STATE OF NEW MEXICO

ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION COMMISSION

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

ORIGINAL

APPLICATION OF THE NEW MEXICO OIL CONSERVATION DIVISION FOR ADOPTION OF AMENDMENTS TO RULE 19.15.17 (THE PIT RULE); STATEWIDE

CASE NO. 14292

REPORTER'S TRANSCRIPT OF PROCEEDINGS

COMMISSIONER HEARING

BEFORE: MARK E. FESMIRE, CHAIRMAN
JAMI BAILEY, COMMISSIONER
WILLIAM C. OLSON, COMMISSIONER

April 3, 2009

Santa Fe, New Mexico

This matter came on for hearing before the New Mexico Oil Conservation Commission, MARK E. FESMIRE, Chairman, on Friday, April 3, 2009, at the New Mexico Energy, Minerals and Natural Resources Department, 1220 South Saint Francis Drive, Room 102, Santa Fe, New Mexico.

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CHAIRMAN FESMIRE: At this time, we will reconvene Case No. 14292. The record should reflect that this is a special meeting on Friday, April 3rd, 2009, of the New Mexico Oil Conservation Commission.

The New Mexico Oil Conservation Commission is convened to consider Case No. 14292. This is the second day of this cause.

And I believe, Mr. Brooks, you were about ready to introduce a new witness.

MR. BROOKS: Yes.

MS. FOSTER: Mr. Commissioner, just for the record, I'd just like to put on the record that Mr. Bill Carr is not present. He does represent ConocoPhillips, as well as the Industry Committee. Thank you.

MR. BROOKS: That's what I was going to raise. Mr. Carr's absence was the point I was going to make.

MS. FOSTER: Thank you, Mr. Brooks.

MR. BROOKS: Okay.

CHAIRMAN FESMIRE: Mr. Carr knew we were going to reconvene at 8:30? Does anybody know where he's at?

MR. BROOKS: I do not.

MR. HISER: I do not. As far as I know, he's going to be here.

MR. BROOKS: Here he is.

CHAIRMAN FESMIRE: Wait a minute. Here he comes.

MR. BROOKS: Should we wait for him? Or do you want to proceed ahead?

CHAIRMAN FESMIRE: The record should reflect that Mr. Carr has now walked in the door and is present.

MR. CARR: Mr. Chairman, I would like the record to reflect that the clock shows it is now 8:30.

CHAIRMAN FESMIRE: I've seen this done at the legislature too.

And that having been said, Mr. Brooks, were you ready to introduce your next witness?

MR. BROOKS: I call Edward J. Hansen.

CHAIRMAN FESMIRE: Mr. Hansen, for the record, you have been sworn; is that correct?

THE WITNESS: That's correct.

EDWARD J. HANSEN

after having been first duly sworn under oath,

was questioned and testified as follows:

DIRECT EXAMINATION

BY MR. BROOKS:

Q. State your name, please.

A. Edward Hansen.

Q. By whom are you employed?

A. By the New Mexico Oil Conservation Division.

Q. In what capacity?

A. As a hydrologist.

Q. And what is your background and training, very briefly?

A. Well, I have a master's degree in environment science, specializing in groundwater protection from hazardous waste. I have been employed with New Mexico Environment in their -- sorry -- I was employed with the New Mexico Environment Department for approximately 16 years.

Prior to my two-and-a-half years with New Mexico Oil Conservation Division, where I've been involved with numerous groundwater remediation cases and various other permitting aspects involved with the oil field.

Q. Do you have some experience with working with groundwater modeling?

A. Yes, I do. I've performed several model simulations using the HELP model, numbering probably in the thousands, and used the MULTIMED modeling, several simulations numbering in the hundreds, if not thousands, at this point.

MS. FOSTER: Mr. Commissioner, I believe that Mr. Hansen did testify at the Pit Rule. I believe that we would stipulate to his qualifications in the interest of time.

CHAIRMAN FESMIRE: Is that acceptable, Mr. Brooks?

MR. BROOKS: Yeah. I was just about through.

Q. (By Mr. Brooks): One more question: Your qualifications -- well, really, two -- your qualifications have been made a matter of record in the previous proceeding?

A. Yes.

Q. And you have made a study of the effects of proposed rule, the purpose of this hearing?

A. Yes.

MR. BROOKS: We'll submit Mr. Hansen as an expert hydrologist.

CHAIRMAN FESMIRE: Is there any objection?

MS. FOSTER: No objection.

MR. CARR: No objection.

MR. HISER: No objection.

MR. FREDERICK: No objection.

DR. NEEPER: No objection.

Q. (By Mr. Brooks): Mr. Hansen, you're familiar with the --

CHAIRMAN FESMIRE: We'll go ahead and accept Mr. Hansen.

MR. BROOKS: I apologize.

Q. (By Mr. Brooks): Mr. Hansen, you are familiar, I believe, in the matter in which other experts generally testify in these rule-making proceedings?

A. As it relates to the chloride concentrations, yes.

Q. Yeah. The point I'm making is that normally the expert simply goes ahead and makes their presentation, subject to being interrupted frequently by me or by the Commissioners,

but it is not done in a conventional Q & A presentation.

So with that, I will invite you to commence your presentation.

A. Okay. I was tasked about, I don't know, maybe six or eight weeks ago by my bureau chief at the time to identify -- I have a touch of bronchitis, so if you'll bear with me, I'll blow some hot air over these vocal chords for a while. I kind of get a frog in my throat.

So I was tasked by my bureau chief at the time, Mr. Wayne Price, to derive a chloride concentration that would be appropriate for New Mexico for deep trench burials. And with his assistance, we derived a number. And with my presentation, we'll see how that happened, and as part of that, also to model what could be from a potential release from a trench what could be predicted in groundwater from a release.

So with that, we used a couple of predictive models. One is called the Hydrologic Evaluations of Landfill Performance, or otherwise commonly referred to as the HELP model. And that model is a water balance model with several computer codes, including a run-off, evaporation, transpiration, et cetera.

That model was developed by the United States Army Corps of Engineers for the U.S. EPA. The other model we used was a Multi Media Exposure Assessment Model, or commonly referred to as MULTIMED. That model is referred to as a pseudo

two-dimensional computer code because it uses both vadose zone and aquifer transport models. And that was developed by the United States Environmental Protection Agency.

The HELP model uses actual daily weather data. It's used for determination of releases from the bottom of unlined pits, or in this case, lined trenches. It's one of the most accurate predictors of release rates from waste disposal areas. It's used in New Mexico, certainly, and by other states and industry.

The MULTIMED model uses the HELP output for an input of one of the most sensitive parameters; that's the infiltration rate. It's used for the determination of release concentrations over time in an aquifer, and it's a conservative predictor of release concentrations in times when generally, speaking for environmental concerns -- conservative, meaning it predicts higher concentrations and shorter times -- that will occur in an aquifer.

The HELP model has two basic sets of data uses. One, of course, is weather data. And some of the more important or sensitive input variable would be a daily participation. And soil data, it uses various soil components for input parameters, including a liner or liners.

So we used one set of weather data for 50 years from 1951 through 2000. This data comes from a data-compiling service, and they obtain their data from the National Climate

Data Center. We use the Permian Basin, and I would just like to point out this table, which is an excerpt from OCD's Exhibit 16 in Case No. 15 -- sorry -- 14015 -- of course, our last Pit Rule hearing case.

And I'll just point out the bottom line here. Our chloride concentrations from our OCD's pit sampling done in May of 2007 and also some Industry Committee sampling results -- but, primarily, what I want to point out at this point is just the difference between the maximum SE, which is southeast, and the maximum NW, which is northwest, and the difference between those two.

That's really what I -- at this point -- we'll get into some of these numbers later on. But right now just note there's a couple of orders difference between these numbers, these being the southeast and the northwest. The southeast, of course, being a couple of orders of magnitude higher than the northwest.

COMMISSIONER OLSON: In regards to those numbers, do you remember what the average was -- I'm just curious -- for the southeast?

THE WITNESS: I don't actually remember.

COMMISSIONER OLSON: Okay. Sorry. I was curious. Thanks.

THE WITNESS: And, of course, this is a map of New Mexico showing San Juan Basin and the Permian Basin.

Here's our weather station at Hobbs. This is, of course -- this area receives more precipitation in the eastern portion of the Permian Basin than the western portion. This is a more conservative area to choose our weather data.

Of course, again, as we saw from our pit sampling data, our primary concern for chlorides is in the Permian Basin. This is where we see the higher chloride concentrations in the pit contents.

So we modeled a release from an unlined pit for kind of a baseline to show the difference between what might be released from an unlined pit and what might be released from an on-site trench burial. We used a closed pit with poor vegetation, so we had two feet of soil over the waste.

For the release of an unlined trench burial, we, of course, went by the current regulation, which is four feet of soil with poor vegetation. That's being conservative. The liner on top of the waste, which is, of course, required by Part 17 currently. We're not proposing any amendment to that requirement.

The waste -- and, of course, the liner underneath the waste, and I put in parentheses "and sides" because through the model we can say no run-off from bottom of that trench so, in effect, we're also including the sides. And, of course, I have a notation down below, "Assuming the liners are installed in accordance with Part 17."

So here's a depiction, a cross section of a closed unlined pit that we have as a conceptual model -- not to scale, of course. We have two feet of sandy loam cover. We have the waste about -- we went conservatively with a 12 1/2 feet deep. It wouldn't necessarily be that deep, but it might be.

Of course, we have precipitation as a HELP model input. And then by Part 17 rule, we have 100 feet of vadose zone. That is from the bottom of the pit to groundwater. We used parameters for sandy loam to conservative. There could be tighter soils, but, typically, in New Mexico our conservative value would be a sandy loam for a vadose zone.

So you'll see here we have the output from the HELP. Of course, it is from the bottom of the pit, and it's used as the MULTIMED input. And MULTIMED output would be -- what I tried to depict is about a meter away from the downgradient edge of the pit and where you see a ten-foot mixing zone in the aquifer. This is a cross section of an on-site trench burial as our conceptual model.

Of course, we have, again, precipitation as a HELP model input, four feet of cover by regulation. And then what I have here in the black line is the required geomembrane. And you'll note also that there's a required geomembrane over the top of that trench that we've put into our model.

Again, we used about 12 1/2 feet of waste. It could be less, but we wanted to be conservative -- and, again, 100

feet of sandy loam for our vadose zone. HELP output, of course, is any leakage that might occur through the liner. And that's used as a MULTIMED input. And, again, the MULTIMED output I tried to depict as about one meter from the downgradient edge of that trench. Also, you'll see the ten-foot mixing zone.

So for our -- so we ran the HELP model, and the output values that we have for an annual average release rate is about 1.2 inches per year from Hobbs weather, so we called that Permian Basin. I labeled it as an unlined pit. And we also got a release rate for what I labeled as a good liner. That is a trench that's installed in accordance with Part 17. And that's about .09 inches per year release rate, or roughly about 2.2, 2.3 millimeters per year.

Of course, these values were used as input values for the MULTIMED model. So the MULTIMED model, I used several input values. I put up a few ones here. Some of the more important ones, of course, are the source specific values, infiltration rate being very important, and initial concentration, of course. And we'll get into that.

And the vadose zone variable, thickness being an important one, and aquifers' specific values, and, of course, the mixing zone being a sensitive parameter. Some of the more sensitive input values we used, of course, were the infiltration rate, and we obtained those from the output from

the HELP model. The 100 feet from the bottom of the trench to groundwater, of course, that's required by our current Part 17. The 10-foot mixing zone is a little different than what we had previously used in Case 14015. Previously, OCD used a mixing zone of eight feet. That was derived by the model. But after reading the final deliberations of the Commission, we decided to use the ten-foot mixing zone as a more appropriate mixing zone.

And, of course, our primary concern here today would be the chloride concentrations of the release. And for the Permian Basin, which, as we saw, where we would see the higher concentrations in New Mexico for pit contents, we used 60,000 mg/L for the initial concentration. I'll point out that the MULTIMED for an input uses mg/L because it uses a leachate concentration. That leachate is what would leak through a liner.

So I'll just spend some time on this slide. The proposed value that we have is 3,000 mg/L as our regulatory limit. And starting with that value, that, of course, is after a synthetic precipitation leaching procedure on a sample. And that number represents the reasonable maximum chloride concentration that would occur in pit contents in New Mexico. Of course, that's with allowable stabilization, and we'll get into that.

So the 3,000 mg/L chloride concentration, that's

using -- again, that's actually the concentration in synthetic leachate -- is the equivalent to the 60 mg/Kg in the trench content.

Q. (By Mr. Brooks): 60,000?

A. 60,000. So 60,000 is not 3,000, but because the test method will use a 1:20 dilution, that is pit contents to the leaching solution. And because chloride is very soluble -- it might be better to say chloride salts that we are concerned about. Generally, sodium chloride is very soluble in water.

So what happens is that for the test procedure, you take -- and I'm going to simplify the test procedure -- but you take 100 grams of sample and put it into two liters of water or two liters of leaching solution, which is actually slightly acidic, about a pH of five. So you put it in a leaching -- Synthetic Precipitation Leaching Solution, and mix it overnight. And then take a sample of that one solution. Not the solid itself, in this case, or the pit contents or the trench contents itself, but rather taking an analytical reading of the solution.

And the reason it's not a 20:1 dilution is that the method itself has a formula that limits it to 20. So it's always going to be a 20 dilution. So, of course, if you divide 60,000 by 20, you have 3,000. So 60,000 mg/Kg in the trench contents may be equivalent up to 240,000 mg/Kg.

And how that happens is, of course, that by Rule 17,

you can mix -- and often should mix -- soil to stabilize clean soils. And what do we mean by clean soils? It means it would be relatively low in chloride. It's not going to be zero, of course, but we're assuming zero here. It might have 50 or 200 mg/Kg chloride, and that would add a bit to the chloride concentration in the trench, but we're assuming that clean soils are close to zero for these calculations.

So we're taking one part of pit contents and mixing it with three parts of clean soils to come up with four parts that could be disposed of in a trench. And, of course, if you divide 240 mg/Kg, you should have 60,000 mg/Kg.

So why 240 mg/Kg? Now, again, I'll direct you to the table I have below of the pit contents that OCD sampled in May of 2007, and you'll see those results. The maximum concentrations that we had as far as mg/Kg were in the neighborhood of 226 -- 226,000 mg/Kg.

Also, I'll direct you to the liquid contents of the trench that would be indicative of what the pit contents could be -- waste contents could be, and we have 244,000 mg/L. We didn't take the highest, but rather used the reasonable maximum concentrations that have been observed in New Mexico.

So the other factor to consider is that mg/L is not mg/Kg. So how do we obtain mg/L if we have mg/Kg? We assume the worse case that the pit contents would not dissolve into an equal mass of leachate. So we're assuming all of the mass of

chloride would go into an equal mass of leachate. And, of course, the leachate is what would come out of the trench.

So, of course, our output is chloride concentrations over time and groundwater that is one meter from the downgradient edge of the trench.

And here we have depicted our two outputs for MULTIMED, and the red line represents a closed, unlined pit. You see a release after about 140 years that would reach groundwater -- and this is in groundwater, of course. And then we have what we called a good liner. That's the trench burial after about 2000 years, we have a release. And that's with the 60,000 mg/L.

The summary of those results we have after about 2000 years, the groundwater standard for chloride will be exceeded if the trench contents has a chloride concentration of 3,000 mg/L SPLP, meaning the synthetic leachate procedure. And the chloride concentrations will peek at about 12,000 -- sorry -- 1,250 mg/L in groundwater with a ten-foot mixing zone. This is, of course, assuming 50 mg/L background concentration.

