moveable hydrocarbons in that interval.

25 Q. Anything further on this slide, Mr. Knights?

1 A. I can talk for an hour on these slides.

2 Q. No, let not do that. We'll move on. So
3 that's sort of a general review.

4 A. Right.

5 Q. Because this was looking at all NuTech's
6 analyses. And this next slide here I think is a
7 specific well. And just touch on, if you would, the
8 key takeaway, because you're looking at a specific
9 well here, how this relates to your analysis regarding
10 NuTech.

11 A. Key takeaways, the producing oil-water
12 contact in 350 is on here, so they have a test above
13 it and a test below it. The actual recoveries are on
14 the far right. So above the oil-water contact, they
15 had about a 1.4 percent oil cut. But if you look at
16 the green shaded, there's a considerable net pay, over
17 40 percent oil saturation.

18 Once you go below the oil-water contact,
19 you still have NuTech's original significant portion
20 of well above 40 percent oil saturation. And even
21 their revised version, where they did change it, they
22 still had a good portion of section above 40 percent.

23 And if you look at NSAI's, again, Jim
24 has a few points. But if you look at the actual
25 recovery on a swab, there was 100 percent oil cut.

1 But I think another thing to point out
2 is, on ESP, which discussion residual oil, residual
3 oil is relative to the current reservoir conditions,
4 and ESP reduces the pressure at the wellbore. So that
5 would change the reservoir characteristics, and if
6 there was any residual oil there, you would expect it
7 to be mobile with an ESP, at least near wellbore.

8 And if you look at the recoveries, it's,
9 you know, two payrolls of oil out of 18,000, or .1
10 percent oil cut, indicating there's very little
11 conventional net pay and not a significant amount of
12 residual oil that's close to that.

13 Q. I think you said 18,000, but you meant 1800
14 barrels of water?

15 A. 1800 barrels, yes. Thank you.

16 Q. You indicated here that NuTech had a
17 San Andres top. Explain --

18 A. Yeah, you know, I tried to put some
19 reference on here, because almost everybody in this
20 thing talks about San Andres. And San Andres is very
21 large unit, and they basically talk about it as one
22 amalgamated consistent zone, and it is not.

23 But in this interval, the producing
24 oil-water contact at 350, you notice the top, or the
25 aquifer, as a couple feet below that. So, there's a

1 lot of discussion on, "Where did this San Andres come
2 from?" Well, based on how you pick the top, it's very
3 close to the producing oil-water contact. So you
4 wouldn't need much of anything to get some that have
5 water in.

6 The other thing that points here is
7 where the saturations reach zero, so those blue
8 highlighted lines, those would be permeability
9 barriers, in my estimation, where there's zero oil
10 saturation and low porosity and low permeability.

11 But it shows that even just below the
12 producing oil-water contact and within the Grayburg
13 above and just below this oil-water contact, there are
14 a significant number of these permeability barriers.

15 Q. Now, this next slide, this is another
16 overview. We're moving into I believe Ops Geologic
17 from NuTech. Explain how this relates to your
18 analysis or assessment, diligence assessment, of Ops
19 Geologic's petrophysical work.

20 A. So yes, this was the third and fourth
21 petrophysical analysis that we received. But, again,
22 comparing it to the data, comparing it to the
23 Netherland, Sewell analysis, I just focussed on the --
24 just to get it quickly over, the red in the bottom
25 that shows significant hydrocarbon saturations in the

1 high side, up to 70, 80 percent oil saturation. And
2 even in the low side, the Ops model shows up to
3 60 percent oil saturation. But if you go to the core
4 data, the direct physical evidence, there's no
5 fluorescence, no cut, and background gas is basically
6 background gas.

7 That interval combined in that whole
8 interval, you know, 3700 barrels of water and no oil,
9 indicates that, from a conventional standpoint, that
10 both Ops low side and high side are, I'd say,
11 optimistic.

12 Q. And what does this tell you, looking at the
13 direct evidence? What does this tell you about the
14 reliability of Ops Geologic's analysis?

15 A. That is a scenario. It's very optimistic
16 and, in my estimation, unrealistic.

17 Q. Next slide here, explain what this shows.
18 And this, again, is looking at the EMSU, a specific
19 well, the EMSU 679. Just hit as far as the takeaway
20 points that are important for the Commission to
21 understand here.

22 A. So due diligence, looking at the direct
23 physical evidence, on the right-hand side we have the
24 EMSU core data, and it's an oil saturation and
25 porosity. The main thing is, I look at, okay, here is

1 the actual hard physical data. What does the analysis
2 look like?

3 And if you go to the analysis on the
4 left side, there's a lot of similar situations that
5 don't exist in the core. So if you take just that
6 upper left-hand box, above the green arrow and left of
7 the dark line, you notice in the Ops model, we have a
8 lot of high oil saturations in these low porosity
9 intervals. Now, if you go back to the core data on
10 that same section, they don't exist in the core data.
11 And that's kind of consistent as you notice the
12 differences in the quadrants.

13 The other important thing here, I think,
14 is the aquifer, which I have defined as negative 700
15 and below. Those are highlighted in the dark blue.
16 Again, let's go to the core initially and we look at
17 core saturations in the deeper intervals. Very low
18 oil saturations.

19 Now you go to the log analysis on the
20 left side and you notice that there's significantly
21 higher oil saturations in the analysis that doesn't
22 correspond or contradicts the actual core data.

23 So, again, it kind of gives you the
24 concept that it's highly uncertain and really
25 unreasonable that the Ops Geologic saturations don't

1 match the actual physical data. So concerns in the
2 certainty of their analysis.

3 Q. Next slide here, I think this, again,
4 touches on Ops Geologic. If you would, just the key
5 takeaway here as Ops Geologic high and low scenarios
6 relate to your assessment of the direct evidence
7 available in the core.

8 A. So this was the low side. On the left-hand
9 side was the low side Ops model which, at least from
10 my understanding, used the core data, uncorrected core
11 data as their base. And they said they correlated to
12 the uncorrected and made their petrophysical analysis.

13 But when I look at the uncorrected
14 average core oil saturation, it's 14.86 percent. And
15 if I look at their analysis, it's 30.4, almost
16 100 percent higher than the average core uncorrected.
17 So the calibration there, from what I've read and
18 understand, I saw a big discrepancy there.

19 The other thing on the right-hand side
20 is a little different display. I had both their low
21 side and high side saturations. And this is for the
22 679 well that had core. And as you go down the area,
23 the red arrows are where Ops' is significantly higher
24 than the core data.

25 And the other thing to note on this is

1 that as you get down below, say, negative 650 or so,
2 there's a significant break-off in the core
3 saturations, and especially at negative 700. There's
4 very, very limited oil saturation in that interval.

5 Interestingly enough, in the Exxon sales
6 package, they had their limiting factor at the lowest
7 as a negative 700 as their estimate of their bottom of
8 the ROZ.

9 The other thing that's curious is, at
10 the bottom of the 679 core data, you see a core
11 analysis that is SCR, so it's solid -- SHR, solid
12 hydrocarbon residue. And Trentham in his papers
13 discusses that when you see solid hydrocarbons, that
14 an indication you're at the bottom of the ROZ. And
15 there's also another core sample that's up higher that
16 also has the SHR, solid hydrocarbon residue.

17 And so in these things, the other thing
18 that's interesting if you go in the lower part, you
19 see in the core a general decreasing in oil saturation
20 as you go from, say, that 600 to 700. And that's also
21 an indication that you're at the bottom of the ROZ or
22 potential ROZ, based on both Melzer and Trentham's
23 models.

24 Q. Anything more on this, Mr. Knights?

25 A. I could, but I...

1 Q. Okay. Next one, let's move on. This next
2 one, again, is looking at a specific well. And you
3 portrayed Ops Geologic's petrophysical analysis here
4 in a slightly different manner. Explain your key
5 takeaway here and how it relates to your assessment of
6 reliability and viability of Ops Geologic's analysis?

7 A. And this is another well that shows the
8 consistency in their petrophysical analysis, which I
9 always enjoy. But it does show higher oil saturations
10 in the lower porosity rock, preferably lower
11 permeability.

12 But the other thing it shows is that the
13 high porosity, high quality rock with high perm,
14 there's a significant amount of rock falling in there.
15 And I think this relates to potential recovery, that
16 if you were going to inject CO₂, if I was a CO₂
17 molecule, where would I go? I would go the high perm,
18 high porosity rock before I would migrate in the lower
19 perm, low porosity rock.

20 And I know typically in CO₂ recoveries,
21 you use a volume of CO₂ relative to the hydrocarbon
22 pore volume. But in these cases, with the incredible
23 amount of pore volume in the higher porosity, higher
24 perm, I think that may be underestimating the CO₂.
25 Because you'll probably need to fill up some of that

1 water wet hydrocarbon pore volume before you get the
2 CO2 to focus or be forced into the lower porosity,
3 lower perm areas.

4 Q. Your takeaway from this next slide,
5 Mr. Knights, as it relates to your discussions up to
6 date about porosity and cutoffs and Ops Geologic's
7 parameters?

8 A. Yeah, so Mr. Birkhead mentioned a number of
9 times in his testimony that he used a 2.9 grain
10 density for dolomite. And he basically came up with
11 that because I'm just assuming that all of these rocks
12 have 20 percent anhydrite in them.

13 And so 2.9 is above the standard 2.87
14 dolomite matrix. If you used a 2.87, then all of his
15 porosities would be reduced in the dolomite section by
16 1.5 percent.

17 But I point you to Exhibit A-5, the
18 Exxon, and you'll notice two things in this. They
19 used a 6 percent porosity cutoff, but they also used a
20 rogue density of 2.84 as a basic for their matrix.
21 That 2.84 is probably a 3 and a half percent porosity
22 drop, so if Mr. Birkhead would have used a 2.84, some
23 of his porosities would be reduced by three and a half
24 percent.

25 The Table B-1 and B-8 are the actual

1 core data from the 679 well. And if you look at the
2 core pieces that were just dolomite and didn't include
3 anything, the range was from 2.81 to 2.87. And so in
4 some of these areas where you had a dolomite that may
5 have been 2.82, you may have overestimated the
6 porosity by about 5 percent.

7 Q. And you've got an image here. What does
8 this show?

9 A. Those are just some of the rocks -- I'm a
10 geologist, I love rocks. So on the left-hand side,
11 you see the San Andres reservoir that had vugular
12 porosity, and it was filled with anhydrite. And so a
13 situation like that, if you used 2.9, you would create
14 porosity in the dolomite and you would have no
15 porosity in the anhydrite, when in both cases, it
16 could be zero percent porosity in both. But that's
17 the way that the secondary anhydrite can fill pore
18 throats and doesn't have to be at the surface.

19 And then the middle one is a 13 percent,
20 10 millidarcy San Andres rock that is fantastic. And
21 then the other is anhydrite, which is common in these
22 systems. But just a picture of the real rocks.

23 Q. Next slide here, this is moving off of the
24 petrophysical analysis and you're getting into your
25 barriers to waterflow. Explain, if you would,

1 Mr. Knights, starting at the top, what this shows and
2 where it came from and how it relates to your analysis
3 about edge water --

4 A. Migration path?

5 Q. Yeah.

6 A. So the upper is a cross-section. This is in
7 a 1939 paper. So these were freshly drilled wells; a
8 lot of people paying a lot of attention to it. They
9 broke up the reservoir into three packages, Zone A,
10 the deepest, that probably relates to Zone 5 and 6 in
11 Melzer -- I mean, in Lindsay's Zone B, which is
12 separated by a low perm interval, and then Zone C,
13 which is on the uppermost, is another flow pattern
14 that you would have migration up the lateral pathway
15 your fluid migration.

16 The other thing I've marked on here is
17 the estimated two original oil-water contacts at 325
18 and 350.

19 And the thing that's important on here
20 is noticing that Zone A goes below the oil-water
21 contact interior to the field. Zone B goes to the
22 oil-water contact slightly to the edges. And Zone C
23 kind of expands past the oil-water contacts, but
24 outside of the thing. So when you're looking at a
25 structure map of the top of the San Andres or the

1 Grayburg, that these structures change with depth.

2 Q. Next, talk about how that cross-section
3 relates to the next image below, how this relates to
4 your analysis. And what are you showing in the next
5 image in the same exhibit here?

6 A. So the simplest thing is to take the light
7 green bounded area that says "Area of Zone A Oil."
8 That is where the top of the Zone A goes below the
9 oil-water contact. And going to the next one outside,
10 the Zone B, that's where the Zone B goes below the
11 oil-water contacts.

12 But I think the most interesting thing
13 to me was, in 1939, these hatched areas are all where
14 they had water in the field, in the middle of the
15 field, in 1939. All these areas, if you look at this
16 model, it says there was water encroachment within the
17 field in 1934 that migrated in '35, '36, '37, all
18 showing that you had water movement and migration
19 that's entered the field.

20 MR. RANKIN: We may be having a microphone
21 malfunction. It's been worn out. Can we take a
22 quick break to see if it needs a new battery?

23 THE WITNESS: Was I just not close enough?

24 MR. RANKIN: Maybe, Mr. Knights, just make
25 sure you're close enough so that it's picking you up

1 without interference.

2 BY MR. RANKIN:

3 Q. I won't ask you to restate it, but just to
4 be clear, your testimony here is that what this early
5 paper was showing, it was showing edge water
6 encroachment in the middle of the field; is that
7 correct?

8 A. Yes. And it's documented in that 1939 paper
9 as "Edge Water Drive."

10 Q. In your opinion, Mr. Knights, does this edge
11 water drive that was documented back in the 1930s
12 explain the -- how does it relate to the arguments
13 that Empire is making about these bubble maps showing
14 unexplained water production across the field,
15 including on the highest structure area of the field?

16 A. Well, primarily, the preferred path of
17 migration along bedding planes, so along the
18 intervals, so if you looked at the A, B and C up on
19 top, that lateral migration along the permeability is
20 a preferred mechanism.

21 MR. RANKIN: How do you feel, Mr. Hearing
22 Officer, about the microphone?

23 HEARING OFFICER HARWOOD: I'm thinking there
24 is a battery issue. Maybe you could just swap out
25 with him and see if that improves it, Mr. Torgenson.

1 BY MR. RANKIN:

2 Q. So I think, Mr. Knights, you were explaining
3 that, in your opinion, that the perm barriers would
4 create preferential lateral pathways for edge water
5 encroachment up onto the structure; is that right?

6 A. Yes, correct. And, you know, even those
7 vertical perm barriers as Dr. McBeath was asking, in
8 the 211, over 30 or 40 feet, you have permeability
9 barriers that cause pressure separation from the
10 reservoirs, indicating that these horizontal bedding
11 planes, even though thin, could be very valid
12 permeability barriers.

13 So another thing that comes up when you
14 start talking about the migration paths along the
15 bedding planes, if you go to the 1998 Love paper, he
16 talks about conformance issues.

17 That conformance diagram that he used is
18 basically in the area on the crest of the structure
19 and they denoted that there were high perm streaks in
20 that interval along horizontal beds where water cycled
21 through the waterflood, and that they could cut those
22 off by putting cement and causing those high perm
23 streaks that were horizontal to be blocked off.

24 And that seems like a very simple
25 pathway to get water from the edge water either

1 downdip or near these water contacts to anyplace in
2 the actual field.

3 Q. How does that analysis relate, Mr. Knights,
4 to Dr. Buchwalter's model and analysis where he could
5 only find -- his only explanation for this water was
6 from the San Andres? Explain what could have been
7 differently in his model that could --

8 A. Well, the --

9 Q. -- using a varied structure to answer his
10 problem or address his dilemma.

11 A. Well, very simply, Buchwalter decided, how
12 do I get water to this well? Well, he put a vertical
13 fracture, like this, through the 82 horizontal
14 barriers to get the water there, when, if you look at
15 the 1998, a very simple explanation would be a small
16 high perm streak along a bedding plane that would
17 bring edge water drive to anywhere in the field.

18 Q. But he didn't do that in his model, did he?

19 A. No. And he also didn't incorporate any
20 geology, which I thought was -- since they had for
21 petrophysical analysis. None of the porosity perms or
22 oil in place were used in his model either.

23 Q. One other item here -- well, let me ask this
24 question. Based on your analysis of this edge water
25 drive and the structure and preferential pathways for

1 flow, is this sufficient to explain, in your opinion,
2 the water bubble maps from Mr. West's testimony
3 showing his testimony unexplained water production
4 around the EMSU?

5 A. I would say it's the more reasonable
6 assumption that that's how this water got into the
7 area.

8 Q. In fact, that was the determination back in
9 the '30s; is that right?

10 A. Correct.

11 Q. One other item here that we didn't address,
12 so I'd like you just to touch on. You called out
13 specifically the EMSU 239. Explain why you have that
14 called out here and how it relates to this overall
15 analysis.

16 A. Well, again, like any due diligence, what
17 you look for is anomalies in the data and you
18 investigate those.

19 So that really high water-contact bubble
20 was basically at the 239 well. And so I looked at
21 that well, and it was initially completed in the Queen
22 as a gas well and in the Upper San Andres as an oil
23 well. And that was completed in 1936 and made about
24 104 barrels a day. And then by 1959, it was down to
25 about 20 barrels a day. So that indicated that that

1 reservoir was actually depleting, so it isolated from
2 anything below it.

3 In 1973, they drilled that well down
4 below the oil-water contact. They did not have a
5 test. But that was 1973, and they perfed that
6 interval.

7 Then in 1981 is the next, really, data
8 point I have, is that map that shows that that well
9 had high water.

10 And so it just seems, besides my
11 original geology of I think the water came from edge
12 water through high perm streaks along bedding planes,
13 that even the wells that have high water could be
14 explained easily by drilling below the oil-water
15 contact.

16 The other thing about that oil-water
17 contact is that's the only oil-water contact at 350,
18 but in 1973, there had been a significant amount of
19 oil produced in all these zones. So that also could
20 impact the edge water drive coming in up above the
21 structure in the lower zone.

22 Love in the 1998 paper also mentions
23 edge water drive.

24 And so I think the explanations for the
25 higher water contact, using the simplest explanation,

1 is the bedding plane geology edge water drive.

2 Q. In your investigations, did you identify any
3 literature that identified -- that the explanation for
4 the water production in the EMSU was from San Andres
5 fractures coming up?

6 A. No, no. I saw no evidence of any fracture
7 communication.

8 Q. I think when you were talking about the 239,
9 I think you may have said that it was completed in the
10 upper San Andres. But it is a Grayburg well.

11 A. I mean, Grayburg.

12 Q. Okay.

13 A. I apologize. It's a Grayburg well. Thank
14 you for correcting that.

15 Q. Anything further on this slide, Mr. Knights?

16 A. No.

17 Q. Next slide here, if you would just touch on
18 the high points, the key takeaways here, and how it
19 relates to your assessment of the Ops Geologic
20 parameters in their analysis.

21 A. Well, Ops Geologic used a -- the only thing
22 they varied was the sensitivity and the oil
23 saturation. Typically in the oil industry, you use
24 permeability cutoffs to do a net pay sensitivity.

25 And so I just wanted to show on this

1 thing, if they had used a porosity or a permeability
2 to look at the sensitivity to their oil in place, that
3 would have been probably more valid.

4 The things I put on here are what they
5 used as a baffle cutoff of 1.5 percent porosity. And
6 then I also put on here their permeability models that
7 show it relates to an incredibly low permeability. So
8 the threshold for their perm barriers is unreasonable,
9 to me.

10 They used a 4 percent fee effective for
11 their actual cutoffs. And if you look at their perm,
12 that relates to a .005 and a .01 millidarcy, which is
13 relatively aggressive, since the typical oil industry
14 standard is for a gas reservoir of .1 millidarcy and
15 for an oil reservoir of 1 millidarcy.

16 I also put on here Jim Davidson's
17 7 percent fee effective using this model; that way at
18 least have some intervals from a conventional basis
19 above 1 millidarcy, probably a 50/50 cutoff, which is
20 a standard way of using the cutoff.

21 And then one thing I always like to look
22 at is what does a high quality reservoir look like,
23 how much of this reservoir is high quality. And at
24 10 percent, that would be most of the rock above
25 10 percent has a greater than 1 millidarcy

1 permeability.

2 Q. Using that assessments, Mr. Knights, what
3 does this tell you about Ops Geologic's --

4 A. So just, again, describing the reservoir as
5 a critical component, especially in a tertiary
6 recovery, so if you go from right to left, 31 percent
7 of this rock, using a 10 percent porosity cutoff, is
8 really high quality. So you have a third of the rock
9 is really high quality, high porosity, good perm. And
10 so that's where most of your recovery factor is going
11 to come from.

12 If you go down to the 7 percent, you
13 basically have another third of the reservoir that's
14 reasonably good reservoir, probably, you know, 50, 60
15 percent of it is going to be higher than 1 millidarcy,
16 50, 60 percent is going to be lower. But that portion
17 of your oil in place will be a lower recovery factor.

18 Now you go to Ops Geologic and you say,
19 okay, 4 percent porosity, what do we get? Well, we
20 get another third of the reservoir. So a third of the
21 reservoir is what I could would consider poor quality,
22 low permeability. But the Ops model, as we saw
23 previously, that's where most of their oil is in
24 place.

25 Q. Just to be clear, the color coding here

1 relates to your tiering across the EMSU, correct?

2 A. Yes. And basically, the ratios are
3 basically the same for each one of those. But the
4 green would be the producing Grayburg. The potential
5 ROZ would be from negative 350, the producing
6 oil-water contact down to 500. Negative 500, the
7 transition zone between 500 and 700. And the aquifer
8 is from negative 700 and below.

9 Q. And Goodnight's disposal operations are in
10 what you've identified as the aquifer, right, below
11 minus 700?

12 A. Correct. All their injection is below in
13 the aquifer.

14 Q. Just real quick, the key takeaways here,
15 discussing Ops Geologic's analysis and their, in your
16 opinion, unreasonable parameters, how does this relate
17 to your determination about barriers across the zone?

18 A. The little green bars on the left-hand side
19 and the -- you almost can't see them on right-hand
20 well, but there are, I think, two little baffles that
21 are identified using that 1.5 percent.

22 But if you just go in the 7 percent, or
23 even simpler, is if you look at Ops' permeability
24 model on the right-hand columns, those areas that do
25 not have any wiggles, that is below .2 millidarcies.

1 And if you use that .2 millidarcies, you have
2 significant perm barriers.

3 The back lines I estimated at about
4 7 percent porosity cutoff. And if you look at those
5 in the well to the right, you have probably a 50-foot
6 zone that's continuous low perm. And if you just
7 correlate that over to the well on the left, that
8 comes out to, I don't know, probably 100 feet of
9 continuous vertical low perm that would be a
10 significant perm barrier by any estimation. And if
11 you go up and down the well, you have a significant
12 number of these small perm barriers.

13 But, again, looking at the 211 well, you
14 only need a few feet of perm barrier to create
15 pressure isolation. But all of these intervals were
16 going to be tremendously impeding any potential
17 vertical flow through the intervals.

18 Q. And, again, you've got your tiering based on
19 mean sea level of right-hand side, right?

20 A. Correct. That's unambiguous depth rather
21 than an ambiguous nomenclature name.

22 Q. Next slide here, again, talking about perm
23 barriers and potential fracture pathways, what does
24 this next exhibit show -- slide show on --

25 A. So this is the RR Bell San Andres core. And

1 basically, you can read through, but there's a number
2 of those zones that are horizontal thin beds that are
3 very low permeability. There's one that's .3
4 millidarcy, .3, .1 millidarcy. All of those would be
5 significant barriers to vertical flow, and they are
6 along bedding planes.

7 And you can see the different colors of
8 the rocks. As you go up and down, each one of those
9 is a separate depositional environment that's a
10 bedding plane that goes across the EMSU. So
11 basically, horizontal layers that are sufficiently low
12 to be permeability barriers to vertical flow.

13 Q. Are you seeing any vertical fractures
14 indicated at this --

15 A. And I see no vertical fractures in this
16 section of this rock, which, in part, as far as I can
17 tell, is the only evidence indicating fractures. But
18 I don't see any in this well.

19 And then the extension of those
20 fractures through the Grayburg and through the
21 permeability zone are around Jim's high gamma ray
22 spike and his anhydrites. And then getting those down
23 to there, I don't see any evidence in this photo that
24 there's an extensive vertical fracture network.

25 Q. Continuing on your discussion and also this

1 is about vertical fractures here, and this is from the
2 core of the EMSU 679, I think this is from Empire's
3 exhibit, but you made some modifications to it,
4 explain to the Commission what you did here and how
5 this relates to your analysis about potential
6 fracturing and communication between the zones.

7 A. So the implication that fractures are going
8 to extend 300 to 400 feet down into the San Andres
9 using the 679 data, if you look at this one 8-foot
10 section of core, what you can see is that there are
11 fractures, but they're isolated to individual layers.

12 So you have a fractured interval, then
13 you go above and you see a non-stained, non-fractured
14 interval, then you see a stained interval, and then a
15 non-fractured stained interval. So none of these
16 fractures extend over a large vertical section.

17 The other thing in Lindsay's paper, if
18 you read it, it basically says that most of or
19 predominantly these fractures occur in karsted areas.
20 And these karsts are layers, so it's not a large karst
21 like Carlsbad Caverns. These are layers that are
22 bedded. And if those are fractured, that would also
23 indicate that you can have significant perm along a
24 karst, but it's going to be along a bedding plane that
25 would allow fluid to migrate along the bedding planes

1 up from the edge water drive or any other mechanism.

2 But the primary fluid migration pattern
3 is going to be along bedding planes, and that's just
4 standard geology.

5 Q. Moving on to -- well, I think this is
6 getting into the oil-in-place analysis or some more
7 discussion about Ops Geologic's assessment about the
8 potential for production here. What does this show?
9 And explain how it relates to your analysis.

10 A. There's a lot of discussion about
11 San Andres, San Andres water. So I just took the Ops'
12 San Andres structure map and on the right-hand side
13 labeled all the wells that have drilled below the
14 producing oil-water contact and into the San Andres.

15 And so I think there's nine wells that
16 are penetrated below the producing oil-water contact
17 and in the San Andres, by their definitions. There
18 are also a number of wells that are very close to the
19 producing oil-water contact.

20 And, again, this producing oil-water
21 contact was designated in 1939 or so. And so post
22 that drilling, there's been a significant amount of
23 extraction of oil which would have helped the edge
24 water migrate up along bedding planes into the center
25 of the thing.

1 The other thing this indicates is, and
2 goes for later on, is that we already have wells
3 penetrating into the San Andres, and if there was any
4 oil there, it would probably be already depleted.

5 Q. And, again, that's San Andres as defined by
6 Ops Geologic, right?

7 A. Yes.

8 Q. And that's above what Empire had identified
9 as its perm barrier, correct?

10 A. Correct.

11 Q. Next slide here, just at a high level, what
12 does this show and how does it relate to only
13 analysis?

14 A. Well, another thing that was brought up in
15 this thing was a recovery factor. And so Tall Cotton
16 is the only isolated CO2 recovery in an ROZ zone, so I
17 basically had to look at it.

18 Basically, my analysis, using just a
19 standard rate cum plot showed that there was 8 million
20 barrels of oil as my estimate at ultimate recovery.
21 The current recovery now is about 5 million barrels.

22 Q. Okay. And that's the basic gist of this
23 one, key takeaway?

24 A. Key takeaway, my estimate of 8 million
25 barrels is the recovery of the Tall Cotton complete at

1 ten-acre spacing.

2 Q. Next slide here, how does that relate to
3 this analysis of the Tall Cotton Field?

4 A. Well, the way to get to a recovery factor is
5 you've got to have an oil in place and a recovery. So
6 I've got a recovery at 8 million barrels. Now I need
7 to figure out what oil in place I'm going to use.

8 Basically, I came up with 126 million
9 barrels per section. And that EOR at ten-acre spacing
10 was 8 million, and you come up with a recovery factor
11 of 6 percent.

12 Q. Okay.

13 A. The other -- I'm sure people will ask me
14 questions about this.

15 Q. Well, if there's something you feel is
16 important so say, you know...

17 A. Well, it's just that the Tall Cotton, even
18 though it's a lesser quality rock than most of the
19 other CO2 floods that I've reviewed, the EMSU is
20 significantly less quality rock with respect to
21 porosity, oil saturation in the cores and net to gross
22 than that Tall Cotton.

23 So my estimate is that, you know, a
24 range between 1 and 6 percent recovery factor would be
25 reasonable, using the Tall Cotton as an analogy and

1 using Ops' net pay cutoffs as a standard.

2 Q. Next slide here, explain how this relates to
3 your economic analysis of potential recovery in the
4 EMSU, based on Ops Geologic's petrophysics.

5 A. So this is Ops Geologic low side cases. I
6 used their low side case because I thought the high
7 side case was unreasonable and not of expectations.

8 But what it does show is that there is a
9 concentration of oil in place, basically just in the
10 crest. So identified by about three or four wells.