So what do we conclude by that? The on-site trench burials with chloride concentrations of 3,000 mg/L -- of course, that's what we're proposing -- or less, then the trench contents will be protective of human health and the environment given the siting design and construction and operational closure requirements of Part 17.

I have some references that we used for the modeling.

Q. Mr. Hansen, bottom line, then, is your modeling would predict that there would possibly be an impact to groundwater because it exceeds standard -- well, first of all, before I ask you the conclusory questions, let me go back to the slide where you grabbed the time versus -- and that's your slide number 15.

Now, Mr. Carr seemed to be a little bit confused about this -- or was it Mr. Hiser, I guess. I don't like for those gentlemen to be confused.

MR. HISER: Mr. Carr was.

CHAIRMAN FESMIRE: Well, I sure don't like for Mr. Carr to be confused.

Q. (By Mr. Brooks): What is the significance of that purple line that goes more or less along the bottom, but not quite?

A. Right. That's the WQCC standard for chloride in groundwater at 250 -- actually, in this particular graph, it's set at 200, but --

Q. Why is it set at 200?

A. Because we are assuming there's a background concentration of 50 mg/L. The standard is actually 250 mg/L.

Q. You're assuming there's already some salt in the water? In the groundwater?

A. Some chloride, yes.

Q. Okay. Now then, your modeling would predict the possible impact to groundwater would cause it to exceed standards as a result of one of these pits that had a maximum concentration of chloride at what point in time?

A. The unlined pit?

Q. No. The pit -- the deep trench burial done in accordance with the proposed amendments.

A. That's approximately 2000 years.

Q. Okay. Now, there was some testimony in Case No. 14015 about the useful life of liners; do you recall that testimony?

A. I do.

Q. Okay. Have you, yourself, done any studies about liners?

A. I have not, no.

Q. The useful lives that were suggested in that proposing, were they longer than the period of time in which these plastic materials have existed in this world?

A. Yes.

Q. So one would have to surmise, then, probably that they were based on some kind of modeling procedure, mathematical studies?

A. Well, yeah, they were based on, actually, subjecting plastics to extreme conditions. So they were laboratory studies.

Q. Right. Okay. Well, a jingle that I was told when I was a child was something about the wonderful one-horse shay who had lasted 100 years to the day -- and I can't remember the rest of the jingle. But, anyway, the point of it was that on the day, the last day of the 100 years it disappeared in a puff of dust.

Do things in the real world deteriorate in that manner?

A. Well, there may be something, but as far as I know, plastics do not. No.

Q. Okay. Now, if this liner were to deteriorate like the wonderful one-horse shay and disappeared in a puff of dust, then you would have an unlined pit on your hands, right?

A. Right.

Q. And how long would it take from the time the liner disappeared in a puff of dust before it would impact groundwater based on your model?

A. Well, approximately 140 years.

Q. Okay. But in reality would that happen, or would you expect the liner to continue to have a retarding effect for a longer period of time than its predicted useful life?

A. Well, as it came out in Case 14015, of course, those values are half-lives. As explained to me by Dr. Coyner through personal communications, that's -- say in this case we have a 20 mil liner. After -- and the years vary -- but let's

say 450 years typical, the half-life would be, say, equivalent of about a 10 mil liner. So at about 1,000 years you might have something equivalent to a 5 mil liner and so on.

Q. So what you're saying -- but my point is -- yeah. Okay. That's fine. That's fine. I accept that. Did you finish your answer?

A. So the point is that you would still have in -- and, of course, the primary concern was not life expectancy but rather installation. So the bottom line is that the tougher you can start with, the better. The tougher liner you can start with the better to ensure a proper installation.

And so a 5 mil liner still might be very good at retaining water if it's installed well. But we want to start out with a tough liner like a 20 mil liner to ensure good installation at the beginning so we'll have extended life.

Q. Would you expect a well-installed liner to continue to have a retardant effect on the movement of water well beyond its predicted useful life?

A. Yes.

Q. Okay. Mr. Hansen, do you have copies of OCD Exhibits 7, 8, and 9 in front of you?

A. I do.

Q. Is Exhibit 7 a copy of your resume?

A. It is.

Q. Is Exhibit 8 a copy of the PowerPoint

presentation that we've just seen?

A. It is.

Q. And then what is Exhibit 9?

A. Exhibit 9 is the modeling output files for HELP and MULTIMED.

Q. And were Exhibits 8 and 9 prepared by you?

A. They were.

MR. BROOKS: I submit Exhibits 7, 8, and 9.

CHAIRMAN FESMIRE: Is there any objection?

MR. CARR: No objection.

MR. HISER: No objection.

MS. FOSTER: Was Exhibit 7 prepared by you?

THE WITNESS: Yes, it was.

MS. FOSTER: That's your resume? Yes? No objection.

CHAIRMAN FESMIRE: Mr. Frederick?

MR. FREDERICK: No objection.

CHAIRMAN FESMIRE: Doctor?

DR. NEEPER: No objection.

CHAIRMAN FESMIRE: No objection having been stated, we will admit Exhibits 7, 8, and 9 for the record.

[OCD Exhibits 7, 8, and 9 admitted into evidence.]

MR. BROOKS: I pass the witness.

CHAIRMAN FESMIRE: Ms. Foster?

MS. FOSTER: I have no questions. Thank you.

MR. CARR: No questions.

MR. HISER: I guess I get to ask the questions now.

CROSS-EXAMINATION

BY MR. HISER:

Q. Mr. Hansen, it's good to talk with you again about groundwater modeling and vadose zone modeling in the Permian Basin.

And I have a couple of questions for you mostly, I think, to examine what I think Mr. Brooks was trying to do, which is the conservativism that you've used in the modeling demonstration that you have presented here for the Commission's consideration.

I'd like to start with the HELP model and the MULTIMED model, both. Could you tell me a little bit about how those models were developed and what the intended use of those models were?

A. Okay. The HELP model was developed about the time that regulations for hazardous waste landfills and municipal solid waste landfills, those regulations were being developed. And so the concern was, how can we predict how much leachate will be produced from a landfill? How much might leak from a landfill?

So they were primarily developed for the use of regulatory agencies to determine those sorts of predictions.

Q. And was U.S. EPA involved in the development of these models?

A. They were, yes.

Q. Now, U.S. EPA is going to be approaching the issue of leachate that's collecting underneath a landfill from a human health and environmental-based concern; is that correct?

A. That's correct.

Q. And if you have an agency which is interested in evaluating the quality of the leachate underneath the model from a human-health-based and environmental concern, are they going to be choosing a liberal approach, which is minimizing what comes through that liner? Or are they going to be choosing a more conservative approach, which they would try and look at a more worse case situation of what might come through that liner for subsequent evaluation of health impacts or environmental impacts?

A. Well, of course, their goal in any modeling exercise is to be as accurate a predictor as we can, but they'll want to use a more conservative approach to account for any variables that the model may not be able to account for otherwise.

Q. And one of the ways that EPA assists you as a modeler who's using one of these models is they provide you a set of sort of regulatory recommended parameters for a number of those model inputs; do they not?

A. I'm not sure by what you --

Q. You would call them like default standards, which they say this thing would be set in a range, but our default set is here, here, here, and here. And then you can adjust those and exercise your modeling discretion, but they provide you some guidelines as to what, in general, their standard default would be?

A. Right. But those defaults are based on particular studies that you, again, try to have an accurate prediction, ultimately.

Q. And in your selection of the parameters that you presented as a model today to the Commission and to us, you basically have used the regulatory defaults that EPA has recommended, except where you have sort of indicated in your presentation -- or to some extent in Exhibit 9 -- that you've substituted something that would be more site-specific or relevant to New Mexico; is that correct?

A. Well, yes and no.

Q. Would you care to elaborate on that?

A. Yes. Some default values were used for New Mexico -- say, soils. But no, in that we used specific weather data, daily weather data for a particular weather station.

Q. But you did that because you were looking at this saying that we're concerned primarily about the leachate that we're going to see from the heavily chlorated areas in the

Southeast in which Hobbs would give you a fairly accurate representation of weather conditions in that area. Was that your rationale for the selection of Hobbs?

A. Yes.

Q. Okay. Now, you gave us, I think, in your PowerPoint exhibit on page 9 -- I don't know if you want to flip back there or not for the benefit of the folks in the audience.

This is a little -- sort of a cartoon, if you would, of what a Rule 17 deep trench burial would look like; is that correct?

A. That's correct.

Q. Okay. Now, in this you talk about -- and I think it's in -- I can't remember if it's in the slide before. Yes, it's in slide number -- two before that, so that would be 7.

You talked about sort of what a release from an on-site trench burial, you're talking about four feet of cover or liner, waste, and then liner, and then on down to the groundwater, which is sort of your conceptual model; is that correct?

A. That's correct.

Q. Now, in fact, your conceptual model is a little more complex than that; is it not?

A. Yes.

Q. Because if you look at the modeling parameters,

you'll see that, in fact, we have a top layer here of about six inches, which is what?

A. The topsoil.

Q. The topsoil. Okay.

A. Yes.

Q. And so the topsoil is going to be characterized differently from the -- and then you characterize that as the top 6 to 12 inches. Then you had another layer, which was what?

A. That's generally what we call an infiltration layer.

Q. Okay. And then you had another layer, which was what?

A. Of plastic.

Q. Was there a layer between the plastic and infiltration layer presented in your model?

A. Well --

Q. You can look at Exhibit 9 if you need to refresh your memory.

A. Okay.

Q. And I believe this is in the section where you're presenting different layers.

A. Yes.

Q. And I would help you out with a page number, but I don't have any sticky tabs with me today.

A. It uses 6 inches as a lateral drainage layer.

Q. Okay. So you had 6 inches of a lateral drainage layer. And what's that layer used for?

A. That represents what precipitation might shed off of that top plastic L-shaped trench.

Q. Does it typically have any difference in composition from the layer up above it?

A. In this case, no.

Q. So you assume that it did not?

A. I assume that it did not.

Q. And then the next layer down was -- was that where your liner came in?

A. That was the plastic, yes.

Q. Okay. And then you had another layer, which was represented in the waste, if you would. In other words, the stabilized pit contents?

A. Yes.

Q. And then another layer of --

A. Of plastic.

Q. -- of liner. And then, finally, you get to the vadose zone, and ultimately down way below that we get to 100 feet below per the rule. We're assuming that's where the aquifer would be present; is that correct?

A. That's correct.

Q. Okay. Now, if in your modeling -- you didn't

actually model real constituents, did you?

A. Well, it's called a default chemical for modeling purposes. The default chemical would be what we call a conservative constituent.

Q. But, anyway, you don't enter the term "chloride" and the model doesn't adopt any particular physical chemical characteristics for chloride?

A. Right.

Q. It just uses a series of parameters that you've established in model input; is that correct?

A. In this case, that's correct. I mean, you could assign some particular attenuating factors to particular constituents, but in this --

Q. But in this particular case, if I look at the model inputs, every place where there's a value that can be put in I see that there's zero, which means you're assuming that there's no -- there's none of that impact occurring on the concentration of this chemical, which is moving through these different horizons.

A. That's correct.

Q. That's speaking of the biological chemical reactions; is that correct?

A. That's correct.

Q. So pretty much what you're doing is you're just looking at the gravimetric drop and what's going to stick to

stuff as it's going on. It's just a physical matter as it's going through all those layers.

A. As a contaminant goes through the vadose zone, some will retain in the residual water that's in the vadose zone. But other than that -- I mean, that's correct.

Q. Okay. Now, you've got a number of years of modeling of groundwater hydrology in the State of New Mexico, correct?

A. That's correct.

Q. And just as a matter of general, I guess, truth in modeling, would you expect that chloride would behave exactly like this tracer? Or would it, in fact, exhibit some of those characteristics that you've set for purposes of this model today?

In other words, does chloride bind chemically to any of the constituents that may be present in the earth's crust?

A. There may be some binding.

Q. And you see that just as a matter of physical principle, don't you, in different levels of dissolution that might occur in the various chloride salts? Where sodium chloride is one level of solubility, magnesium chloride may have another, iron chloride may have a much different solubility than, say, sodium chloride, correct?

A. That's correct, yes.

Q. Okay. Although your general agreement is that of

the various things, chloride tends to be more soluble of all the constituents, which is why we've talked about it in this hearing; is that correct?

A. That's partially correct, yes.

Q. But you would expect from the exercise of your experience that in reality -- now, I'm talking about what's happening on the ground as opposed to what's happening in the computer model -- that you would see some level of that chemical or other binding that may occur as it's traveling down through these layers, which would be different from none of that which is being predicted in the model; is that correct?

A. That is correct, yes.

Q. Okay. Now, one of the questions I have as well is that you were looking at an aquifer -- and what's the major aquifer in the southern region of the state?

A. Well, a large aquifer in the southeastern part of the state is the Ogallala aquifer.

Q. And approximately how thick, I guess, is the proper term for that aquifer? I know it varies, but if you were to give sort of a general average.

A. Well, for modeling purposes, we use 70, which is 70 feet, which might be on the thicker end of the Ogallala.

Q. Okay. And then you used a thinner percentage of it actually being actively mixed; is that correct?

A. That's correct.

Q. And that thinner percentage is -- are you saying, then, that the mixture is going to be -- that the chloride is only going to float around on the top ten? Or do you use that because you were setting some sort of finite bound where you were going to evaluate the number that you were getting out of the model?

A. Well, we use ten as an appropriate mixing zone at the bottom of the trench. So I don't know what you mean by floating, but that's where we wanted to capture what would be a concentration at the bottom of the trench.

Q. So the mixing zone then -- let me see if I understand what you used it for -- actually, the average concentration within that area is what you measured as your model output, and that's how you came up with the red line and green lines, respectively, for the unlined pit and the lined pit?

A. For that ten feet, yes.

Q. Okay. And if you were to, over the fullness of time, look at that, would you expect that that concentration would become higher or lower as material moved and dispersed throughout the water in the aquifer?

A. Well, it would depend where in relationship to the trench you were to take that. I mean, at one meter -- we would conservatively want to say that at one meter away we're going to say it's still ten feet.

Q. Right. But if I were to say go ten meters away, what would happen?

A. Well, it could disperse somewhat and have a lower concentration.

Q. Okay. And you used the one meter as a convention to give us a common point of measurement between a couple of programs. Is that why you chose that point?

A. Well, yes.

Q. Not to mention the Commission has beat it out of you in the last year and a half?

A. And just due to HELP model -- or sorry -- MULTIMED input limitations.

Q. Okay. So sort of driven in part by modeling convention?

A. Right.

Q. So now, you were looking at the -- you've chosen this number of 250 as a point of comparison with chloride. Where does that number come from?

A. That's the WQCC standard for chloride groundwater in groundwater.

Q. Okay. And when we're assessing whether or not a material which is going to be discharged or deposed complies with that number -- speaking now in the Water Quality Control Commission sense -- where do we evaluate that concentration? Is it at the point where the waste is? Or do we evaluate it at

the place which is -- place of withdrawal for present or reasonable foreseeable future use?

A. Well, the rule -- it's at the place of withdrawal for present or foreseeable future use --

Q. Okay. Now --

A. -- which could be one meter away.

Q. It could. It could be further. But that's what the rule specifies; is it not?

A. It is.

Q. Okay. I want to go back and talk a little bit more conceptually about your model. You were here in the previous pit hearing; were you not?

A. I was.

Q. And you probably remember Dr. Buchanan who testified at that hearing and is going to be testifying yet again at this hearing.

A. I do remember. Although I was not here for --

Q. For all this testimony?

A. Yes.

Q. One of the topics that came up in that was something that's called the chloride bulge. Do you remember what the chloride bulge is?

A. I wasn't here during that.

Q. I will refresh you. Subject to Mr. Brooks objecting here in a little bit.

The chloride bulge is -- he testified that a lot of places around New Mexico in the native soils you see one level of chloride in the upper levels of the horizon, and then there's sort of a bulge where there's a higher level of chloride, and that varies in its depth below the surface.

Does that sound familiar to you?

A. It doesn't. Like I say, I wasn't here for most of his testimony.

Q. Have you done any soil profile characterization yourself or where you would have had a reason to look at chloride levels between the surface and the groundwater?

A. I haven't personally conducted those, but I have reviewed many of the vadose zone monitoring results.

Q. Well, since it's not -- since you're not comfortable with that, let me just ask you a different question, and maybe we can approach it that way.

Under the models that you've presented here, which is the HELP model and the MULTIMED model, do those models account for the ability of chloride to stay in the upper level of horizon? Or are they always going to move that chloride maybe slowly but ineluctably downward?

A. Well, in our particular model, we didn't use any variation throughout the vadose zone. We assumed one type of material. So in this case, we didn't account for -- it could, if other types of soils were used.

Q. So there could be a difference depending on the material that was passing through? And, basically, the only thing that you were looking at -- or as you explained to me earlier -- that your models do is it would keep some chloride that would be hung up in the residual water as it's passing through these different zones; is that correct?

A. That's correct.

Q. So it's not addressing other mechanisms that may be present?

A. That's correct.

Q. Okay. Now, I'd like to flip to one assumption in particular -- and let me see if I can find it. I've lost my place now. And that's where it's the big slide where you're sort of presenting all of the stuff about the model. Maybe you can remember where that is. It's towards the end. Here it is. It's on page 13. It's your MULTIMED conceptual model input.

And as I understand it, you said that we have 3,000 mg/L Synthetic Precipitation Leaching Procedure, which is the waste limit that the Division is proposing, correct?

A. That's correct.

Q. And then in your second slide, you're trying to say that well, that procedure itself has dilution factor in it, and so, in fact, the mg/Kg that might be there could be larger, perhaps as much as 20 times.

Is that what you're showing in your second bullet

point?

A. Yes.

Q. And then in your third bullet point, as I understand it, you're trying to account for the fact that the rule would allow, and in some cases good engineering practice requires, there be some mixing of non-contaminated -- let's use that term -- for soils in order to stabilize the materials that's going to be placed in that deep trench that you could work with with equipment; is that correct?

A. That's correct.

Q. And so you're saying that might be looked at like a 4:1 ratio, so potentially as much as 240,000 mg/Kg, and so this number corresponded reasonably well to the OCD's sampling results that they had done in the previous Pit Rule, Case 14015; is that correct?

A. Other than -- yeah. As the rule calls out, 1:3 ratio for pit contents to clean soils, giving a 4x solution, yes.

Q. Now, what I want to do is I want to really focus, though, on this last bullet point. Because this is the one that, to me, is perhaps a little bit more troubling.

Now, here you've said that 60,000 mg/Kg chloride concentration in a stabilized trench -- which is as I understand it is the 240,000 divided by four, which is what you and your counsel just spoke about -- it equates to 60,000 mg/L

in the leachate.

How did you arrive at that conclusion?

A. Well, as I said, we took what could be a worse case, all of the chlorides dissolving into an equal mass of leachate, to have an equal concentration.

So that's, I mean, using the most conservative approach.

Q. Now, if one goes to a standard engineering test, wouldn't you find that the equation for the conversion from mg/Kg in the soil to the pore water would be more in the line of the concentration of the pore water equals a row factor over divided by theta, which is the infiltration rate times the concentration of the soil?

A. Well, typically, both densities would be taken into consideration; however, what we're focusing on is what might possibly leach through plastic, which would not be pore water.

Q. Well, what we have is, respectfully, 40 millimeters to 120 millimeters of plastic and 100-how-many feet -- 130 feet -- 125 feet of non-plastic. And so does that assumption hold for the area where we have soil or soil-like material?

A. What we're concerned about is the bottom of the trench, and what can come out of it. So at the bottom of a trench and what can actually go through that thin layer of

plastic is what we're concerned about rather than --

Q. So I mean, but if we're assuming an equal concentration of -- well, let me back up.

So you did not apply the standard engineering equation to the soils and stuff that's going through; is that correct?

A. It wasn't appropriate, that's correct.

Q. So your argument is that it's not appropriate because we have a plastic liner at the bottom of this layer, and that's your testimony?

A. Yes, yes.

Q. Okay. All right. Now, so basically you're saying that we've assumed that if I had 240,000 mg/Kg of chloride in the original plan and I've got that down to 60,000, that we have roughly a 1/16 or a 1/6, somewhere in that range, of this thing is water.

Is that consistent with the stabilization assumptions?

A. Could you -- sorry. Could you repeat that?

Q. Well, I'm just -- because you're assuming that we're taking all of the salt that's in here, and we're mixing that with an even quantity of water.

First of all, I guess my question is, how did we get that water in here given the amount of precipitation that's available, the fact that it has to pass the paint filter test

when it goes in, the fact that we have a shedding layer over top of it, and that we have vegetation?

A. Right. Okay. Let me -- I see your concern. And let me back up a little bit.

The 60,000 mg/L is what we have to -- well, the mg/L is what we have to put into our MULTIMED. That's an assumption that we have to use for MULTIMED modeling.

Q. 60,000 mg/Kg or 60,000 mg/L?

A. Just mg/L. It doesn't matter the concentration. That's what we have to use for MULTIMED.

Q. But if that number is wrong it brings into question the rest of the MULTIMED results; would it not?

A. So what we do is relate it back -- we want to relate it back to the actual test method, which is, again, taking 100 grams of a sample and putting it into two liters of a solution. And so this 60,000 mg/Kg relates directly to 60 mg/L similarly as we would take, say, 1,000 milligrams of sample and putting it into a liter of water and shaking it overnight, something like that.

Q. But the analogy, Mr. Hansen, I think makes me even more nervous. Because if we're using 100 milligrams to two liters, and you're saying we're using that same analogy here, and say that I've got -- I'm lost -- 100 kilograms or 100,000 kilograms of pit contents, I'm modeling that by two liters. In comparison to that, I now have a veritable ocean of

water, do I not, that I'm trying to mix in order to achieve that pore water concentration?

A. Well --

Q. Two liters of water to 100 milligrams is a lot of water and not very much solid.

A. You do, but what comes out of the plastic would be a similar mixing -- I mean, would have a chance to dissolve into that leachate.

Q. But, Mr. Hansen, are you asking the Commission, then, to believe that the amount of chloride that will enter the pore water is going to be the same whether I have my trench full of pool water and a little bit of soil versus whether I have virtually a dry trench, which is a little bit of water which is mostly tied up with particles?

Because that's what you're asking us to do; is it not?

A. No, no. If you have, say, 60,000 mg/Kg in that trench contents and it comes in contact with water, then we call that leachate. And what would go through a plastic liner, we're saying worse case could be 60,000 mg/L.

Q. So you're assuming that all water -- so, basically, you're asking us to say that, regardless of general engineering, which says that pore water does not take all of whatever it's exposed to but leaves some of it attached to whatever has been there before, you're going to assume that

goes there, and all that pools on top of the liner, and that just goes through, even though the leachate test that you seem to be using as the basis for that assumes a large volume of water with a small quantity of waste, whereas we have, by your own rule, a lot of waste and as little water as we can possibly have in it?

Is that sort of an accurate portrayal of what we're hearing?

A. That's true, but keep in mind that what we've modeled is about .09 or, say, 2.2, 2.3 millimeters per year. So that's a small amount of water and small mass of chloride.

Q. Yes. But it would be even smaller if the point that I'm making is correct.

A. It would still have that same mass, even though a small volume of water would be going through that plastic.

Q. It would still have the same leachate rate, but it might have a different chloride load; is that not a correct statement?

A. Like I say, we assumed worse case.

Q. Would you be surprised if the standard engineering equation -- that your assumptions differed by a factor of ten?

A. I would be, yes.

Q. Okay. What about by a factor of two?

A. I would say somewhere between three and five.

Q. Okay. Now, I've got, I think, one last question. I think that Mr. Brooks was talking to you about the impact of the liner. And, basically, when you modeled this, did you use the assumption that liner disappeared after the working life, or -- it wasn't clear to me from the line of questioning if that was the assumption that you used or what. So could you just tell me again?

A. No. I mean, we didn't assume that, no.

Q. Okay. You didn't. So you assumed that -- what you were talking about the half-life where you thin the liner each successive period or --

A. Right, right.

Q. Okay. Thank you.

Now, it would seem to me, I guess -- one last question. I'm going to steal Mr. Frederick's fire here.

MR. FREDERICK: Don't do that.

MR. HISER: Well, I figure you're going to make the point. I may as well make it first.

Q. (By Mr. Hiser): Your model results appear to show that there's going to be an exceedence of water quality standard under all these assumptions; is that correct?

A. That's correct.

Q. Now, isn't it your job as the Division to ensure the protection of these water quality standards?

A. It is.

Q. So how can the Division be here in front of the Commission proposing this approach where you're showing that there's going to be a modeled exceedence? Or do you believe looking at all the things that the model has left out that if you account for those things the actual centration is going to be at or about the water quality standards that the Division is sworn to uphold?

A. Well, as we've discussed earlier, those standards are for the present and reasonably foreseeable future, even though reasonably foreseeable future has not been defined. It's typically referred to in terms of hundreds of years. Here we're talking about thousands of years. So even if this were true, I'm not sure we can call it reasonably foreseeable future.

Q. Okay. So you're comfortable that either the conservatism of the model or else the distance that the chloride may be showing up is far enough out that this proposal would fully comply with the Water Quality Control Commission water quality standard for chloride at 250 mg/L?

A. That is correct, yes.

Q. And you would agree that there are a number of levels of conservatism that have been built into this exercise?

A. Yes.

MR. HISER: I don't believe that I have any other questions.

But, Mr. Chairman, if you'll indulge me for just a minute so I can look through my notes?

CHAIRMAN FESMIRE: Sure.

MR. HISER: I do have one question. I'm sorry.

Q. (By Mr. Hiser): It goes back to your assumptions on page 7. And this is a question which I think is near and dear to Commissioner Bailey's heart, and that is that the release from an on-site trench burial, four feet of soil covered with poor vegetation, are you telling me that the Division's proposed standards that were done by the Pit Rule after all that discussion is just going to result in poor vegetation for hundreds, if not thousands, of years in the future? Or was that just a convenient thing that you grabbed?

A. Well, again, that's a conservative value we placed into our modeling.

Q. Now, does the Division believe that we're actually to see better vegetative recovery with the standards adopted by the Pit Rule in Case 14015?

A. Considering that you do have to reestablish vegetation and monitor for a couple of years, yes, we do believe it would be better than that, yes.

Q. All right. So that would also tend to reduce the water loading going into the trench area potentially with future infiltration; is that correct?

A. That's correct.

Q. Okay.

MR. HISER: I believe that concludes all my questions, Mr. Hansen. Thank you.

CHAIRMAN FESMIRE: Mr. Frederick?

MR. FREDERICK: All right, Mr. Chairman. Do you want to take a break before I go ahead? Or do you want to just plow through this?

CHAIRMAN FESMIRE: How long do you think it's going to take?

MR. FREDERICK: Oh, probably at least a half hour.

CHAIRMAN FESMIRE: Okay. Why don't we go ahead and take a ten-minute break and reconvene at five minutes to 10:00 on that clock.

[Recess taken from 9:44 a.m. to 9:58 a.m., and testimony continued as follows:]

CHAIRMAN FESMIRE: Okay. Let's go back on the record in Case No. 14292. The record should also reflect that, again, all three Commissioners are present. We, therefore, have a quorum.

I believe, Mr. Frederick, you were about to begin your cross-examination of Mr. Hansen?

MR. FREDERICK: That's correct, Mr. Chairman.

CROSS-EXAMINATION

BY MR. FREDERICK:

Q. Good morning, Mr. Hansen. How are you?

A. Good morning. I'm doing quite well.

Q. Good. Was it your idea to change the standard from 250 mg/L chloride to 3,000?

A. No. No, it wasn't.

Q. Who came up with that number?

A. Well, the 3,000?

Q. Yes.

A. As I said, I was tasked by our bureau chief at the time, Mr. Wayne Price, to explore what might be an appropriate number for a typical drilling operation in New Mexico for deep trench burial. So, as described in this presentation I've just given, based on sample results, we derived the 3,000 --

Q. Okay.

A. -- the sample results of pit contents.

Q. So most of the oil field waste would qualify for deep trench burial?

A. Given -- taking the other siting criteria into consideration, then, of course, one of the primary siting criteria would be the 100 feet to groundwater. Yes, it would.

Q. Okay. Now, in deciding to change the rule, was there any new data that led you to change the rule besides just Mr. Price telling you to?

A. Not that I was aware of, no.

Q. Okay. Any experience or anecdotal information

that caused you to up the standard to 3,000?

A. Not that I was aware of, no.

Q. Okay. Do you know how many more on-site trench disposals there may be as a result of this change?

A. I don't.

Q. Any idea as far as orders of magnitude? Ten more? 100 more? 1,000 more?

A. I couldn't speculate. I'm sorry.

Q. Okay. And coming up with the 3,000 mg/L, did you consult anybody outside the agency?

A. No.

Q. Did anybody review your results outside the agency after you came up -- view your modeling results before this hearing outside the agency?

A. Other than through the hearing process, no.

Q. Okay. Now, you testified that the 3,000 mg/L, based on your modeling results, would be protective of public health; is that correct?

A. That's correct.

Q. And is that the purpose, general purpose of the Pit Rule? To protect public health?

A. One of the general purposes, yes.

Q. Okay. And in the last hearing you testified in favor of a 5,000 mg/L standard; is that right?

A. That's correct, yes, for trench burials.

Q. Okay. And you also testified at the same time, though, that on-site deep trench burial should be minimized; is that correct?

A. That's correct.

Q. Why was it important in the last hearing to minimize on-site deep trench burial?

A. Well, at that time, of course, we had no idea what would be the final rule by the Commission. I think the Commission made great strides forward in that we have acquired liners for pits and for on-site burials.

So at that time, we didn't even know that was going to happen or what kind of material that might be. So given those unknowns, we wanted to try to limit trench burials.

Q. Okay. In your model, you assume a surface area that waste disposal site is a half an acre?

A. Yes.

Q. Okay. Is that typical? Can they be larger? Can they be smaller?

A. Yes, it could be smaller. It could be larger. But I think that's typical.

Q. Okay. All right. And that area is uncontrolled? There's no fencing around it?

A. That could be the case, yes.

Q. And are you aware of any legal prohibition about the use of the surface over that deep site trench burial site?

A. For on-site burials, for surface use over that area, you do have to obtain permission from OCD as I recall from Part 17.

Q. So the surface owner, does OCD have control or jurisdiction over what the surface owner does with respect to the surface?

A. No. The operator has to petition the Division.

Q. But the surface owner doesn't have to petition?

MR. BROOKS: Mr. Chairman, I would object to his asking this question. This witness doesn't know what the OCD's jurisdiction is since that's a legal question.

CHAIRMAN FESMIRE: I think he can ask if he knows and respond from there. We'll overrule the objection with that one caveat.