11 The Upper San Andres, which has already
12 been penetrated and produced, in that core area of
13 about four sections, they have about 10 million
14 barrels of oil per section. And 10 million barrels at
15 ten acres comes out to about 156,000 barrels. And I
16 just did, okay, on a per well basis, 1 to 6 percent
17 recovery, would be 1,500 barrels or 9,300 barrels,
18 which are credibly low.

19 And then I went to the Lower San Andres,
20 which is a much thicker reservoir. If you look at the
21 thickness, it's between 900 and 1,000 feet thick.
22 Other interesting thing here is that the RR Bell,
23 which is an older well, is kind of a unique
24 oil-in-place calculation. If you look at that, it's
25 at 40 million barrels per section, but all the other

1 wells around it are, you know, in the 20 million
2 barrels.

3 And anytime you see an anomaly like
4 that, again, you'd like to investigate it and say is
5 there a normalization process with the petrophysics,
6 or is there something that unusual, or is that just a
7 single 40-acre amount of oil in place.

8 The other thing you notice on these maps
9 as you extrapolate outside of this area, the oil in
10 place significantly reduces. And if you look at some
11 of the estimates from Empire, they used a constant oil
12 in place across the entire unit.

13 But if I was going to do a pilot, if you
14 believed these maps, I would use these areas as my
15 pilot project. But based on the recovery factors from
16 the Tall Cotton, I see very little evidence of
17 economic potential recovery.

18 Q. Now, you mentioned Empire using a constant
19 saturation across an area. Are you talking about
20 their economic analysis that Mr. West presented?

21 A. Yes. And John McBeath's analysis, as well.

22 Q. Okay. And you reviewed Empire's economic
23 analysis?

24 A. Briefly, yes.

25 Q. Okay. And did you identify that they were

1 using any of the data provided by any of their
2 experts' petrophysics, geologists, in their economic
3 analysis?

4 A. No, they did not.

5 Q. Next slide here is, I think, your last
6 slide. Explain what this means and how it relates
7 again to your analysis about whether or not there's
8 potentially economic recoverable hydrocarbons?

9 A. Most of my analysis on this was rebutting
10 some other analysis. But in my opinion, Jim
11 Davidson's analysis seemed to fit the data better than
12 anybody else's. So using his analysis, and especially
13 since Jim created his model, but then he applied it to
14 five other blind tests outside the EMSU, and they all
15 corroborated the actual data, I felt very comfortable
16 that his model was at least a reasonable
17 representation of the oil in place in the EMSU.

18 If you look down at the table in the
19 bottom, if you notice, the other tables were 10
20 millions barrels per section and 20 million barrels
21 per section. Now, in the producing zone, the actual
22 Grayburg, I have about 21 million barrels in the
23 Grayburg on a per section basis.

24 But as you go below that, the potential
25 residual oil zone, which is the 150 feet below the

1 producing oil-water contact, I have about 9 million
2 barrels per section.

3 Now, if you get down to the transition
4 zone, between 500 and 700, I've got about 5, 6 million
5 barrels in place. And even if you use the most
6 exaggerated recovery factors, that becomes
7 insignificant relative to economics. And anything
8 below negative 700 where Goodnight is injecting, it's
9 just minuscule. Significantly insignificant to any
10 concept of economic recovery.

11 Q. Mr. Knights, you testified at the beginning
12 that you had experience conducting evaluations,
13 assessments for more than two dozen CO2 fields across
14 the Central Basin Platform, right?

15 A. Correct.

16 Q. How does this proposed project here in the
17 EMSU relate to what you've seen and you've assessed in
18 terms of CO2 recovery or potential for an actual
19 project, relative to your experience across the
20 Central Basin Platform?

21 A. It would be significantly below the quality
22 of reservoirs that I've evaluated previously.

23 Q. Have you seen anything in your analysis that
24 would -- does this compare in any way to anything
25 you've seen in your analyses of CO2 recovery projects?

1 A. No. This is a unique animal. Like I
2 mentioned before, all these things are unique animals
3 and you have to take it from the data that you have
4 and evaluate it.

5 But in my opinion, there's significant
6 physical data to suggest that Jim's petrophysical
7 analysis is probably the most accurate of all.

8 And the other thing I can say is I don't
9 think anybody has underestimated the oil in place. So
10 I think there's another case that could be lower than
11 Jim's.

12 Q. What is your opinion -- when you refer to
13 "Jim," you're referring to Dr. Davidson, correct?

14 A. Yes. I apologize. Dr. Davidson and I work
15 in the same office, so I'm very familiar with him.

16 Q. Okay. What's your opinion about whether
17 Empire's producing zone and Goodnight Midstream's
18 disposal zone are in communication?

19 A. There's absolutely no evidence that there's
20 any communication. And there's significant evidence
21 that says there's a significant number of permeability
22 barriers between the Goodnight injection zone and all
23 of the shallow producing zones and the potential ROZ
24 zones that are above, say, you know, Jim's gamma ray
25 spike at about negative 500.

1 So my overall concept is between
2 negative 500 and up is unique, separate. There's some
3 oil saturation up there that somebody might be able to
4 go after. And then from 700 down, it is a complete,
5 separate, isolated reservoir that has unique
6 characteristics. And those two won't interfere with
7 each other at all.

8 Q. What's your opinion about whether
9 Goodnight's injections impair Empire's ability to
10 develop recoverable hydrocarbons?

11 MR. WEHMEYER: Object. This is outside the
12 scope of any of his filed testimony.

13 HEARING OFFICER HARWOOD: Mr. Rankin.

14 MR. RANKIN: Mr. Hearing Officer,
15 Mr. Knights has testified that the scope of his
16 testimony is to evaluate the geology, whether there's
17 any recoverable hydrocarbons and whether there's any
18 communication between those zones that would affect
19 recovery. That is exactly what his scope of
20 testimony is.

21 HEARING OFFICER HARWOOD: I'll allow it.
22 Overruled.

23 BY MR. RANKIN:

24 Q. Mr. Knights, what's your opinion about
25 whether Goodnight's injection is impairing Empire's

1 ability to develop recoverable hydrocarbons in
2 Goodnight's disposal interval in the EMSU.

3 A. It would have no impact, in my opinion.

4 Q. What's your opinion about whether Empire can
5 develop a potential ROZ in the shallower EMSU
6 intervals while Goodnight continues to dispose of
7 produced water into its disposal zone?

8 A. I think that very -- correct. Could you
9 repeat the question?

10 Q. What's your opinion about whether Empire can
11 potentially develop an ROZ in the shallower EMSU
12 intervals while Goodnight continues to dispose of
13 produced water into its disposal zone?

14 A. Yes. I think -- is that the shortest
15 answer?

16 Q. In other words, in your opinion --

17 A. They're completely isolated and separated.
18 And any activity above negative 500 or above negative
19 700 and below 700 are going to be completely isolated.

20 Q. Based on everything you reviewed and
21 everything you've heard, do you believe there's any
22 basis to suspend Goodnight's injection operations?

23 A. Not, I do not.

24 MR. WEHMEYER: Objection. This is
25 absolutely outside of anything the witness would have

1 personal knowledge on, and it's speculation in terms
2 of what the Commission should do.

3 HEARING OFFICER HARWOOD: That will be for
4 the Commission to decide. Sustained.

5 MR. RANKIN: Very well.

6 BY MR. RANKIN:

7 Q. Mr. Knights, you've heard some discussion
8 during Empire's testimony from their witness that more
9 data is required in order to make a determination on
10 the potential for ROZ development in the EMSU.

11 What's your opinion about whether or not
12 more data is required to make that determination?

13 A. I believe there's plenty of data here to
14 make a decision. I think the -- well, I mean, if
15 somebody will ask me, I'll...

16 Q. Okay. So your bottom line takeaway is that
17 there's plenty of data to make a decision about
18 whether there's a potential ROZ or whether there's
19 injection impacting any potential recoverable
20 hydrocarbons, correct?

21 A. Correct.

22 Q. Let me ask you this, Mr. Knights. What's
23 your bottom line takeaway opinion about what Empire is
24 proposing to do here and what Goodnight has been doing
25 and whether -- what's your bottom line analysis about

1 those two things?

2 A. Well, I think there's two isolated --
3 different, separate, isolated reservoir potential, and
4 one is an aquifer that is incredibly large and
5 unusual. And one is shallow and isolated and has, in
6 my opinion, maybe a marginal amount of oil in place to
7 be attacked from an economic standpoint.

8 Q. You said that the San Andres is very large,
9 correct?

10 A. Yes. I think one of the most interesting
11 things is that it's actually under-pressured, so .38
12 psi per foot. And the amount of withdrawal of fluid
13 and the amount of injecting fluid, with seemingly no
14 indication of pressure buildups, indicates that it's
15 just a tremendously large reservoir.

16 And it goes back to Melzer and
17 Trentham's theories about how this water was placed
18 and how the migration paths happened and where they
19 did. And matches with the larger scope things that we
20 see in the Central Basin Platform on where the oil is.

21 Q. And just explain, if you would, how that
22 relates to your bottom line opinion. I mean, the size
23 of the reservoir and the pressures, how does that
24 relate to your ultimate conclusions here?

25 A. The concept of fluid migration, especially

1 vertically, would need a pressure differential and a
2 reason to go up. And when you have a significantly
3 large reservoir that's under-pressured and with the
4 withdrawal rates and injection rates showing it has
5 incredibly high permeability, there's no reason for
6 the water to go up at all.

7 MR. RANKIN: Thank you very much,
8 Mr. Knights.

9 Mr. Hearing Officer, I have no further
10 questions of Mr. Knights and make him available for
11 cross-examination.

12 HEARING OFFICER HARWOOD: All right. It's
13 10:24. We'll call it 10:25 to make the math easier.
14 Let's come back at 10:40. We'll take our mid-morning
15 break.

16 (Recess held from 10:24 to 10:40 a.m.)

17 HEARING OFFICER HARWOOD: Mr. Wehmeyer,
18 cross-examination?

19 MR. WEHMEYER: Thank you.

20 CROSS-EXAMINATION

21 BY MR. WEHMEYER:

22 Q. We've never met before, and didn't get a
23 chance to visit at the deposition. That was somebody
24 else, yeah?

25 A. Correct.

1 Q. Similar to my visit with Dr. Davidson, what
2 I want to kind of talk a little bit about some of the
3 data relied on, some of your methods and ultimate
4 conclusions.

5 And before getting into that, I wanted
6 to talk about some of the process that brought you
7 here. I'm going to try to share my screen.

8 And in terms of your original report, do
9 you remember authoring a report on or about August 26,
10 2024?

11 A. Yes.

12 Q. And if we get down to your signature page,
13 you signed that report?

14 A. Correct.

15 Q. That was under penalty of perjury?

16 A. I would assume so.

17 Q. And, in fact, you also stamped numerous of
18 your reports with your geology seal?

19 A. Correct.

20 Q. When you put the stamp on the report -- do
21 you remember, did you a stamp this one?

22 A. I don't know. Is it on there?

23 Q. I don't know if I lost it on the watermark
24 with the copy job. I've seen it on others. I just
25 don't know if I lost it.

1 A. I do not know.

2 Q. What's the significance when you stamp those
3 reports?

4 A. It's just a professional geologic stamp,
5 license. I'm a licensed petroleum geologist.

6 Q. Basically, that the work conforms with the
7 standards associated with your license?

8 A. Yes.

9 Q. Now, Mr. Rankin covered at the start of your
10 testimony some of these changes you made. And I just
11 want to make sure the commissioners have a handle on
12 how drastic these changes were that you made.

13 The first which you said you were
14 working in the wrong foot increments in interpreting
15 Dr. Davidson's work; is that right?

16 A. Correct.

17 Q. And so will you explain to the commissioners
18 what your error was when you signed your first report
19 under penalty of perjury with respect to that
20 half-foot increment?

21 A. I summed the hydrocarbon pore volumes, and I
22 assumed that it was 1 foot, but it was -- that wasn't
23 me, was it?

24 Q. No, sir.

25 HEARING OFFICER HARWOOD: Thank you, Sheila

1 for cutting that person off.

2 A. Could you rephrase the question.

3 Q. Yes, sir. With respect to the half-foot
4 increment that you erred on in the first place, will
5 you tell the Commission how you made that error.

6 A. It was a list of hydrocarbon pore volumes
7 and I summed them up, but it was for half-foot, so I
8 needed to multiply it by .5. And it was -- the file
9 was labeled -- it confused me.

10 Q. So with respect to your opening testimony,
11 you rendered opinions as a geologist about
12 hydrocarbons in place here. Yes?

13 A. Correct.

14 Q. Tell the commissioners by way of order of
15 magnitude how this changed those oil-in-place
16 estimates.

17 A. 100 percent.

18 Q. So you swore under penalty of perjury, you
19 think you actually stamped this thing with your
20 geology seal, with Netherland, Sewell letterhead --
21 and you can tell the Commission Netherland, Sewell
22 letterhead is on here. Yeah?

23 A. Correct.

24 Q. And you said: These are my opinions. These
25 are the reasonable opinions based on my work.

1 And you were literally off in terms of
2 the hydrocarbons before this Commission by a factor of
3 100 percent?

4 A. Correct.

5 Q. Okay. How did the error come to your
6 attention?

7 A. I'm not really sure.

8 Q. And that wasn't the only change. After
9 Mr. Padilla took your deposition -- and Mr. Padilla,
10 he's not a geologist, is he?

11 A. I don't know.

12 Q. Okay. Mr. Padilla takes your deposition and
13 you make another big change to your opinions, don't
14 you?

15 A. Relative being -- a change from 30 percent
16 cutoff to the 20 percent saturation cutoff.

17 Q. Tell the commissioners in terms of order of
18 magnitude on the saturation cutoffs, how does that
19 affect the volumes of hydrocarbon here, oil in place?

20 A. I don't know. But it added oil in place.

21 Q. A significant amount, doesn't it?

22 A. I don't really remember. Maybe 20, 25
23 percent.

24 Q. Okay. So you're off by a multiple of
25 100 percent because you didn't know the correct foot

1 increments. And then you're off by another 20 to
2 30 percent because of the cutoff percentage?

3 A. Yes.

4 Q. How did that error come to your attention?

5 A. That wasn't an error. That was a --

6 Q. Interpretation?

7 A. I used 30 percent in my original, more of
8 what I expect the oil in place to be. But then I
9 realized that everybody else was using 20 percent, and
10 so I thought, well, just for relative purposes, I
11 should join the bandwagon and use 20 percent water
12 saturation cutoff.

13 Q. The water saturation, I mean, that's a big
14 variable in input into all of these formulated arrived
15 at oil in place?

16 A. Yes. One of the primary cutoffs.

17 Q. And scientific method you used for making a
18 deviation from what you swore to in the first place to
19 what you swore to and sealed in the second place was
20 you, quote, unquote, wanted to join the crowd?

21 A. Yes. To make it easier for comparable
22 reasons.

23 Q. One of the slides that Mr. Rankin visited --
24 first, with respect to the core in 679, did you ever
25 physically look at that core?

1 A. No. I had pictures.

2 Q. Well, I guess if you didn't physically look
3 at the core, you also never went in and described the
4 core. Do I have that right?

5 A. Correct.

6 Q. I thought I had Mr. Rankin's presentation
7 already pulled up to avoid wasting your time. I
8 didn't, so let me get to it. Actually, it threw me
9 off. It was titled "Trial Exhibits." I did have it.
10 This is not trial exhibits, it's the presentation, but
11 I've got it. All right.

12 A. Everybody makes a mistake.

13 Q. We're in the presentation that you just went
14 through, and I want to focus on this core. So we know
15 you didn't look at the core. We know you didn't
16 describe the 679 core. In building a facies model,
17 which is what Dr. Davidson used -- yes?

18 A. I believe he did.

19 Q. -- wouldn't it be really important to
20 actually look at the core and study the core and
21 describe the core as part of building that facies
22 model?

23 A. Not necessarily.

24 Q. You also didn't use the RR Bell core at all
25 as part of the analysis, did you?

1 A. In my analysis?

2 Q. In Dr. Davidson's analysis, which, again,
3 you rely on his analysis in terms of building
4 oil-in-place numbers, right?

5 A. Yes, his petrophysical analysis.

6 Q. Would using the RR Bell core have been
7 important to that if you're going to rely on a facies
8 model?

9 A. I really don't know.

10 Q. With respect to the facies model, in terms
11 of rock facies, that would be a geologist that would
12 assist with identifying and selecting rock facies.
13 Yes?

14 A. It would be helpful to be a geologist.

15 Q. Did you assist Dr. Davidson in his rock
16 facies selection?

17 A. No.

18 Q. Dr. Davidson, is he a geologist?

19 A. Not by degree, no.

20 Q. Why didn't you help Dr. Davidson with the
21 rock facies selection if you're a geologist or
22 actually a geologist that's been designated as an
23 expert in this case?

24 A. Because Jim is an expert petrophysicist, and
25 one of his main jobs is describing rocks from their

1 petrophysical characteristics, which are not always
2 visual but actually quantitative.

3 Q. As we talk about reliability of testimony, I
4 want to focus in on this EMSU 679 core. Did you add
5 the purple arrows that go up and down?

6 A. The blue and green arrows, I added. And the
7 depths at the bottom, I added.

8 Q. So 4230, 4232?

9 A. Yes.

10 Q. And the descriptions there to the side of
11 the blue arrows, when it says, "Non-Fractured, Non-Oil
12 Stained," did you add that?

13 A. Yes.

14 Q. And so in your testimony with Mr. Rankin,
15 what you were explaining is that you have oil-stained
16 intervals that you can see the staining, and then you
17 have an interval next to it that's not oil-sustained?

18 A. Correct.

19 Q. And just for the commissioners, as we assess
20 qualifications and reliability of testimony, how were
21 these cores prepared?

22 A. I would assume standard procedures.

23 Q. Can you describe those standard procedures?

24 A. Not specifically.

25 Q. Now, if we just take -- let's take this one

1 as an example. Can you see my cursor? I'm at 4236.

2 A. Yes.

3 Q. Do you see the blue arrow?

4 A. Yes.

5 Q. And then there's a green arrow immediately
6 below it. You added both of those?

7 A. Correct.

8 Q. And you saw fit to add the verbiage
9 "Non-Fractured, Non-Oil Stained," to the one below it?

10 A. Correct.

11 Q. Explain to the commissioners what's
12 important about that distinction between the stained
13 above and the non-oil-stained below, according to you?

14 A. It shows stratigraphic variation over
15 limited intervals of about a foot to half a foot, that
16 you can have stratigraphic variations in a horizontal
17 sense.

18 Q. Can you explain, as a matter of geology, how
19 on earth it could be that you could have this very --
20 you would agree this is very highly oil-stained right
21 here where I'm indicating at the bottom of the green
22 arrow?

23 A. Correct.

24 Q. And then just immediately touching it, there
25 would be no oil staining whatsoever?

1 A. Correct.

2 Q. Just explain, as a geologist, now that
3 happens, so that the commissioners understand.

4 A. Well, there's probably a permeability
5 separation, a depositional separation. It could be an
6 unconformity, that fluid properties migrating through
7 one does not migrate through the other. And it also
8 indicates that there's lateral migration and not
9 vertical migration.

10 Q. As a scientist, are you familiar with the
11 term that Dr. Davidson used after coming back from the
12 break and visiting with counsel, called a
13 "preponderance of the evidence"?

14 MR. RANKIN: Objection.

15 BY MR. WEHMEYER:

16 Q. Is "preponderance of the evidence" --

17 MR. RANKIN: Characterization. Objection.

18 HEARING OFFICER HARWOOD: Rephrase. Leave
19 out the "after visiting with counsel."

20 BY MR. WEHMEYER:

21 Q. So you were in here when we were on this
22 issue of barriers and I said: Are you going to sit
23 here for Netherland, Sewell and tell these
24 commissioners that there's a barrier?

25 And he said no.

1 Do you remember that?

2 A. I remember that diatribe. I'm not really
3 sure I understand what the conclusions were.

4 Q. And then we came back from lunch and he
5 started speaking of a preponderance standard. Do you
6 remember that?

7 A. I don't remember those exact words.

8 Q. Does preponderance have any scientific
9 meaning? Sounds kind of like a legal thing. Does
10 preponderance have any meaning in your science world?

11 A. I mean, it means -- to me, it means a lot.

12 Q. Okay.

13 A. I have more than just a piece of data.

14 Q. And we may have just missed. Is that a
15 scientific term, that you're aware of?

16 A. Scientific? I don't know if I have a
17 scientific dictionary, but not a defined scientific
18 term.

19 Q. As you've worked with Dr. Davidson over the
20 last 15, 20 years, have ever heard him use the phrase
21 or term "preponderance"?

22 A. I don't know.

23 Q. Well, let's pick your -- I asked why, as we
24 look at this 4236 -- and, again, after all the work
25 and the many written statements in the case that

1 you've signed, there's been at least five different
2 signed statements by you, right?

3 A. I think -- yeah. One revised, one revised
4 and a sur. Five.

5 Q. Plus a sworn deposition?

6 A. So is that six?

7 Q. I wouldn't count the deposition. But you
8 did that, too.

9 A. Okay.

10 Q. So after all of those, Mr. Rankin and you
11 selected 24 slides here, give or take, to come and
12 tell the story. And this was one of them, right?

13 A. Yes.

14 Q. And I asked how on earth do you explain
15 that, and you said -- you gave the commissioners how
16 you would explain the difference between how you can
17 have oil staining immediately above and non-oil stain
18 immediately below, right?

19 A. Yes. I'm not sure I understand that
20 question.

21 Q. Yeah. I asked how, as a matter of science,
22 do you explain this highly oil-stained core, and then
23 immediately below it, there's no staining at all. And
24 then you gave the commissioners under oath here an
25 explanation, according to you as a geologist, how that

1 happens.

2 A. How it could happen, yes.

3 Q. And is that to the standard of whatever
4 certainty you would hold yourself to and Netherland,
5 Sewell to as part of your work in the case?

6 A. I believe that's a good explanation of how
7 that could occur.

8 Q. It's not just a wild guess. You chose 24
9 slides. This is one you thought was most important.
10 I asked how on earth does this happen from what you
11 decided was an important slide. You gave the
12 commissioners your answer, and you're standing by that
13 and that's the degree of rigor that you, as an expert,
14 bring to it. Yes?

15 A. I'm still not sure I understand the
16 question.

17 Q. Is this a part of a full diameter core
18 analysis?

19 A. This is probably half-slabbed core.

20 Q. So with respect to core analysis, with
21 respect to each foot, are they going to actually pull
22 that core out and clean it before measuring porosity
23 and permeability?

24 A. I would probably say in some cases, they do,
25 in some cases, they don't.

1 Q. And then there's going to be a smaller piece
2 from the thick side of the slabbed core that's crushed
3 to acquire oil and water saturation?

4 A. Correct.

5 Q. And the cleaning of the core, that's going
6 to be done before the core is slabbed, correct?

7 A. Before the core is slabbed?

8 Q. Yes. The cleaning of the core to measure
9 porosity and permeability is going to happen before
10 the core is slabbed. Do you understand that that is
11 part of the Core Labs process on full diameter core
12 analysis?

13 A. I would defer to my petrophysical expert on
14 that. He understands.

15 Q. And then only after all that is the slab
16 going to be photographed and described? Or you don't
17 know?

18 A. That could be a procedure.

19 Q. So following --

20 A. Sounds reasonable.

21 Q. So following full diameter core analysis,
22 the core will have been stripped of all appearance of
23 non-oil-stained core in each foot and a piece of core
24 that is oil-stained and then you get the photographs.

25 In terms of the procedure that came for

1 these photographs to be, you have no idea, do you?

2 A. Typically, they're not cleaned before they
3 do the core analysis.

4 Q. Dr. Lindsay shot through the roof when he
5 saw this slide from you. Do you understand the
6 explanation for how two pieces of core that are
7 touching each other and one is heavily oiled-stained
8 and other one is not, is that it has literally been
9 cleaned out as part of this procedure? That literally
10 all of the oil that was in that slab, that looked just
11 like the one above it --

12 MR. RANKIN: Objection, Mr. Wehmeyer is
13 testifying.

14 HEARING OFFICER HARWOOD: Overruled.

15 A. So yes, that could be an explanation for
16 that as well.

17 Q. Wouldn't that be a more likely -- I'm not a
18 geologist. But just looking at this thing, wouldn't
19 that seem to make more sense, as a matter of science,
20 when you see something that heavily oil-stained
21 immediately above the one that is not?

22 A. Yes. I think that would be reasonable.

23 Q. Why before coming in here and giving the
24 Commission these opinions, did you not do the work to
25 be able to speak authoritatively and clearly on

1 important issues like this?

2 A. I guess I could have done more rigorous
3 detail, but the specifics I was trying to get to here
4 was that the fractures do not extend across vertical.

5 Q. Well, as we talk about fractures, again, so
6 to help orient the commissioners, this core is about
7 3 inches in diameter, give or take, 3 and a half
8 inches?

9 A. Okay.

10 Q. So as we get this core, even if it went all
11 the way down to the Grayburg, you're only getting to
12 look at 3 inches. And so if a fracture is apparent
13 here and doesn't work perfectly vertically straight
14 through the entire core, it's going to meander outside
15 of the 3 inches in diameter and you're got going to
16 see the continuous nature; isn't that right?

17 A. Correct.

18 Q. And so as you talk about noncontinuous
19 fractures, that they're observed in shorter intervals,
20 there's no way to view one fracture that's going to go
21 perfectly straight up in the core, is there?

22 A. Correct.

23 Q. Now, just while we're on the slide, and I'm
24 jumping around a bit, but fracture studies, did you
25 perform any fracture studies here?

1 A. No.

2 Q. Did you perform any frac gradient studies?

3 A. No.

4 Q. And so if the commissioners wanted to know
5 with respect to these fractures -- and we can agree
6 that there's fractures in this core, right?

7 A. Correct.

8 Q. And because you showed a different slide --
9 I'm now working off of your Slide 18. That doesn't
10 show a lot of fractures. That was one of the reasons
11 you chose this one?

12 A. No. I chose this one because it had some
13 stratigraphic variability and permeability
14 variability.

15 Q. Obviously, whether we're talking RR Bell or
16 the 679, we can certainly find plenty of sections in
17 that core that has extensive fractures in it, can't
18 we?

19 A. I do not know. I didn't look at all the
20 core.

21 Q. And I guess the discussion about fractures,
22 was that really to the ends of Mr. Rankin's questions
23 over this idea of impermeable barriers or baffles of
24 barriers to flow?

25 A. Could you restate that question?

1 Q. Yeah, just why we're talking about
2 fractures.

3 A. Why we're talking about -- is that a
4 question or --

5 Q. Yes, sir. And I appreciate you asking me to
6 rephrase.

7 The reason that we're talking about
8 fractures and core is because this is part of your
9 story on the testimony that pertains to communication
10 between the Grayburg and the San Andres?

11 A. Correct.

12 Q. And so did you review Bob Lindsay's fracture
13 study that he prepared?

14 A. Yes.

15 Q. And he's also now prepared one for the
16 RR Bell core. Would you like to see that one?

17 A. Not really.

18 Q. But I'm trying to understand in terms of the
19 baffles, what were your parameters for setting a
20 baffle flag? Or did you set the baffle flag or are
21 those Dr. Davidson's over on the --

22 A. Those are Dr. Davidson's.

23 Q. Did you come up within any baffle flags?

24 A. The only baffle flags are on one of my other
25 slides here, where I represented two wells, using a

1 sensitivity of where I would create some baffles in
2 those two logs.

3 Q. And what were your standards for those
4 baffles?

5 A. Well, they're two visual things. One using
6 Dr. Birkhead's permeability estimate of less than .2
7 millidarcies. And then I also used a 7 percent
8 porosity as an analogy for things that are less than 1
9 millidarcy perm.

10 Q. You've seen Mr. Birkhead's slides. There
11 are certainly places in the core that have very low
12 porosity but very high permeability.

13 A. Low porosity and high permeability?

14 Q. Yes.

15 A. Yes.

16 Q. That is the characteristic of the rock in
17 this area. You will find places that have low
18 porosity, high permeability?

19 A. Yes. The lower the porosity, the least
20 likely it is to have high perm.

21 Q. However, as it comes to bear here on what
22 was actually observed and measured in the core, that
23 is not the case in a great many places. There are
24 plenty of places with low porosity that have very high
25 permeability?

1 A. Plenty of -- I didn't do a statistical
2 analysis on that.

3 Q. So in terms of talking about barriers to
4 flow or baffles to flow, you have not done a study
5 looking at in instances of low porosity, what the
6 permeability looks like; is that true?

7 A. No. I've looked at all the porosity perm
8 plots, so I've looked at all that data.

9 Q. So now I'm just going to illustrate -- can
10 you see in -- this is a slide that I think you either
11 showed the exact slide or some variation of it, right?

12 A. Yeah. I understand it, though.

13 Q. To orient the commissioners, the purple dots
14 are core measurements out of the 679. The lighter
15 green is North Monument. Blue is the 458. And the
16 other shade of green is the Bell. Correct?

17 A. Was that to me, correct?

18 Q. Yes.

19 A. Yes.

20 Q. And so with respect to your baffle cutoff,
21 you were looking at 7 percent porosity?

22 A. That was one of my estimates, and the other
23 was .02 millidarcy from Dr. Birkhead's work.

24 Q. .02 or .2?

25 A. .02.

1 Q. And so if it was less than 7 percent
2 porosity, did you give consideration to permeability,
3 or did you call that a baffle?

4 A. No. I just said that that was perm
5 barriers, potential perm barriers.

6 Q. Something with less than 7 percent porosity
7 you called a potential perm barrier?

8 A. Correct.

9 Q. That was the only standard?

10 A. No. Also the .02 millidarcy from
11 Dr. Birkhead's work.

12 Q. So would it have to be less than 7 percent
13 porosity and also less than .2 millidarcy in
14 permeability?

15 A. No.

16 Q. So if it was nearly under 7 percent
17 porosity, that was enough to trip a flag for you to
18 call it a perm barrier?

19 A. Yeah, a potential perm barrier.

20 Q. Irrespective of what the permeability would
21 be below that 7 percent?

22 A. Correct.

23 Q. Where in science would you find that
24 7 percent porosity would be a perm barrier? Where can
25 I read that as a matter of industry standard or

1 acceptance?

2 A. Now, that is -- literature, I'm not sure.
3 But 7 percent is basically that 50/50. Half of those
4 are above 1 millidarcy and half of them are below
5 1 millidarcy. So it gets you a likelihood that that
6 is maybe not more than likely, but a reasonable
7 vertical perm barrier.

8 Q. Okay. And so if -- and I'm not being a
9 smart aleck with this. But other than taking your
10 say-so, if the commissioners wanted to know where does
11 this standard of less than 7 percent porosity somehow
12 become a perm barrier, what is that?

13 A. It would go back to the porosity perm plot,
14 and you look at the plot and you look at 7 percent
15 porosity and you look at the distribution of
16 permeabilities within there. You do have a few points
17 that are very, very high permeability, but you have a
18 significant portion of those that are lower
19 permeability.

20 So when you put those barriers up, if
21 you have a significant number of -- there's a 50/50
22 chance that that's a perm barrier, and you have enough
23 of those, it becomes a preponderance of the evidence.

24 Q. And I'm just trying to understand this.
25 Because you didn't give consideration to permeability

1 on your 7 percent porosity cutoff for making a
2 barrier. And I hear you're cutting it two ways. You
3 were cutting it at Mr. Birkhead's .2 millidarcy on
4 perm --

5 A. .02.

6 Q. .02. -- or you would cut it at anything
7 under 7 percent porosity, right?

8 A. Yes. Those are two reasonable definitions
9 of -- the .02 is probably highly likely. The
10 7 percent is probably reasonably likely.

11 Q. But wouldn't you want to know what the -- if
12 you're cutting this off as 7 porosity, wouldn't you
13 want to know, based on these particular rock
14 properties, what permeability looks like in that rock?

15 A. Well, the problem with using actual
16 permeability is you need a core data. And for
17 99.9 percent of the rock when you're making these
18 analyses, you're not going to have core data. So
19 you're going to have to use some statistical analysis
20 to determine more than likely or less than likely what
21 the perm of that rock would be if you did not have
22 core data.

23 And if you look at this graph, you can
24 see very few points at 7 percent porosity are in the
25 high permeability. So it's very unlikely that you'll

1 have a 7 percent or lower porosity that has a high
2 permeability, but you will have some.

3 Q. Well, help me. And this is me being a
4 lawyer and not an engineer or a scientist. I'm seeing
5 the 7 percent, your cutoff -- am I indicating
6 correctly on this X axis with the cursor where your
7 cutoff would be?

8 A. Yes.

9 Q. Am I at the right increment over here at the
10 far left, this .02 millidarcy?

11 A. Yes.

12 Q. As you talk about core, aren't all of the
13 data plots that I'm circling here instances that would
14 be over .02 millidarcy of permeability but less than
15 7 percent porosity that were actually measured in
16 these four different cores?

17 A. Correct.

18 Q. And obviously, if you have those types of
19 millidarcy of permeability, fluid will flow, won't it?

20 A. Not necessarily.

21 Q. Why not?

22 A. Well, the 1 millidarcy is a standard
23 traditional cutoff for oil fluid flow. And so
24 anything below that is probably more than likely going
25 to be a barrier to fluid flow.

1 Q. We'll take that in two pieces. Let's just
2 start first with the one that you just offered here.
3 So that the commissioners aren't mislead, that would
4 be in conventional mobile oil type environment. Yes?

5 A. Correct.

6 Q. So if we're looking below -- so you said you
7 set your baffle flag at 7 percent porosity. Based on
8 actual measured core data, if we use the 1, you can
9 tell the commissioners that there's piles of plots
10 here that have over 1 millidarcy of permeability
11 measured at less than 7 percent porosity, true?

12 A. Correct.

13 Q. And according to you, over 1 millidarcy, we
14 should all be expecting fluid to flow at that
15 permeability, right?

16 A. Yes, in a horizontal perspective.

17 Q. What if we add CO2 and we're no longer
18 speaking in a conventional world? You understand this
19 whole proceeding that week three of this is over
20 Empire going in with CO2?

21 A. Correct.

22 Q. I only ask, this is being a little bit smart
23 aleck, because we've spent a lot of time talking about
24 mobile oil in conventional world. And in terms of
25 mobile oil, you understand Empire is not expecting to

1 get mobile oil in the San Andres? We're on the same
2 page with that?

3 A. Correct.

4 Q. If you apply CO₂, the 1 millidarcy of
5 permeability that you spoke to in the conventional
6 world, that comes down significantly, doesn't it?

7 A. Correct.

8 Q. How far down would that come?

9 A. I do not know.

10 Q. Would .1 at least be a reasonable estimate?

11 A. .1 for a gas reservoir would be about what
12 Dr. Davidson assumed was a 7 percent porosity cutoff.

13 Q. I'm talking about permeability now. I'm
14 sorry, we may have missed.

15 If you're adding CO₂ can you now expect
16 fluid to flow at .1 millidarcy of permeability?

17 A. Gas to flow at .1 millidarcy.

18 Q. At what point would you have oil flow?

19 A. Somewhere between -- less than 1 millidarcy,
20 I would assume, if it's got a gas component.

21 Q. How about water?

22 A. Water, probably around that 1 millidarcy,
23 plus or minus.

24 Q. Have you done that work?

25 A. No.

1 Q. You're guessing at this?

2 A. No. I am making a professional judgment.

3 Q. Okay. But just as we put this plot into
4 perspective, you would set your baffle flag -- you did
5 set your baffle flag over here at 7 percent porosity.
6 And so now I'm asking -- in a CO2 world, you talked
7 about one, and I showed you where we've got plotted
8 core in four different cores in the San Andres and
9 Grayburg that have plots that are well over 1. If we
10 add CO2, we get even more of these data points that
11 would then fall into fluid --

12 A. Some mobility, yes.

13 Q. With respect to permeability barriers, if we
14 come back to your -- what I'm trying to figure out
15 is -- were you here during the opening remarks by
16 Mr. Rankin, the very first day? We came in on a
17 Thursday and there was opening argument. Do you
18 remember that?

19 A. I probably don't remember it specifically,
20 but I think I was here.

21 Q. You were here, yeah. And Mr. Rankin said
22 that his experts were not given any guidance on where
23 the analysis was supposed to end up or where the
24 conclusions were to lie. He wanted them to come and
25 make an objective assessment. Do you remember him

1 mentioning that in opening arguments one way or the
2 other?

3 A. To that effect, yeah. I would assume that
4 that was...

5 Q. I want to look back at your original report.
6 I think this is the one before the correction, and
7 this is no gotcha with the correction or not, but this
8 was the very first one you signed. Can you read that?
9 What was the second charge that you were given as part
10 of your work here? Can you read Number 2 to the
11 commissioners?

12 A. Evaluate and confirm the presence of
13 geologic barriers isolating the San Andres Formation
14 from the overlying Grayburg Formation.

15 Q. Why were you not engaged to just evaluate
16 the potential presence of barriers? Why were you
17 engaged to actually confirm the presence of geologic
18 barriers?

19 A. That is what it states there, but my
20 analysis, if it did not find barriers, that would have
21 been my analysis.

22 Q. Is the reason that you were retained to
23 confirm the presence of barriers that Goodnight had
24 already drilled and was injecting saltwater into
25 Empire's oil unit?

1 A. Could you rephrase that?

2 Q. At the time that you were hired to confirm
3 barriers, was the reason they were asking you to
4 confirm, as opposed to evaluate whether they existed
5 at all, because they were already injecting into the
6 oil unit?

7 A. At the time, I did not know. And although
8 it does say "confirm the presence of geologic
9 barriers," I interpreted that to be confirm or
10 unconfirm or deny.

11 Q. Can you tell the commissioners about an
12 instance in which you would have been hired before
13 this to confirm geologic barriers?

14 A. No.

15 Q. So if the commissioners want to know how
16 often you go around, as a Netherland, Sewell expert,
17 confirming the presence of geologic barriers, this
18 would have been the first time you were hired to do
19 that?

20 A. It was the first time there was something
21 written that said that in a bullet point. But
22 confirming permeability barriers is basically what I
23 do for a living, determining net pay and what is a
24 barrier, what is a reservoir, what is non-reservoir,
25 what is quality of rock, what is poor quality of rock,

1 what is reasonable quality of rock.

2 Q. So just coming back here to confirming the
3 presence of these baffles, in your reports, and I can
4 show you examples, but you use the phrase "potential
5 barriers to flow." You know that you have hedging
6 language throughout these reports that do not say
7 Netherland, Sewell is saying there is, in fact, a
8 barrier. It says that there might potentially be a
9 barrier?

10 A. Correct.

11 Q. Is that the testimony of Netherland, Sewell
12 in this case today?

13 MR. RANKIN: Objection. Netherland, Sewell
14 is not testifying. Mr. Knights is testifying.

15 HEARING OFFICER HARWOOD: Well, he's an
16 agent. I'll allow it allow. Overruled.

17 A. Can you repeat the question.

18 Q. I'm just trying to see if you're sticking
19 with the reports or if we need another revision.

20 Is it the testimony of Netherland,
21 Sewell, through you, as its agent, that there is a
22 potential barrier?

23 A. Yes.

24 Q. Is it the testimony of you, as Netherland,
25 Sewell's agent, that there is, in fact, a barrier?

1 A. There are many barriers between the 350 and
2 the 700 feet that I kind of evaluated.

3 Q. Is it the testimony of Netherland, Sewell --
4 and Netherland, Sewell is the entity actually engaged
5 here to work, right?

6 A. Correct.

7 Q. Is it testimony of Netherland, Sewell that
8 there is, in fact, across the entirety of the EMSU an
9 impermeable barrier that prohibits the flow of any
10 fluid from the San Andres into the Grayburg? Yes or
11 no?

12 A. Could you repeat that again? I got to get
13 all these.

14 Q. That's okay. The goal is to get this as
15 accurate at possible, and I appreciate you asking me
16 to break it down and clarify. I'll strike that.

17 As we visit concretely here on this
18 project, let me start with the first question, is it
19 the testimony of Netherland, Sewell, or you as its
20 agent, that there is a potential barrier to flow
21 between the Lower San Andres and the Grayburg?

22 A. Yes, from --

23 MR. RANKIN: Objection. Form.

24 THE WITNESS: Oh, sorry.

25 HEARING OFFICER HARWOOD: Overruled.

1 BY MR. WEHMEYER:

2 Q. Is it the testimony of you and Netherland,
3 Sewell here to this New Mexico Oil Conservation
4 Commission that there is, in fact, an impermeable
5 barrier all the way across the EMSU that prohibits the
6 flow of fluid from the San Andres into the Grayburg?
7 Yes or no?

8 MR. RANKIN: Objection. Foundation. He's
9 talking about formation nomenclature that Mr. Knights
10 did not address in his testimony. So I think the
11 question needs to be specified so he understands the
12 question.

13 HEARING OFFICER HARWOOD: Overruled.

14 A. With a caveat. Can I put a caveat in yes or
15 no or say it's gray? I don't know.

16 Q. Is it gray?

17 A. Well, the specific statement you made, is
18 there a barrier, one barrier across the entirety of
19 the EMSU, I would say I have not identified one single
20 barrier, but many individual barriers.

21 Q. With respect to what you're saying, "many
22 individual barriers," is it the testimony of you, for
23 Netherland, Sewell here to this New Mexico Oil
24 Conservation Commission that taking the many barriers
25 that they prohibit -- that it is an impermeable

1 barrier that does, in fact, prohibit any fluid
2 migration from the San Andres into the Grayburg?

3 A. I would say significantly inhibits.

4 Q. Can you help me with the difference between
5 significantly inhibits and completely stops?

6 A. I'm not 100 percent sure, but the
7 preponderance of the evidence that I've reviewed
8 indicates that there is more likely strong indications
9 of permeability barrier between fluid flow from the
10 Goodnight injection zones and the Empire shallow
11 production and the shallower potential ROZ.

12 MR. WEHMEYER: I'd object to the
13 nonresponsive and ask that that be stricken. And
14 this is to the ends of -- I'm not going to fuss with
15 him or fight over it with him on decorum, but I do
16 need the answer to the specific question I'm asking.

17 HEARING OFFICER HARWOOD: Well, reask it
18 then. I'm not going to strike the answer.

19 BY MR. WEHMEYER:

20 Q. The question is, if you'll focus on --

21 A. Yeah, I'm...

22 Q. -- what is the difference between
23 significantly inhibits and completely stops?

24 A. The degree of certainty.

25 Q. You're saying that that is -- a degree of

1 certainty is what differentiates those two things?

2 A. Yes.

3 Q. Have you opined anywhere on a degree of
4 certainty as to "significantly inhibits"?

5 A. No.

6 Q. And if Mr. Rankin comes back after the
7 break, you're not going to be able to put a percentage
8 on that, are you?

9 A. No.

10 Q. Now, as a geologist, I thought I heard
11 Mr. Rankin's objection a moment ago that you don't
12 know where the San Andres is. You didn't pick any
13 tops of the San Andres, did you?

14 A. No.

15 Q. Well, you're laughing. Help me with that.
16 Why are you laughing on a question when we've got 21
17 witnesses in this thing, and the Commission has got to
18 make a decision, and I ask the geologist, "Did you
19 pick the top of the San Andres" and you laughed? Tell
20 me why that one is a funny one?

21 A. You have a number of geologists picking the
22 top of the San Andres at various places. You didn't
23 need another one to put another estimate on there.

24 The problem with the San Andres is it's
25 just not a defined interval. So it's basically to the

1 winds of whoever is picking it, for whatever reason
2 they're picking, where they are picking it. And I
3 didn't want to get into that quagmire.

4 Q. Well, maybe we are going to get to that
5 person, but we've deposed everything that moves, and I
6 haven't seen it yet.

7 Who is the Goodnight witness that is
8 going to get on the stand and tell the Commission that
9 they picked the top of the San Andres?

10 A. I would assume that would be Preston
11 McGuire, I think.

12 Q. Did he pick them or did he rely on hearsay
13 from someone that is no longer with the company?

14 A. I do not know. Again, I tried to stay away
15 from that.

16 Q. Do you know where the Lovington Sand is?

17 A. I never really looked for it. The
18 nomenclature was new to me.

19 Q. In terms of if the commissioners want to
20 know where the top of the San Andres is -- strike
21 that.

22 If the commissioners want to know,
23 according to Mr. Knights, where the Upper San Andres,
24 is that any analysis you performed? Could you all
25 tell them where the Upper San Andres is?

1 A. No.

2 Q. If they wanted to know where the Lower
3 San Andres is, as the geologist here, could you tell
4 them where the Lower San Andres is?

5 A. No.

6 Q. If they wanted to know where the Lovington
7 Sand is, you couldn't tell them where the Lovington
8 Sand is?

9 A. No.

10 Q. Now, in terms of the -- as we continue this
11 barriers to flow, we saw at Number 2 here in your
12 report that your task was to confirm the presence of
13 geologic barriers isolating the San Andres Formation
14 from the overlying Grayburg Formation. I read that
15 correctly?

16 A. Yes, you did.

17 Q. You heard your counsel's objection earlier
18 that you didn't know where the San Andres was, right?

19 A. Correct.

20 Q. So how did you confirm the presence of
21 geologic barriers isolating the San Andres Formation
22 from the overlying Grayburg Formation if you didn't
23 even pick the tops, you don't know where it is, you
24 don't know where the Lovington is, you don't know
25 where Upper San Andres is or the Lower San Andres is?

1 A. I defined my own internal nomenclature.

2 Q. Will you help the commissioners with what
3 your methodology was to pick the -- was it just the
4 7 percent porosity cutoff, as you went about work here
5 as a geologist? Was that it?

6 A. No.

7 Q. What then was your methodology? Move now
8 not from data but the we're moving over to
9 methodology. What was your methodology to confirm a
10 barrier?

11 A. Trying to look at preponderance of data and
12 defining where reservoirs are. And so the two
13 reservoirs that I've defined that people variously
14 call whatever name they want to, are the Goodnight
15 injection zone, which is significantly below a
16 negative 700 feet and it was defined by permeability
17 fluid flow, water supply wells and injection wells,
18 that had a unique characteristic from a reservoir
19 quality perspective.

20 And then I had the additional
21 information on the Grayburg producing oil-water
22 contact that has significantly different reservoir
23 characteristics.

24 And then I had the petrophysical
25 analysis that analyzed below the producing oil-water

1 contact and that negative 700, which I considered
2 aquifer below that and found numerous amounts of
3 indications of permeability barriers, horizontal
4 permeability barriers.

5 And I didn't see any evidence of any
6 indication of communication between those two separate
7 reservoirs. And nomenclature was not in my -- I
8 just -- I think that just confuses things.

9 Q. Then why did you use it in the very first
10 paragraph of what you wrote?

11 A. When you're first tasked for a performance,
12 you're given all kinds of directives and people are
13 trying to say how they view the reservoir. They view
14 it as Grayburg San Andres, the actual unit was named
15 Grayburg San Andres. I think it ill defined
16 originally, and I think the definition of San Andres,
17 in my opinion, should have developed over the history
18 of the -- with the new data, indicating that there are
19 different reservoirs within the San Andres.

20 And much like the Grayburg has 82
21 separate parasequences that have different
22 permeabilities of perm barriers between those, the
23 San Andres is likely having a similar set of
24 stratigraphic barriers and reservoirs that have
25 different qualities throughout the whole thing.

1 And I just did not get into the -- what
2 you call San Andres, what Preston would call
3 San Andres, what Adam would call San Andres, what
4 anybody in the room would call San Andres. I just
5 didn't think that was important to my oil in place or
6 the definition of reservoir isolation between one and
7 the other.

8 Q. So if you we just come back to what you say
9 your charge was, so that we've got this in one place
10 for later in closing argument, evaluate and confirm
11 the presence of geologic barriers isolating the
12 San Andres Formation from the overlying Grayburg
13 Formation.

14 It would be your testimony to the
15 Commission that you don't have an opinion on that
16 because you don't know where each of those formations
17 are?

18 MR. RANKIN: Objection. Foundation, form.

19 A. Yes, I don't have any testimony.

20 HEARING OFFICER HARWOOD: Overruled.

21 And, Doctor, when these objections come
22 up, you have to wait. Okay?

23 THE WITNESS: I apologize.

24 A. Am I supposed to answer now? I was asking
25 for the question again.

1 Q. I'm sorry, I just didn't understand. I'm
2 not fussing with you. And I appreciate the --

3 A. I don't mind.

4 Q. Yeah, I appreciate you doing that.

5 If the commissioners want to know
6 whether you have confirmed the presence of geologic
7 barriers isolating the San Andres Formation from the
8 overlying Grayburg Formation, you would tell them that
9 you don't have any testimony on that, do you?

10 A. It's depending on whose personal
11 interpretation of the San Andres.

12 As specific depth intervals that are
13 unambiguous at negative 700 between the producing
14 oil-water contact at negative 350 and negative 700, I
15 believe there is a number of permeability barriers
16 that -- potential permeability barriers that are
17 identified in that interval.

18 And various geologists would call that
19 San Andres Grayburg. I wanted to be very specific,
20 and there's no ambiguity in where I pick these. I
21 have TVD subsea depth and an X, Y. It is not in the
22 interpretation of anybody's what I'm going to call it.

23 Q. You used a new phrase now. This one is
24 actually in your report. What is, quote, potential
25 permeability barrier?

1 A. "Potential" is word we use because we are
2 not 100 percent sure.

3 Q. And in terms of putting a probability
4 percentage on it, we visited earlier, even if we give
5 you a break over lunch, you're not going to be able to
6 give us a percentage on how sure you are or not, are
7 you?

8 A. No. It's more than likely, likely. And the
9 issue with geology and interpretation is, you're
10 actually interpreting every half foot for thousands
11 and thousands of feet. So you really do have to have
12 a preponderance of data or a most likely case.

13 Because if you're trying to be certain
14 and 100 percent certain, then you almost can never
15 make a financial decision or a decision at all if you
16 want 100 percent certainty.

17 Q. Well, no, I asked what is a potential
18 permeability barrier. You said it's something not
19 100 percent sure. I asked can you put a percentage on
20 it. And your answer is you cannot put a percentage on
21 it; is that correct?

22 A. I can, but I won't.

23 Q. I'll take that. And even if we take a
24 lunch, you're not going to come in and all of a sudden
25 have an answer after visiting with counsel, are you?

1 A. Not without -- but if I go to sleep, I may
2 have a different interpretation, as that's where I do
3 most of my thinking.

4 Q. While you're asleep?

5 A. It's amazing. I wake up in the morning and
6 go, "Oh, my gosh."

7 Q. Okay. So as we come back to your
8 methodology here to get to potential permeability
9 barriers, did you review literature?

10 A. Specifically for the perm barriers, I mean,
11 I attempted to review when people say they want
12 literature basis. I did look, but there's very little
13 literature on permeability barriers.

14 Q. Well, the -- with respect to the EMSU here,
15 you know, Dr. Lindsay has written a Ph.D. discussing
16 that water is migrating from the San Andres up into
17 the Grayburg.

18 MR. RANKIN: Objection. Mischaracterizes
19 the testimony of Dr. Lindsay and his Ph.D. thesis.

20 HEARING OFFICER HARWOOD: Rephrase.

21 BY MR. WEHMEYER:

22 Q. Have you read Dr. Lindsay's work on water
23 migration the San Andres into the Grayburg?

24 A. First part, yes. Second part, no.

25 Q. Does Dr. Lindsay opine that water is finding

1 its way up into the Grayburg from the San Andres?

2 A. I did not get that from reading his
3 testimony or looking at his figures.

4 Q. What about hearing his testimony here in the
5 proceeding?

6 A. If he stated that, I would probably disagree
7 with that interpretation.

8 Q. Did you read the Chevron paper that spoke to
9 water migration?

10 MR. RANKIN: Objection. Foundation and
11 form.

12 HEARING OFFICER HARWOOD: Overruled.

13 A. I'd have to see which specific Chevron
14 discussion that you're talking about.

15 Q. As the expert here, you can't -- after we've
16 seen the Chevron paper flashed 20 times, you can't --
17 you have no idea what Chevron paper I'm talking --

18 MR. RANKIN: Mr. Hearing Officer, there's
19 several Chevron papers.

20 HEARING OFFICER HARWOOD: I'm sorry, what
21 was that? I heard what you said, there are several
22 Chevron papers.

23 In fairness to the witness, can you
24 identify the paper you're talking about,
25 Mr. Wehmeyer?

1 BY MR. WEHMEYER:

2 Q. Any Chevron paper.

3 A. Could you rephrase the question?

4 Q. Do you recall seeing in this courtroom any
5 Chevron paper in which Chevron discussed migration of
6 fluids from the San Andres into the Grayburg?

7 A. Again, I have seen a lot of data. I'm not
8 sure which ones were Chevron. But if you could show
9 me, I would gladly make a statement.

10 Q. I'm actually going to move over to -- what
11 about pressure data, the 211 well with the RFT
12 measurements that were taken of that well back against
13 the Technical Committee Report, initial pressure
14 measured up in the Grayburg? Have you done any kind
15 of studies based on the pressure data, on pressures,
16 to identify whether there's depletion occurring?

17 A. Define "study." I've reviewed data and
18 observed data and analyzed it mentally that shows that
19 there's pressure barriers.

20 Q. My question is pressure depletion in the
21 San Andres as a result --

22 A. Same.

23 Q. And I'm specifically talking about the RFT
24 measurements in the 211 well. And I can show you the
25 slide.

1 A. I think I have the slide in my mind. But I
2 think you said San Andres first, or Grayburg?

3 Q. The measurements were in -- the RFT tool was
4 measured throughout the Grayburg into the San Andres.
5 The initial pressure reading was out of the Grayburg
6 in the Technical Committee Report.

7 A. Again, I'm not sure whose San Andres you're
8 talking about. But I'm familiar with the depths and
9 the pressure variations that indicated permeability
10 barriers between them.

11 Q. This is a slide that you're familiar with?

12 A. Yeah, I've seen that.

13 Q. So in the 211 well, all of the little
14 bullseyes, those are measurements off the RFT tool in
15 1986, which would go down into the San Andres,
16 correct?

17 A. By someone's definition of San Andres, yes.

18 Q. And do you see that there's a 282 psi
19 depletion that's reflected here off of what would be
20 anticipated pressure off of the Technical Committee
21 Report original pressure reading?

22 A. The initial pressure reading in the
23 San Andres?

24 Q. In the Grayburg.

25 A. In the -- I'm confused. That pressure, that

1 1527, is, by this, in the San Andres.

2 Q. That would have been predicted in terms of
3 where it should have been based on the pressure
4 gradients.

5 A. Predicted from? Do you know what the
6 pressure gradient was in the San Andres at 3700 feet?
7 I can't ask questions. I'm just kind of --

8 Q. I'm just trying to figure out with your work
9 here as a geologist, if you're talking about barriers,
10 did you do any of your own geological work here or
11 engineering work to look at pressure depletion to see
12 if there's pressure depletion between the Grayburg and
13 the San Andres? Yes or no?

14 A. I don't think I had any pressure data in
15 what some people call the San Andres.

16 Q. We were talking about literature. Have you
17 seen any literature that says there's an impermeable
18 barrier across the EMSU that would isolate the
19 San Andres from the Grayburg?

20 A. Literature that says specifically perm
21 barriers across the entire EMSU, no.

22 Q. Okay. So if the Commission wanted to know
23 after 100 years of oil and gas development out here
24 whether anybody has written that there is a potential
25 permeability barrier across the EMSU, you haven't seen

1 that, have you?

2 A. Correct.

3 Q. Have you seen any literature that would
4 report bedded anhydrite all the way across the EMSU?

5 A. No.

6 Q. If anhydrite is bedded, what did does
7 "bedded" mean?

8 A. It means it's a horizontal layer.

9 Q. How thick does it need to be?

10 A. Does it need to be for what?

11 Q. To be able to call it "bedded anhydrite."

12 A. I don't know. A couple inches, half foot.

13 Q. And so here, if bedded anhydrite is a couple
14 inches -- again, you haven't done any kind of a
15 fracture gradient analysis in terms of what would
16 cause existing fractures to expand or widen or
17 actually break through that rock, have you?

18 A. No.

19 Q. If fluid does migrate from the San Andres
20 that Goodnight's injecting -- are you with me so far?

21 A. Yes. An assumption.

22 Q. -- if the potential baffle doesn't keep that
23 water down there -- are you with me so far?

24 A. If and if. Yes.

25 Q. -- would you agree that that would interfere

1 with Empire's oil and gas operations in the Grayburg?

2 A. May I ask a clarifying question?

3 Q. Sure.

4 A. "Interfere," what does that mean?

5 Q. Make more expensive. Cause the loss of oil.
6 Cause less oil to be recovered. Or is the answer I
7 don't know?

8 A. I don't know.

9 Q. And the reason I ask that is because counsel
10 asked you -- do you remember, like, the last three
11 questions he had of you were about whether Goodnight's
12 operations are having an effect on Empire? Right?

13 A. Sure.

14 Q. I'm going to step sideways here for just a
15 second. In terms of evaluating an ROZ project, you
16 said you've been involved as a consultant assisting
17 clients in evaluation an ROZ project?

18 A. Yes.

19 Q. And if we come here to the EMSU and we
20 hypothetically play out that Empire approaches you to
21 ask you about an ROZ in the San Andres -- are you with
22 me so far?

23 A. Which San Andres?

24 Q. All of the San Andres Formation.

25 A. All of them.

1 Q. Let's do the entire San Andres that's in the
2 unit that the Commission formed in 1984. Then are we
3 on the same page?

4 A. I think so, but -- yeah, sure. I'll try.

5 Q. You know right this second that Goodnight is
6 injecting into Empire's earlier established oil unit,
7 right?

8 A. I know the depths that they're injecting
9 into.

10 Q. Are you familiar with any other instance,
11 have you ever seen that in your career, where a
12 commercial saltwater operator is injecting into
13 somebody's designated unit?