THE WITNESS: Well, OCD's jurisdiction over surface owners, my limited knowledge of it is --

Q. (By Mr. Frederick): If you don't know, that's fine.

A. I don't know.

Q. Okay. Now, do you know whether under the rule the boundaries of the pit are required to be demarcated in any way?

A. Under the rule, they're not required to be demarcated on the surface; although, we do require that it be noted on a deed or similar device.

Q. Is there any leak detection required on these on-site disposals?

A. No.

Q. Any monitoring of groundwater soil after they're complete?

A. Not required.

Q. And no inspection of the liner installation by OCD before the waste goes in it?

A. OCD could possibly inspect it, given that they're required to have to notice the OCD prior to closure, but it's not required that OCD inspect it.

Q. Were you concerned in the last hearing about the cumulative impacts of on-site deep trench disposals?

A. Yes.

Q. Can you explain the nature of your concern there?

A. Well, if there are disposals, several disposals in a limited area -- even though each individual disposal may contribute a small amount of chloride -- if there are several disposals in a limited area, that could accumulate in the groundwater to have a broader impact on the groundwater.

Q. Okay. Under the current rule with the 250 mg/L chloride standard, would on-site trench disposal be the exception to the rule?

Let me rephrase that. Would the eligibility -- if you just considered the SPLP test, would the current standard

eliminate most oil field waste from on-site trench disposal?

A. I would make a comparison to, say, sample results -- say, OCD sample results to what that, you know --

From what I can recall, I would say perhaps in the southeast portion of the state that might be an appropriate statement, yes.

Q. Okay. So it would minimize deep on-site trench disposal in the southeast anyway?

A. Yes.

Q. And that's no longer the case under that -- or that will no longer be the case under the proposed change of 3,000 mg/L? Most waste would not qualify?

A. Well, again, excluding -- if you exclude the siting criteria, that would be true. But, of course, with the siting criteria of 100 feet to groundwater, I'm not sure.

Q. Okay. Now, the rule doesn't place any limit on -- and we're just talking about leachate contents here. It doesn't place any limit on TDS; is that correct?

A. That's correct.

Q. Okay. And with respect to manganese or sulfates, iron or zinc?

A. That's correct.

Q. Okay. Why does the rule --

A. I'm sorry. As far as testing goes.

Q. Okay. Why does the rule require the leachate to

meet 3103A standards, in your opinion?

A. Well, in my opinion, it would be because -- and I think Commissioner Olson kind of hit it -- a material, if the trench happened to be dug into and exposed that 3103A, which is, of course, those are the human-health-based standards, we want to have an additional level of protection built into a permanent disposal site.

Q. Do you know whether chloride, excessive levels of chloride, have any effect on human health?

A. Well, from my education, I know that, say, drinking seawater can be detrimental to human health. So a very high concentration of saltwater could be -- of course, that would include chloride.

However, the human body is quite adept at devoiding salt. Of course, chloride has -- the standard in WQCC is an anesthetic standard. It's not a human health standard, but rather a standard that might impact taste or odor or color or something.

Q. Okay. If the leachate exceeds the 3,000 mg/L chloride standard, is there any correlation between chloride and -- between the chloride concentrations and TDS, sulfates, manganese, or any other of those 3103B standards?

A. Okay. I think I understand what you're asking. I mean, as we, of course, stated before, chloride being one of the more conservative constituents -- in other words, it wants

to pass through the vadose zone without any attenuating factors more so than -- or has less attenuating factors than other constituents might have, like you mentioned; however, some of these other standards -- or constituents, as you mentioned, were to come in that same water as it goes down through the vadose zone.

Q. All right. So if the chloride standard is exceeded, the TDS standard will be exceeded by more than 3,000 mg/L, correct?

A. That would be true for TDS, but probably not the others you mentioned.

Q. Do you have any feel for a correlation between the chloride concentration and the other constituents, or can you not predict it?

A. I couldn't predict it. I mean, that would be --

Q. Now, in your modeling efforts, you modeled the good liner scenario, correct?

A. That's correct.

Q. And is that the same as a best-case scenario?

A. Well, I guess as we've talked here today, I would say no.

Q. What about it isn't a best case scenario?

A. Well for one, we used poor vegetation as opposed to let's say good vegetation. We used some defects in the liner.

Q. Okay.

A. That would be it.

Q. Okay. But you did assume more or less a perfect liner installation and five pinholes per acre in the liner?

A. Well, no. That would not be a perfect installation. We hope it would be a good installation. A good installation may have some defects in that liner.

Q. And the defects were -- I think you assumed five pinholes per acre?

A. Actually -- sorry. We assumed one pinhole per acre and four defects per acre.

Q. Okay. Yeah. I put those together. Sorry.

A. A pinhole being one millimeter; and a defect being a square; and defecting, one centimeter square.

Q. All right. And with those, the defects, you had permeability of liners 4×10^{-13} centimeters per second? Is that about right?

A. That sounds about right.

Q. And that -- how would you describe virtually impermeable?

A. Probably about 4×10^{-12} centimeters per second.

Q. Okay. Now, last time you modeled the poor liner scenario, correct?

CHAIRMAN FESMIRE: Could you be a little more clear about last time?

MR. FREDERICK: In the last -- I'm sorry.

Q. (By Mr. Frederick): In the last pit proceeding, you modeled the poor liner scenario?

A. Yes.

Q. Okay. And is it often the case when you're trying to predict an impact on public health that you would not only model, perhaps, the optimistic scenario but also the less than optimistic scenario, such as the poor liner scenario?

A. Well, I'm trying to recall. The poor liner scenario, again, I don't remember all the variables, but that was a different case that we were trying to make, in that we didn't know what sort of material, if we were going to have a liner at all, what sort of standards would be set for the construction and placement of the liner.

So the point there was, we were trying to get some sort of standard for the installation of that liner. In this particular case, of course, we do already have the condition of rule, so we had a set of variables that we knew were good.

Q. Do you have reason to conclude that there's going to be 100 percent compliance with the Pit Rule with respect to liner installation?

A. I don't have reason to believe that.

Q. Okay. Now, you didn't present a poor liner scenario here. Did you model any poor liner scenario and not present it?

A. No. What I did is what you have seen here today.

Q. Okay. Just curious.

A. Okay.

Q. Now, in the last case, you testified that a poor liner would increase the infiltration rate by two to three times; is that correct?

A. Well --

Q. And I can give you your Exhibit 21 to refresh your recollection, if you'd like.

A. Well, I'm sure the Commissioner will take administrative note of that, and that sounds about right, yes.

Q. Okay. And did you recall it would also result in more flux, somewhere in the neighborhood of two to four times? The good liner scenario?

A. Well --

Q. I'm probably not going to be able to find it now that I'm up here. Here it is.

Would you like me to -- I can hand you my marked-up --

CHAIRMAN FESMIRE: Would you like to approach the witness?

MR. FREDERICK: I'm sorry, Your Honor. May I approach the witness?

CHAIRMAN FESMIRE: You may.

MR. FREDERICK: Thank you. Here you go. And I'll

have to have that back after it refreshes your recollection.

CHAIRMAN FESMIRE: Would you like to show it to Counsel?

MR. FREDERICK: Sure. Would Counsel like to see it? You can certainly take a look at it, along with my notes.

Q. (By Mr. Frederick): Does that refresh your recollection about the last hearing?

A. Yes.

Q. Do you have a reason to believe that there won't be noncompliance with the Pit Rule resulting in a poor liner installation?

A. I don't have any reason to believe there would be 100 percent compliance. I think given the 20 -- our prescriptive liner requirement with the 20 mil reinforced, if that material is used, even if some of the others are not -- some of the other requirements for installation are not used, that 20 mil reinforced should be closer to a good than a poor installation.

Q. Okay. But, again, you're just -- since there's no inspection requirement, you're essentially trusting the operator to install it correctly?

A. That's correct.

Q. Okay. Now, we talked about earlier that you're talking about an uncontrolled surface area roughly half an acre in size. How would -- if somebody had plowed up the surface

area, how would that impact your model?

A. Well, if they plowed it up and removed the vegetation and didn't replace it, it would increase the percolation through the bottom liner to a small amount, to a small degree.

Q. How would a telephone pole placed through the liner affect your model?

A. Well, if they put it deeper than four feet beside the permanent marker, it would potentially increase the percolation rate.

Q. Now, you mentioned the permanent marker. It's right in the center of the trench, right?

A. Right.

Q. The trench is half an acre, and there's no demarcation of the boundaries of the trench, correct?

A. At surface, that's correct.

Q. Okay. Now, your model pretty much assumes no change in any parameter for 2000 years, correct?

A. Well, that's correct, yes.

Q. Okay. And if the liner permeability starts out at cumulative five pinholes per acre, that's at day one?

A. Yes.

Q. How would that permeability or that defect change over time? Or would it stay exactly the same for hundreds of years?

A. Well, I'm not sure I can speak to that point other than to say that -- and I realize this is hearsay. I've had personal communications with the author of the lifetime expectancy studies.

Q. It's not a religious organization, is it?

A. Actually, Dr. Robert Coyner, who's with the Geosynthetic Research Institute, has told me that defects won't change. I mean, there shouldn't be increased holes, but the properties of the material will change over time to the effect that it will decrease the life span in half.

And his description was that if you had 20 mil -- you start out with a 20 mil, then in a certain amount of time in a conservative -- and I think it was mentioned in that study of about 450 years, then you'd have a 10 mil liner after that time and so on.

In which, it goes to installation integrity. Of course, it's already installed and hopefully not disturbed, I think is what you're getting at.

Q. Do you know, given what the hearsay you just relied on -- you're an expert. I think you can, to some extent, rely on other experts out there. How does that affect the permeability over time?

A. Well, of the plastic itself -- as I say, it shouldn't -- I mean a 1 mil has the same permeability as 12 mil, to a certain extent. I mean, there's a vapor

permeability, which, I mean, it's too small to even bring up here, but -- so the permeability would stay the same.

Q. Okay. So we talk about liner failure over time, and again, do you have information about how long liners last in the field under these kind of conditions?

A. Not field data, no.

Q. So do you know how I heard 70 years or 270 years? Do you have any feel at all for how long? Any more hearsay evidence on how long liners last?

A. As I say, I mean, I'm sure the Commission can rely on their administrative notice from the last case involving pits, Case 14015. But as I recall, I think it was 449 years, give or take, for a half-life. And as I recall, that was a conservative number, so it could be longer, but a half-life of 450 years, roughly.

Q. How does the permeability change after the liner -- after you pass that half-life?

A. Well, again, as explained to me by Dr. Coyner, if you go from a 20 to a 10, the permeability, given the significant figures that we've been talking about, won't change.

Q. Okay. You used a 50-year-old senior model, correct?

A. That's correct.

Q. And that begins on day one?

A. Yes.

Q. And ends 50 years later?

A. Yes.

Q. And then you're passing that sludge through the vadose zone?

A. Correct.

Q. What would cause the contamination to end at year 50? The infiltration to stop at year 50?

A. Well, if you ran out of chloride mass, it would be one reason for it to stop. We used 50 for a couple of reasons; one, we had 50 years of precipitation data; and the other, it gives a more concentrated or conservative approach to impact to groundwater.

In other words, if we had used 100 or 2000, it would dilute it somewhat. So we used the higher or more conservative number.

Q. So are you passing the entire mass of the chloride in the pit in 50 years into the groundwater; is that what you're --

A. No.

Q. It's a pulse that -- you're not turning off -- that mass of chloride in the contents isn't exhausted at the end of 50 years, is it?

A. Depending on the concentration, it could be. But I'm just saying for modeling purposes, we wanted to use the

more conservative approach, and that's one way to do it is to kind of limit that pulse. I know it sounds counterintuitive.

Q. It does a little bit.

A. But for -- in particular, with MULTIMED, that limiting -- in other words, 50, say, versus 100 years or 1,000 years, it would be similar to results of what you just saw. But, actually, 50 concentrates it just a little bit more, so we went with that little higher, more conservative value.

Again, kind of more conservative, worst case, reasonable worst case.

Q. Okay. So you've got a half-acre trench that is 12.5, the contents is 12.5 feet deep, and there's 60,000 mg/Kg chloride in there, is that going to be exhausted at the end of 50 years given your rate of infiltration for the source?

A. I haven't calculated it out. Probably not.

Q. Okay. And so -- and you are testifying it's more conservative to, at your infiltration rate, have a 50-year pulse and then turn off the source and just let that pass through, rather than to have continuous bleed?

A. Yes.

Q. Okay. And how sensitive was your model to changes in saturated conductivity throughout the various layers?

A. I don't have any specific numbers in mind, although I have run, like I say, MULTIMED, if not thousands of

times, hundreds of times, and have made comparisons to that particular parameter, and it's not a particularly sensitive parameter. Although, when I say not particularly sensitive, I mean if you were to increase the saturated hydraulic conductivity of the vadose zone by twice, it wouldn't double the concentration seen in the groundwater.

Q. It would not?

A. No. It might increase it by 10 percent. I'm just throwing that number out.

Q. So you assumed the vadose zone, is it -- in the vadose zone, you assumed a saturated conductivity of 2×10^{-4} centimeters per second?

A. Of that, saturated soils, yes.

Q. Saturated?

A. I'm sorry.

Q. The saturated conductivity of the vadose zone?

A. Of the vadose zone, yes.

Q. Now, the unsaturated conductivity is really what dictates the flow through the vadose zone, right?

A. That's correct. And MULTIMED uses Richard's equation, which as I'm sure you're aware, is the standard for calculating flow of unsaturated media.

Q. You're giving me more credit than I'm due.

Now, the moisture content you assumed was .283 in the vadose zone; does that ring a bell? You can look through your

exhibit if you would like.

A. Maybe I'll look through there.

Q. And, actually, it doesn't matter for my question, but my question is going to be, how sensitive was your model to changes in moisture content?

A. Again, it's not a particularly sensitive parameter. As you approach 70 percent, it starts to act like a saturated media. But up until that point, I just use examples of if you were to double a particular value for a particular parameter, in this case, soil moisture, it wouldn't double the concentration, the final value that we're looking for in concentration of groundwater. So, in my mind, that's not a sensitive -- it might increase it a little bit, but not a lot.

Q. What if your liner conductivity is changed from 4×10^{-13} centimeters per second to $^{-12}$, 10×10^{-12} centimeters per second? That's a small change. That's an order of magnitude change, still very slight conductivity, virtually impermeable. Still, how would that affect concentrations, timing, and amounts?

A. Probably virtually no change.

Q. Okay. What if -- again, what if you have a poor liner? How would that -- what conductivity would you expect with a poor liner installation?

A. Well, all I can say to that question is that as you pointed out in the last case, there was an increase by two

to four times.

Q. Okay. Now, let's talk about mixing the pit contents. Three parts clean soil, one part waste, right?

A. Right.

Q. How is that mixed up? Is it going to result in a uniform mixture?

A. I'm not sure how uniform it's going to be or what the faces of uniformity would be, but --

Q. Do you know how it's mixed?

A. It would typically be mixed with a backhoe.

Q. A backhoe. So in that scenario, if you've got an average concentration of 60 mg/Kg in the mixture, you would have pockets of pure waste and pockets of less than 60 mg/Kg in that kind of scenario?

A. I'm not sure how large those pockets would be, but I'm sure --

Q. Okay. How do you think that -- how would that affect the mixture you're getting in the leachate?

A. Well, I guess I'll go back to what we were discussing with Mr. Hiser. Is that what we're modeling and, of course, what we're interested in is what's at the bottom of that waste on top of the liner?

If there was a pocket of pure waste and a pocket of clean soils, that film of water on top of that plastic would have the same concentration if it were uniformly mixed or not,

so it shouldn't affect it.