14 A. Not that I'm familiar with, no.

15 Q. This would be the first one?

16 A. That I've seen, yes.

17 Q. So coming back to this, if Empire approaches
18 you and says, "I'm looking at an ROZ development.
19 Maybe it costs \$1.2 billion, and I'm going to do the
20 entire San Andres" -- are you with me so far?

21 A. I think so, yes.

22 Q. -- and that's not a hypothetical in terms
23 of -- you heard Mr. West actually sit up here and
24 testify that Empire's intention, Phil Mulacek, they do
25 everything big, they're going to go all the way down

1 to the top of the -- to the top of the Glorieta. Did
2 you hear Mr. West's testimony?

3 A. I heard that.

4 Q. -- would you tell them this is a concern,
5 that there is vast amounts of saltwater being injected
6 into the interval that you want to conduct your
7 tertiary operation in?

8 A. Would that be a concern of mine?

9 Q. Yes.

10 A. To them?

11 Q. Yes.

12 A. No.

13 Q. Why?

14 A. Because if the alleged resource is in the
15 San Andres and it is residual, it's not going to be
16 moved by injection of fluid.

17 Q. Isn't it going to make a CO2 program
18 different -- injecting that fluid is going to change
19 pressures. It's going to cause more expensive use of
20 CO2. Once oil becomes mobile after the CO2 invades
21 those pore spaces, it can be washed out of the
22 recovery wells. All of these are potential lost
23 hydrocarbon in this hypothetical, aren't they?

24 A. I would assume that might be an impact.

25 Q. And so, again, coming back to your advice to

1 Empire who approaches you in light of this saltwater
2 injection, you can tell this Commission that any
3 investor, be it a bank that's lending -- you represent
4 banks making decisions on whether to lend, right?

5 A. Yes.

6 Q. Operators making decisions on whether to
7 drill?

8 A. Yes.

9 Q. Working interest owners making decisions
10 over whether to elect to participate on an AFE, to
11 participate in a project?

12 A. Correct.

13 Q. You are absolutely going to tell them that
14 this saltwater injection is a concern, aren't you?

15 A. I don't know, really.

16 Q. Now, in terms of the baffles, were you able
17 to map a single baffle that went all the way across
18 the EMSU? Were you able to correlate that in your
19 logs, a baffle that you could -- if you started
20 2 inches over here and you could follow it all the way
21 over?

22 A. I did not map.

23 Q. And that's actually a question, in and of
24 itself. I didn't find a single map you created in
25 this entire case. Did you create one single map

1 through three statements, two of them you revise, and
2 a deposition, and you being a geologist, is there one
3 map you actually made here?

4 A. Well, the maps in my presentation were
5 basically data posted at individual wells. But I did
6 not contour a map around the EMSU.

7 Q. I know you took Ops Geologic's maps and
8 contours, right?

9 A. Yes. I reviewed --

10 Q. Other than just adding some numbers to maps
11 that other geologists made, you didn't make a single
12 map here, did you?

13 A. Correct.

14 Q. And this is truly not a smart aleck
15 question, but don't geologists, like Love creating --
16 isn't, like, the first thing you're doing is you're
17 looking at the actual core and you're making maps?

18 A. Well, in the due diligence process, making
19 maps, much like picking San Andres tops, kind of
20 confuses the issue. I have enough maps and things to
21 basically do diligence on and see if they're accurate,
22 see if they make sense, and use their information.

23 Because a lot of times when I'm
24 reviewing something, the other people have spent a lot
25 more time looking at the environment, geologists, and

1 basically, I just want to confirm, validate and use
2 whatever data I can from other experts.

3 Q. So the other experts here, you said they
4 spent a lot more time doing the evaluation?

5 A. Correct.

6 Q. You didn't rely on any of Dr. Davidson's
7 maps, did you?

8 A. I don't know if he made maps.

9 Q. I didn't see one. So to state it
10 differently, you're not aware of a single map that
11 Netherland, Sewell made here, are you?

12 A. Correct.

13 Q. And so if we just come back to the work, you
14 like to rely on all the other work because they've
15 done more work. That was your testimony a moment ago?

16 A. Correct.

17 Q. Here, that would be NuTech and Ops Geologic,
18 wouldn't it be?

19 A. That was the data that I reviewed from a
20 validation standpoint, yes.

21 Q. Now, as we continue to talk about the
22 mapping, you were not able to map -- did you even try
23 to map a particular baffle that would have gone across
24 the EMSU, whether it's 2 inches thick or 400 feet
25 thick?

1 A. No, I did not.

2 Q. And you can tell the Commission, though,
3 based on looking at these logs, there is not going to
4 be one single baffle that goes all the way across, is
5 there?

6 A. I cannot say there is not.

7 Q. After all of your work here, if there was
8 one to be found, do you think your work would have
9 found that baffle?

10 A. Not necessarily.

11 Q. So I guess just...

12 A. I'm trying to answer it.

13 Q. No, no, I appreciate your cooperation. None
14 of this is a fuss with you. I'm just trying to get my
15 head around how, if you're the barrier guy and you're
16 the geologist and you have all of these logs and we're
17 talking about baffles or barriers, if there was one,
18 why you didn't map it to bring it in here and show the
19 commissioners?

20 A. Why I didn't map it. I guess the number of
21 logs and the data that we have, even if we could map
22 it between the points, there would be a lot of
23 extrapolation where you don't have data or don't have
24 quality data to actually have a high degree of
25 confidence in the data.

1 Q. So basically what you're saying is, if you
2 were going to try to map a baffle or a barrier that
3 would go all the way across, there's too much
4 uncertainty in your data to be able to do that and
5 come in here and give an opinion to these
6 commissioners?

7 A. For a single barrier, yes.

8 Q. Now, help me. If I'm understanding your
9 report correctly, I didn't see that you really tied
10 this back to logs or core at all. In terms of the
11 idea of a baffle or barrier, it looked to me like you
12 left geology and went to engineering and said that you
13 observed mud losses. Is that fair?

14 A. That's probably fair.

15 Q. So if the Commission wants to know on this
16 baffle or barrier testimony, is this geology or is
17 this, like what you said in your report, you know,
18 really what I saw documented were mud losses and so
19 that's where my opinion lands, it would be fair to say
20 this is more of an engineering mud loss type of
21 opinion for these commissioners?

22 A. Yes. Integrating the geology and the
23 engineering, I came to my professional opinion.

24 MR. WEHMEYER: May I approach to just show a
25 demonstrative?

1 HEARING OFFICER HARWOOD: Approach the
2 witness?

3 MR. WEHMEYER: I'm trying to honor decorum.
4 Before I leave my place at Bar, I want to make sure I
5 have permission to go get that board.

6 HEARING OFFICER HARWOOD: Sure. That's
7 fine.

8 Do you need to move, Mr. Rankin, to see
9 what Mr. Wehmeyer is pointing out? Feel free to do
10 so.

11 BY MR. WEHMEYER:

12 Q. So I'm just going to kind of lay out what
13 we've got. Can you see the black? Do you see the
14 black line?

15 MR. RANKIN: Mr. Wehmeyer, just let me know
16 what images we're looking at so I can understand what
17 they are.

18 BY MR. WEHMEYER:

19 Q. We've got the SWD wells on here and we have
20 numerous of the other deeper wells that --
21 conventional wells that have been drilled. And what
22 we've got is a map by Ops Geologic, top of the Lower
23 San Andres.

24 We've got purple. They've mapped in the
25 purple, the mud losses. Because we've heard all about

1 the mud losses and how we know this is happening,
2 right? You've heard that in here and we've read that
3 1,000 times, right?

4 A. Correct.

5 Q. Purple is the mud losses in the various
6 wells that have been reported. Red is Ops Geologic's
7 top of the San Andres. This brown is the Lovington
8 Sand. Black is the Lower San Andres.

9 So are we oriented now in terms of -- I
10 think really the easiest way is if you focus in on
11 purple being those mud losses and the red being Ops
12 Geologic's top of San Andres, and blue Goodnight's,
13 what Preston McGuire got from somebody else. Blue
14 would be the Goodnight top of San Andres.

15 A. Okay.

16 Q. Are you with me so far? Have you tired to,
17 like, actually correlate this? As we talk about,
18 well, it's explained by the loss of mud during
19 drilling, have you tried to map where the loss of mud
20 happened in relation to anybody's top of San Andres?

21 A. No. Just TVD subsea absolute value.

22 Q. And you can tell the commissioners here that
23 purple is the loss of the drilling fluid that is
24 all -- there is zero correlation between where fluid
25 was lost and anybody -- the Lovington Sand, the top of

1 the San Andres, either side's top of the San Andres --
2 if you've got opinions about mud losses having some
3 relevance here, can you explain to the Commission how
4 that is based on the actual data?

5 A. Why there is mud loss?

6 Q. Yes. How does the mud loss, with the
7 variable depths that this happened -- tell the
8 Commission anything about whether there's
9 communication between the San Andres and the Grayburg.

10 A. Again, I -- the tops, San Andres Grayburg, I
11 think between negative 350 and negative 700, I've got
12 significant indications of multiple permeability
13 barriers that may not individually go across the
14 entire EMSU. But individual reservoirs, even in the
15 loss circulation, can be stratigraphically isolated.

16 Q. They might be stratigraphically isolated or
17 they might not be, right?

18 A. They -- sure.

19 Q. And with respect to stratigraphic isolation,
20 you've heard testimony about the baffles. You're not
21 disputing as a matter of geology that there can be
22 baffles within that might change pressures in isolated
23 intervals, but that wouldn't extend across the EMSU,
24 are you?

25 A. That wouldn't?

1 Q. Correct.

2 A. Could you state that again? I'm not sure --

3 Q. You're not disputing that in a particular
4 well, there can be isolated areas of baffles that
5 would not be extensive across the entire 14-acre EMSU?

6 A. Yes, that could be correct.

7 Q. And, again, I've heard so much about the
8 mud. I told the guy, I said, "I've got to see it on
9 one" -- "just show me, where is the mud happening so I
10 can get my head around this."

11 Can you explain to the commissioners, if
12 they go back and read your witness statements and it
13 says, "I have opinions about potential flow barriers
14 based on where mud was lost," by reference to this
15 correlation or comparison across the log section, can
16 you show them how that testimony is supported?

17 A. How it is -- I'm a little confused on the
18 question.

19 Q. Yeah. And I -- on some days, I'm an okay
20 lawyer. I'm a terrible geologist and engineer, I can
21 tell you that. So help me if I'm just asking the bad
22 question and I need to ask it differently.

23 But if the idea of your baffles are
24 explained as a matter of engineering, which is what we
25 just covered before I stood up here.

1 I said: If it's geology, let's see it
2 mapped.

3 You said: I don't have that.

4 I said: Is it really more engineering?

5 You said: Yes, it's the mud losses.

6 I'm showing you the mud losses. I'm
7 showing you what someone at Goodnight at some point in
8 time felt was the top of San Andres, what Ops Geologic
9 has mapped as the top of San Andres. And I've even
10 put the Lower San Andres on here, too, and I've even
11 given you the Lovington Sand.

12 Can you tell the commissioners, in your
13 own testimony, how on earth does this support the idea
14 that there is an impermeable barrier across the EMSU
15 that would isolate injection from the Grayburg?

16 A. At one specific -- I'm not sure.

17 HEARING OFFICER HARWOOD: This would be a
18 good place to break for lunch?

19 MR. RANKIN: Mr. Wehmeyer, I can't see it
20 from where I'm sitting. Ms. Hardy, perhaps you guys
21 can send us a copy of what we're looking at, because
22 I just can't tell what we're looking at from this
23 distance. And I wouldn't mind being able to look at
24 it so I can prepare for redirect.

25 MR. WEHMEYER: Sure. And I should have

1 pointed this out. If this helps, A, it's over here
2 on the very far -- so that there's no cherry-picking,
3 A is on the very far western edge. A minus is over
4 here at the southeast. We have some data points way
5 out here east.

6 So as you track these, I will send the
7 answer key --

8 MR. RANKIN: Mr. Hearing Officer, I'm not
9 asking for Mr. Wehmeyer to testify. I'm just asking
10 him to share the document with me so I can see it.

11 HEARING OFFICER HARWOOD: Why don't you guys
12 do that over lunch.

13 Chairman Rozatos, what time is your
14 pleasure for the Commission to be back?

15 CHAIR ROZATOS: Let's return back at 1:15.
16 I think it will be a perfect time. And that will
17 give them some time to also exchange information.

18 HEARING OFFICER HARWOOD: We'll break for
19 lunch and be back at 115. Thank you.

20 (Lunch recess held from
21 12:01 to 1:19 p.m.)

22 HEARING OFFICER HARWOOD: All right. Let's
23 see, where were we. Cross-examination, Mr. Wehmeyer.

24 MR. WEHMEYER: Thank you.

25 BY MR. WEHMEYER:

1 Q. When we left off at the break we were
2 visiting on these various logs with the plots. I'm
3 going to try to bring this up. The coloring is better
4 electronically.

5 And what we've done here by way of
6 demonstrative is attempt to show across the EMSU the
7 alleged mud losses against Goodnight's top of
8 San Andres, Empire's top of San Andres. We've also
9 mapped here the Lovington Sand in brown.

10 So, again, to just orient here by way of
11 the colors, the purple is the mud losses and drilling
12 that are reported. The purple along the bottom, can
13 you see that?

14 A. Yeah.

15 Q. You're welcome to refer to the hard copy. I
16 don't think I can zoom in on this. I'm going to try.

17 A. I think the one that you previously
18 mentioned was the loss circulation zones.

19 Q. Yes, that was the purple, is what I'm
20 getting at.

21 A. You called that purple.

22 Q. In terms of actually doing your work here,
23 did you ever actually go in and plot well by well
24 where the alleged circulation losses occurred?

25 A. I did have that in spreadsheet form and

1 reviewed the drilling reports to see where those
2 occurred.

3 Q. With respect to the Andre Dawson, do you see
4 that would have actually occurred above everybody's
5 pick of the San Andres?

6 A. Yes.

7 Q. Again, just in terms of the idea that any
8 barrier, if it's based on mud losses, would be
9 isolating injection in the Lower San Andres and the
10 Grayburg, in light of the Andre Dawson well there with
11 the mud loss, alleged loss circulation, can you
12 explain how that would work as a barrier in that
13 location?

14 A. Yeah. Loss circulation is where you have a
15 change in the reservoir, the pressure differential,
16 indicating that you have a barrier on top and a
17 barrier on bottom. And specifically in the Dawson
18 well, that was a very minor volume of loss
19 circulation. And later on, they had some significant
20 loss in variation down in where most of the other
21 wells also lost their circulation.

22 So I think each one of these loss
23 circulations, the top of those is a distinct
24 permeability barrier from everything above it.

25 Q. But, again, in terms -- have you made any

1 effort to go back and look at the actual logs against
2 the loss circulation to try to make a correlation or
3 distinction there?

4 A. Very minor. It wasn't blatantly obvious
5 that there was a large porosity differential. But the
6 pressure and the loss of a significant amount of fluid
7 indicates that it is actually a significant
8 permeability barrier.

9 Q. And, again, I'm just trying to understand.
10 Can you talk us through, with this data on -- well,
11 strike that. The first question is, have you gone
12 well by well where Goodnight alleges circulation
13 losses and tried to correlate that to the porosity and
14 permeability interpretations of Netherland, Sewell to
15 somehow tie those together?

16 A. Yes. I looked at that.

17 Q. Did you create any actual work product as
18 part of that effort?

19 A. No.

20 Q. So if the Commission wanted to see that rock
21 product, that doesn't exist. True?

22 A. Not in my testimony, no.

23 Q. You talked about secondary authorities
24 earlier. As we talked about the producing oil-water
25 contact, as I understand it, you had some critiques of

1 Dr. Buchwalter's material balance simulation?

2 A. Yes.

3 Q. And what's --

4 A. Disagreements.

5 Q. Let's talk about the producing oil-water
6 contact. Are you aware that the producing oil-water
7 contact actually was lowered from 350 feet to about
8 500 -- strike that. Are you aware that the producing
9 oil-water contact lowered from 300 feet to about 540,
10 550 feet?

11 A. I don't understand. I mean -- yeah, you'll
12 have to explain a little more.

13 Q. Do you know this within the Grayburg, the
14 producing oil-water contact actually lowered with
15 production, that it moved deeper subsea?

16 A. In the EMSU?

17 Q. Yes.

18 A. No.

19 Q. If the producing oil-water contact lowers by
20 200-plus feet, what would that do to the water in the
21 Grayburg?

22 A. I'm not sure I understand the question.

23 If --

24 Q. If the producing oil-water contact lowers
25 through production of the Grayburg -- are you with me

1 so far?

2 A. I don't understand that concept, where that
3 would happen.

4 Q. In terms of the producing oil-water contact.

5 A. So you had an oil-water contact?

6 Q. Yes.

7 A. And you produced oil?

8 Q. And it goes down.

9 A. And it goes down?

10 Q. Yes.

11 A. Yeah, I'm not sure how that physically
12 happens. Ask a question.

13 Q. And I'm probably asking the question
14 incorrectly here. Are you aware of the oil-water
15 contact in the EMSU ever lowering?

16 A. No.

17 Q. If it did lower, what would that do to water
18 in the Grayburg?

19 A. I don't know how to answer that.

20 Q. So just looking at this Chevron paper from
21 1989, EMSU Grayburg estimated oil-water contact at 550
22 subsea. Where is your producing oil-water contact
23 based on your work?

24 A. 350.

25 Q. So that would be off by 200 feet from what

1 Chevron is writing about in 1989, correct?

2 A. Yeah. I have seen no evidence at all of a
3 producing oil-water contact below 350 feet TVD subsea.

4 Q. So the additional drilling of new wells
5 after the '80s couldn't lower that oil-water contact?

6 A. I don't see how that would physically be
7 possible. I believe in gravity.

8 Q. With respect to the secondary authorities we
9 were visiting on earlier, the 1996 Chevron paper that
10 I mentioned, was this part of anything you reviewed in
11 your literature search in terms of trying to identify
12 literature that would have spoken to communication
13 between the San Andres and the Grayburg?

14 A. I don't believe I reviewed this. Is this an
15 exhibit?

16 Q. Exhibit I-7. You've never seen this before?

17 A. I've seen the exhibit, but reviewing the
18 paper, I'm not sure.

19 Q. Okay. According to you, this is not
20 literature that would indicate that there was
21 communication between the San Andres and the Grayburg
22 at EMSU?

23 A. I would have to remember this. I would have
24 to reread that and come to a conclusion.

25 Q. You haven't done that as part of your

1 barrier work in this case?

2 A. I may have reviewed this. But I definitely
3 didn't come to a conclusion that there was any
4 communication between the San Andres and the Grayburg.

5 Q. Here's another Chevron paper. A portion of
6 the water production is probably attributable to
7 communications of Zones 4 and 5 with the Lower
8 Grayburg and San Andres aquifers. Although
9 siliclastics between each zone generally prevent
10 vertical communication in some localized areas of the
11 field, they do not act as permeability barriers. When
12 the barriers break down in the Lower Grayburg
13 members, the prolific San Andres aquifer can influx
14 into the oil productive horizons, resulting in large
15 volumes of water production.

16 Did you read this as part of your
17 literature search before coming in with barrier
18 opinions?

19 A. I did read this, yes.

20 Q. Why does this not satisfy you that authors
21 had already written about communication?

22 A. This was represented in the AGU, not the
23 EMSU.

24 Q. It actually comes out of the Technical
25 Committee Report from 1983, yes, on the EMSU?

1 A. I do not -- I see the Technical Committee
2 Report of the Arrowhead Grayburg Lea unit on this.

3 Q. Can you explain as a matter of geology why
4 communication would occur between the Grayburg in the
5 San Andres and the AGU but not in the EMSU?

6 A. It's a different geologic setting.

7 Q. With respect to the critiques of
8 Dr. Buchwalter's model, isn't it the position of
9 Goodnight and its experts that Dr. Buchwalter should
10 have mapped the entire east half of New Mexico and
11 about half of Texas, too, as part of the simulation?

12 A. I have no clue.

13 Q. In terms of the critiques of Dr. Buchwalter
14 and how big his simulation model should have expanded
15 geographically is not something you've looked at?

16 A. I've reviewed his model and have some
17 criticisms of it. I don't know that that specific
18 thing represents my opinion.

19 Q. As we continue to talk about literature, I
20 asked you earlier about Ph.D.s and papers written by
21 Dr. Lindsay. Here, he's talking on the Arrowhead
22 Grayburg. And do you see the areas where he indicates
23 bottom water?

24 A. Yes. I see where he picks that out.

25 Q. Was this part of your literature search?

1 A. I did review this.

2 Q. And this isn't good enough for you to
3 indicate, as a matter of geology, that there would be
4 communication between the Grayburg and the San Andres?

5 A. Absolutely not.

6 Q. Were you in here for Dr. Lindsay's
7 testimony?

8 A. Yes.

9 Q. An additional paper written by Dr. Lindsay:
10 Evidence of communication between San Andres and the
11 Grayburg here, and a few well locations in Arrowhead.
12 There was a problem with the Upper San Andres
13 Formation bottom water production that ascended up
14 into the Grayburg strata via vertical plumes of water
15 along swarms of narrow, short space, fractures.

16 And then at Page 1004: These plumes of
17 vertically oriented Upper San Andres Formation bottom
18 water only affected small areas in the unit and in
19 most cases, only affected one well, though mapped as
20 though it was affecting a larger area.

21 Similar vertically oriented plumes of
22 Upper San Andres Formation water were also encountered
23 in individual wells further north in Eunice Monument
24 South Unit, EMSU, and EMSU-B.

25 Was this part of your literature search?

1 A. Yes.

2 Q. And this wasn't good enough for you either?

3 A. I had a different explanation that I think
4 is more reasonably geologically based.

5 Q. From Dr. Lindsay?

6 A. Correct.

7 Q. I'm going to try to get over to your slide
8 presentation now. Actually, I shall show this real
9 quick before we leave this.

10 We've also prepared a demonstrative from
11 an aerial perspective plotting the Goodnight top of
12 San Andres against the Empire top of San Andres
13 against the pressure losses. Have you done any work
14 like this to try to compare where the tops against
15 where are the alleged loss circulation events?

16 A. No.

17 Q. In terms of the geology here, I'm at your
18 Slide 2 -- and actually, I just want the Commission to
19 know what work you did versus didn't do.

20 Here at Slide 1, you did not create
21 this, did you? This was somebody else?

22 A. I pushed the buttons to create that, yes.

23 Q. Where did you get this?

24 A. This was created out of Drilling Info, or
25 now Enverus.

1 Q. That was a map from Drilling Info?

2 A. Yes.

3 Q. The second slide with the geology, you
4 didn't create this either?

5 A. No.

6 Q. In terms of the idea of migration pathways,
7 if this was really a migration pathway, how could oil
8 have gotten into these little tiny pores with low
9 permeability? If this was a failed migration pathway,
10 how did that oil saturate long enough to get into
11 these little tiny pores in incredibly low permeability
12 situations?

13 A. Well, the alleged hydrocarbon that might be
14 in those pores, I'm not sure I can explain how that
15 got there. But the migration pathways of oil
16 generated from the Wolfcamp and migrating through the
17 entire system is very complicated, so...

18 Q. Did any of the oil in the Grayburg come from
19 the Wolfcamp, or you don't know?

20 A. I would assume that that also came from the
21 Wolfcamp.

22 Q. Would it have passed through the San Andres,
23 or you don't know?

24 A. I'm assuming it would have passed through
25 the Grayburg in horizontal migration paths.

1 Q. No, my question is, how does it get from the
2 Wolfcamp to the Grayburg? Did it go through the
3 San Andres?

4 A. Complicated migration paths. I do not
5 believe it had to go through the San Andres.

6 Q. No, my question here is a matter of
7 scientific probability. Did it go through the
8 San Andres?

9 A. The oil that's in the Grayburg, I don't
10 believe so.

11 Q. Can you explain to the Commission how, with
12 scientific probability, the oil got from the Wolfcamp
13 to the Grayburg, or you don't know?

14 A. I do not know.

15 Q. I'll move over to your rebuttal. Actually,
16 this is the original testimony.

17 I have a question at Slide 5. As we
18 talk about geology, did you do any rock outcrop work
19 in this case? Did you look at any rock outcrops?

20 A. No.

21 Q. You know that Dr. Lindsay and Dr. Trentham
22 both have done rock outcrop studies as part of
23 studying this area?

24 A. Yes.

25 Q. Now, wouldn't evaluation of the rock outcrop

1 study be useful to identifying the rock facies within
2 the facies model here in the EMSU that Dr. Davidson
3 used?

4 A. I did not do anything with facies, and none
5 of my analysis had facies.

6 Q. You know that Dr. Davidson did, right?

7 A. Correct.

8 Q. And in terms of all of the petrophysical
9 analysis that you used then to calculate oil in place,
10 that all came from Dr. Davidson in his facies model?

11 A. Correct.

12 Q. Doesn't that give you concern, as a
13 geologist, that your work is derivative and
14 100 percent relying upon what was done by
15 Dr. Davidson, and he didn't look at any outcrop and
16 didn't actually study the core, describe the core
17 before putting together a model that was 100 percent
18 predicated on facies?

19 A. What was the question there?

20 Q. With you relying on that data, and, again,
21 all of your outputs -- so the Commission understands,
22 if we move and now start talking about oil in place,
23 100 percent of your work is dependent on the
24 petrophysical work done by Dr. Davidson. True?

25 A. I reviewed Dr. Davidson's and everyone

1 else's petrophysical analysis, so I incorporated all
2 of that data. And trying to validate data, I think --
3 actual physical data contradicts most of those
4 petrophysical analyses except Dr. Davidson's. So in
5 validating his model, his facies model, however he
6 interpreted it, seemed to match the actual physical
7 data. So I think I validated Dr. Davidson's model as
8 being the most accurate of any of the ones that I was
9 presented.

10 Q. Matched what actual data?

11 A. The core data.

12 Q. But you didn't describe or study the core,
13 and you never looked at either it -- and you didn't
14 look at the RR Bell core at all, did you?

15 A. No. What you do is you correlate to the
16 actual quantitative data, the measurements from the
17 core data, the oil saturations and the porosities,
18 much like the other petrophysical analyses either
19 should have done or tried to do.

20 Q. But if you're working off of a -- if you've
21 chosen at the petrophysical level to base all of your
22 work off of a facies model, the geology is all the
23 more important in terms of actually looking and
24 describing the core and studying rock outcrops, so
25 that you know what rock do I actually have in this

1 particular environment?

2 A. I would say no. The actual validation of
3 the petrophysical model is comparing it to the actual
4 physical data that you have. And if it doesn't match
5 that, you can't use it. And if it does match it,
6 that's a more valid analysis.

7 Q. What physical data did you have in the 679
8 well beneath the core?

9 A. We had none.

10 Q. Now, coming back, I just want to make sure
11 we've got this in the bumpers. With respect to your
12 work, now you mentioned that you looked at NuTech and
13 you looked at Ops Geologic. But in terms of your
14 calculation of original oil in place that you've
15 offered testimony, written and verbal, to this
16 Commission over, that was all derivatives off of what
17 Dr. Davidson did?

18 A. Correct.

19 Q. So I understand that you now say: Well, I
20 looked and criticized Ops Geologic, I looked and I
21 criticized NuTech.

22 But so there's no vagueness here, if
23 Dr. Davidson's work, petrophysical work, is wrong,
24 then your oil-in-place values are incorrect. True?

25 A. Well, I would say all of interpretations of

1 anything aren't wrong. It's a most likely realistic
2 case, and there could be sensitivities around there.
3 But like anything, making a statement of 100 percent
4 factual, this is the actual answer, I can't say that.

5 But I can say from my professional
6 opinion, that Dr. Davidson's is the most reliable,
7 most likely case of oil in place in the EMSU within
8 the depth intervals that I evaluated.

9 Q. I've forgotten my question now, but I don't
10 think that was an answer to it. I'm just trying to
11 take this down into pieces so we understand.

12 So you're saying all of the
13 petrophysical work by everybody is wrong, right?
14 You're saying, it's a matter of how wrong?

15 A. I'm saying that I looked at all the analyses
16 and I compared it to the actual physical data, and
17 there was a large discrepancy in most of the analyses.
18 The one that was closest to, which I also said that I
19 think he may have overestimated oil in place also, was
20 Dr. Davidson's. So I used that as an indication of
21 the oil in place and the potential recoveries of the
22 oil in these intervals.

23 Q. Well, you were off by a factor of 100
24 percent, just because you didn't know how to read the
25 data, right?

1 MR. RANKIN: Objections. Badgering the
2 witness.

3 HEARING OFFICER HARWOOD: It's
4 argumentative. Rephrase or withdraw.

5 BY MR. WEHMEYER:

6 Q. I mean, it's a real question. When you talk
7 about it's a matter of, you know, who's accurate, who
8 is not accurate, and that you've somehow looked at all
9 this and you're the final say on it. I mean,
10 literally, in terms of the data you looked at, you
11 swore under oath to this Commission and put your seal
12 on an opinion that you've said is off by over
13 100 percent?

14 A. Correct.

15 MR. RANKIN: Objection. Mr. Knights
16 testified that he identified and corrected the
17 record.

18 HEARING OFFICER HARWOOD: It has been asked
19 and answered.

20 BY MR. WEHMEYER:

21 Q. Let me try to see if I have these steps
22 right on what happened.

23 Do you remember you came up with the
24 original saturation of 30 percent, was what you wanted
25 to use?

1 A. 30 percent cutoff, yes.

2 Q. And that was back when you were off by the
3 factor -- just in timing on these errors, that was
4 when you were off by 100 percent because you misread
5 the intervals?

6 A. Yes. The paper submitted was 100 percent
7 wrong.

8 Q. And we visited before the break on why did
9 you change it, and you said: Well, I did what
10 everybody else, the rest of the club was doing. I
11 think was the phrase you had.

12 Is the real reason you moved the
13 30 percent to 20 percent is because you had already
14 had the volumes crammed down so low, when you realized
15 the 100 percent mistake, you had to chop it in half,
16 and then the 30 percent was an effort to just add some
17 volumes back so that you didn't get laughed out of
18 this hearing?

19 MR. RANKIN: Objection. Argumentative.

20 HEARING OFFICER HARWOOD: It is
21 argumentative. I'll sustain it.

22 BY MR. WEHMEYER:

23 Q. Was part of the reason that you went from 20
24 percent saturation to 30 percent saturation because
25 now you realize, oh, no, I have to chop my oil in half

1 because I read the depth interval wrong?

2 A. No.

3 Q. But, again, just before we leave this, so
4 that the Commission understands, all of your outputs
5 that you did not amalgamate from NuTech and Ops
6 Geologic and Dr. Davidson, and take the best of the
7 three, you threw out Ops Geologic, you threw out
8 NuTech, all of your work is a 100 percent derivative
9 of what Dr. Davidson did?

10 A. Correct.

11 Q. And you know he chose the facies model. He
12 had all sorts of different models he could have
13 adopted. He chose the facies model?

14 A. I believe so, yes.

15 Q. Rock facies is a concept of geology. This
16 is lithology. This is something that's happening 4400
17 feet beneath the surface of the Earth?

18 A. Correct.

19 Q. So I'm just asking you, as a geologist,
20 where all of your work and your oil-in-place volumes
21 is dependent on Dr. Davidson, and he chose a facies
22 model, and he didn't describe the core, he didn't look
23 at the core, he did use the RR Bell core, he didn't do
24 a rock outcrop study, that doesn't give you concern?

25 A. Not at all. Basically, when you look at an

1 analysis, you don't decide how they did it. But you
2 validate it on the results. And Jim Davidson matched
3 the core better on five offset the wells that he blind
4 tested and corroborated the information on each of
5 those other fields.

6 I really enjoyed the Seminole one, where
7 he showed that the swept zone has been CO2 flooded for
8 40 years, still had between 15 and 25 percent residual
9 oil zone saturation, indicating that a residual oil
10 saturation matched his volume metric estimates.

11 And I think all those validation points
12 pointed to Dr. Davidson as the most accurate analysis
13 that I had at the time.

14 Q. You talked about sensitivities a moment ago.
15 Did you run a sensitivities analysis?

16 A. In my summary, I've done sensitivity
17 analyses in my head basically using the net pay
18 scenarios that I use for the 4, 7 and 10 percent
19 porosity. And I showed percentage-wise how that would
20 have affected the oil in place in the EMSU and also
21 how it broke down the reservoir quality on how much
22 was really high quality, medium quality and low
23 quality. And so I ran those scenarios.

24 Q. So the question is, did you run or perform
25 here a sensitivity analysis that you would put the

1 Netherland, Sewell stamp on as a sensitivity analysis?

2 Yes or no?

3 A. I ran -- well, yes.

4 Q. Where do we find that in your papers?

5 A. The slide that has the Ops permeability, the
6 different porosity cutoffs, those variations.

7 Q. Where you reported Ops' volumes?

8 A. Correct. Their net pay analysis. That was
9 based on a porosity cutoff, which, in fact, all four
10 of the -- or five of the petrophysical analyses had a
11 very similar porosity. And so using that, I didn't
12 feel I had to do a separate porosity net pay analysis
13 for each of the things.

14 But those percentages were probably
15 equivalent for each of the sensitivities. So we had
16 30 percent of rock and very high quality greater than
17 10 percent. We had another third of the rock that's
18 medium at 1 millidarcy and above. And then you had
19 another third using the Ops Geologic model at about 4
20 percent porosity. By their porosity calculations,
21 that was basically another third of the rock.

22 Q. And I truly don't know this. Did you
23 discuss sensitivity analysis anywhere in here, or is
24 this something you said you did in your head?

25 A. I did not have a writing of a sensitivity

1 analysis.

2 Q. So if the commissioners want to see a
3 sensitivity analysis, they're not going to find that
4 in any of your written statement, are they?

5 A. They can look at the net pay analysis that I
6 had in my summary comments that shows that I had a 4
7 and a half, 7 and 10 percent as different levels of
8 quality of rock defined in the reservoir.

9 Q. With respect to that sensitivity analysis
10 that you now testified to that you performed, you said
11 Ops Geologic was part of that analysis?

12 A. Part of the analysis?

13 Q. Of the sensitivity -- their 4 percent
14 porosity would be part of your sensitivity analysis?

15 A. Yes. I showed what their volume differences
16 would have been from a net pay consideration using
17 different porosity cutoffs. Because they had a
18 tendency to just use saturation as a cutoff. As an
19 industry standard, the most common use of net pay
20 scenarios is to use a permeability related to a
21 porosity cutoff to define reservoir quality.

22 Q. Even in an instance here, where porosity and
23 permeability do not directly track with one another
24 and there's variability in porosity with permeability?

25 A. Correct.

1 Q. Now, with respect to Ops Geologic on the
2 sensitivity analysis, ultimately, does that land at
3 their volumes? When you say you performed a
4 sensitivity in your head --

5 A. Their maps were their 100 percent volumes.

6 Q. Okay.

7 A. And if I used a 7 percent, that would be
8 reduced by another 32 percent. And if I used 10
9 percent, that would be reduced by another 30 percent.

10 So, basically, on the Ops Geologic
11 model, I have a third of their rock is very high
12 quality, high porosity; a third of their rock is
13 medium, and basically that was Jim Davidson's cutoff
14 that he used; and then Ops Geologic has another third
15 of their oil in place in the low porosity that is
16 relatively lower quality, low porosity, based on a
17 porosity cutoff. And that's where most of their oil
18 is, in the low porosity.

19 Q. And so I'm just trying to get back to -- as
20 you talk about the sensitivity analysis that you said
21 you ran in your head, is Ops Geologic then in that
22 analysis -- I mean, you just testified, you said:
23 That's part of my sensitivity. Right?

24 A. Correct.

25 Q. Would that be the high case?

1 A. It would be an unrealistically high case,
2 yes.

3 Q. But you said you used that for your
4 sensitivity analysis here. Correct?

5 A. I used that as a porosity to get to a net
6 pay distribution. I'm not sure of the question.

7 Q. And so to the extent that you're -- in a
8 sensitivity analysis, would Ops Geologic then be your
9 high case?

10 A. No.

11 Q. What would be your high case in the
12 sensitivity?

13 A. At the moment, it would be some kind of
14 distribution around Dr. Davidson's oil in place.

15 Q. Where would we see that in either your
16 handouts or your written testimony?

17 A. You do not have that.

18 Q. So I'm just trying to take this in pieces.
19 On the sensitivity, what I have in my mind as an
20 lawyer, not a scientist, there's going to be a high
21 case and a low case, right?

22 A. Yes.

23 Q. And a middle case?

24 A. Yes.

25 Q. I asked you: Did you run a sensitivity?

1 And you eventually said you did.

2 And I said: What is your sensitivity?

3 And you said: Ops Geologic and

4 Dr. Davidson.

5 I mean, is it that simple?

6 A. No, it's not that simple.

7 Q. What would, then, be the high case in your
8 sensitivity that you ran?

9 A. There's just not enough data to be
10 comfortable with a high side case. I mean, right now,
11 the most likely case is Dr. Davidson's and some
12 semblance of distribution around that. Right now, if
13 I had to do it off the top of my head, I'd say
14 10 percent up and 10 percent down.

15 Q. You said off of Dr. Davidson's, and I'm not
16 going to continue to beat the horse about the facies
17 model, but did you actually discuss in your original
18 testimony, actually, your original testimony, a
19 4 percent porosity cutoff?

20 A. Could you ask that question again?

21 Q. Did you originally start this project at a
22 4 percent cutoff, 4 percent porosity?

23 A. I don't understand did I start the process.
24 I was using whatever was provided to me. So Ops used,
25 I think, 4 percent effective porosity as their cutoff.

1 Jim Davidson used a 7 percent effective porosity for
2 his cutoff. To tell you the truth, I don't remember
3 what NuTech used.

4 Q. So I'm in your rebuttal report, and I'm
5 going to try to zoom in, because I want you to explain
6 what this is and why this is.

7 Do you see the paragraph that begins,
8 "In NSAI's analysis of oil saturation"?

9 A. Yes.

10 Q. So NSAI, that's you and your company, right?

11 A. Yes.

12 Q. NSAI, that would also be Dr. Davidson,
13 right?

14 A. Correct.

15 Q. "We used a consistent porosity cutoff of
16 4 percent to evaluate the reasonableness of the three
17 petrophysical models to conduct an empirical
18 analysis."

19 Why did you use a 4 percent porosity
20 cutoff?

21 A. For consistency. So I was doing a variation
22 on oil saturation. And so if I used a consistent oil
23 saturation but an inconsistent porosity, all these
24 petrophysical analyses couldn't be compared
25 appropriately.

1 So I took all the lowest porosity that
2 somebody used as 4 percent on Ops. I said, okay,
3 let's just use that as a common porosity cutoff so
4 that I am just looking at the variability of
5 saturation.

6 Q. I'm now moving over to your original report.
7 As we come back to this concept of facies, which is
8 what Dr. Davidson's work is based off of, there was a
9 lot of discussion yesterday on shallow water
10 environment versus deep water environment.

11 You say here, "Oil entered the
12 San Andres Aquifer and migrated through a complicated
13 porosity system to create several isolated reservoirs
14 with varying compositions of salinity and hydrocarbon
15 saturation. These include both mobile oil and
16 productive fields across the CBP and residual oil
17 scattered along the migration pathways."

18 I'm actually at the wrong spot. Sorry
19 about that. Here we go. This is what I wanted to
20 focus on. And for reference, this is out of your
21 revised original report. "The EMSU is located along
22 the northwestern edge of the CBP, as shown in Figure
23 1. The unit is composed of the producing Grayburg
24 Reservoir and the underlying San Andres Aquifer."

25 And, again, in the testimony, we've had

1 great difficulty today on -- you said you don't know
2 what San Andres is, you don't know what Grayburg is.
3 But when the commissioners go back and read these
4 reports, they're going to see that you speak of
5 San Andres and Grayburg all over the place, don't you?

6 A. Probably it's inconsistent. My definition
7 of San Andres, I tried to be consistent at relating it
8 to the Goodnight injection interval, which some of the
9 people call the Lower San Andres.

10 Q. If I take the tops off of the various logs
11 here and just ask you to show the Commission, I have
12 some logs that don't have tops on them, to show them
13 where, according to you, in that particular log the
14 San Andres is versus the Grayburg, would you be able
15 to do that?

16 A. Not particularly well. Or I could do it as
17 inconsistently as everybody else. But what I could do
18 is define the top of the Lower San Andres, where the
19 Goodnight injection level is, at basically some of the
20 tops of the major loss circulation zones. Because I
21 think that is a definitive indication of a
22 significantly different reservoir quality in size and
23 component that is isolated and separate and different
24 from shallower reservoirs.

25 Q. I'm just showing you off of the plot here

1 that's at Figure 4 that the loss circulation zones are
2 all over the place. You are not going to testify that
3 wherever there's a loss circulation zone, that that
4 becomes the San Andres and Grayburg, are you?

5 A. No. It's a perm barrier and it creates
6 separate reservoirs.

7 Q. My question was, San Andres versus Grayburg,
8 you said you would go to where the mud losses are,
9 you're not telling the OCC that it's your geology
10 opinion that you would pick San Andres Formation from
11 Grayburg Formation based on wherever the mud loss
12 occurred, is it?

13 A. Again, anyone that uses a formation as a
14 nomenclature, it's very arbitrary. I use depths and
15 reservoir quality.

16 And the reservoir quality in the Lower
17 San Andres is distinctly determined by, number one,
18 the loss circulation zone, but then, again, the water
19 supply wells that show it has a tremendous
20 permeability and a large, significantly large,
21 aquifer. And then the water injection that shows a
22 significant amount of water that's injected at very
23 high permeabilities with very little pressure changes,
24 which also indicates it's a very large aquifer.

25 Q. Would you agree with me that the San Andres

1 and the Grayburg are all in the EMSU -- those are both
2 in the EMSU, right?

3 A. They are both, yes.

4 Q. And the unit interval is all of the Grayburg
5 and all of the San Andres, correct?

6 A. I think so, yes.

7 Q. So coming back to Page 5 of your original
8 report, "These formations were deposited in typical
9 marine and restricted-marine environments, with most
10 of the EMSU deposition occurring in a predominantly
11 shallow-water carbonate ramp environment." I read
12 that correctly?

13 A. Correct.

14 Q. Is that still your opinion?

15 A. Yes. It's a little indistinctive because it
16 doesn't supply the actual depths. But for the
17 significant other shallow waters in the Grayburg,
18 actually the producing interval.

19 Q. So if we just took one of these logs as an
20 example, take that one, where is the Upper San Andres
21 and where is the Lower San Andres?

22 A. Well, from the preponderance of data, I
23 would suggest that the top is somewhere equivalent to
24 the large loss circulations that we have across this
25 in probably eight of the eleven wells. So probably

1 somewhere there.

2 Q. If you're picking off of the loss
3 circulation intervals, you can tell the Commission
4 that the depth of formation is going to change by
5 hundreds of feet, isn't it?

6 A. I don't think so. I think most of them are
7 around negative 700 feet at the top of where the major
8 loss circulation and injection zones are. Both of
9 those indicate that it's a large aquifer from a
10 permeability standpoint and uniquely different than
11 any of the overlying Grayburg or the Upper San Andres
12 reservoirs above that Jim Davidson's either high gamma
13 ray or that negative 500 or negative 700 feet, which I
14 define as kind of demilitarized zone, that I think
15 most of the perm barriers within that separate the two
16 reservoirs, and everything above negative 500 is
17 completely separate and just --

18 Q. So your testimony is that the loss events
19 are happening at 700 feet subsea?

20 A. Approximately that depth. Maybe a little
21 different.

22 Q. I have this plotted here at subsea. And
23 based on the actual data, I'd like you now to
24 explain -- and here, I'll give you the legend. The
25 green is going to be mud loss depth. Can you help me

1 with how this would look like 700 feet subsea?

2 So we have the EMSU 628. That one is at
3 139 feet. We have the Ernie Banks. That one is at
4 970 feet.

5 A. What are the three numbers?

6 Q. We have the EMSU 713. That's at 933 feet.

7 I'm just trying to understand where --
8 how are you saying these all happened at 700 feet
9 subsea?

10 MR. RANKIN: Mr. Hearing Officer, I'm
11 confused by what I'm seeing on the screen. I don't
12 know what these numbers are or where they came from,
13 who created this document.

14 So I guess I would object to it being
15 used for cross-examination because I don't know what
16 any of these numbers are or where they came from.

17 HEARING OFFICER HARWOOD: More foundation,
18 Mr. Wehmeyer.

19 BY MR. WEHMEYER:

20 Q. Have you ever tried to actually place on a
21 map or a plat well by well where the actual subsea
22 depths are in each of the wells that are under study
23 here, the loss circulation?

24 A. The loss circulation zone on a map?

25 Q. Yeah.

1 A. I believe I have.

2 Q. So, again, you're the one that started with
3 700 subsea feet. If the data is that in the EMSU 628,
4 the loss occurred at 1,039 feet, we can agree that
5 that is not 700 feet, right?

6 A. Correct.

7 Q. If the SWD N 11-1, the loss circulation was
8 at 1,051 subsea, that is not 700 feet, is it?

9 A. Correct.

10 Q. In the EMSU 713, if it happens at 932
11 subsea, that's not 700 feet, is it?

12 A. Yes. If, yes.

13 Q. In the Ernie Banks SWD, if it is lost at
14 970, that's not 700 feet, is it?

15 A. Correct.

16 Q. If in the 1028 it happens at 1,013, that's
17 not 700 feet, is it?

18 A. Correct.

19 Q. In the Nolan Ryan, if it's 1,043, that's not
20 700 feet, is it?

21 A. They're all below 700 feet.

22 Q. So, again, the idea that we would choose the
23 place of loss of circulation, what happened to define
24 San Andres versus Grayburg, in terms of being able to
25 correlate that across this field, there's no way to do

1 that, is there?

2 A. You wouldn't use one piece of data to define
3 a reservoir.

4 Q. So you would agree that if you're picking
5 tops off of just circulation loss, that would not be a
6 valid scientific basis or engineering basis to pick?

7 A. That data only, no.

8 Q. Now, coming back to your paper. So we're
9 back to your paper here at Page 5, "These formations
10 were deposited in typical marine and restricted-marine
11 environments, with most of the EMSU deposition
12 occurring in a predominantly shallow-water carbonate
13 ramp environment."

14 First, do you stand by that testimony
15 that EMSU is predominantly shallow water?

16 A. Yes.

17 Q. Have you done any work here to show where
18 shallow water would transition, if at all, to deep
19 water?

20 A. No.

21 Q. So the best we have is that after your
22 geology work, the EMSU is predominantly shallow water?
23 And if the Commission wanted to know anywhere not
24 shallow water, nothing you have an opinion on or
25 anything you've done as a matter of geology. True?

1 A. Predominantly, yes.

2 Q. Now, tell the Commission about the
3 importance of being in a -- the EMSU and San Andres
4 being in a shallow water environment. What does that
5 mean about rock type?

6 A. It's very variable and generally thinner
7 deposits.

8 Q. You would expect less mud in that
9 environment, wouldn't you?

10 A. Yes.

11 Q. You would expect more oil in that
12 environment, wouldn't you, in a high energy -- in a
13 higher energy shallow water environment as compared to
14 low energy deep water environment?

15 A. There would be -- yeah, there would be
16 higher porosity.

17 Q. Which, in this instance, would equate to
18 more oil in place?

19 A. Yes, above the oil-water contact, it should.

20 Q. Now, as we visit on rock facies, if you're
21 shallow water, you would be more grain dominated and
22 less mud dominated, wouldn't you?

23 A. You would be more likely to be more grain
24 dominated versus mud dominated.

25 Q. Now, we've talked about how much depth we

1 have of 679 core in the EMSU. If we're below that,
2 and you're talking about rock properties off of the
3 log, you're going to need a spectral gamma, aren't
4 you?

5 A. Spectral gamma is very useful.

6 Q. Because that's the only way that you're
7 going to be able to tell am I looking at thorium, is
8 this gamma reacting to potassium, is it reacting to
9 uranium. Yes?

10 A. Yes.

11 Q. In this instance, did you have any spectral
12 gamma whatsoever within the EMSU boundaries?

13 A. Not within the boundaries of the EMSU.

14 Q. And so, again, coming back to your work
15 being based off of Dr. Davidson's, does it give you
16 concern as a geologist that a facies model was
17 developed in a shallow water environment in which rock
18 typing was picked without having any spectral gamma to
19 differentiate out of uranium, thorium or potassium?

20 A. Well, we did have spectral gamma rays in
21 nearby offset wells to the southeast and to the north
22 that were used in my evaluation to indicate that those
23 were actually uranium. And I think extrapolating that
24 over the EMSU is a reasonable geologic assumption.

25 Q. How far away were those wells?

1 A. I'd say maybe two, three miles.

2 Q. Would the rock outcrop study be more
3 valuable?

4 A. A hundred miles away, no.

5 Q. As we talk about uncertainty in this
6 particular instance, would you give me that in terms
7 of picking rock types here, in the absence of core, in
8 the absence of spectral gamma, that certainly
9 reasonable folks could disagree over one level of rock
10 quality picked? For example, moving from a wackestone
11 to a mud dominated packstone or a mud dominated
12 packstone to a grain dominated packstone, that there
13 could at least be one facies of rock change reasonable
14 uncertainty there that you could move?

15 A. I guarantee that some people would call
16 things differently, much like the nomenclature of the
17 top of the San Andres.

18 Q. I'm not fussing with you, but is that a yes?

19 A. Yes.

20 Q. And in this instance, if all you did was
21 move over Dr. Davidson's rock facies and assume a
22 level of one better rock type -- are you with me so
23 far in the assumption?

24 A. Mm-hmm.

25 Q. -- that you then move to oil saturations

1 that look very similar to the ones prepared by Ops
2 Geologic and NuTech, don't you?

3 A. I'm not sure that's the case. But if it
4 would be the case, then those would contradict the
5 actual core data in the rest of the model. So I would
6 go to Jim Davidson and say, "This model is not
7 working."

8 Q. If you'll listen to my question.

9 A. Okay. Sorry.

10 Q. We've already covered that you can agree
11 that reasonable minds, reasonable science minds, could
12 disagree here about one level of rock type. There's
13 at least that amount of uncertainty here, according to
14 you.

15 A. Okay. I'll go with that assumption.

16 Q. And here, if you move Dr. Davidson's rock
17 type over by just one level, do you know how closely
18 that would compare to what Ops Geologic did?

19 A. No.

20 Q. Would you expect it to look very similar to
21 what Ops Geologic did?

22 A. No.

23 Q. Why?

24 A. Because the oil in place numbers were
25 dramatically higher than I would have expected

1 relative to the core data.

2 Q. Well, you mention core, and we know we don't
3 have core deep into the Lower San Andres.

4 A. Right.

5 Q. But with respect to the core, you understand
6 that Ops Geologic actually made corrections to
7 eliminate certain of the core plots because it would
8 have led to an unreasonable n value?

9 A. I think I'm aware of that, yes.

10 Q. And in terms of just fussing with Ops
11 Geologic, if we looked at the n value -- I understand
12 that Dr. Davidson wouldn't agree he'd arrived at an n
13 value. But some of his plots were all the way over to
14 10 on his n value. If you looked at his analysis and
15 where it fell on the plots --

16 MR. RANKIN: Objection. Mr. Wehmeyer is
17 testifying.

18 HEARING OFFICER HARWOOD: Let's hear the end
19 of the question first.

20 Mr. Wehmeyer, in the interest of maybe
21 saving time, how about rephrasing it?

22 MR. WEHMEYER: Absolutely. And I think
23 we're on the same page. I apologize for the long
24 question. I'll strike that.

25 BY MR. WEHMEYER:

1 Q. So the question is, I understand that
2 Dr. Davidson didn't use an Archie's equation, right?

3 A. Mm-hmm.

4 Q. So he didn't do m and n values, did he?

5 A. No.

6 Q. Ops Geologic chose a modified Archie's
7 equation, with a variable m and n. Yes?

8 A. Correct.

9 Q. Have you seen that done in the petrophysical
10 world?

11 A. Yes.

12 Q. So in terms of them varying m and n on a
13 modified Archie's, this is not something crazy?

14 A. No.

15 Q. Scott Birkhead isn't a nut? This is
16 something that's --

17 A. Shortcut.

18 Q. Okay. Now, with Dr. Davidson's work, even
19 though he didn't use an m and n, you can't determine
20 what the m and the n would be off of his plots and
21 work, can you?

22 A. Dr. Davidson couldn't.

23 Q. And, in fact, some of those n values reach
24 all the way to 10, don't they?

25 A. I do not know, but that would not surprise

1 me.

2 Q. Which would be even higher than the n value
3 used by Ops Geologic, which got to about 9 in certain
4 places?

5 A. I assume that's correct.

6 Q. Did you do a study of the critical water
7 saturation, basically a look at how much water can
8 even move if the Netherland, Sewell analysis is
9 correct?

10 A. I did not do a study, no.

11 Q. So in terms of telling the Commission about
12 what percentage of your water saturations would be
13 critical or irreducible, that's not something you've
14 done, not something --

15 A. No.

16 Q. -- you would be able to talk about?

17 A. Well, I mean, I'm exposed to residual oil
18 saturations and residual water saturations just in the
19 industry, but not specifically here.

20 Q. So if they wanted to know, based on the
21 majority of Dr. Davidson's rock typing, how much of
22 that water -- and those water saturations, they go up
23 over -- they immediately go to 92 percent, don't they?

24 A. Yes.

25 Q. And so just by choosing that rock type and

1 that facies model, you can't get more than 8 percent
2 oil into the model simply as a matter of rock typing;
3 isn't that right?

4 A. That's probably correct.

5 Q. So you pick the rock type. So just based on
6 rock type -- and, again, no spectral, no core, we
7 know we've got -- you've looked at -- at least 92
8 percent immediately has to be water?

9 MR. RANKIN: Objection. Mischaracterizing
10 the testimony. Mr. Knights testified that they did
11 have spectral and they did use spectral in their
12 analysis.

13 HEARING OFFICER HARWOOD: Overruled.

14 BY MR. WEHMEYER:

15 Q. Do you want me to reask it?

16 A. Yes, please.

17 Q. Yeah, no, it's an interruption. I totally
18 get it.

19 So you've looked enough at
20 Dr. Davidson's facies model. You know that based on
21 the rock type he selects for the majority of the Lower
22 San Andres reservoir formation, that just by the rock
23 type, it only allows a maximum of 8 percent oil in
24 because it's going to put at least 92 percent
25 saturation into it, isn't it?

1 MR. RANKIN: Objection. Mischaracterizes
2 the testimony of Dr. Davidson.

3 HEARING OFFICER HARWOOD: Overruled.

4 A. Looking at that Sc chart, some of those
5 curves, where they hit the very high resistivity
6 index, I think those lower values to the right may be
7 in that 7 to 8 percent. So if that was the lithology
8 that was defined, then that would be a maximum
9 saturation.

10 Q. Right. And the people that define lithology
11 would be geologists, right?

12 A. Correct.

13 Q. And Dr. Davidson is not a geologist?

14 A. Well, I would amend that. Geologist
15 petrophysicist. Because petrophysicists distinctly do
16 more lithology work than I do.

17 Q. Did he do any lithology work here?

18 A. Using log characteristics, yes.

19 Q. Log characteristics off of triple combo,
20 which really -- again, just in terms of keeping
21 credibility with this Commission, doesn't it all just
22 come back to his gamma ray reading? If the gamma ray
23 spikes, he says this is non-reservoir?

24 A. That was a significant data input into his
25 analysis, yes.

1 Q. So as soon as the gamma ray spikes, it
2 immediately becomes non-reservoir, and practical
3 matter, just making this simple, at that point you're
4 going to have 92 percent plus water saturation, you
5 can't put in more than 8 percent oil. True?

6 A. On some of those curves, that is correct.

7 Q. As we talk about some of those curves, the
8 majority of the rock in the Lower San Andres that he's
9 chosen would be wackestone or worse?

10 MR. RANKIN: Objection. Mischaracterizes
11 the evidence. Dr. Davidson testified that he didn't
12 use wackestone in his model.

13 HEARING OFFICER HARWOOD: Do you have more
14 foundation? Maybe something to show him or refer him
15 to specifically?

16 MR. WEHMEYER: Mr. Knights and I are on the
17 same page. He knows where these rock types end up.
18 BY MR. WEHMEYER:

19 Q. You know where the -- you've looked at the
20 facies model in terms of what rock -- you want to
21 know as a geologist, what rocks is Dr. Davidson giving
22 me here? Right?

23 A. Well, basically, I don't really care what
24 rocks they are. I look at the results of the
25 analysis. And I compare it to the actual hard-core

1 data that I have and see if that makes sense or seems
2 reasonable.

3 Q. What hard-core data did you have in the
4 EMSU?

5 A. For the EMSU, the 679 core data. And in the
6 Grayburg, I had a lot of production data.

7 Q. Now, the Grayburg, that was produced
8 conventionally.

9 A. Correct.

10 Q. No --

11 MR. RANKIN: Mr. Hearing Officer,
12 Mr. Knights was cut off. He was answering a question
13 and Mr. Wehmeyer cut him off.

14 HEARING OFFICER HARWOOD: Okay. I'm sorry I
15 missed that.

16 MR. WEHMEYER: Well, I'm happy for him --

17 BY MR. WEHMEYER:

18 Q. I didn't mean to cut you off. Go ahead.

19 A. I don't actually remember what I was talking
20 about.

21 HEARING OFFICER HARWOOD: Stop. Let's not
22 get into the same situation we got into yesterday.
23 Remember, it's a radio transmission. Guys, give each
24 other time. Okay?