Q. Okay. And the concentration in the rule allows for 3,000 mg/L or greater if background is greater, whatever background happens to be. But if background is deemed greater, I take it the leachate at the bottom of the pit would be more. Do you have any kind of feel for how much more?

A. Okay. So if you're asking if the pit contents were allowed to be greater because the background was greater for chloride what would be the leachate?

Well, for modeling purposes, we would assume, again, worst case, that all of that chloride could dissolve into an equal mass of water, and so it would be higher -- not higher than the background, of course.

Q. Do you have any feel for worst-case scenario if background -- if the SPLP on the background soil is somehow higher than the waste itself, what's the limit on that? Do you have any feel for the limit on that?

A. Well, just from a practical standpoint, I mean, I think the background issue -- I mean, it would be a relatively rare case. I mean, it could happen, say, over a potash spoils or something or potash mine spoils or something like that.

But, of course, I mean -- say, an example of pure sodium chloride, I mean, I guess, could be the ultimate restriction. And that would be about maybe -- that would be 600,000 --

Q. I'm really not looking for putting it in a potash mine, but what's a realistic? Is there anything out there that's not in a potash mine that's going to generate over 3,000 mg/L? I'm curious, actually.

A. I guess I'll go back to what has been observed by the Industry Committee of 400,000, 420,000 mg/Kg chloride.

Q. Now, that's sludge, though, correct?

A. Well, that's their pit contents.

Q. Pit contents. And background isn't going to be -- isn't background going to be some kind of naturally occurring soil?

A. Well, I mean, I thought we were just kind of talking hypothetical, what's possible. And like I say, I mean, if they put in pure sodium chloride, then it could be higher. But, typically, if we saw something higher than 240,000, I would be surprised.

Q. And what kind of SPLP would result from 240,000? What would the leachate standard, again, be? Are you going to divide that by 20?

A. So that would be what? Two --

CHAIRMAN FESMIRE: 81 divided by --

THE WITNESS: What it would be -- about 21 -- well, I'd have to, you know -- it would be -- divide that by -- so it would be 100,000 more or less, something like that. So 5,000, roughly, I guess.

Q. (By Mr. Frederick): That would be 5,000. So in that case, what would you put into your model if background was -- if suddenly the standard now, instead of 3,000 mg/L, the standard is 5,000 because of background? What would you put in your model then?

A. About 100,000.

Q. Okay. And how would that impact the results of your model, assuming all the other variables are constant?

A. Again, I guess I would direct the Commission to the administrative record. We actually did model 100,000 at 50 feet, so it would increase it.

Q. Do you recall how much?

A. I don't.

Q. Okay. All right. Do you -- in your model, do you assume that the infiltration area through the bottom of the pit is 167 meters squared? Is that right? Do you remember that?

A. That sounds like an accurate number, yes.

Q. Okay. So that seems to assume that you start off with a .5 surface area acres, and then 167 meters squared is less than half an acre. Is that -- I'm wondering if there was a reason for that. I'm wondering why you picked 167 square meters.

A. I'm not sure. That sounds like it could be a half acre. It could be. I'd have to crunch some numbers.

Q. Did you make an effort to -- well, I can tell you that I calculated it, but I'm just a lawyer now, so I don't -- I thought it was about .04 acres. I'm just wondering if that -- if that was on purpose, or if you had -- and I can -- do you want to refer to your -- which I've also marked.

Do you have your Exhibit 9?

A. Yes.

Q. And I think it's on page 27, but I'm -- at the second to the last parameter that you talk about on page 27.

And I guess my question is: Does that match the .5 acres, to your recollection?

A. I'm just doing some math in my head, so --

Q. I think I have a calculator if you want to borrow it.

A. That's okay. So 100 -- about 200 by -- I guess I'm just calculating it's about 200 x 200 foot. Maybe it's closer to an acre. I'm not sure why we used an acre rather than a half. Maybe because, I guess, it could be larger, but --

Q. All right. The surface area of the infiltration through the bottom of the pit, now, that's going to affect how soon and how much gets to the groundwater table; is it not?

A. Yes, yes.

Q. Okay. All right.

MR. FREDERICK: I believe that's all I have,

Mr. Chairman.

CHAIRMAN FESMIRE: Dr. Neeper?

DR. NEEPER: I do have some questions.

CROSS-EXAMINATION

BY DR. NEEPER:

Q. Mr. Hansen, I will begin with some questions in which I attempt to clarify what I believe might be some confusing points that were brought up by previous cross-examination to clarify things, if I can.

And then I will move forward into my own questions that concern your modeling. I'll try to take these as best I can in reverse order of how things were presented to you to get where your memory is freshest where I can.

You were asked about how changes in the saturated hydraulic conductivity or the unsaturated hydraulic conductivity might affect the propagation of this salty water pulse into the soil. If I am correct, you answered it would have a small effect, maybe a factor of two; is my memory correct there in terms of concentration?

A. No. I guess what I was saying is if you were to double the saturated hydraulic conductivity of the vadose zone soils, you would see certainly less than double. And I just threw out a number, 10 percent.

And, of course, it would depend on the soils and what sort of precipitation or infiltration rate you have. But it

would certainly be less than double the concentration.

Q. It would be a smaller effect on the concentration.

My question, then, is, what would be the effect on the speed of propagation? Is not the speed of propagation proportional to the hydraulic conductivity?

A. Okay. I'm not --

Q. I can rephrase the question if I have to, if that helps.

A. Of course, hydraulic conductivity is not a velocity or a speed. It's the capacity of how much water can go through a particular -- in this case, soil. So there's other factors involved like, of course -- the most important part being gravity and the effect of porosity of the material.

So it would increase the speed but --

Q. I'll try to simplify the question.

For a given head, that is pressure difference, either saturated or unsaturated, if I doubled the hydraulic conductivity, would not the liquid move twice as fast?

A. As I said, I mean, there's -- I mean, if you change the hydraulic conductivity of the soils, you're assuming it's probably a different type of soil, and that might have a different effect of porosity.

Q. You're not understanding my question.

If you are doing a modeling exercise and the only

parameter you change is the hydraulic conductivity and you doubled it, would not the velocity of the liquid at any given point double?

CHAIRMAN FESMIRE: In the vadose zone? Is that what you're saying?

DR. NEEPER: In the vadose zone, but it would also -- I almost slipped into testifying.

Q. (By Dr. Neeper): I am asking the question relative to the vadose zone.

A. Again, I have to say a hydraulic conductivity is not a speed or velocity, so I guess I can't answer the question. I'm sorry.

Q. I'll accept that you can't answer the question.

It was discussed that your model concerned a 50-year pulse. I did not understand this when I read the output. Does this mean that at the bottom of the trench you shut off all fluid motion after 50 years?

A. At the bottom of the trench, yes.

Q. So, essentially, it was as though you added a perfect, very perfect liner at the bottom of the trench at the end of 50 years. And the pulse of it started in the first 50 years and continued on downward doing whatever it would do?

A. Essentially, yes. Yes.

Q. Would that not slow the process of a downward infiltration if I abruptly shut off all infiltration above it?

A. For MULTIMED modeling purposes, no.

Q. Very good. You had discussed in response to a question that you had personally talked to Dr. Robert Coyner of the Geosynthetic Institute.

A. That's correct.

Q. When we had the work group for the -- prior to the pit hearing, I believe you were present in many of the meetings of that work group; is that correct?

A. That's correct.

Q. Do you remember the work group calling Dr. Coyner on the telephone?

A. I do.

Q. Do you remember my asking him what would happen to the lifetime or the properties of a liner material if it were stressed? And if you remember that question, do you remember his answer?

A. No.

Q. Mr. Hiser brought up some questions regarding the concentration of the release, and I believe this was the slide that was on the screen at the time. His question dealt with engineering parameters like the porosity and the relative saturation of what was in the burial unit.

If you had, let us say, pure water in the burial unit -- this is hypothetical, but it will help us get to the answer of the question -- if you have pure water in the burial

unit and you're 240,000 mg/Kg, you would then have 240,000 milligrams in a liter of water there; is that correct?

A. I don't quite understand the question.

Q. I'll rephrase the question. Because I'm not trying to trick you, and I'm not trying to lead you to a place where you can't answer the question.

You have suggested that the leach standard could be related back, and as I calculate this if you use just a 1 kg/L density for soil that it would relate back to about 240,000 -- excuse me -- mg/Kg in the initial pit contents and 60,000 mg/Kg in the burial unit. Am I being better with my question?

A. Yes, yes.

Q. If what were in the burial unit happened to be soil that was 100 percent water, you would then have 60,000 mg/Kg of water --

A. Yes.

Q. -- or 60,000 mg/L, since 1 liter of water weighs about a kilogram. The water in the soil is usually less than the total volume of soil; is that not correct?

A. That is correct.

Q. So the salt that is dissolved in the pore water, then, would be adding greater concentration than 60,000 mg/Kg of water -- or 60,000 mg/L of water; is that correct?

A. If we were concerned about pore water, yes, that would be correct.

Q. Yes. So in Mr. Hiser's example, if it were the pore water that was trickling through, the effect would be to have a concentration of the immediate substance coming out of the pit at greater than 60,000 mg/L, not less. Is that not correct?

A. No. Again, I'd have to go back to the testing method. It all goes back to our testing method.

So what's -- what can -- and, of course, our conceptual model for this exercise, we wanted to see what might leak out of the bottom of that plastic and relate it to our testing method, which is not related to pore water or mg/Kg directly.

And I tried to make that not just the line of comparison, but rather what we're actually going to test and what the rule requires as far as a test and a concentration limit.

Q. I think I've confused you with my question, and as such, I should try to bring it up in another way.

Mr. Hiser asked about isn't some of the chloride lost as a plume propagates downward. Is chloride regarded as a conservative tracer?

A. It is.

Q. And what do we mean when we say conservative tracer?

A. It means there would be very little attenuation

factors with that particular tracer or constituent as it goes down through the vadose zone.

Q. So we would not expect very much chloride to be lost from a plume as it goes down in a one-dimensional calculation?

A. Other than the chloride that would be retained in residual water as it went through the vadose zone.

Q. Okay. Mr. Hiser brought up the point of your soil layers on top of the burial unit, and he suggested that sometimes one of those layers is called, I believe, a lateral drainage layer -- there just you may have used that word.

A. (Witness nods.)

Q. Would that be standard landfill practice to put in a lateral drainage layer in a hazardous waste landfill?

A. In a hazardous waste landfill, yes.

Q. Is that required for a burial unit?

A. No. As far as the modeling goes, we put that in there, just not as a separate layer. It's not required by Part 17. But as a practical matter, that's what will happen. So we wanted to make our conceptual model reflect what will actually happen in the field.

Q. Yes. I understand that your conceptual model was meant to reflect reality in the field, which is not reality of a hazardous waste landfill.

A. That's correct.

Q. Thank you. I believe I understand it correctly, but I want to make sure one more time. The HELP model calculated what happened down to the bottom of the bottom layer of the burial unit or the trench, and then the MULTIMED, using the output from HELP or on a 50-year pulse output from HELP, calculated what propagated downward in the ground; is that correct?

A. And into the groundwater, yes.

Q. And into the groundwater.

Mr. Frederick brought up that he believed you had used a 167 square meter as an area of the bottom of a sample trench, and you had agreed.

Did you consider or have you looked at how much actual liquid is released over time by such a trench, if it behaved as you calculated?

A. I'm not sure I --

Q. I can rephrase that. How many barrels per year of saltwater are coming out of the bottom of your trench?

A. I haven't calculated that, no.

Q. Thank you. You mentioned that the diffusion of water through the walls of the trench was insignificant.

Did your model, in any way, beneath the trench -- or the plume of water, saltwater is moving, did your model, in any way, consider the diffusion of the water vapor?

A. No.

Q. Can your model, in any way, consider the colligative properties of the saltwater; that is, how the salt in the water changes the physical properties of the liquid itself?

A. Other than density, no.

Q. In your professional experience with concentrations as they are discussed here, would you expect that to be significant? The colligative properties? Would they significantly alter or influence --

A. Well, considering the small volume of 2.4 or 2.3 millimeters per year, no.

Q. A plume from an unlined pit, by your calculation, results in the exceedence of groundwater standards in about 140 years. Do I understand that correctly?

A. Yes.

Q. So if we did assume a total failure of a liner, then would we not expect severe impact on the groundwater at 140 years after failure?

A. Well --

Q. I'm not arguing here whether it failed a little, I'm saying if it failed a lot.

A. I mean, of course, we used two-foot cover versus a four-foot cover, so that is significant. But, I mean, maybe it would be 160 years versus 140 years.

Q. But you would agree the order of magnitude is 100

years, not 1,000 years?

A. Yes.

Q. Is that in agreement, if you remember, with approximate modeling that I presented during the pit hearing of downward propagation from a pit?

A. Same order of magnitude, yes.

Q. Same order of magnitude, okay.

Did you or your model, in any way, consider the upward transport of chloride from the burial unit for the unlined pit?

A. No.

Q. HELP, then, is a code that is designed just for landfills where all the attention is on the downward propagation; is that correct?

A. Yes. I'll qualify that a bit in that HELP does give you a water storage that may occur in various layers, and there could be, actually, some upward water storage over time. But in this particular case, it was downward.

Q. HELP literally includes rainfall going in and evaporating -- evapotranspiration going back out; does it not?

A. Yes.

Q. Does it not transmit any contaminants with that? Or does it handle contaminants at all? Or does it simply move the water?

A. It's water.

Q. So, in fact, any effect on or near the surface of the ground was totally ignored in your model; is that correct?

A. Well, as far as chloride concentrations, there's no direct output for HELP. It does, like I say -- could give you water storage, but in this case it was downward.

Q. The concentration allowed in a burial unit as proposed by this rule change, in this proposed rule change is based entirely on your model. Did I understand that correctly?

A. Well, as pointed out in this slide, it was based on what we see as far as a reasonably maximum chloride concentration in the pit contents.

Q. It's based on what the operator might need, might need to dispose?

A. Correct. And with that, we model what that could mean as far as if there was a release from a trench burial. So it's kind of separate issues.

Q. Did you consider anything to do with the possible upward transport?

A. No.

Q. It did not enter the considerations at all in arriving or developing this proposed regulatory limit?

A. Right. Because of the trench construction with the liner on top, we didn't consider that. Right.

Q. The liner is emitting, by your estimate, about .09 inches or 2.2 millimeters of liquid per year at the bottom.

Is that liquid coming in the top in sort of a steady state form, or is the burial unit accumulating net water or losing net water over this time?

A. It's coming in through the top and leaving the bottom, assuming the same defects on top as the bottom.

Q. If it can come in through the top, why can't it not go back out through the top?

A. Well, there has to be a head. There has to be an actual film of water on that plastic to drive it through those defects. So, I mean, there would have to be some water at the bottom of the top liner, I guess. And, of course, the gravity would force it downward.

Q. You're telling me there's no unsaturated flow through a defect?

A. No vapor flow.

Q. Unsaturated flow? You just told me there had to be a film of liquid water --

A. Uh-huh.

Q. -- in order for the water to go through this defect.

A. The HELP model uses another code to calculate what, given a certain head, what water will go through those defects, and it does not account for vapor transported through those defects.

Q. So this is back to an earlier question. I'm just

reaffirming it. The HELP model assumes downward transport. It is built just for landfills, and its inherent assumptions do not even let it consider a possible upward transport; is that correct?

A. Well, like I said, other than the water storage that could be upward and because of transpiration evaporation, so depending on the soils, I mean -- but I guess more to the point of your question for this particular case, it was downward, yes.