25 BY MR. WEHMEYER:

1 Q. I've enjoyed our visit. I think you and I
2 are on the same page more frequently than Mr. Rankin.

3 So as we come back to -- I said hey,
4 look, you're the geologist, you do this work. First
5 thing you're going to want to know is: What rocks is
6 my petrophysicist giving me? Fair?

7 A. I would ask Jim what rocks are there.

8 Q. And what did he tell you?

9 A. As you know, Jim can be pretty loquacious.
10 So it was long diatribes of why these rocks are what
11 I've determined them to be. And I was enjoying my
12 conversations and learned something every time I
13 talked to him.

14 Q. Did you ever get an answer on what rocks are
15 these?

16 A. The ones that were in his model. And he
17 actually never output a model of this foot is this
18 rock type.

19 Q. Okay. So if the Commission wants to know --
20 and I'm not being a wise guy with it, I promise. If
21 the Commission want to know, when I went to go do my
22 oil-in-place estimations, I asked Dr. Davidson, "What
23 kind of rock do I have here?" do you know? Yes or no?

24 A. Not by foot. But basically the deeper water
25 a little more on the mud side than the grainstone

1 side.

2 Q. Where did he call deeper water?

3 A. Deeper water is probably throughout the
4 system, but predominantly lower in the Spraberry was
5 deep water and shallower above the -- in the Upper
6 San Andres, you know, above that gamma ray, that was
7 primarily lower.

8 Q. I think we just moved southeast quite a bit.
9 Not Spraberry. San Andres?

10 A. Oh, did I say Spraberry?

11 Q. Yeah. That's okay.

12 A. San Andres.

13 Q. And so the rock types, the best you -- well,
14 let me take it in two pieces.

15 First, would you agree that whatever
16 rock type was the predominant rock in his facies
17 model, you're a little bit unclear on that right now
18 as you sit in this chair?

19 A. Correct. On a foot-by-foot basis, yes.

20 Q. And not being a wise guy, but it is a little
21 odd that the geologist would be asking the educated
22 engineer, "What type of rocks are these?" as opposed
23 to you doing the work on the front end to assist the
24 petrophysicist with, "This is the lithology that you
25 should expect in this particular environment. This is

1 deep water, this is shallow water. This is what we
2 need to be looking at from outcrop"?

3 A. Not at all.

4 Q. Now, you said you checked what he did
5 against -- I don't want to misquote you -- direct data
6 or the --

7 A. Direct physical evidence.

8 Q. Direct?

9 A. Physical evidence.

10 Q. Direct physical evidence. How did you check
11 his Lower San Andres? What direct physical evidence
12 did you have? Was that just Grayburg?

13 A. That's a good question. Yes, the only
14 direct physical evidence we have in the Lower
15 San Andres is the reservoir quality by the saltwater
16 supply wells and the injection wells, indicating
17 permeability, reservoir quality and reservoir
18 dimensions.

19 Q. But, again, this isn't rock type. This is
20 just going to be a gamma log?

21 A. Correct.

22 Q. Which comes back to, as I talked about,
23 couldn't we all agree here amongst reasonable people
24 that the rock facies could be off by a level of one?

25 A. Okay.

1 Q. Now, returning to just the water
2 saturations, because I want to keep the forest in view
3 here, the majority of the rock that Dr. Davidson's
4 model selected was mud dominated packstone or worse,
5 right?

6 A. Potentially. I'm not sure.

7 Q. Well, you've seen the plots on the graph,
8 right?

9 A. Yeah.

10 Q. And, you know that by making that selection,
11 even if you moved over to mud dominated packstone, you
12 have 80 percent water saturation right off the bat,
13 don't you?

14 A. Yes. High water saturations.

15 Q. And which to the other side of 1 minus
16 equation, means you could maximum have maybe 20
17 percent residual oil zone, right?

18 A. Correct.

19 Q. Through just the facies selection?

20 A. Correct.

21 Q. And then in the modeling that you all
22 selected, if there was not at least 20 percent oil
23 saturation, zero credit for oil was then put into your
24 model, correct?

25 A. The net pays, yes, would have been zero.

1 Q. So it really gets this simple if you're
2 looking at this from the Netherland, Sewell approach:
3 Dr. Davidson makes his facies picks for the majority
4 of the Lower San Andres.

5 A. Mm-hmm.

6 Q. And based on those facies picks, you have to
7 start with 80 percent water, or even more water, and
8 based on that facies pick, you cannot put enough oil
9 in to get past the 20 percent threshold for your model
10 to give that oil any credit for oil in place?

11 A. Correct.

12 Q. I want to talk a little bit about the 20
13 percent threshold. You've seen literature, you've
14 heard testimony from Steve Melzer, Dr. Trentham about
15 ROZs.

16 A. Correct. Yes.

17 Q. And 20 percent is what they've spoken to as
18 an acceptable threshold to get started at for an ROZ
19 project?

20 A. As I understand it, it's the low side. You
21 need --

22 Q. But it is an oil saturation -- and I'm so
23 sorry. You go ahead.

24 A. And so you need at least 20 percent to make
25 it reasonably viable. And that has to do with the

1 residual oil saturations that are common in these
2 rocks.

3 Q. And, again, just to keep this simple for my
4 simple brain, this is not you have to start at 40
5 percent and you produce it down to 20 percent residual
6 oil and you stop? Based on their literature and their
7 work on ROZs, 20 percent would be an acceptable
8 place -- that's a lot of oil down there -- 20 percent
9 would be an acceptable place to start?

10 A. To start as a minimum?

11 Q. Yes.

12 A. If I had less than that, I wouldn't even
13 consider it.

14 Q. Yes?

15 A. Yes.

16 Q. Okay. So your model literally kicks out all
17 of the residual oil that Dr. Trentham and Steve Melzer
18 would start an ROZ project at, doesn't it?

19 A. Yes.

20 Q. And, again, in terms of the rock facies
21 that's selected, in terms of moving from grain
22 dominated packstone over to a mud dominated packstone,
23 that comes down very much to shallow water environment
24 versus deep water environment, correct?

25 A. Yes, it does.

1 Q. And here, I asked you as the geologist, do
2 you have any opinions to share, could we go well by
3 well, depth by depth, and you tell where is shallow
4 water environment, where is deep water environment,
5 that's nothing you've done as a geologist, nothing you
6 have opinions on, true?

7 A. I mean, I could have opinions if I reviewed
8 something specifically.

9 Q. You haven't done it to date?

10 A. I have not done it, no.

11 Q. Additionally, all rock with less than
12 7 percent porosity, all of that oil is kicked out of
13 the Netherland, Sewell model, isn't it?

14 A. Correct.

15 Q. And so you understand that in ROZ
16 development, oftentimes you will find some of your
17 highest oil saturations in some of your lower porosity
18 rock, right?

19 A. I don't know if I agree with that.

20 Q. Do you have a position one way or the other?

21 A. In the better reservoirs, the higher oil
22 saturation is in the higher quality rock. You get
23 better recovery factor. But in some reservoirs, I
24 could imagine that you would have more of the oil in
25 the low permeability rock because it hasn't moved and

1 won't move.

2 Q. Under typical conventional environment,
3 right?

4 A. Correct.

5 Q. Coming back to Mother Nature's waterflood.
6 You heard Dr. Lindsay testify in here that as water
7 pushes through here, mobile oil is going to be pushed
8 out. What we have left is residual oil that clings to
9 pore throats and, you know, pore volume, with the
10 water on the inside, waiting to be released through
11 something that can reduce the viscosity, such CO₂?

12 A. Yes.

13 Q. So this comes back to -- you understand that
14 Scott Birkhead has testified here that what he's
15 actually observed in core and what he's modeled is
16 that, oftentimes, the higher saturations of oil occurs
17 in the lower porosity environments, true?

18 A. So yes.

19 Q. But, again, just in terms of keeping the big
20 picture here for the commissioners, if it's below
21 7 percent porosity, we never get those volumes in your
22 model. Those are all kicked out, right?

23 A. Correct.

24 Q. You would agree with me, because we're not
25 dealing in conventional environment here, and this

1 whole fuss is over tertiary, that through the
2 injection of CO₂, it is then possible to reduce the
3 viscosity to recover the oil from these type pore
4 throats and vary these pore volumes, true?

5 A. Yes, that is the concept.

6 Q. In terms of oil wet versus mixed wet,
7 there's been a lot of discussion about that. Is this
8 an oil wet environment or a mixed wet, or might it be
9 something in between?

10 A. I think it might be somewhere in between.

11 Q. If you move from an oil wet environment over
12 to a mixed wet environment -- are you with me on the
13 assumption? -- what would that do to your modeling?

14 A. I'm not sure. I would defer to Dr. Davidson
15 on that.

16 Q. But before you came in and testified on
17 volumes, you didn't ask him, "Did you model this off
18 of oil wet versus mixed wet?"

19 A. No.

20 Q. But that certainly would change the volumes,
21 wouldn't it?

22 A. I would defer to Dr. Davidson.

23 Q. We're going to go back to your slide show.

24 While we're talking about ROZs some of
25 the recipe or the Cookbook of ROZs, you're looking for

1 things, no one is expecting mobile oil in a ROZ
2 development; we can all agree on that?

3 A. Correct.

4 Q. There's pages of testimony that I've read
5 from the Goodnight witnesses about: Golly, we've
6 produced a gazillion barrels of water here, and we
7 have very little oil that's come up with it. Right?

8 MR. RANKIN: Objection. Mischaracterization
9 of the system.

10 HEARING OFFICER HARWOOD: Yeah, I don't
11 remember "golly" being in any of the technical
12 reports. Rephrase.

13 MR. WEHMEYER: It's all my simple mind can
14 appreciate.

15 BY MR. WEHMEYER:

16 Q. Have you read the other witness statements
17 in the case?

18 A. Yes.

19 Q. Has there been a lot of paper spent on:
20 We've produced a whole lot of water, but we have very
21 little oil?

22 A. Yes.

23 Q. And for an ROZ development such as this one,
24 if you're advising a client, you would tell him that's
25 exactly what you'd expect, right?

1 A. No, I don't think so. I think the ESP, the
2 changing of the reservoirs would anticipate -- be a
3 significant indication that there was a significant
4 ROZ there.

5 So the concept that we don't produce any
6 oil so there must be oil there, is -- I don't think
7 that's a positive statement.

8 Q. I'm taking the opposite side of it. If
9 somebody says, "I produced a lot of water and I don't
10 have oil" --

11 A. Yeah.

12 Q. -- if they're here talking to you on the
13 ROZ, you'd say, "That's normal. You would expect
14 that"?

15 A. Yes.

16 Q. And we can go log by log, but to the
17 commissioner's cherry-picking comment, we can go into
18 actual logs and we can look at the mud logger's
19 report, and in the Lower San Andres -- are you with me
20 on what we're -- deep in the San Andres.

21 A. Deep in it.

22 Q. We can find gas shows, we can find oil
23 fluorescence, we can find odor. Those aspects of
24 Dr. Trentham's recipe and Cookbook are present in many
25 of these logs, aren't they?

1 A. In many of the logs, in some instances, yes.

2 Q. And additionally, off the top of my head, I
3 know it's the 660 and I think it's the 658, Mr. Rankin
4 will correct me on it, those wells were tested with an
5 ESP and an electric submersible pump, and those did,
6 in the Lower San Andres, produce oil along with the
7 saltwater? There was mobile oil?

8 A. There was some mobile oil, yes.

9 Q. And just the way oil works in the pore space
10 and in those pore throats, if you're getting mobile
11 oil, you know there has to be residual oil left
12 behind?

13 A. Correct. Yes.

14 Q. And we may be able to work pretty quickly
15 through this from here. In terms of just economics --
16 you with me so far? -- I see in your papers that you
17 kind of wave your hand over and go, this is not
18 economic to fiddle with. Fair?

19 A. Yes.

20 Q. But you haven't actually run any economic
21 assessments here. You have haven't looked CapEx,
22 OpEx, revenue anticipated?

23 A. Just on a screen basis.

24 Q. Did something happen in your head that you
25 woke up with, said, "Yeah, I looked at it"?

1 A. I'm not sure.

2 Q. Where would I see the work? If the
3 Commission wants to see an economic assessment, says
4 you're going to be the economics guy, where in your
5 papers do we see the economic assessment, other than
6 your say-so?

7 A. It would be the last two slides in my
8 summary slide deck.

9 Q. You've analyzed CapEx and OpEx?

10 A. I generally use the data that I'm given. So
11 I used the Tall Cotton data, from there.

12 Q. Let's talk about Tall Cotton. In terms of a
13 recoverability factor, you haven't seen any EMSU, have
14 you?

15 A. No.

16 Q. Is that something you'd want to see?

17 A. At this moment, no.

18 Q. How about even oil compositional analysis?
19 Ignore miscibility, just API of the oil.

20 A. No.

21 Q. Okay. Now, Tall Cotton, might it have been
22 that oil was overstated in the first instance?

23 A. Yes.

24 Q. And with respect to Tall Cotton, you've
25 heard the testimony about they actually fracked in --

1 they were trying to -- they didn't want to wait.
2 Kinder Morgan wanted the juice out of the squeeze
3 faster. And so they fracked into the injector wells.
4 Do you remember that testimony?

5 A. I remember the testimony, but I have no
6 confirmation that that's actually what happened.

7 Q. That's an interesting point in itself. So
8 in terms of what happened at Tall Cotton by way of the
9 recoverability of the residual oil, you don't know
10 what happened as a technical matter, do you?

11 A. I know the direct physical evidence is the
12 performance and the rate cum plot is 5 million barrels
13 of data over 15 years, and a decline curve that gives
14 me whatever happened in this instance that's an
15 estimated oil recovery that would accomplish from that
16 development.

17 Q. Just looking at this -- and I know you're
18 not an engineer, but looking at the graph on the
19 bottom right, when you see a curve like that, would
20 you expect that there was something from a technical
21 engineering perspective that happened to that
22 production?

23 A. Something happened to the production, yes.

24 Q. That it would be different than and not
25 explained by somehow the oil just couldn't be -- the

1 EOR was no longer effective?

2 A. I really don't know exactly what that is.
3 But I would suggest there's plenty of plausible
4 explanations.

5 Q. One of them being that they fracked the
6 injector wells?

7 A. That would be something that might affect
8 it.

9 Q. Why would you supply the Commission with
10 this slide? As we talk about it, you've only offered
11 24 slides and it's important to get things right. Why
12 would you give the Commission testimony about Tall
13 Cotton being a good analogy here without actually
14 digging in to understand, from a technical
15 perspective, what happened out there?

16 A. Well, I don't think that data is available
17 publicly. So to this public data, this is the only
18 ROZ-isolated interval that I could even attempt to get
19 somewhat close to a recovery factor.

20 So I thought it was important to at
21 least look at that data and come up with at least a
22 screening perspective on what that recovery would be.

23 Q. This slide, you showed just for record
24 reference. We're looking at your Slide 13. Are you
25 with me there?

1 A. Correct.

2 Q. I'm not sure anybody knows -- what is
3 Goodnight's position as to what Ops Geologic's average
4 grain density was? Is the point of this fussing with
5 what you think Ops Geologic's grain density is?

6 A. No. They have a ternary diagram that he
7 suggested it was 2.9 for the dolomite end.

8 I think if you're talking about his
9 grain density, that would be the amalgamation of how
10 much percentage of dolomite, how much percentage of
11 sandstone, how much percentage of the other mineral
12 interests. And you get an average main grain density
13 of that.

14 The only thing I was suggesting here is
15 that he used 2.9 with a constant 20 percent anhydrite
16 to get that up from the typical 2.87 grain density
17 that would normally use for the dolomite component in
18 his analysis.

19 Q. I just don't want the Commission to be left
20 with any misimpressions. For example, on EMSU 679
21 core average matrix 2.83, is that grams over cubic
22 centimeters?

23 A. Correct.

24 Q. And you think Ops Geologic -- well, let me
25 stop at that. That's an average, isn't it, 2.83 grams

1 per cubic centimeter? Is that an average of what was
2 measured in core?

3 A. Where? I'm not quite sure.

4 Q. Here, I can highlight it.

5 A. Oh, yes. Okay.

6 Q. That's an average over the whole core,
7 right?

8 A. Yes.

9 Q. Is Exxon a client of yours?

10 A. No.

11 Q. Exxon, they were at about 2.84 grains per
12 cubic centimeter?

13 A. Correct.

14 Q. What do you think Ops Geologic's average is?

15 A. I do not know.

16 Q. If you went back and averaged it and it was
17 2.835, could we all agree that that is incredibly
18 reasonable and right in line with core and what Exxon
19 came to?

20 A. It's still -- I think the 2.9 is a little
21 high relative to the industry standards. So I would
22 use a 2.87 there, recalculate his, see what a thing --
23 I think it would reduce his 2.83 to maybe -- I don't
24 know.

25 Q. But the core average is 2.83. Exxon came up

1 with 2.84. If Ops geologic's average was not 2.9,
2 whatever you speculate on, was 2.835, you would agree
3 that that's at least in line with core and in line
4 with what Exxon came up with?

5 A. Yes.

6 Q. What was the average grain density of
7 Dr. Davidson's model?

8 A. I believe his dolomite density was 2.87.
9 But I would defer to Dr. Davidson.

10 Q. Higher than the average in core, higher than
11 Exxon and higher than what Ops Geologic came up with,
12 correct?

13 A. Yeah, if that is correct, if that's what he
14 used.

15 Q. And we're just popping through these things
16 to clean up and make sure I covered.

17 The Zone B water on this Slide 14 --

18 A. Mm-hmm.

19 Q. -- so that the Commission is clear, those
20 arrows are not in this publication, are they?

21 A. Correct.

22 Q. You said there's an influx of Zone B water
23 with the arrows off to the right?

24 A. The paper defined edge water drive, and this
25 is an indication that the high water contacts were

1 about where the reservoir went below the contacts.

2 Q. Where did the paper define edge water drive
3 as coming from?

4 A. Downdip.

5 Q. Is there anything in the paper that says
6 water is entering in from the east?

7 A. No. That's an observation from this map.

8 Q. An observation from -- you put the arrows on
9 the -- the only thing on the map are the arrows that
10 you added that would indicate water is coming from the
11 east.

12 A. Well, all the hatched areas are water that
13 was present in there in 1934, '35, '36 and '37.

14 Q. On what basis would you say that water came
15 from the east?

16 A. Because it's right on the eastern edge of
17 the map.

18 Q. And is this the Grayburg that is being
19 spoken of here?

20 A. This is Grayburg.

21 Q. Have you not heard -- again, you're the
22 geologist. Have you not heard the extensive testimony
23 in here that the Grayburg pinches off to the east and
24 that there's no water moving in or out from the east?

25 A. I've heard that it does get tighter and it

1 pinches out to the east.

2 Q. And in terms of literature saying here at
3 EMSU water is entering from the east, have you seen
4 any such literature in the Grayburg?

5 A. No.

6 Q. And, again, so the Commission is aware, you
7 put the arrows coming in from the east, and the reason
8 you put the arrows coming in from the east was because
9 you found these little shaded spots in this diagram?

10 A. Correct.

11 Q. When was that paper written?

12 A. 1939.

13 Q. So we've got over 80 years -- I'm trying to
14 do -- I've heard an engineer one time say, "I never do
15 public math." I thought that was kind of probably a
16 good thing.

17 But over 80 years since the paper, the
18 paper doesn't say the water is coming in from the
19 east. But you've cited the paper here and you put the
20 arrows on -- and the geology. I guess I should ask
21 that first. Geology says the water is not coming in
22 from the east, right?

23 A. No, this is an observation.

24 Q. And, again, so that the Commission
25 understands, before you put the arrows on here and

1 brought it and swore to it, the observation you formed
2 give them the methodology you used in getting to that
3 observation?

4 A. Yes.

5 Q. I'm sorry. Let me re-ask it.

6 Data, methods, conclusions. If they
7 want to know what the methodology you used to say
8 water is entering into the Grayburg from the east,
9 tell them your methodology?

10 A. Reviewing this document and seeing that the
11 eastern flank had some anomalous early water.

12 Q. Moving to the cartoon, or whatever you want
13 to call it, above it, so that the Commission is not
14 misled, the perm barriers were not in this
15 publication, were they?

16 A. No. I highlighted those.

17 Q. And neither was the little dotted line? I'm
18 trying to follow this dotted line. Do you see if they
19 wanted to --

20 A. Yes.

21 Q. That's not in the paper. That's something
22 you added, right?

23 A. Correct.

24 Q. And perm barrier, is this where you used a
25 7 percent porosity to define this perm barrier?

1 A. No. They have little marks there.

2 Q. Well, I want to ask you about the little
3 marks, to make sure we're talking the same thing. Are
4 these the little marks you're talking about?

5 A. Yes.

6 Q. Can you help the Commission with where they
7 would find the little marks that close the top of what
8 you call the perm barrier?

9 A. Close to the top of the perm barrier?

10 Q. For it to be a barrier, it has to close on
11 the top, right?

12 A. No. The perm barrier can be any layers in
13 there. It's not the entire -- you don't need an
14 entire thickness. All you need is some --

15 Q. Let's take it in pieces. First, I said the
16 little dot -- the tiny dotted line, that wasn't on the
17 original, you added that?

18 A. Correct.

19 Q. And the colored perm barriers, that wasn't
20 on the original document. You added that?

21 A. Correct.

22 Q. And so then I asked: Did you use your
23 7 percent porosity cutoff for this perm barrier? You
24 said no?

25 A. No.

1 Q. You said you did it based on the little
2 lines that they drew, right? Yes?

3 A. Yes.

4 Q. And so then I asked: Are these the little
5 lines?

6 And I'm indicating here there's lines
7 that go along -- are you with me? Those are the lines
8 you're speaking of?

9 A. Yes.

10 Q. But the lines never close -- literally at
11 the top of what you've called a perm barrier, there
12 are no lines. If that was your methodology, how did
13 you decide to call that a perm barrier and to
14 effectively put in lines where the author of the
15 cartoon chose not to?

16 A. For simplicity and geologic interpretation
17 to close the polygon.

18 Q. But the author of this that was trying to
19 communicate something through the writing, can we
20 agree that they intentionally did not close the top of
21 what you've now called a perm barrier?

22 A. Yes.

23 Q. Okay. So then on what scientific basis did
24 you have to close it and then come in here and testify
25 to the Commission about it?

1 A. I did make a big assumption that the perm
2 barrier on the east and west and the bottom have a top
3 somewhere.

4 MR. WEHMEYER: I think I'm at a place that I
5 may be able to pass the witness, but I would like
6 just two minutes to visit with my clients, if I could
7 ask for the afternoon break now. But if that doesn't
8 please the Commission, I'm happy to proceed.

9 HEARING OFFICER HARWOOD: Chairman Rozatos,
10 it is 2:50 p.m. What's your thinking?

11 CHAIR ROZATOS: Yeah, we need to take a
12 break, let's take a break now. And we can come back.

13 HEARING OFFICER HARWOOD: All right. Is 10
14 minutes enough?

15 MR. WEHMEYER: That's perfect. Thank you.

16 HEARING OFFICER HARWOOD: Let's come back at
17 3:00.

18 (Recess held from 2:51 to 3:00 p.m.)

19 HEARING OFFICER HARWOOD: Mr. Wehmeyer.

20 MR. WEHMEYER: Thank you. On behalf of
21 Empire, we pass the witness.

22 THE HEARING OFFICER: All right.

23 Mr. Moander, I believe you'd be next.

24 MR. MOANDER: Yes, Mr. Hearing Officer. OCD
25 does not have questions for this witness, and we'll

1 pass the witness.

2 HEARING OFFICER HARWOOD: All right. Rice
3 operating, Mr. Beck?

4 MR. BECK: Just a couple of questions.

5 CROSS-EXAMINATION

6 BY MR. BECK:

7 Q. Mr. Knights, if I think you said that if
8 Empire came to you, told you that they were going to
9 drill down to the bottom of the San Andres and spend
10 1.2-or-something-billion dollars on doing it, you
11 would voice them a concern about the injection going
12 on at the bottom of the San Andres, right?

13 A. I would give them one of many concerns, but
14 that would be a minor one.

15 Q. And what are those other concerns?

16 A. The actual presence, the volume of the
17 presence. The thickness of the San Andres is a
18 negative. You can't CO2 flood an individual zone. You
19 have to flood the entire section. Some of the perm
20 barriers in there may also be an issue. I think the
21 karsting that is evident from the loss drilling
22 circulation and the amount of fluid -- water
23 withdrawal from the water supply wells. And the
24 ability to inject, indicating that it's a
25 significantly large volume of -- pore volume of water

1 that is in the system that they would have to overcome
2 to get to those -- the alleged oil in the smaller
3 porosity throats trying to get that CO2 to contact that
4 oil. I think those would be my major concerns.

5 Q. And what if they came to you and said,
6 "Okay. Well, given those concerns, we're just going
7 to exploit the CO2 tertiary recovery, the potential ROZ
8 above negative 700 subsea"?

9 A. Yeah, I think negative 500 would probably be
10 my estimate of where the current -- if I was -- if I
11 was going to reclaim a unit, I would say negative 500
12 would be the base of the productive oil unit and the
13 potential ROZs. And that anything developed up there
14 would be isolated and separate from the deeper
15 reservoir that's currently being injected from
16 Goodnight.

17 Q. And so when you say that it's isolated, I
18 was a little bit confused about there was seemed to be
19 a lot of discussion on whether there was there --
20 there was one significant barrier in the EMSU,
21 permeability barrier, whether there were multiples.

22 At a base level, it sounds like you're
23 of the opinion that there's no communication above
24 that permeability barrier and below, right?

25 A. Correct.

1 Q. Now, explain me how that is if there's not
2 just one single permeability barrier that you've
3 found?

4 A. Well, there's evidence that there's a number
5 of tight streaks in there that it may be thinned and
6 laterally extensive. It's difficult to actually map
7 it across the whole unit. But those tight streaks are
8 perm barriers, but there's also other vertical
9 impediments to vertical flow.

10 So if you have a fluid trying to move up
11 through this stratigraphic column and it hits a high
12 perm streak, it's not going to go up, it's going to go
13 laterally across there. And so there are indications
14 of a lot of low perm barriers, but there are also some
15 layers and including -- he pointed out there's some
16 loss circulation zones a little higher in the section.
17 All those would be impediments to vertical fluid
18 migration up into the above reservoirs.

19 Q. And I think you went through this with
20 Mr. Wehmeyer, but you, in part of your work, you
21 advise banks on investing in new discovery projects of
22 oil like this?

23 A. Yes.

24 Q. And you do that for working interest owners,
25 I think you said?

1 A. Working interest owners, companies, new
2 developments, new business ventures, private equity
3 firms due diligence, screening of projects before
4 someone goes to the next level of is this worth
5 kicking the tires.

6 Q. And if one of those clients came in and
7 asked you for the EMSU, is there a permeability
8 barrier in communication between the disposal zone and
9 the potential ROZ above it, what would you tell them?

10 A. I'd say there's plenty of evidence that I've
11 seen that indicates that there's no communication
12 between those two and those are isolated and separate
13 reservoirs.

14 MR. BECK: All right. Thank you.

15 Pass the witness.

16 HEARING OFFICER HARWOOD: Thank you,
17 Mr. Beck.

18 Mr. Suazo, Pilot Water Solutions?

19 MR. SUAZO: No questions from Pilot,
20 Mr. Examiner.

21 THE HEARING OFFICER: All right. Then we
22 come to the Commission. Anybody want to volunteer?
23 I put Dr. Ampomah in the hot seat yesterday first. I
24 can do that again.

25 CHAIR ROZATOS: I'll start.

1 HEARING OFFICER HARWOOD: All right.

2 CHAIR ROZATOS: I'll start. I don't have
3 any questions.

4 THE HEARING OFFICER: That makes it easy.

5 CHAIR ROZATOS: Yes.

6 THE HEARING OFFICER: All right. Well, I
7 don't see any volunteers, so I'm just going to pick
8 on Mr. Lamkin first.

9 Do you have any questions, Mr. Lamkin,
10 for Mr. Knights?

11 COMMISSIONER LAMKIN: I do have a couple
12 questions.

13 EXAMINATION

14 BY COMMISSIONER LAMKIN:

15 Q. Good afternoon, Mr. Knights. Thank you for
16 your testimony.

17 So with regard to the correlation of the
18 wells that had anomalous water production volumes, did
19 you look into whether or not those wells were
20 perforated across the bedding planes that you
21 hypothesized are the conduits to fluid flow?

22 A. Yes.

23 Q. Was that in one of your figures, or is that
24 in your testimony somewhere?

25 A. In the testimony. I think it's in my

1 rebuttal testimony on Page 5. I discussed that 239
2 well in pretty specific detail on where it was perfed
3 and where it was drilled deeper.

4 Q. Was that the only well that you analyzed?

5 A. That's the only well that I went into detail
6 on.

7 Q. Was that the only well that you found was
8 perforated across that bedding plane?

9 A. That was the only one I investigated, since
10 that was the largest anomalous thing that most people
11 pointed to.

12 Q. Okay. Other than potential communication,
13 vertical communication between the San Andres and the
14 Grayburg, can you think of any other possible
15 explanation as to why you would see a pressure
16 reduction in the San Andres prior to oil being
17 produced from that zone?

18 A. I think the only one would be the
19 production, early production in the San Andres of
20 (audio glitch) waterflooding actually started in -- or
21 being pervasive in the Central Base Platform.

22 Q. Was there any consideration made to a
23 poroelastic effect causing a pressure drawdown in the
24 San Andres from the removal of reservoir fluids in the
25 Grayburg formation?

1 A. No, I did not consider that.

2 COMMISSIONER LAMKIN: I think that's all my
3 questions. Thank you.

4 THE HEARING OFFICER: Thank you, Mr. Lamkin.
5 Dr. Ampomah.

6 EXAMINATION

7 BY COMMISSIONER AMPOMAH:

8 Q. Thank you, Mr. Knights, for your testimony.
9 I do have a couple of questions for you. If we can
10 have your slides up, that would be much useful to me.

11 Now, my first question to you is,
12 Mr. West talked about Empire using 18 percent
13 recovery factor based on Seminole as an analogous to,
14 let's say, the EMSU. Can you comment on that
15 18 percent?

16 A. I think, basically, the reservoir quality of
17 the EMSU is significantly less than the Seminole and I
18 don't think that's a very good analogy at all.
19 Seminole is a relatively good quality reservoir with a
20 lot of the oil in the higher porosity intervals. And
21 I think the Tall Cotton analysis that I did, although
22 very cursory, is probably more in line with what I
23 would expect in the EMSU.

24 Q. So, there was a discussion on the Tall
25 Cotton. And, you know, I just want to know, let's

1 say -- you just look at the Tall Cotton. Apart
2 from -- well, let me put it this way. Are there any
3 technical difficulties that they faced, you know, that
4 contributed to, let's say, less recovery from the Tall
5 Cotton, or it's just purely based on geology?

6 A. Basically, there could be technical issues
7 that I'm unaware of. But I use the actual physical
8 data of the production and its trend currently.

9 Q. But you also listened to Steve Melzer
10 talking about all the technical issues, even they did
11 not listen to him, you know. So he talked about
12 actual technical issues that really resulted in that
13 failure. Did you incorporate that into your analysis?

14 A. No, I didn't. Most of the stories of things
15 that go wrong, there's always stories, but I try to
16 look back at the actual data and say, "Well, okay,
17 this is the data. If you can explain it, I'd love to
18 see it. Can you show me that data," and then I'd make
19 adjustments.

20 But in this case, it was a screening,
21 and I think it's -- you know, anything on the
22 technical issues that may have caused that to be a
23 lower recovery, I did not incorporate.

24 Q. So the Seminole did have -- does the
25 Seminole have a main pay zone and then the ROZ?

1 A. Correct.

2 Q. Is it not analogous to the EMSU, based on
3 even your testimony and that of Dr. Davidson's
4 testimony?

5 A. Do I think that's a good analogy?

6 Q. Yeah?

7 A. No. It's higher quality rock.

8 Q. Now, let's talk about rock quality. So I
9 know that there are different ways that we can come up
10 with the rock quality. Especially even if we do -- we
11 can also utilize the portal sizes, which has been more
12 or less established in the industry.

13 So why did you or your team not really
14 do more detail analysis, especially when you are
15 referring to the reservoir quality?

16 A. Yeah. I guess there could have been more
17 detailed work done, but I think the -- yeah, just do
18 not do that.

19 Q. So the actual reservoir quality analysis
20 that Dr. Davidson worked on, would you agree that
21 probably it's extreme?

22 A. Extreme low? High?

23 Q. Okay. So if you look at the profile that he
24 used, the RI, and then the saturation, and he tried to
25 more or less use the -- that plot to more or less

1 illustrate that the EMSU or San Andres is more or less
2 oil wet. So I'm saying that if you look at that plot
3 superimposed with the saturations, is it not really
4 extreme, especially when, at some point -- if you pick
5 this facies model, then you are more on less saying
6 probably the oil -- the water saturation is going to
7 have to start from 80 percent or 90 percent.

8 Was that on extreme?

9 A. It is dependent on the actual lithology that
10 you interpret. And I think Dr. Davidson used the core
11 data in the upper San Andres to build that model and
12 take that down from the log characteristics. So I
13 think it's a case -- I'm not sure if it's an extreme
14 case.

15 Q. Can we go to Slide Number 2 on your
16 presentation. You know, I know there was a discussion
17 on this one. Can you tell the Commission that it is
18 your testimony that there was a migration of the oil,
19 one is the Wolfcamp being the source rock for the
20 Grayburg and the San Andres? Is that your testimony?

21 A. Correct. Yes.

22 Q. I'll ask you the same question. Can you
23 explain to the Commission how this migration pathway
24 happens? When you say complex, it's complicated, I
25 don't really understand. So how complicated, how

1 complex it is?

2 A. My description of complex is basically
3 looking at the different accumulations in the
4 San Andres throughout the Central Basin Platform.
5 They're in different areas and different types of
6 accumulations.

7 And in some areas where you may expect
8 to find oil, you don't. In some areas, it's just
9 unusual where the oil is. And I can't really explain
10 how it got there. And there's not a simple path. So
11 that's what my complex issues is. I don't understand
12 how the oil got there.

13 Q. And based on your testimony, you talk about
14 the San Andres being so extensive throughout the EMSU
15 and even beyond; is that correct?

16 A. Correct. And I guess the Lower San Andres.
17 Because there's an Upper San Andres and a Lower
18 San Andres. And so a lot of my difficulty with the
19 nomenclature is people say "San Andres" and it's not
20 specific. So for the large aquifer, I'm discussing
21 the Lower San Andres that is where the Goodnight is
22 injecting.

23 Q. So, in the unitization documentation, was it
24 specified Lower and Upper San Andres, or it was
25 Grayburg and San Andres?

1 A. Yeah, it was Grayburg and San Andres.

2 Q. So, do you have any objection when Empire
3 says that the unitization zone is right from the
4 Grayburg to the bottom of the San Andres?

5 A. No. I think that's an accurate description
6 of the unit.

7 Q. Now, another question that I had, you know,
8 we've been going back and forth on this. You have a
9 lot of experience. You've helped a lot of companies,
10 you know, in these types of litigations.

11 Have you ever seen any external company
12 that do not have any producing, let's say, interest in
13 the unitization zone, being allowed to bring in water
14 from different sources to inject? Have you seen that
15 before?

16 A. No.

17 Q. Why do you believe that there has never been
18 a precedent for that?

19 A. I do not know. But I think in this
20 situation that there would be a distinct physical
21 geologic reason why they both can coexist.

22 Q. Let's move to Slide Number 4. So you said
23 that you classified the San Andres as a -- whether
24 upper or lower, or let's say the lower, okay, as a
25 large aquifer.

1 A. Yes.

2 Q. Large aquifer. How do you determine the
3 boundary?

4 A. That is a very good question, because I
5 think one of the most surprising things in going
6 through this is understanding that the San Andres is
7 under pressured at about .38 or so psi per foot. And,
8 again, complexity, I don't really know how to explain
9 that. But the amount of water that was withdrawn in
10 the early days and the amount of water that was
11 injected and the very limited changes in pressures
12 would all point to just a very large aquifer that, you
13 know, taking out 340 million barrels and having
14 limited pressure drop would portend to a very large
15 tank being that 340 million barrels was a very small
16 component of that.

17 Q. Can we go to the slide where you showed --
18 you actually marked the perm barriers, the one that
19 you did yourself --

20 A. Yes.

21 Q. -- that opposing counsel was going back and
22 forth with you on? Right there, this one.

23 So which zone are we in on the top
24 figure?

25 A. That's all the Grayburg. So that is the

1 producing intervals in the Grayburg. That was
2 discovered in 1928, I think. But this paper was 1939
3 after they had drilled, you know, 450 or so wells.
4 And it was basically an amalgamation of the data at
5 that time.

6 Q. And based on your discussion, were you more
7 or less using this as analogous potential barriers
8 that could be seen in the San Andres?

9 A. These were all barriers that are in the
10 Grayburg, so these are not in the San Andres.

11 Q. So, when you talk about the barriers, the
12 perm barriers, that exist in the San Andres, is it
13 analogous to what we see in here?

14 A. A little. I believe there's intervals, and
15 in my TVD depth between, say, 500 and 700 TVD subsea,
16 that there's a lot of petrophysical events, that
17 there's multiple perm barriers, both very, very
18 extremely low and very moderately low. But a number
19 of those barriers in amalgamation, I think, is an
20 incredibly strong barrier to vertical fluid flow.

21 Q. And do we have an extensive mapping based on
22 the log data, how this would look like?

23 A. I have not done that mapping, no.

24 Q. So, I'm thinking about how -- let's say we
25 have perm barriers within the area where we are

1 injecting, and then we are saying that it is a large
2 aquifer. I'm trying to figure out, you know, if there
3 are barriers in there, you know, why are we saying it
4 is a large aquifer? I'm trying to just understand
5 that.

6 A. Well, the large aquifer comes from the
7 pressures. I think the last analysis I saw was that
8 in a small area, there was 39 million barrels of oil
9 injected, the pressure gradient --

10 Q. Water injected? No.

11 A. Water injected. This is a water disposal in
12 the Lower San Andres. And the average pressure for
13 those five wells had a pressure gradient of .381, and
14 after 39 million barrels were injected into that over
15 about a year and a half, the pressure gradient was
16 tested in all five of those wells, and the average was
17 .383.

18 So that's 39 million barrels and a
19 very -- if you calculate that at the .002 gradient at
20 the depth of 5,000 feet, that comes to about a .25 psi
21 per million barrels injected. And so that's one of my
22 big indications of -- you know, when I talk about
23 direct evidence, I think the biggest direct evidence
24 is material balance of pressures and volumes.

25 And that really tells you a lot about

1 the actual reservoir size, but as you were mentioning,
2 you know, the actual boundaries, that is very
3 difficult. Especially if you have these limited
4 pressure variations with that kind of volume being
5 injected in there.

6 Q. So is there an expert from Goodnight who is
7 going to really discuss to the Commission the pressure
8 situation? Is there someone that is going to testify
9 on that?

10 A. Yes. I'm --

11 Q. So, I'm not going to bother you with that.
12 I'm not going to bother you with that.

13 A. I've been exposed to it, but I am not the
14 expert on the pressures. But it was very important in
15 my testimony and my understanding of the reservoirs.

16 Q. Okay. Can we go to Slide Number 5, or even
17 probably Slide Number 6 would be helpful. Slide
18 Number 6, yeah. Let's go to 6.

19 So here, you're showing us the
20 locations, you know, in the oil zone and then also
21 within the San Andres, where we do have the water
22 supply wells and then also the injection wells that
23 are ongoing right on the east side. Where is the
24 proposed new injections from Goodnight? Where is it
25 going to be?

1 A. I would like to make a correction here.
2 This is basically an alphabetical order. It's not a
3 location order. So just from right to left was just
4 the well numbers in order. So it's not --
5 logistically, that's not west to east. It's just a
6 diagram.

7 So I was trying -- what I was trying to
8 present with this was all of the critical data and
9 critical wells that have tests or indications of fluid
10 mobility in all of the zones. So all of the red wells
11 in the middle or either petrophysics or the only wells
12 that tested something below the producing oil-water
13 contact. So sorry about that. I didn't make that
14 clear before.

15 Q. Okay. Okay. Now we talked about the perm
16 barriers. So I also confirmed the testimony from
17 Dr. Davidson that there are anhydrites that causes
18 those perm barriers.

19 A. Yes. His interpretation was anhydrites are
20 low permeability, low porosity intervals.

21 Q. So when he was testifying, it sounded like
22 he doesn't have any concrete evidence?

23 A. Direct core data, I don't think he has in
24 that interval.

25 Q. What about mud logs?

1 A. Mud logs, I think there were a few to go
2 through there, but I don't know if there was. I'd
3 defer to Dr. Davidson.

4 Q. And then he also testified that it was not
5 continuous. Is that fair?

6 A. Yeah, he could not -- I don't think he could
7 correlate, you know, one interval across the entire
8 area.

9 Q. Now, are these perm barriers something that
10 has been established, you know, in the Permian or,
11 let's say, in the EMSU as well established perm
12 barriers, isolated formation that has been well
13 established that there are perm barriers here that
14 more or less serve as a cap rock.

15 A. I think the only detailed information is
16 from the Seminole and the Hobbs units in their CO2
17 applications. They went through and had detailed
18 studies and said that there was no communication
19 throughout the San Andres from the deeper zone.

20 But I don't think there's any, you know,
21 confirmation, literature that states this is a
22 consistent perm barrier across the Central Basin
23 Platform.

24 Q. And I thought you said you don't want to use
25 the Seminole as analogous field to the EMS?

1 A. Exactly. And those are the only two that I
2 know that have had deeper studies on that
3 communication between deeper. But, again, not a very
4 good analogy.

5 Q. So let me ask you. Has there been any
6 discussion about the perm barrier issues between
7 Goodnight and Empire?

8 A. I don't believe -- I'd have to defer to -- I
9 mean, I wasn't in the communications there.

10 Q. And has there been any communication from
11 Empire based on even all the testimony that you've
12 listened to about any perm barrier?

13 A. I don't think -- I have not been familiar
14 with any communications between anybody at Empire.

15 Q. So, you know, you're tasking the Commission
16 to really make a tough decision here where you're
17 providing as expert testimony that there exists a perm
18 barrier that separates out Goodnight's injection zone
19 from where you believe the ROZ could be.

20 Now, if I ask you right now, where is
21 the Grayburg, is it extensive in the EMSU, I'm sure
22 you're going to say yes.

23 A. Yes.

24 Q. Right? If I ask you about the Lower
25 San Andres, you say it's extensive, right?

1 A. Correct.

2 Q. If I ask you about the Upper San Andres, you
3 can really pinpoint that and say right here is there,
4 right? Why can't we have the same for the perm
5 barrier? We need right evidence, you know, stronger
6 evidence that could be mapped.

7 A. I think that's a good question. It could be
8 you could do some geologic considerations and make a
9 map that would support it, but I think all the current
10 data that I've reviewed doesn't suggest that there's
11 any communication between the two. And I think the
12 pressure differences and just the reservoir
13 characteristic, the dramatic differences between the
14 Lower San Andres and the Grayburg in that Upper
15 San Andres, I think are sufficient to basically make
16 that statement. In my opinion, that's strong
17 indications of a barrier.

18 Q. So, that one we're talking about time, t is
19 equal to 2024, right? But Goodnight is proposing to
20 inject huge volumes of water. And, you know, I don't
21 want to go into the pressure discussion with you. I
22 prefer to wait so we can get into that. But you've
23 seen these baffles, and based on your testimony, it's
24 not extensive?

25 A. Well, the individual baffles are not

1 extensive, but the preponderance of significant
2 numbers of them in all the wells that we looked at, I
3 think amalgamated the preponderance of them since
4 there's significant perm barriers as a group.

5 Q. Yeah, but that is essentially based on some
6 of the logs that you looked at. But there's no
7 well-documented evidence, more or less, and there is
8 no core to support that claim.

9 A. Okay.

10 Q. And even Dr. Davidson and yourself, you're
11 saying that we don't need any further data, the
12 Commission has enough data to make decisions. Do you
13 still stand by that?

14 A. I think for the injection in the lower
15 thing, that there's no pressure buildups, no
16 indication of vertical migration, that there's no
17 evidence that I think that has any influence on the
18 shallower reservoirs above.

19 Q. So is there someone from Goodnight who is
20 going to tell us about Goodnight's injection and their
21 perceived impact on existing operations?

22 A. Yes.

23 Q. Okay. Can we go to Slide Number 7. Thank
24 you.

25 You know, and, let's say, majority of

1 the experts, almost everybody has a lot of experience
2 in the industry, right? So you are presenting your
3 portion, NuTech presented their portion, and Scott
4 also did the same thing.

5 Now, my question to you is, as you've
6 shown us this, even from the original one, the revised
7 one, and then even your original one and all of that,
8 first question is, do you see any evidence of oil in
9 the San Andres?

10 A. No -- well, the only -- in some of the
11 cores, there was some staining. But from a
12 significant portion, continuous saturations that is
13 kind of required for an ROZ, no.

14 Q. Well, if we look at the EMSU 679, I mean, it
15 is well established that there is oil, at least based
16 on that EMSU 679. And then also the RR Bell well, it
17 is established that there is at least some oil in
18 place.

19 A. There is some oil. And I think most of the
20 analysis went to the significance of that oil and its
21 aerial extent or its vertical extent.

22 Q. So assuming that NuTech, Ops Geologic, they
23 overestimated the oil in place, what about the core?

24 A. The core? For which?

25 Q. Okay. Let me rephrase my question.

1 Assuming that NuTech, Ops Geologic and
2 even Dr. Davidson, you know, they've all
3 interpreted -- Scott also did the same, Dr. Birkhead.
4 So they've done all of this and there is a contention
5 with regards to which one is correct, which one is
6 correct, my question is, what is the core saying?

7 A. Well, the core correlates best with
8 Dr. Davidson's.

9 Q. I want to show you, this one will be Scott's
10 rebuttal. So he compared EMSU 679 compared to that of
11 Goodnight's and Empire.

12 COMMISSIONER AMPOMAH: So I want to approach
13 the witness and show him to refresh the memory.

14 BY COMMISSIONER AMPOMAH:

15 Q. So in here, we are looking at the EMSU 679
16 that do have actual evidence of the core. Now you're
17 saying that it is only Dr. Davidson's analysis that
18 matched the core, let's say, to your satisfaction.

19 What you see on Track 9 and Track 10, is
20 it not a good match?

21 A. 9 and 10? I think if you look --

22 Q. Yeah, let's go to where the spot is. Yeah,
23 right there.

24 A. Yeah, so there are areas that there are
25 significant differences between the saturations

1 from -- and this is Ops', correct, Ops' petrophysics?

2 Q. Yeah. Dr. Buchwalter.

3 A. It is.

4 Q. Yeah. He's comparing all the different
5 analyses that were done.

6 A. So there's certain intervals in there that
7 are significantly overestimated from the SO,
8 especially as you get lower. And I think I brought up
9 that in my testimony, that, you know, if this is an
10 ROZ, then the depths, the last, I don't know, 50 to
11 100 feet indicate that there's a lowering of oil
12 saturation in the cores, which might suggest the base
13 of an ROZ.

14 Q. So, have you seen any testimony where Empire
15 has estimated, based on the core, or even if Goodnight
16 have done that, based on the core, the actual core,
17 what is the average saturation within the San Andres?

18 A. You know, I didn't do the San Andres
19 nomenclature, so I just did TVD subsea depths. So I
20 have not done what is the oil saturation in the
21 San Andres in this core.

22 Q. Can we bring back the slides one more time?

23 A. Does this have a San Andres top on that? So
24 there, in the lower part of the San Andres?

25 Q. Yes.

1 A. Or what is -- there's two San Andres picks?
2 This is basically a good example of the difficulty of
3 having different people pick San Andres top, because
4 it makes a significant difference on what you're going
5 to do for the average saturation.

6 And basically all my analysis was done
7 on a TVD subsea base, so I didn't get into that
8 nomenclature. But I did see that degradation in oil
9 saturation as you go deeper.

10 Q. Yeah, let's go to Slide Number 8 on your
11 presentation. So on Slide Number 8, I'm just focusing
12 on the analysis that Dr. Davidson worked on. Do we
13 see any oil saturation?

14 A. There are a few intervals that are about 40
15 percent, but most of them are below 20 percent.

16 Q. But we gain 20 percent and 40 percent or,
17 let's say, below -- above 20 percent. Do you see
18 significant saturations?

19 A. Only above the producing oil-water contact.

20 Q. But what about the below the producing
21 oil-water contact?

22 A. Very limited.

23 Q. Do we see, or it is not?

24 A. Well, I guess numerically, I would say
25 there's maybe 50 feet out of 250, or maybe 10 to

1 20 percent of the rock is above 40 percent. I don't
2 know, rough estimate.

3 Q. Yeah, let's go to --

4 A. But not a lot.

5 Q. Can I proceed?

6 A. Yes.

7 Q. Okay. So based on Dr. Davidson's testimony,
8 he testified to the Commission that he believes that
9 there is an ROZ on the Upper San Andres. Do you
10 believe that or not?

11 A. Not from this well.

12 Q. So generally, and this is just an example,
13 so he testified to the Commission that he believes
14 that there is an established ROZ in the Upper
15 San Andres. Is that your testimony or you, more or
16 less, probably have a problem with that?

17 A. Again, he's using the San Andres
18 terminology. I know between negative 350 and negative
19 500, I have a potential ROZ, but not a definitive.
20 And if I was looking at this well, I would say that
21 this wouldn't be a strong indication of an ROZ.

22 Q. Yeah, then let's look at Slide Number 10.
23 These are all core data, which I like. Is this
24 showing any oil saturation or no oil saturation within
25 the San Andres?

1 A. Again, I'm not sure the depth of whose
2 San Andres top, but yeah, I would have to re-jigger
3 this for whoever's San Andres top I'm trying to use.

4 But the big picture on this is that the
5 core data saturations and the profile versus porosity
6 versus the same theme in the analysis doesn't appear
7 to be -- appears to be contradictory a little.

8 Q. You know, let's say from my point of view,
9 Goodnight is giving us different estimations of, let's
10 say, oil saturation, Empire is doing the same. So if
11 we can stick to the core, because the core is the real
12 evidence that we all have here, let's say, all the
13 models that have been done trying to fit to the core
14 and based on that, try to predict how it's going to be
15 on the other ones. So I just want to look at the core
16 and just look at the core and see what it's saying?

17 A. Yes.

18 Q. You know, we can just debate about the oil
19 estimations here and there. But what is the core
20 showing us?

21 So on this particular slide, you have a
22 potential ROZ, you do have a transition zone and then
23 you have the aquifer. So I'm asking you, looking at
24 the core, the EMSU 679 core data, do we see any
25 evidence of oil saturation?

1 A. Yes. There is oil saturation in the core.

2 Q. Okay. Let's go to Slide Number 11. So I
3 asked you whether you've calculated the average
4 saturation in the core. You said you've not done
5 that.

6 A. I guess this gives the average saturation in
7 the core. So if I did say that, I was in error.

8 Q. Okay. So let's focus on the first track.
9 Is this one the actual core or the corrected core?

10 A. The actual, not corrected.

11 Q. So how was the 14.8786 calculated?

12 A. There's the arithmetic average of the core
13 values.

14 Q. Without any cutoffs or the core values?

15 A. Yes.

16 Q. Did the Empire do the same analysis?

17 A. I don't remember.

18 Q. So, it would be good for the Commission to
19 know, based on the existing core data, what is the
20 actual average saturation that we are seeing in the
21 core. You know, I can cross-check. I'm pretty sure
22 some of Empire's experts probably might have presented
23 that. So, that is something that would be very, very
24 helpful to the Commission. At least you've presented
25 something here, but I don't know how it -- created

1 this. But these are real data that we do have.

2 So, it would be good for the Commission
3 to know what is the actual average oil saturation
4 within, let's say, the Upper San Andres, the Lower
5 San Andres. That would be very, very helpful to us.

6 A. I don't believe we have any core data in the
7 Lower San Andres.

8 Q. So when you put your marker right in there
9 and you say it's an aquifer, where is that?

10 A. That? That's a negative 700 TVD subsea.

11 Q. So where is that?

12 A. Depending on which geologist you talk to, it
13 could be various places.

14 Q. I mean, so what should I take? I mean, the
15 Commission, what should we take?

16 A. In my opinion, basically 700 and below,
17 there's no evidence of hydrocarbons and a lot of
18 evidence of significant water. Above that, above 500,
19 I think you have some evidence, higher evidence of oil
20 in place in the core and in the log analysis. And in
21 between 500 and 700 feet, it's like a -- what I call a
22 transition zone, but very little oil in place,
23 probably doesn't look like an ROZ to me, but...

24 Q. But sir, so this one is just a type log. I
25 mean, how are you going to -- isn't your testimony --

1 I know there was a backup for that? Isn't it your
2 testimony to the Commission that right within the
3 San Andres minus 700 across is all -- is your
4 testimony that across 700 on all wells is an aquifer?
5 Isn't that your testimony?

6 A. Yes. Below that subsea depth I believe is
7 all on aquifer, yes.

8 Q. But I thought there was back and forth where
9 you identified that barrier, you said below that was
10 when you were getting all the mud losses.

11 A. Yes.

12 Q. I mean, it was a little bit -- it was so
13 curious to me that -- you know, I've worked with a lot
14 of petrophysicists, a lot of geologists, and only God
15 knows how long it takes them to all come to a
16 conclusion on where the tops are? So it's a little
17 bit surprising to me that the senior geologist, you
18 said you depended on the petrophysicist to get you the
19 tops. Is that not surprising?

20 A. No. As I mentioned before, the quagmire of
21 where you pick the top, if I waited for a geologist to
22 come up with a specific top and define it, I would be
23 waiting for my analysis.

24 But using the subsea depths, which is --
25 a lot in the CO2 work, you do pore volume out of our

1 pore volume depth migration. So I think the critical
2 part is what is your volume of oil versus depth.
3 And so I basically -- it hurt some people, but I just
4 took the TVD subsea depth and -- waiting for someone
5 to have a definitive definition of what the San Andres
6 top is.

7 Q. So is it your testimony that the average
8 core saturation within, let's say, depending on how
9 you call it, but the San Andres is 14.86 percent?
10 That is your testimony?

11 A. For this, for the core interval, that's the
12 total interval.

13 Q. So it's your testimony that your original
14 oil saturation is 14.86?

15 A. Part of that's in the Grayburg, though, I
16 believe, by most people's definition.

17 Q. So I just want to know, you've looked at the
18 data, you've provided this to the Commission, the
19 14.86, is it within the San Andres? Or where is it?

20 A. It is the complete data set, and I guess if
21 you gave me specific tops, we could calculate the
22 average porosity. Each person is going to have a
23 different top, but I think the important thing here
24 is, as you get lower in this section, the oil
25 saturation in the core goes significantly lower.

1 So at that negative 700 TVD subsea in
2 this well, there's a significant shift in the oil
3 saturation to be much lower.

4 Q. Yeah, I was trying to do a little bit of
5 math where I would just use oil-in-place calculation
6 formula to try and get some numbers here.

7 Now, so you estimated 14.86, and I
8 really wanted to understand, is it a good number for
9 the Commission to calculate, let's say, roughly how
10 much oil is going to be in place based on the core?

11 A. I think it all depends on what your tops
12 are. I think the way I would do it was, I'd stick to
13 my intervals of 350 to 500, 500 to 700, and 700 below,
14 and I'd have the core average oil saturations for
15 those intervals and then it would match up with all my
16 analysis.

17 Q. Yeah, I thought that was what you were
18 trying to show the Commission, that, see, these are
19 all the core points that we have, but the average
20 saturation is 14.86. I thought that is what you
21 wanted the Commission to take out from here.

22 A. Yeah, most of the analysis was -- I believe
23 this was from a rebuttal, so it was basically do due
24 diligence on the other petrophysical analysis and
25 saying, okay, does it match core, which one do I agree

1 with, which one do I think is the best representation
2 of the core data?

3 And so this wasn't specifically done for
4 an oil-in-place calculation, but I'm very supportive
5 of your questions and the information that would be
6 helpful to you.

7 Q. Yeah, so if you look at Mr. McBeath's
8 economic analysis that he presented to the Commission,
9 he used 10 percent also. So I was just curious, if
10 the core is telling you 14.86, why then even use
11 10 percent, you know, estimating to say that there is
12 no economic value?

13 A. I think it would depend on the depth
14 interval that you were evaluating. And I don't
15 remember exactly the depth interval that John was
16 evaluating.

17 Q. Now, so there was a lot of testimony,
18 especially with the Empire experts, they talk about
19 the core data should be the minimum value. But it
20 sounds like Dr. Davidson does have a different opinion
21 even where he wants to apply a correction factor to
22 even that data. Can you try to explain to the
23 Commission, you know, both ends?

24 A. Well, the core data oil saturation does need
25 a correction, and Dr. Davidson used one, I think it

1 was 1.22, but it looks like the other experts in this
2 case used a much larger correction.

3 And so that difference between 1.22
4 and -- I really don't have the numbers on the top of
5 my head, but it was significantly more correction.
6 And I think one of the issues that I had with that is
7 that down in the Lower San Andres, that's going to be
8 lower in the section, and if it is a residual oil,
9 you'd use a lower B sub o, since it has already been
10 flushed. And I think that kind of, just in a
11 ballpark, would indicate that you need a lower, you
12 know, expansion factor to have your uplift.

13 And I think Dr. Davidson did a pretty
14 rigorous calculation and came up with his range of
15 1.22 up to 1.26, I think. And I think that's a most
16 likely reasonable -- I mean, you could have some
17 variations around there, which I think he did, but he
18 just used one number.