Q. In this case, it's downward. Okay.

Liner installation was discussed, and in your model, you used the default that is called a good liner; is that correct?

A. Yes. Well, I mean it's not called a good liner, but a good installation.

Q. Is that term used in the literature that you cited in the references with regard to default values built into the code?

A. Yes.

Q. So "good" is a technical term if you speak that term to the code? If you input that?

A. Right.

Q. You expressed that with your good presumption, it presumes so many defects per acre of liner, and you said that was so many pinholes, and I believe one hole -- but I'll let

you correct me as to what that assumption is.

A. It's a little more involved than that but, basically, yes.

Q. The code, then, is assuming a very large area of many acres, and it's saying on the average we will have this much leakage through holes, and we will calculate that in a one-dimensional average fashion. Is that correct, regarding the nature of code?

A. Yes, yes.

Q. Your presumed average pit, however, was about 160 square meters in bottom area. So for the fluid motion coming out the bottom of that, then the code would, in effect, assume some faction of those holes; would it not?

A. In that if it were greater, which I think 167 square meters would be greater than an acre, yes. I mean, it could be 1.01.

Q. We can deal later with whether or not 160 square meters is larger or smaller than an acre. Let me hypothesize that it's much smaller.

But do not holes usually come as one each or none each? In other words, you have calculated a leak rate assuming on a defect rate for a large area. But if you have one of those defects in your pit or in your burial unit, you're going to have, in effect, a much larger leak rate for that given area than you presume?

A. It's all relative to the size of the areal extent of that trench or pit or whatever we're modeling. So I guess to answer your question, no.

Q. You've answered my question in the negative. I'm going to try the question again, because it's very specific.

Let us presume that the code assumes there being good installation, there is one hole per acre. And you have calculated from your trench of 160 square meters a 2.2 millimeter per year leak rate.

That would be true, would it not, for a whole acre with one hole in it? But if you have one hole in your 160 square meters, you're going to have a lot greater leak rate to that because you have more hole per unit area of your landfill, your would-be landfill, your installation.

A. Again, to say it's relative to the size of the extent -- if you have one acre with a certain leakage rate, it's going to be the same leakage rate, or there's a half acre or ten acres or -- given the same good number of defects, it's not going to change.

Q. Let us -- let me try this question again.

If you had a certain leakage rate per acre with one hole per acre --

MS. FOSTER: Mr. Commissioner --

Q. (By Dr. Neeper): -- with one hole per acre --

MS. FOSTER: -- I would hate --

CHAIRMAN FESMIRE: If you're going to object, object.

MS. FOSTER: I would hate to object to Dr. Neeper, except that he stated that he's asked this question now for the third time.

DR. NEEPER: I will withdraw the question.

MS. FOSTER: Thank you.

DR. NEEPER: I'll save the Chairman the problem of either having to rule or --

CHAIRMAN FESMIRE: I appreciate it, Doctor.

Q. (By Dr. Neeper): Do you know of or have you ever heard of rodents burrowing into hazardous waste landfills?

A. I don't know of it. I have heard of it.

Q. Okay. You have assumed a so-called good installation. Is there any way that the sidewalls of a trench can be inspected and smoothed and the bottom inspected and smoothed before the liner is put in the trench?

A. Could there be inspections made for smoothness? I guess I'm not --

Q. I'll try the question again. A good assumption assumes smooth, carefully prepared bottom in a landfill; is that not true?

A. That's true.

Q. It would then, if applied to a trench, assume smooth, carefully prepared surfaces for the trench for the model to be applicable; is that not true?

A. That's the assumption that we model, yes.

Q. Is there any way to have engineering examination of a trench to be sure there are no protuberances, that you have smooth surfaces throughout the trench, so as to achieve what is called a good installation?

A. Yes.

Q. How can you do that?

A. Well, prior to installation of the plastic, you can make a visual inspection of that trench bottom and sides.

Q. Could you go into the trench and examine it?

A. Yes.

Q. Do OSHA regulations prohibit you from going in there unless you shore up the sidewalls of that trench?

A. My understanding of OSHA regulations is they have a specific definition for a trench. We use the word "trench" although it doesn't meet the definition of an OSHA trench. So, therefore, I would say, yes.

OSHA would not consider what we call a trench a trench; and, therefore, you could.

Q. So you have answered then that, yes, the insides of a trench can be examined by a person?

A. Yes.

Q. Initial moisture distribution in the soil at zero time for your modeling, as I understand from the literature, was established by looking at the steady state, what would be a

steady state of infiltration between the bottom of the liner and the aquifer at the presumed infiltration rate.

Would that be correct for the way you handled the modeling?

A. Using the term "steady state" loosely, yes.

Q. So your initial moisture distribution in the soil beneath the burial unit was based on a presumed .09 inches per year infiltration?

A. Yes.

Q. Because there was no trench there before the trench was dug, is it reasonable to use that moisture distribution in the soil?

A. Yes, because it's based on the HELP modeling for -- specifically, for a trench, a closed trench.

Q. But wouldn't the moisture distribution be established by a situation in which there is no pit or no trench?

A. I don't understand the question.

Q. Your initial conditions for the MULTIMED model assumed that the moisture profile in the soil was established by .09 millimeters inches per year of infiltration.

A. Correct.

Q. Is that correct?

A. Yes.

Q. That .09 is what results after a trench is in

place; is that not correct?

A. Yes.

Q. Would it not be more correct to say the true initial moisture distribution in the soil is what nature established when there was no trench in place?

A. I'm sorry. I don't understand the question. Our focus is on a trench and the release from that trench. I'm sorry.

Q. I'll try one more time and then let it go because I don't want to belabor the point.

If I open the trench very abruptly, is not the moisture distribution below the trench what nature established in the absence of a trench before I dug it?

A. You're comparing the moisture content of the soil prior to a trench versus --

Q. The moisture content of the soil beneath the trench --

A. The trench.

Q. -- between the bottom of the trench and the aquifer.

A. And we wanted to try to use the most conservative values for a trench in place, a closed trench in place, so rather than using what might be -- and we didn't, actually -- to be more conservative, we didn't use a recharge value. So we just took what could leak out of a trench without a recharge

value, to be more conservative.

Q. I'll try it one more way.

Is the recharge -- is the emanation from your bottom liner greater than or less than the natural recharge?

A. I don't actually know what the natural recharge value is. Just from what I know of recharge values, it's probably very close to the same. But --

DR. NEEPER: No further questions.

CHAIRMAN FESMIRE: Okay. At this time, we will take public comment. Is there anybody in the audience who would like to make a public comment on the record?

Okay. Commissioner Bailey, how long will your questions take?

COMMISSIONER BAILEY: Nothing, because I defer to Commissioner Olson.

CHAIRMAN FESMIRE: And I got a hunch that's going to take awhile. So why don't we go ahead and break for lunch early today, and we'll be back at one o'clock, and we'll begin with Commissioner Olson's examination of the witness.

[Noon recess was taken from 11:29 a.m. to 1:02 p.m.]

CHAIRMAN FESMIRE: Let's go back on the record. The record should reflect that this is the continuation of Case No. 14292, that all three Commissioners are present, there is, therefore, a quorum present.

The record should also reflect that we were about to

begin the examination of Mr. Ed Hansen by Commissioner Olson.

Commissioner Olson?

EXAMINATION

BY COMMISSIONER OLSON:

Q. Yes. Mr. Hansen, I guess maybe I'll just start with a question on your modeling.

You had modeled, I think, as you've shown here, a concentration of 60,000 mg/L when you expect to get leaching, essentially, to the actual concentration that was in the material. I guess, how did you go come up with that number?

A. You mean 60,000 mg/Kg?

Q. Well, you're using -- you're coming up with a number here as to what's acceptable to remain in the pit, and I think last time we had a number of 5,000 presented to us. I was wondering why that's changed.

A. Well, a couple of important points there; one, when we used the 5,000, I think it came out a little bit -- when we were using 5,000, of course, that equates generally back to what we were proposing with the 3:1 stabilization, and, of course, the 20:1 dilution with the SPLP. That equates back to 100,000 in the trench contents.

And, of course, the highest number that we had available was 400,000, which would equate for the 4:1, or 4 times dilution through stabilization. So we used the worst possible case we could, you know -- head of operations for, and

came up with 5,000.

With the 5,000, of course, we were also proposing some limiting factor with our siting criteria of the 100-mile radius. This time we are proposing 3,000, but we have the limiting factor of 100 feet to groundwater; 3,000 being what we call the reasonable maximum.

Based on all the data that OCD collected, we found about 240,000 was the reasonable maximum; not necessarily the maximum, but reasonable maximum.

Q. Well, I guess that's what's being proposed here now is a 3,000 mg/L of SPLP leachate for chloride. I guess I still may come back to how you come up with that number versus 1,000 or 2,000 or some other number.

A. Well, I mean, it's all based on a reasonable maximum of 240,000 starting out in the pit contents, and then dividing that by four, which could be your possible stabilization number. If you mix in three parts of clean soils, that breaks it down to that 60,000 mg/Kg of chloride in the trench, what you'd actually put in the trench.

Our testing method is based on a 20:1 dilution, so dividing that 60,000 by 20, you come up with 30,000. So the limit that we're proposing is for what is tested by using that Synthetic Precipitation Leaching Procedure and not what's actually a dry -- what would be considered a dry weight concentration. It's actually what are leachable chlorides from

the trench contents.

Q. Right. I understand that, but I guess I'm thinking along the lines of wouldn't you normally do some type of iterative process to find out what the appropriate level would be? Is that the way you normally do things? You'd kind of be running your model trying to find out what the appropriate level is for leaving in this type of system?

Because it seems to me here you're just saying to take the maximum and then saying the maximum is okay based upon the modeling. Is that -- or am I interpreting that wrong?

A. That's a fair characterization considering all the other siting and construction, et cetera, criteria, yes.

Q. And then in regards to --

A. And can I put another --

Q. Yeah, sure.

A. And we didn't use the maximum that we've observed. We just -- getting back to what we're characterizing as a reasonable maximum, which is what OCD has observed through our sampling programs.

Q. Right. So you're looking at saying this is the maximum that we've observed is the maximum acceptable for being put in the burrito system, and being subject to leaching from there?

A. Right, right.

Q. And, I guess, just a couple of questions on this

mixing zone. So the model is allowing -- if I remember right from the last time we went through this -- the model is allowing for mixing under the area of the trench with a 10-foot aquifer thickness. It's technically allowing groundwater contamination under the trench system. It's only measuring it under your model when it reaches one meter out from the pit area; is that correct?

A. Ten feet of the total thickness of the aquifer, yes, one meter and assuming downgradient edge of that, yes.

Q. All right. And then back to the question of Mr. Hiser about reasonable foreseeable future use. Isn't that where the groundwater is measured to determine compliance with New Mexico standards under Water Quality Control Commission regulations?

A. Yes. The place of withdrawal, yes.

Q. Is that your understanding? Because that is the potential place of foreseeable future use.

A. Yes.

Q. And let's get back to the issue of the levels again. Right now, the 3,000 mg/L of chloride and leachate, that's a consistent increase over what we have in the current rule; is that correct?

A. Yes.

Q. And at the last hearing on the Pit Rule when OCD proposed comparable levels, they were proposing 5,000 of

leachate at the time. OCD also proposed that there be surface owner approval of deep trench burial; isn't that correct?

A. I believe so, yes.

Q. So if we're looking at comparable levels to be left on the surface owner's property, why wasn't the Division proposing a surface owner approval, then, as they did last time?

A. I think through the -- as I recall, through the hearing process, there was some testimony brought up about there may be a conflict with recently enacted by the state legislature the Surface Owners Protection Act. And so at this time, they didn't want to conflict with that particular act.

Q. But you are familiar with the Surface Waste Management Rules for small landfarms, correct?

A. Yes.

Q. And that requires virtually no chloride be left on the site, yet that requires surface owner approval for a small landfarm, correct?

A. That's correct.

Q. So wouldn't it seem appropriate that since we have a relatively benign material that requires surface owner approval that we have a similar type requirement for deep trench burial when we have highly contaminated waste?

A. I think as previously discussed, the landfarms, of course, are direct surface disturbances. Of course, no one

could use the surface for any purpose during that period, whereas a deep trench burial, the surface could be used because we're talking about a subsurface use of that land.

Q. I guess, what surface uses could it be used for? If you have -- you don't want to disturb the cap, right?

A. That's correct.

Q. So what surface uses remain for that piece of land?

A. I would say uses that would not disturb the vegetative surface of that property.

Q. But that appears to be most all uses, then. You couldn't graze it then because you wouldn't want to graze the vegetation that's on it.

A. Maybe under normal -- including agricultural vegetative uses.

Q. Well, I guess you wouldn't want to grow a crop of alfalfa on top of it and be having a center pivot come across the top of that and apply large quantities of water, would you?

A. It may increase some water coming to that top plastic, but it would be shed. I'm not sure it would increase the potential for leaching if it's irrigated properly, I mean, assuming alfalfa would take up the moisture. That's the goal, of course.

Q. But then alfalfa is also a deep-rooted crop, isn't it?

A. Yeah.

Q. Roots can go down to ten feet or so in alfalfa.

A. Or deeper, but they run into that plastic and --

Q. I guess in that circumstance, wouldn't the Division want to discourage that just because it would increase potential problems with the buried waste at that point?

A. Of course, the marker would be there to indicate to potential farming activities.

Q. Have you known of markers disappearing before?

A. I haven't known that from personal experience, but I suppose that could happen.

Q. So, I guess, are there any other uses the land could be used for then?

A. I would just be speculating.

COMMISSIONER OLSON: I think that's all the questions I have.

CHAIRMAN FESMIRE: Okay.

EXAMINATION

BY CHAIRMAN FESMIRE:

Q. Mr. Hansen, could we go to page number 15 in the PowerPoint? I think it was pointed out that this does -- both the unlined pit and the good liner -- does at some point exceed the 250 mg/Kg -- mg/L -- what's my unit?

A. Mg/L.

Q. Mg/L -- the standards that are set by the WQCC.

So we are, in essence, pushing that exceedence out for what looks to be under a good liner, a little over 2,000 years; is that correct?

A. That's correct.

Q. But at some point, it is going to exceed the standard?

A. As the modeling results indicate, yes.

Q. So we could be saying that this is in essence pushing out a problem that New Mexico will have to deal with at some point in the future, right?

A. I would say beyond reasonable, foreseeable use, yes.

Q. And the benefit would be a lesser cost to oil and gas producers in the State; is that correct?

A. That's true, yes.

Q. And the corresponding economic benefit to the State, right?

A. I'm not an economic expert, but that sounds reasonable.

Q. Now, didn't OCD do a calculation to estimate how many wells per year would be affected by this change?

A. Not that I'm aware of. What I do know is that the Environmental Bureau looked at an area that could be effective, say, over the Ogallala aquifer in particular, and about 1/3 of that area would be over 110 feet to groundwater.

Q. So they could estimate that about 1/3 of the wells in Southeastern New Mexico would fall under this in any given year, right?

A. Given that's where oil and gas wells were.

Q. If you assume that the well distribution was equivalent to the areal distribution?

A. Correct.

Q. So 2/3 of the wells will not be affected by this change, right?

A. That's correct, given the same set of --

Q. Okay. Now, Mr. Hiser talked to you about mass flux rates out of the -- for lack of a better word -- the burrito, in the trench. And if I understood his argument correctly, one of his arguments was that there wasn't enough liquid in there to get to the leachate concentrations that you had modeled; is that correct?

A. That's correct.

Q. But doesn't that assume that the only liquid available to create the leachate is the liquid that's already in the trench?