19 Q. And did that correction factor increase the
20 saturation or --

21 A. Yes.

22 Q. -- decrease the saturation?

23 A. No. Increase. Increased by about 22
24 percent.

25 Q. Okay. So how much weight do you put on the

1 analysis, Empire's experts' analysis and
2 Dr. Davidson's analysis and then also the core?

3 A. I go back to the core as being my hard,
4 distinct physical evidence, and so I tried to compare
5 all the analysis back to that core data. And
6 Dr. Davidson seems to be, in my opinion, the best
7 correlation with the actual core data.

8 Q. So is Goodnight going to provide the
9 Commission what they believe the average oil
10 saturation is within the Upper San Andres and then the
11 Lower San Andres?

12 A. Yes. I could do that if someone would agree
13 on the San Andres top.

14 Q. I mean --

15 A. But I can do it from a depth interval. I
16 feel very comfortable that's where.

17 Q. Now, I think Goodnight does have the tops,
18 right?

19 A. Yes.

20 Q. So, when you say that, depending on the top,
21 I mean, you as the chief geologist understands, you
22 know, making a case for Goodnight? So, Goodnight does
23 have a top or you don't have a top?

24 A. No, I do believe Goodnight has an
25 interpreted top.

1 Q. So Goodnight can provide the commission
2 their top, and then also let's say the average oil
3 saturation within that, both for the Upper and the
4 Lower. And I'm hoping that Empire should provide the
5 Commission with the same data.

6 A. Excellent.

7 Q. And we do -- I don't know if the Commission,
8 we do have the actual core data or not in terms of the
9 numbers. But it would be good for us to also look at
10 it and do our own calculations with that as well.

11 A. Excellent.

12 Q. Slide Number 14. Okay. We've already
13 talked about it. You said this one was in the
14 Grayburg, so I appreciate that.

15 Now, there has been a lot of discussions
16 about Dr. Buchwalter. Now, the more I listened to
17 Goodnight's experts, the more I get more comfortable
18 with the work that he did.

19 So, is it your testimony that within the
20 San Andres, there are high streak permeability bugs
21 cast within the San Andres?

22 A. Within the lower San Andres, yes.

23 Q. Now, tell the Commission why you are
24 opposing to what Dr. Buchwalter did when he put that
25 permeability within the San Andres as part of his

1 simulation?

2 A. I'm not sure I -- not sure I disagreed with
3 the -- I mean, I think the reservoir model, what I
4 disagreed with is the geology he puts into it and the
5 oil in place.

6 The permeabilities, you know, the
7 distribution of permeabilities maybe, the magnitude.
8 You know, I didn't really have that much of an opinion
9 on the actual permeabilities.

10 Q. So Dr. Davidson and then yourself presented
11 different theories as to how he could have gotten the
12 water into the Grayburg, you know, for the wells that
13 were producing more water.

14 A. Yes.

15 Q. So you have all the theories that could be a
16 possible solution. Why did Goodnight not present that
17 in a model to the Commission?

18 A. I do not know.

19 Q. So let me follow up on that and ask if
20 Goodnight had all the input data that Dr. Buchwalter
21 used in his model? I'm asking if you know if
22 Goodnight got all the input data that went into
23 Dr. Buchwalter modeling.

24 A. Did we get all the data? I'd have to
25 default to, I think, John McBeath. But I don't think

1 we -- I think there was a hard time getting all the
2 actual data out of the model and the data that
3 supported the input parameters.

4 Q. So I just want to reiterate this point
5 again. Were there any anhydrites identified in the
6 RR Bell Number 4 well and then also the EMSU 679 that
7 had a core? Are there any established or any
8 documented anhydrites that were found in any of the
9 core?

10 A. I think I recognized some anhydrites
11 initials by some of the cores, but I didn't -- I don't
12 remember seeing a significant bedded anhydrite
13 interval.

14 Q. Let's go to Slide Number 24. Thank you.
15 So, here you're showing Tier 2 and then Tier 1. And
16 the bottom, I presume, is it oil or water saturation?

17 A. That is oil saturation.

18 Q. So here, when you see a producing zone,
19 which formation are we talking about?

20 A. The green symbols at negative 350 are
21 Grayburg. And if you use Ops' model, some of the
22 San Andres.

23 Q. Okay. So here, do we see, so assuming
24 you're saying that the green is all Grayburg,
25 producing zone --

1 A. Yes.

2 Q. -- and then the blue will be the potential
3 ROZ, which will be based on your nomenclature, that
4 will be the Upper San Andres.

5 A. Correct.

6 Q. And then you have the Lower San Andres and
7 then, let's say, the aquifer zone, more or less
8 becoming the transition zone and then the water
9 aquifer?

10 A. Correct.

11 Q. Okay. Do we see any oil saturation within
12 the Tier 2 and then Tier 1?

13 A. In which interval?

14 Q. All of them, just -- or you can just focus
15 on the residual zone and then also the transition
16 zone.

17 A. Yeah, the potential ROZ, there is some
18 Tier 1 and I'd say a significant amount of Tier 2.

19 Q. And then I saw that maybe this one is
20 different, but the one that I reviewed earlier on, it
21 sounded like it had a total oil in place there. I
22 think there were three.

23 A. Yeah, there were three columns.

24 Q. Yeah, what -- did you change your testimony,
25 or...

1 A. No, I just shortened it so it would fit on
2 that half of the graph.

3 Q. Yeah, because the one that I reviewed, it
4 sounds like you were showing over 200 million for the
5 potential residual zone. Is that a correct number?

6 A. Yes. So what I did to get to that number
7 was extrapolated the averages for the wells across the
8 entire EMSU. And basically, I don't think that's a
9 realistic way of doing it, but I wanted to be --
10 originally, I was just trying to match what other
11 people did by, okay, how do I compare my oil in place
12 to theirs? Well, they extrapolated it over the entire
13 interval, so I did also.

14 But I think the critical issue on
15 recovery is the concentration of oil. You know, if
16 you have, you know, one barrel of oil in 100 feet or
17 one barrel of oil in 1,000 feet, the higher
18 concentration is much more valuable, you get a higher
19 recovery factor.

20 So I think the critical issue that I'm
21 trying to focus on here is the oil concentration in
22 MBO per section.

23 Q. Yeah, but -- so based on your analysis, I
24 saw over 250 million barrels. So are you saying that
25 Empire should not go for it?

1 A. Well, if it was equally distributed over the
2 entire area by just extrapolating the data points,
3 that's the number you get to.

4 But I think a better way of analyzing it
5 is to look at the concentration in a section area.
6 And if you were to do a pilot, you'd pick a section,
7 and this is the average oil in place in that section.

8 So I think it's a much easier reference
9 if you're going to go to that next step of trying to
10 determine how economic it would be to recover.
11 Because you can do a pilot in a square mile area and
12 come up with a spacing, you know, how many wells are
13 in it, you know how much oil you're recovering, rather
14 than having a large volume of 250 million barrels over
15 11,000 acres and, you know, ten-acre spacing, you
16 know, you'd need a thousand wells. This way you can
17 get a more functional economic unit to kind of
18 evaluate your --

19 Q. You know, you talked about the San Andres
20 being under pressure. And I promise I'm not going to
21 go much detail with you on that, but, you know, coming
22 to that conclusion, did you incorporate the supply
23 water wells, the withdrawals from those wells into
24 your analysis?

25 A. Well, there were two points. I think there

1 was a 1959 study that was introduced a little earlier
2 that had about a .38 something. And then just some
3 recent data that I think was supplied to the
4 Commission that showed this local area where Goodnight
5 has injected a number and came up to 3.83 as a
6 current.

7 And so 1959 to current, having almost
8 identical pressures, I guess that kind of incorporates
9 the ups and downs of supply, injection and withdrawals
10 in the region.

11 Q. In one of your slides, I saw that you had a
12 perm barrier that you put in. I saw that in one of
13 your slides --

14 A. Yes. I t was --

15 Q. -- a yellow region mapped as a perm barrier.
16 Do you remember something like that?

17 A. I think there were a number. There was one
18 in the 746 well and then my cross-section with two
19 wells that I was trying to do a sensitivity analysis
20 on. I forget which one it would be.

21 Q. Yeah, that'll be on Page 24 of your -- of 32
22 total pages?

23 A. Yes.

24 MR. RANKIN: Is it in Mr. Knights'
25 testimony, Dr. Ampomah?

1 A. In the summary slides.

2 Q. Labeled as now Goodnight Number 8 testimony,
3 Exhibit E. E.

4 A. Yeah.

5 Q. There was two wells with a cross-section
6 where we do have a perm barrier, a permeability
7 barrier.

8 A. Page 32?

9 Q. 24 out of 32. Yeah, right there.

10 A. Oh, okay. This is an older one.

11 Q. Oh, there's another one. Is another one --
12 can you talk to it, or --

13 A. Yeah. I can talk to any of it.

14 Q. So, I want to know, is your perm barrier the
15 same as that picked by Dr. Davidson?

16 A. I'm not 100 percent sure. This was an early
17 well, and these are actually the two wells that had
18 spectral gamma rays. And you were asking earlier how
19 far those were away, and I guess there's three
20 miles -- maybe a little more than three miles away.

21 But yes, that perm barrier is -- I think
22 the better slide to do is in my summary slides. I
23 think it's probably halfway through, maybe Page 12.

24 Q. Yeah, probably. Let me just ask a general
25 question. The depend barrier that you picked, they're

1 the same as the ones that the Division picked, or it's
2 different?

3 A. Different. There are sensitivities in perm
4 barriers, and so what I was trying to show in that
5 cross-section is Ops' perm barriers or barriers that
6 were based on a 1.5 percent porosity, which I thought
7 was very low. And then I just tried to use a more
8 reasonable, most likely, you know, 50 percent perm
9 barrier, or not at 7 percent porosity. And then I
10 also used the .02 perm that Dr. Birkhead had
11 determined, and used that.

12 And if you use all -- any of those
13 situations, you can get a significant number of perm
14 barriers throughout the entire section.

15 Q. So is it your testimony that your perm
16 barrier was strictly based on porosity permeability
17 cutoff, and Dr. Davidson perm barriers were based on
18 anhydrites?

19 A. Correct.

20 Q. So which one should the Commission take?

21 A. My guess is both are probably --

22 Q. Anything --

23 A. Together, there's just a lot of perm
24 barriers.

25 Q. So is there a cross-section that shows

1 entirely -- so if you look at this cross-section in
2 Figure 4 that we are seeing right now, can you also
3 have the same cross-section showing the Commission how
4 you picked your barrier throughout the EMSU the same
5 for Dr. Davidson?

6 A. Yes, we could do that. I don't think I
7 have.

8 Q. Now, let me ask you. So these series of
9 questions were based on the cross. I just want to
10 clarify some few things.

11 Did Goodnight already have their own
12 perm barrier before you -- prior to your work?

13 A. I do not know.

14 Q. Did you review the application to the
15 Division?

16 A. I guess, briefly.

17 Q. So there was no baseline for you to compare
18 your work to?

19 A. No, no. I'm basically totally independent.

20 Q. Then when they say that confirm barriers,
21 what were they referring to in your scope of work?

22 A. I'm not really sure what they were
23 confirming to. But in my -- I took that as review the
24 perm barrier and tell me what you believe.

25 Q. Review the perm barrier and tell me what you

1 believe. What perm barrier? If it's not there --

2 A. Correct.

3 Q. -- what perm barrier?

4 A. Well, semantics. But, basically, I was
5 going to look for the communication between those two,
6 and I think they believe there was a perm barrier in
7 there, so I think they said, "Confirm this perm
8 barrier."

9 And basically in my line of business,
10 people tell you a lot of things, but you basically go
11 back to the data, put your professional opinion on it
12 to tell them. A lot of times, it's not what they want
13 to hear. But in my line of work, it's just you have
14 to have, you know, your best effort at getting to the
15 right answer.

16 Q. So you made a comment as part of the cross,
17 you said San Andres is not a defined interval. Do you
18 remember something like that?

19 A. Mm-hmm.

20 Q. But Empire believes that they've
21 characterized, they've described the San Andres. So
22 you know, I'm just trying to understand in terms of
23 you saying that the San Andres is not well defined, so
24 why should we agree with your interpretation?

25 A. Basically, mine is a reservoir

1 characterization, so I look at the oil -- the
2 potential reservoir. So I look at pore volume,
3 permeability and isolation of intervals and zones that
4 can be just exploited economically.

5 And if you have multiple reservoirs
6 in -- you know, one of the big things we have is for
7 many big companies that are in the same reservoir,
8 they all have different nomenclature for different
9 tops and different intervals. And I don't really care
10 what they call it. I'm going to pick -- this is an
11 interval that I think is a boundary here, a boundary
12 here, and this is a separate interval. And then they
13 can call it anything they want, but all I need to do
14 is decide what the reservoir characteristics are in
15 those individual zones.

16 And so I apologize that it's very
17 difficult, this nomenclature thing. It's more of a
18 legal issue than a reservoir characterization.

19 Q. So you also made mention of potential
20 barrier.

21 A. Yes.

22 Q. You recall that? Does that mean that we
23 don't have enough data to confirm that?

24 A. I generally don't like to make affirmative
25 statements of 100 percent certainty on really

1 anything, because in the oil business, you realize
2 that things can happen and you look at the
3 preponderance of data, all the data you evaluated, and
4 it suggests there's a perm barrier there.

5 And I would say, you know, on an
6 individual basis it's a potential perm barrier. But
7 when I have a preponderance of a significant number of
8 potential perm barriers, then it becomes more likely
9 that there's a significant barrier to fluid migration.

10 Q. So, sir, you made a good point here. You
11 said that you don't normally -- you want to attach
12 uncertainty to your estimations; you don't want to
13 really tie yourself to a particular, let's say,
14 decision or something like that?

15 A. Yeah.

16 Q. Now, I've reviewed all the -- you showed us
17 clearly all the wells that you performed petrophysical
18 analysis on. Let's say Dr. Davidson did that. I've
19 also reviewed all the work that Ops Geologic did, that
20 NuTech did. It's all based on uncertainty, right? So
21 why should the Commission not give Empire the
22 opportunity to go and explore based on the
23 uncertainties that we are seeing here?

24 A. Well, I think some of it's precedence. And
25 from my look at the reservoirs, I think the certainty,

1 the alleged resources that are proposed for the lower
2 San Andres, I think Jim Davidson's analysis, in my
3 opinion, is more accurate and indicates that there is
4 little to no significant oil in the lower San Andres.

5 And then it also comes down to, just in
6 general, the New Mexico oil and gas industry in,
7 itself. This water disposal -- you know, there's
8 about 1,700 horizontal wells completed a year in the
9 in the Delaware Basin, and that comes out to about
10 70,000 barrels a month of new production at a
11 water-oil ratio of 3 to 1. That's going to be around
12 210,000 barrels a month that New Mexico is going to
13 have to find a place to put that water. And in a long
14 term, that's just a month. So if you can extrapolate
15 that out, very big numbers.

16 But the other thing is just the
17 precedence of using the San Andres as a water supply
18 and a water injection zone is just an industry common
19 practice. And I think this reservoir is unique in
20 this under pressure, which I'm still fascinated by how
21 that came to be or -- but it does seem to be there.

22 But I think the best thing for the
23 New Mexico State is to have these people both coexist.
24 If I was asked by Empire what I would consider them
25 doing, I'd say, you know, "Your most oil in place, no

1 matter whose petrophysical analysis you're looking at,
2 is in the Grayburg. And you already have some
3 infrastructure there, you have the oil in place and
4 that's probably your most economic chance. And if you
5 go down to the 350 to 500 foot interval, there is some
6 indications. I believe, that Jim Davidson's
7 petrophysical analysis says there's very high risk.
8 But if you believe your petrophysical analysis, then
9 that 150 feet may be the next best thing to do."

10 But I think jumping down into the Lower
11 San Andres, well, I think there's significant evidence
12 that the alleged resources down there may not exist at
13 all. I think there's plenty of activity that they
14 could do above there.

15 I guess that's my general feel of just
16 reviewing the reservoir quality, the oil in place, the
17 certainty of the other evaluations that we've looked
18 at. I think the preponderance of actual physical
19 evidence I think supports my conclusion and Jim
20 Davidson's petrophysical analysis.

21 Q. So are you saying that based on the data,
22 based on the evidence that is available, that is your
23 opinion, right?

24 A. Correct.

25 Q. But so, the Commission, you've not shown us

1 any evidence that there's an isolation between the
2 Lower San Andres and then the Upper San Andres. You
3 cannot -- you don't have the physical evidence to show
4 the Commission that this is the barrier that we
5 believe that there is no communication between the
6 Upper San Andres and then the Lower San Andres. Is
7 there any literature supporting that, any reference
8 supporting that?

9 A. I don't know of any literature that states
10 that.

11 Q. And then your opponent is saying there's no
12 barrier.

13 A. Yeah. I don't quite understand that
14 conclusion.

15 Q. You know, but you've not shown us a
16 cross-section, no literature showing that there's a
17 clear barrier between the Lower San Andres and then
18 the Upper San Andres. So what evidence, what
19 preponderance of evidence, have you shown to the
20 Commission that we've mapped up this as a barrier, so
21 this is our suggestion that let Empire focus on the
22 Upper and there will be no communication from the
23 Lower?

24 A. Is this -- interesting the way this legal
25 process works in the rebuttal versus the just do my

1 work and present a case.

2 So I spent a lot of time rebutting some
3 what I think are very unrealistic data use or saying
4 there is communication between there. I really don't
5 see any evidence. And just the geologic system here,
6 I don't think there's any realistic way there's any
7 communication between the two.

8 But you're correct that as a distinctive
9 literature map, definitive map, I do not have that.
10 I've not created one. And I can see how that would be
11 helpful to the Commission.

12 Q. You know, I've listened to all the
13 testimony, and I'm looking forward to dialogue with
14 Larry Lake, Professor Larry Lake, you know.

15 Let's say -- and I don't want to get
16 into the pressure issue with you, but --

17 A. Interesting discussion, though.

18 Q. Yeah. You know, let's say when you look at,
19 let's say, the production history, what is withdrawn,
20 what is, let's say, put in, your are right, there is
21 clear evidence that there is no communication. Right?

22 But what about that huge volume of water
23 that has been proposed? Have you forecast into the
24 future -- you've even -- based on your own testimony,
25 you're telling the Commission that they are karsts,

1 you know, there are perm barriers, you know, there are
2 some karsts in there.

3 So is that also not a risk if the
4 Commission allows a huge volume of water to be
5 injected, even though now we do not have the evidence
6 that there is a communication?

7 A. Well, again, I'd come back to the -- the
8 strongest evidence is material balance, which is
9 volumes and pressures. And I think monitoring
10 pressures would be a valid way of making sure that
11 there isn't a pressure increase. And when you see
12 one, then you can react.

13 Currently, the way I see this now is
14 that there's a reaction before the evidence shows that
15 there's communications. But I think monitoring the
16 pressure and allowing the current state, and if you
17 allowed four more permitted wells to inject a lot more
18 oil [sic], you'd get to an answer much quicker, the
19 pressure monitoring. And it'd be very interesting.

20 Because just .383 over a large -- I
21 just -- it amazes me how little pressure variation for
22 the volumes of water that were both extracted and
23 input. I just -- it's just amazing. But it's just a
24 unique situation, and I do believe that they can
25 attack their most valuable asset and send in, and

1 Goodnight can help the oil industry produce all the
2 oil they want.

3 Q. Well, but Mr. Wheeler was saying if
4 Goodnight moved two miles away from the operations,
5 they are not going to contest. So it's not like they
6 are shutting you off. They provided options. Why not
7 take it?

8 A. I do not know. That's out of my purview.
9 Is that correct?

10 Q. You know, when you talk about there's no
11 evidence that there's communication, I mean, the
12 question that I will ask you is, if you see that
13 bubble map that was shown to the Commission and you
14 see excessive water production, the question I have
15 for you is, how did the operator solve that problem to
16 have effective material balance communication?

17 A. I do not know.

18 Q. So then it's still -- but so the person who
19 owns all the data is saying there is a communication.
20 And you're saying that you don't know, but, I mean, so
21 then -- and you did not provide any theory or any
22 model showing a different way as to how water can
23 get -- higher production can get through these wells.
24 There's not been any evidence, no models from
25 Goodnight to establish that other than we don't know

1 what went on.

2 A. Well, I agree we did not have a reservoir
3 model. But I think the 1939 paper that showed water
4 at the crest of the structure in 1934, '35, '36 and
5 '37 indicated that it was there.

6 And the perm barriers, basically the
7 migration paths that Dr. Lindsay shows, they're all
8 around bedding planes. So that is the preferred
9 mechanism for migration of all oil; it's laterally,
10 it's not vertical. The perm barriers that are used to
11 identify perm barriers are horizontal permeability.

12 And so, generally, vertical permeability
13 is a magnitude smaller, so using that as a perm
14 barrier, I think would be maybe conservative. But I
15 think, just to geologic mechanisms of layered beds,
16 migration along bedding paths, and also in
17 Dr. Lindsay's fracture analysis, he described that the
18 predominant amount of fractures were in the karsted
19 intervals.

20 And the karsted intervals are relatively
21 thin. In the 679 well, they were between 1 and 3
22 feet, and there was one that was about 10 foot thick.
23 But that's the limit of those karsts. And if most of
24 the fractures are in those karsts, that would be a
25 lateral fracture pattern that would increase the

1 permeability horizontally, which, in my opinion, is
2 the way all the water got into those wells.

3 And I think if you actually look at the
4 volumes, you take it out over the years and the cums,
5 the excessive water volumes, I think I estimated about
6 300 barrels a day. So it may have been a large
7 volume, but it was over a long period. So the actual
8 excessive values, I think from a total perspective are
9 not quite as dramatic as I expected from looking at
10 that big map with a mesh.

11 Q. You know, you made a comment during the
12 cross and I thought that was interesting. You said
13 something to the effect of Empire and its consultant
14 did a significant amount of work, and your
15 responsibility was to review it and critique that,
16 instead of doing independent work to support the case.

17 I mean, can you comment on that
18 statement?

19 A. That's primarily my job, is to evaluate, QC
20 and when needed, do the evaluation myself, but that's
21 a secondary step.

22 Jim Davidson, or Dr. Davidson, is a
23 petrophysicist. You know, he's been there about 20
24 years. But I find him incredibly, incredibly
25 intelligent, and most of his work turns out to be

1 correct. Although criticized as -- you know, we, as a
2 company, occasionally are being criticized for being
3 conservative, but we really are trying to present the
4 most realistic case from the data that we see.

5 Q. Yeah, and even if you look at Dr. Davidson's
6 work, you know, I'm not criticizing his work, you
7 know, same as, let's say, the consultants from Empire,
8 all different strategies, but I do see some
9 similarities in their work.

10 A. I agree.

11 Q. And that is the core, right? So that is
12 where I want to focus on. I mean, these higher
13 volumes, I had my questions, you know, I went back and
14 forth with the experts, you know, with some of these
15 higher saturations and all of that.

16 But I think the real evidence is the
17 core. And I feel like all these analyses, they are
18 more or less in agreement with the core, some way,
19 somehow. Do you believe that?

20 A. To some degree.

21 Q. Okay, okay. Now, is it your opinion that
22 oil-water contact is static?

23 A. No.

24 Q. But I thought Empire's counsel was going
25 back and forth with you on that, and it sounded like

1 you feel like it has to be a constant number that
2 hasn't changed.

3 A. No. But I did disagree that producing oil
4 and the contact going down would be inappropriate.

5 Q. But you believe that oil-water contact is
6 not static?

7 A. It goes up. Gravity.

8 Q. Oil-water contact --

9 A. The water goes up. I may have misunderstood
10 the question as it was directed, but the statement I
11 heard was the oil-water contact effort production went
12 down. And because he was talking about negative 350
13 and negative 550 --

14 MR. WEHMEYER: I can probably clarify the
15 confusion I created. Based on the publication that
16 we showed that slide, they wrote that it was an error
17 on the original one and that it was actually at 540,
18 550 subsea, which is what Dr. -- so the early one was
19 an error, the lower one was accurate, and that's been
20 written on.

21 COMMISSIONER AMPOMAH: Okay. Thank you. I
22 appreciate that clarification.

23 BY COMMISSIONER AMPOMAH:

24 Q. Now, has anyone from Goodnight done total
25 analysis on how the proposed saltwater injection in

1 combination with the existing saltwater injection are
2 going to have, you know, considering the barriers that
3 has been discussed?

4 A. The alleged perm barriers?

5 Q. I'm not going to say that. Is there someone
6 going to discuss that in more detail, you know, to the
7 Commission that you know?

8 A. I'm not sure. You know, I would assume so.

9 COMMISSIONER AMPOMAH: Okay. I think I'll
10 end here. Thank you so much for your time.

11 THE WITNESS: Thank you.

12 MR. SHANDLER: Mr. Hearing Officer, can I
13 have two questions to follow up? I'm over here on
14 the left.

15 HEARING OFFICER HARWOOD: I'm not used to
16 looking over there. Sure, absolutely? Go for it,
17 Mr. Shandler.

18 EXAMINATION

19 BY MR. SHANDLER:

20 Q. All right. So both parties are in the same
21 unit. If the Commission decides it's a tie and wants
22 to divide it up, what is the number where the new
23 division should be in the sandbox?

24 A. Was that a question to them?

25 Q. That is a question.

1 A. I would do negative 500 and negative 700.
2 That interval would be like the demilitarized zone,
3 and we monitor it very distinctly to see if there's
4 any evidence that there's any vertical movement up and
5 down from there.

6 Q. And so there are existing permits that
7 Goodnight has, would they be -- the existing permits,
8 are they in the DMZ zone already?

9 A. I'm not even sure where they're located.

10 Q. And the proposed ones, are they in the DMZ
11 zone?

12 A. I don't -- you mean, perfed within the
13 negative 700 to negative 500 TVD subsea depths?

14 Q. Yes.

15 A. I don't think they are, but...

16 Q. I guess, will there be a witness who will
17 explain historically why the existing Goodnight wells
18 were chosen at that number, where they were drilled?

19 A. I guess the location, I'm not sure. The
20 depth at which they were completed was the
21 understanding of the reservoir and the karsting below
22 that negative 700, approximately, depths.

23 Q. So there was already previous work figured
24 out why these existing wells were drilled to a
25 specific depth?

1 A. I believe so.

2 Q. And that will be presented?

3 A. Yes.

4 MR. SHANDLER: Thank you.

5 THE WITNESS: Is that appropriate?

6 HEARING OFFICER HARWOOD: Thank you,
7 Mr. Shandler.

8 So this brings us to redirect
9 examination. Is there any possibility, remote
10 possibility, that we might finish this witness today?

11 MR. RANKIN: No.

12 HEARING OFFICER HARWOOD: No?

13 MR. RANKIN: No.

14 HEARING OFFICER HARWOOD: Hope springs
15 eternal. All right.

16 Let me ask you, Mr. Rozatos, I mean, we
17 still have almost 25 minutes, shall we use it? Or
18 what are your thoughts, Mr. Chairman?

19 CHAIR ROZATOS: Mr. Rankin, would you be
20 able to have a good stopping point in 25 minutes, or
21 would you just prefer to start first thing in the
22 morning?

23 MR. RANKIN: I don't have my mind how I'm
24 going to segregate out the questions. I'm just going
25 to walk through my notes. So I don't have a distinct

1 stopping point in my mind.

2 I could start and do a few minutes and
3 we could break, or if everyone's -- you know, we
4 could start in the morning. I'm fine either way.

5 CHAIR ROZATOS: For the sake of continuity,
6 then, maybe we should just start first thing in the
7 morning. That will allow you to gather your
8 thoughts, it will allow the witness to have a break
9 as well. And I mean, it's only 25 minutes, so it's
10 not like we're wasting that much time for today.

11 HEARING OFFICER HARWOOD: All right. That's
12 great. And along the lines of hope springing
13 eternal, if you gather your thoughts and get
14 organized overnight, maybe a cross-examination will
15 be shorter.

16 THE WITNESS: It's a good chance.

17 HEARING OFFICER HARWOOD: All right. Great.
18 All right. Then if there's nothing further, we'll be
19 off the record for the day and we'll see everybody
20 again tomorrow at 9:00. Thank you.

21 CHAIR ROZATOS: Thank you, everyone.

22 (Proceedings adjourned at 4:33 p.m.)
23
24
25

AFFIRMATION OF COMPLETION OF TRANSCRIPT

I, Kelli Gallegos, DO HEREBY AFFIRM that on April 22, 2025, a hearing of the New Mexico Oil Conservation Commission was taken before me via video conference.

I FURTHER AFFIRM that I did report in stenographic shorthand the proceedings as set forth herein, and the foregoing is a true and correct transcript of the proceedings to the best of my ability.

I FURTHER AFFIRM that I am neither employed by nor related to any of the parties in this matter and that I have no interest in the final disposition of this matter.

May 9, 2025



Kelli Gallegos

VERITEXT LEGAL SOLUTIONS

500 Fourth Street, NW- Suite 105

Albuquerque, New Mexico 87102

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