A. I believe that's what he was assuming, yes.

Q. But the truth is that at some point in time there's going to be that steady state flow we were talking about. And steady state in this term -- I think the way we were talking about it earlier is that the mass flux rate of

liquid into the trench is going to equal the flux rate out; is that correct?

A. That's correct.

Q. So, you know, down around 2,000 years after the liner has deteriorated and everything else, we're going to have sufficient liquids in that system to create the leachate that you're talking about?

A. I'm not sure I understand your question. You're saying in 2,000 years --

Q. At some point in this system, there's going to be a liquid inflow rate into this system; is there not?

A. Well, I mean, starting day one there will be. But after 2,000 years, I'm going assume there's no more liner or the liner is such that it's no longer serving it's original purpose. Then, yes. I mean, it would --

Q. So if we were to assume that the only liquid available to create the leachate was the liquid that was actually buried in the trench, that wouldn't be a correct assumption?

A. That would be correct.

Q. My statement is correct?

A. Yes.

CHAIRMAN FESMIRE: Okay. I don't think I have any further questions.

Mr. Brooks, do you have any redirect of this witness?

MR. BROOKS: I think one or two questions on the same subject.

REDIRECT EXAMINATION

BY MR. BROOKS:

Q. Relating to Commissioner Olson's questions to you about surface owner approval, did you attend the Commission deliberations on the previous Pit Rule?

A. I did not.

Q. So you don't know, then, what was said at this table about why the Commissioners choose not to put a surface owner approval provision into the previous Pit Rule?

A. I have not reviewed that portion of the transcript regarding that particular subject, so I don't know.

Q. Okay. Did the fact that the Bureau proposed a surface owner approval requirement and the Commission chose not to adopt it, did that have some impact on the Bureau's decision not to propose such a requirement again?

A. Well, yes.

Q. Thank.

MR. BROOKS: That's all I have.

CHAIRMAN FESMIRE: Ms. Foster, anything on those subject?

MS. FOSTER: Well, I do have a question on the subject that you asked concerning --

CHAIRMAN FESMIRE: Okay.

MS. FOSTER: Just one question. I believe you told Commissioner Fesmire that the changes in this rule, the amendments in this, will impact only 1/3 of the potential wells that might be in the Ogallala, correct?

THE WITNESS: Correct.

MS. FOSTER: Is it not the case that in order for an operator to do deep trench burial not only would they have to meet the chloride standards which are now being increased, but they also need to meet the 3103 standards?

THE WITNESS: We haven't proposed any amendments to that current requirement, so that is correct.

MS. FOSTER: Right. So there's no changes in the 3103. We have to meet the original 3103 of the original Rule 17 Pit Rule?

THE WITNESS: Yes.

MS. FOSTER: Correct. So an operator, in order to be able to do deep trench burial, would have to meet the original 3103 standards? There's no change in that?

THE WITNESS: The current standards, yes.

MS. FOSTER: Thank you. No further questions.

CHAIRMAN FESMIRE: Mr. Carr?

MR. CARR: No questions.

CHAIRMAN FESMIRE: Mr. Hiser?

MR. HISER: No questions.

CHAIRMAN FESMIRE: Mr. Frederick?

MR. FREDERICK: I do have a couple.

CHAIRMAN FESMIRE: Okay.

RECROSS-EXAMINATION

BY MR. FREDERICK:

Q. I want to follow up a little bit on Mr. Olson's on-site questions about landowner approval. Now, it's your understanding that the operator doesn't own the surface in most cases, correct?

A. Yes.

Q. So the Pit Rule, though, is authorizing disposal in a deep trench on land that the operator does not own, correct?

A. In many cases, yes.

Q. Does the Division -- OCD isn't going to know whether the operator is authorized to do that or not. It's not requiring any authorization from the landowner; is that correct?

A. That's correct.

Q. What kind of uses, land uses, would be consistent with having this deep trench on your land?

A. Well, I would say most consistent in Southeast New Mexico would probably be range land.

Q. And that would be -- have to be maintained for the life of the trench? That kind of restriction on land use?

A. Well, I mean, I think there could be others, but

that would be the most typical.

Q. Okay. And did you read the OCC's final order in the last Pit Rule proceeding? Are you familiar with it at all?

A. I guess other than the rule itself, no.

Q. Okay. So you don't know why -- the express reasons that OCC provided for not requiring landowner approval?

A. No.

Q. Okay. You say you're not familiar with anything in the rule -- anything in their final order -- that might have said that's waste is not going to exceed WQCC standards, and therefore it's not a problem? Something to that effect?

A. No.

Q. Okay. Now, I'm going to follow up a little bit on Dr. Neeper's question about -- did you -- you're not saying hydraulic conductivity is in direct proportion to the velocity of groundwater contaminant flow, are you? I mean, isn't there a direct proportion between velocity and hydraulic conductivity?

A. Given the gradient and --

Q. All other parameters considered.

A. -- effective porosity, yeah.

Q. Okay. And do you know what the definition -- an OSHA definition of a trench is?

A. Give me a second to formulate that. It's an opening narrower than the depth, I guess.

Q. Okay. But the Pit Rule doesn't preclude an operator from having a deep trench that meets that criteria, does it?

A. Not descriptively, but practically.

Q. Practically. Just curious. Now, Mr. Fesmire brought up economic benefit to the oil and gas industry. You haven't quantified that benefit, have you?

A. No.

Q. In relation to the cost to the public, that benefit hasn't been quantified, has it?

A. I haven't, no.

Q. Okay.

MR. FREDERICK: That's all I have.

CHAIRMAN FESMIRE: Ms. Belin? Dr. Neeper?

MS. BELIN: No questions.

DR. NEEPER: No questions.

CHAIRMAN FESMIRE: Okay. I do have one more question. Given that this change would be a benefit and decrease the cost of -- well, let me start with that.

Is it a pretty fair statement that this change will benefit the oil and gas industry with respect to the operating costs in New Mexico?

THE WITNESS: Well, the assumption is that if waste can be buried on site, it'll save -- the transportation costs will outweigh the disposal costs for a trench burial.

CHAIRMAN FESMIRE: Okay. And if that sort of cost incentive is appropriate now, if oil or gas prices increase, it might not be appropriate in the future?

THE WITNESS: Say that one more time. I'm sorry.

CHAIRMAN FESMIRE: If the Commission were to decide to do this now, that a decision might be appropriate now, but if oil and gas prices were to increase, it might not be appropriate in the future?

THE WITNESS: I'm not sure. To me that sounds like a question for the Commission to decide.

CHAIRMAN FESMIRE: The Commission has to base their decisions on the evidence. We're asking you as a professional in the field, you know, if there's a reason that this is being proposed. Is this a permanent reason, or is it a temporary reason?

THE WITNESS: Well, the change would be permanent until it's, again, changed before the Commission. So it certainly could be temporary.

CHAIRMAN FESMIRE: Okay. And the reason for it may fade in the future?

THE WITNESS: I would say the economics may not be as much of a concern in the future, yes.

CHAIRMAN FESMIRE: On that, is there any redirect or recross?

MS. FOSTER: No, thank you.

CHAIRMAN FESMIRE: Mr. Carr?

MR. CARR: No questions.

MR. FREDERICK: I just have to object to the fact that the rationale given by OCD has nothing to do with economics. But besides that, I have nothing further.

CHAIRMAN FESMIRE: Ms. Belin?

MS. BELIN: No, thank you.

CHAIRMAN FESMIRE: Okay. Mr. Brooks, anything more of this witness?

MR. BROOKS: No. Thank you, sir.

CHAIRMAN FESMIRE: Mr. Hansen, thank you very much.

Mr. Brooks, do you have any other witnesses?

MR. BROOKS: The Division has no further witnesses, Mr. Chairman.

CHAIRMAN FESMIRE: Would you rest?

MR. BROOKS: We rest.

CHAIRMAN FESMIRE: Ms. Foster, do you have a witness?

MS. FOSTER: I do not at this time. Thank you.

CHAIRMAN FESMIRE: Mr. Carr?

MR. CARR: Yes, I do. Would you like to go at this time with my witness, or do you want to go to Dr. Neeper? Mine is very, very brief.

MS. BELIN: Mr. Chairman, members, I have to leave at 2:40, so I had just asked Mr. Carr in advance if perhaps Dr. Neeper could go now. That would be best for us.

But if his witness is really that quick --

CHAIRMAN FESMIRE: That's sounds just honkie dorie. If I had known about it, I would have suggested it.

Dr. Neeper, why don't you take the stand now to testify. Dr. Neeper, you're going to need to be sworn in?

THE WITNESS: Yes, I will.

DR. DONALD A. NEEPER

after having been first duly sworn under oath,

was questioned and testified as follows:

DIRECT EXAMINATION

BY MS. BELIN:

Q. Okay, Dr. Neeper.

A. Good afternoon, members of the Commission. I will hopefully have a two-part presentation. Because as I've already told the Chairman, I expect to request a rebuttal, there being no way to bring information relative to things we discussed this morning into testimony that had to be prepared before any documents were forthcoming to the public and before we could even know what this was all about.

So the formal testimony was prepared in almost total ignorance of what was behind the issues. Nobody was talking about this. I made as many phone calls as I could, and it was a thing that wasn't being discussed. So I made some guesses as to what might be important to the Commission.

So on these slides, you will see some odd marks.

These little purple stars indicate we are including -- that doesn't mean the slide is, in total, the same, but it means it includes evidence that's been in the Pit Hearing. So if you see stuff that's familiar, that's fine; you've seen it before, you don't have to worry about all those numbers. We're just getting them in the record.

On the slide is this little green hash mark, and it simply means we're including evidence from the Pit Hearing, but the evidence is derived from some independent authority. It's not just my word talking.

The first question that occurred to me is: What's in the waste? We've had extensive discussion on that. But as you see, my things -- I used a little different number. I had interpreted originally 3:1 waste stabilization as really being two soil and one water instead of three soil and one water. I think three was the final number.

This will be more leaning in favor of the rule. Whenever I say something that looks negative to the rule, this would be -- if what you want to call it an error or something -- that would be in favor of the rule. And I wondered what does 3,000 mg/L in the leachant imply? If I had in my terms a 3:1 waste stabilization, you'd have -- in principle your waste could be more than 84 percent saturated brine.

That is, my conclusion was the rule was designed so

that you basically couldn't, or could very rarely, make anything so salty that it wouldn't past the test because of the limits of solubility of salt.

This has been discussed; industry pit sampling in the northwest. If we look at the results in terms of the current test with my reduced dilution, there is basically very little that wouldn't have passed the current test.

MR. HISER: I hate to be a stickler for formality, but it looks like Dr. Neeper will be testifying as an expert, and we haven't done any of the expert qualification details. We probably should do that for purposes of the record.

CHAIRMAN FESMIRE: Ms. Belin, I think he's probably right. It would probably be real simple, but we do need to do it.

MS. BELIN: Since he's been qualified before, we don't have to go through it again, but I can have him review his qualifications.

CHAIRMAN FESMIRE: We can refer back to his qualifications in the prior hearing, but we do need to get something on the record that he is qualified as an expert in this hearing.

MS. BELIN: Okay, well, based on Dr. Neeper's qualifications that were presented with our pre-hearing statement and that were presented in the previous Pit Hearing, I would present him as an expert.

And maybe, Dr. Neeper, you can say --

THE WITNESS: I've been qualified before this Commission previously as an expert in soil physics. That is slightly distinct from hydrology.

CHAIRMAN FESMIRE: Mr. Hiser, is that sufficient?

MR. HISER: Mr. Chairman, we have no objection to Dr. Neeper's qualification on soil physics. We do have an objection to him on economics.

CHAIRMAN FESMIRE: Okay. Are there any other objections?

MR. BROOKS: No objection, Mr. Chairman.

CHAIRMAN FESMIRE: Okay. Dr. Neeper is so admitted as an expert in soil physics. If we get into economics, we may have to discuss his qualifications.

MS. FOSTER: I'm sorry, Mr. Chairman, if I might ask Dr. Neeper just one question. I didn't realize you were --

CHAIRMAN FESMIRE: You would like to take the witness on voir dire for a single question?

MS. FOSTER: Well, yes. Because he made the distinction between soil hydrology and soil physics. I just would like to know what the difference is.

CHAIRMAN FESMIRE: Why don't you ask him that one question.

MS. FOSTER: Thank you, Mr. Commissioner.

Dr. Neeper, if I might just ask you, since you did

make the distinction that you just made, what is the difference between a physicist and a soil hydrologist?

THE WITNESS: I'm not familiar with the term soil hydrologist, but I am familiar with the term hydrologist.

Hydrologists deal almost strictly with water, most often in the saturated case, that is, underground aquifers; sometimes in the case of surface water, with surface water hydrology, and occasionally in the case of the vadose zone with unsaturated hydrology. It's paying attention to the motion of water as it is characterized by large-scale average parameters such as hydraulic conductivity, diffusivity, and terms like that.

The physicist may get behind these questions and say, what is going on that causes us to have a big number like a hydraulic conductivity, and what is the microscopic action that's going on behind this, and what happens in the more strange and unusual cases than just water moving, as water has always moved?

So I have been paying attention, for example, in my recent career, to the motion not just of water, but of gas and how contaminants in the gas can dissolve in the pore water and the interaction between the two.

MS. FOSTER: Thank you.

CHAIRMAN FESMIRE: Does that answer your question?

MS. FOSTER: Yes, thank you.

CHAIRMAN FESMIRE: Dr. Neeper, why don't you continue. I apologize for the questions.

THE WITNESS: I welcome the questions. I think it was well put by Mr. Hiser.

What we are finding is that in the northwest, there are probably very few cases that would not qualify under the old rule. OCD pit sampling in the northwest -- and remember this is more restrictive because I haven't diluted it as much as the rule would allow -- there's nothing there that is approaching really the limitation of the existing rule. So we concluded that the purpose of this rule was to allow trench burial in the southeast.

Now, that's obvious at this time, but that wasn't obvious to someone who just only saw the change in the rule, not knowing what was going on. Many cases in the southeast would allow burial. Some of the sampling in the southeast came up with numbers that even if you adjusted them for 4:1 stabilization here still might exceed the standard.

And you say, "How can that be?"

If you look back at some of these numbers, you can determine, based on what you guess the pore water was, that the salt had been concentrated. That is, the samples probably actually contained some solidified salt. It might also have been from other materials in the mixture.

CHAIRMAN FESMIRE: Okay. Doctor, not withstanding

your 3:1 interpretation, but it looks like of the ten samples, three would not qualify for deep trench burial under the proposed standards.

THE WITNESS: Here's two that would not qualify. Here's one that's very close, and given the extra dilution that would be allowed, this one would have gotten in.

CHAIRMAN FESMIRE: But then the DPA7 soil sample would not qualify either, would it? The one under that?

THE WITNESS: This one, yes. This would not qualify and this would not. Okay. There are three.

CHAIRMAN FESMIRE: So three out of the ten in the southeast would not qualify on those samples.

THE WITNESS: Right. And when we look at the chloride over here, we can see here's the 213,000 mg/Kg. Mr. Hansen was showing, sort of, by his estimates, the limits of what could be buried when you measured it in terms of solid content of the soil was more like 244.

What we see is we're just pushing what you might possibly achieve. The rule is basically set so you can bury almost anything you would logically run into. Some of these might --

CHAIRMAN FESMIRE: Notwithstanding the siting requirements, right?

THE WITNESS: Notwithstanding the siting requirements; based only on the leach test, if you had no other

requirements.

But my argument is that most immediate effects are often on the surface of the ground where the plant and animals live. And you've heard me mention this before, the traditionally accepted objective criteria we've heard before has been at this number of 4 mmho/cm of electrical conductivity just because that's easy to measure, I think.

Where is that in terms of where we are today? We're not arguing the Pit Rule. We're talking about where we are today. Given my less than complete dilution standards, I interpreted it. The proposed standard would be a number greater than this. In other words, it would be equivalent -- I'm showing an amount of salt here versus electrical conductivity. Essentially, we would be several times the accepted standard.

If by the time you diluted it out to 3,000, you're about three times the standard for plants. Very little can live. In fact, 3,000 might be a good material for making a pickling brine. Another relationship of where this comes from is we had at one time argued a number more like 500 if you're measuring chloride and ppm soil. The electrical conductivity comes out somewhere maybe 600 on the average.

And the material we introduced before said measured against the species that have been measured, about half the species suffered something like half of their growth or

decreased the productivity by about 1/2 at that threshold. That's something of what the threshold means.

That doesn't mean that there isn't a plant up here that can't grow in saltier soil, but it's trying to tell you where this number comes from. It's saying a lot of species are affected by the time we're at that, and you're leach standard is several times that.

We've seen this before, but when we talk about the porosity and saturation of the soil, the water, again I point out, is held in little spaces between the soil particles unless the soil is totally saturated where all the porosity is full. And so it is the amount of salt that's dissolved in these lenses of water that count, because that's what's available to the plant. So if you have 50 percent porosity in the soil, but only 25 percent of the soil volume occupied by water, half the space is air, and the salt would be twice as concentrated as it would be if you had a full saturation of the soil.

That came into discussions this morning, and we will come back to it later. Here's properties of some typical soils. They run 30s to 40s, sometimes as high as 50 percent porosity. As I remember from the printout shown from the HELP model, 25 percent was used, and I meant to ask about that this morning. It seemed like a low number for soil averages. But if you get a 15 percent volumetric moisture, we would think of that as being moderately dry. Some of our plants would still

be growing in it, but it gives us kind of a peg point for what volumetric moisture is.

Once you get down to these kinds of numbers, 3 to 10 percent volumetric moisture or residual moisture, the water no longer moves from one grain to another.

The permanent wilt point is where most plants will die and not recover if exposed to water with osmotic pressure. It's usually expressed in terms of osmotic pressure, 1.5 MPa, and that corresponds -- the best I can make it up -- to something like if you had it on a soil basis 1,000 mg/Kg and 15 percent volumetric moisture.

What we're talking about in my terms are 3:1 dilution. For if the rule would allow 4:1 dilution for stabilization, you come up to something equivalent to 30- or 40,000 or more mg/Kg or so. The point I make is not which number is exact, but that you're way behind the permanent wilt point of the plant. Nothing is going to grow there for a long time until you clean that out, and salt cannot be easily remediated.

I did some simulations in preparation for the Pit Rule, and these, like simulations presented this morning, are one-dimensional unsaturated flow by using typical soil parameters. I used measured soil moisture rather than rainfall, and I also ignored colligative effect.

Why? I think it's appropriate for me to say now why.

In the year before the Pit Rule, I became fascinated with the movement of salt in unsaturated soil moisture. I spent a long time studying this, and, eventually, I developed in five pages all of the equations necessary to put in the code in order to do what I thought would be a reasonable calculation, taking into account the colligative effects.

My buddy who can run the code, certainly had -- or can monitor and change the code -- had no funding to put in any changes of the extent that it would take us another year, a year and a half, to work out and check. And so we did not get in colligative effects. I'm not aware of a suitable code that does have all the colligative effects, and that's why we'll need to return to that later today.

But our modeling at that time showed that chlorides moved preferentially downward in sandy or loose soils and upward in clay-like soils. And that's what I'm reminding us of. That kind of modeling started with a steady state based on an aquifer down here at some depth, 20 meters, and measured moisture at the top. And then starting with that profile as a natural profile of moisture in the soil, we inserted the waste and let moisture take its course, and we watch where the waste goes.

I include this chart, which you've seen before simply to say we did use measured volumetric moisture in the soil. We did, as best we could, parameter studies with a natural year

and with an artificially wet year where we took a couple pieces of other years and glued them together to make a wet year to do parameter studies and see what would happen.

We calculated several different soils. I'll show only two today, the two extremes; a loose soil where this shows the initial saturation from the aquifer, almost constant moisture in the soil up the point where we would have a pit. This is an unlined pit, and we show that it was highly wet.

In the right-hand graph, I remind you what happened as time went by. This pulse of chloride that was in the pit gradually moved downward, downward, downward, until it did go into the aquifer. The scale -- notice the concentration was 0:1. If you're using an inert tracer, as I understand the HELP model does, then it doesn't matter what concentration you have. You multiply everything by the initial concentration because it's just a number that's carried along.

When we went to a really tight soil, the moisture profile was different. The initial moisture profile from which we started and the movement of the salt was a different showing as time went by, quite a pronounced movement upward to the surface of the soil. And what you measure exactly on the surface depends on whether it rained yesterday or not. This number will jiggle up and down. But it does show that preferential upward movement.

Results of modeling was that the chloride could

travel from an unlined pit to groundwater in about 100 years. I would regard that as the same number as the 140 years that Mr. Hansen came up with this morning. In a tighter soil, it's much retarded going down, but it moved upward towards the ground surface.

What is the significance to today's consideration? We're not considering unlined pits. We're considering burial. We're considering burial of material with a concentration that's 12 times greater than what is allowed by the current rule, and that raises the threat level considerably.

Do these kind of models compare with reality? We did some field exercises to test. We went out and drilled in three locations. One of these locations was supported by industry, and what we found out in the Caprock was the chloride went past 15 feet total depth in pits that were 31 and 11 years old, respectively. Why the 15 feet? That's when I ran out of money to pay the drill rig. Incidentally, the groundwater under that site has about 3,000 ppm of chloride in it.

In Loco Hills, the two pits that were 30 and 6 years after closure we found the leaking edge of chloride 25 to 30 feet down, and one of those pits was lined. So is trench burial secure? This is still coming back from things we thought about in the Pit Hearing.

This is a 12 mil liner. I put a very rounded stone on it with the tip of a ball-peen hammer and gave it a little

smack with another hammer. It was falling at about 1/3 the velocity of rock or something else that would be falling if dumped into a burial unit from above the surface of the ground by a backhoe.

In other words, this was a light tap. We broke a hole in it. This is a 12 mil liner. I used two 12 mil liners, and we didn't penetrate. We just distorted and crunched the liner. Two 12s are not the same as one 20, because with one 20, you have one scrim. With two 12s I had two scrims, so it was quite a bit stronger.

The conclusion of this is with our 20 mil low density polyethylene liner, we are right on the edge of where a tap like this can poke a hole if you have a cavity of some kind behind it, or if you have something sticking up and something else falls down around it. You can't guarantee that there's never going to be a hole poked in it.

But we find -- we're now saying, well, this trench burial has to be secure for thousands of years. Could a closed trench subside? This is one of the old pits closed 30 years before this picture was taken where I was out one year sampling and saw nothing. I came out the next year and saw something unusual. I put up a jug beside it. And what had happened was apparently the pit has subsided and groundwater was now going right down into this hole into the pit. So you can have subsidence.

Economic context, which I understand my colleagues will wish to argue with, I will acknowledge I am not an expert in economics. I will simply put up numbers that I find in the literature, and I bring them to the attention of the Commission, and the Commission can decide whether or not my arithmetic is appropriate. I can do arithmetic. I wanted to know why this came up.

This is the Governor's press release. And it says -- here there were many questions yesterday of did anyone meet with the public? Did anybody meet with someone else? This says the Governor personally met with leaders of the oil and gas industry as well as oil patch legislatures. So these were the meetings that are behind our considerations.

The Governor went on to talk about the price and state that these changes will be proposed for economic reasons. So all I'm establishing in the record of the hearing is that we are considering economics, and I think environmental people should consider economics. Our concern with economics is that they need to be considered in context.

If we're going to talk about economics, let's have the books on the table. Let's see the profit and loss of the industry. Let's see what it costs to drill a well. Let's see what it costs to put in the infrastructure. What fraction of the capital cost of a well and it's associated infrastructure is represented by the cost of the disposal of waste? That is

the context for economics. I welcome that discussion should it occur.

The only cost analysis I could find in the literature was provided in a memo by the secretary. We understand the secretary requested this rule change. The secretary's number provided annual cost savings range to implement on-site burial over waste excavation in the southeast as $3.3 million to $14.1 million annually.

As I say, economics must be discussed in context. The only context I, as an amateur or a member of the public, can find is the revenues to the State from oil and gas production published by the Energy, Minerals and Natural Resources Department. I put this up for about five years. We notice that 2003 was close to half of what was going on in 2007. So certainly these revenues vary, and in some sense, these numbers are proportional of the revenues of the industry.

If I consider Ms. Prukop's $14 million savings, I'll point out that if I go back to 2003, that would be equivalent to about 1 percent of the taxes collected by the State from the industry. I would, therefore, make a rather rash statement that if the State really wished to help the industry economically, and specifically in terms of waste handling, it could do so with a remediation of about 1 percent of the taxes that it collected in a year that was about half as good as 2007. That's the comparison.

I will go ahead and show that the well is completed and revenues are curves that fairly well track, is not that wells completed generate revenue; they don't. Wells completed are risks incurred by the industry. It is that wells completed are proportional to the same price that drives revenues. If it's worth drilling, drilling occurs.

My conclusions from this --

MR. HISER: This would be where I would interpose the objection, Mr. Chairman. Because this is not a statement of fact; it's a statement of opinion as to whether or not there is economic justification.

MS. BELIN: Mr. Chair, Dr. Neeper has stated that when he's talking about economics, he's not talking as an expert soil physicist, he's talking as a lay member of the public, and those are his assessments as a lay person.

MR. HISER: So stipulated. I have no objection.

CHAIRMAN FESMIRE: Thank you. Because I didn't know what to do with that one.

THE WITNESS: I will assist and I will say that is my conclusion. Not meaning it is an expert's conclusion.

CHAIRMAN FESMIRE: Thank you, Mr. Hiser.

THE WITNESS: There's a typo in there. There's a 13; that should be a 12.

Therefore, we did submit some suggested modifications for the modification language. One is that trench burial is

allowed dependent on the depth to groundwater. But if I dare say it rashly, OCD doesn't have good information on the depth to groundwater. There are some charts that with interpolations there are things put out by the geologic survey. But, in fact, it is known where the groundwater is on the site because if you're drilling a hole, you've just drilled through it if it's there.

Now, that gets into a sticky problem you might have because if you say you're drilling to install a monitor well into the aquifer, the State Engineer might want to have some jurisdiction, I understand. So I tried to make wording that would not incur the wrath of the State Engineer. This is why there is circumlocution in this wording.

I suggest, "An operator who closes a drying pad or temporary pit by on-site trench burial shall determine the depth to any soil or rock saturated with water" -- I did not say groundwater. I did not imply anything about beneficial use -- "or delivery of a well within 200 feet below the ground surface" -- that gives you some room for whatever depth you want to bury it -- " and record that depth on or with the drilling log."

He didn't have to report it anywhere. He didn't have to tell anybody. But if a controversy arises and the OCD inspector wants to know, the record is there, and everybody will know, and we won't be arguing over that fine point. I'm

just trying to solve arguments.

And Mr. Fesmire suggested in a comment that if this is an economic relief, then it should have some form of expiration. I, therefore, suggested we insert a clause that says prior to June 16, 2011. That is, the new standard holds until that date and does not exceed 250 mg/L after that date.

That concludes my direct testimony, Mr. Chairman. And I would at some point like to use a rebuttal-type testimony because it would need new figures in order to deal with the kinds of issues we were dealing with this morning.

MS. BELIN: Yeah. As Dr. Neeper says, he has rebuttal testimony. I don't know if you would like him to proceed with that now, or if you have a different procedure for that.

CHAIRMAN FESMIRE: Why don't we go ahead and have him -- and it's limited to his areas of expertise, right?

MS. BELIN: I believe so. You're just talking about -- you're not talking about --

THE WITNESS: I believe it's all within my areas of expertise. And since some of these slides were prepared this noon, I do not have printed copies. I apologize for that. I can make the files available to the industry and counsel immediately.

CHAIRMAN FESMIRE: Do any of the parties have an objection to continuing with Dr. Neeper's rebuttal testimony?

MR. CARR: No, I do not.

CHAIRMAN FESMIRE: Ms. Foster?

MS. FOSTER: I do not. Are those files in digital format? Because I can just throw it up on the computer.

THE WITNESS: Yes. I can give you my thumb drive, and you can copy it directly into your computer. In fact, you can do so right now, if you wish.

MR. BROOKS: Mr. Chairman, the Division has no objection; however, we would request that Dr. Neeper provide printed copies at some point in case we have to prepare a record.

CHAIRMAN FESMIRE: Okay. Ms. Belin, why don't you go ahead and proceed with the rebuttal portion of the Doctor's testimony.

MS. BELIN: Did you want Dr. Neeper to give you the drive before he testifies?

MS. FOSTER: No, that's fine.

MS. BELIN: Okay. Why don't you go ahead with your rebuttal, Doctor.

THE WITNESS: I'm going to need the owner of this computer to help me get out of here and get into somewhere else because it's not behaving like my computer.

REBUTTAL EXAMINATION

BY MS. BELIN:

THE WITNESS: The testimony this morning considered

the use of the HELP model to develop an estimate of the bottom discharge from a lined trench, and then subsequently to use the MULTIMED model to follow that discharge, or 50 years' worth of that discharge, as to what happened to it in the next couple thousand years.

This headline was copied from the documentation that goes with the HELP model, and the last page of that documentation includes these particular references. Here are three rather lengthy technical papers in the literature, and here is one that's of similar length.

You notice these go back what looks to us like a long time, starting in 1989. These people laid the foundation for the equations that become the assumptions or the techniques or the calculational methods within the HELP model. This is kind of where it comes from.

And so to see what's going on in that, you can go back to these papers, if you wish. This is available to everybody because the lead to this was in Mr. Hansen's pre-hearing papers. I will, for short, call them G&B, but from paper part one, they say, "A liner is a low permeable barrier used to impeded liquid or gas flow. If there was or were such a thing as impermeable barrier, it would be possible to prevent leakage."

What they're getting at is there isn't any liner that isn't going to leak somehow, so don't be surprised that there

is some leakage. They go on to say none of the materials presently used in civil engineering to line large areas is impermeable. I, therefore, say the Commission should recognize that all liners leak to varying extents. That's why many hazardous waste landfills have a double liner in which the second liner is designed to capture the leak from the first liner and to pipe off that leak to put into a container.

OCD has performed a straightforward modeling exercise. And I do not, either by my cross-examination or my testimony, impune the professionality of those people. They did what they could in the time they had available, and they used a standard model that's adopted and out there.

They, however, could treat only one unique set of reasonable, but not fully illustrative, parameters. They did not explore the parameter space. They plugged in one set of condition and said on that, we will base a rule. In their single model, which represented a so-called "good" installation. The trench burial leaks approximately 2.2 millimeters of water per year. That's as though it were flowing in one layer, the layer would be 2.2 millimeters thick. That's what it is meant in hydrologic terms.

And "good" is a term that the witness said, yes, that's a technical term in the assumption of the software. That's what you tell us what this is: Good. All right. That amount of leak sounds small, but how much is it? If your

trench bottom is 160 square meters, then the leak is about 2.2 barrels a year. In less than two-and-half years it becomes a reportable release. Nobody's going to report it, but that's what we mean.

OCD's Exhibit 8 suggests that the 3,000 mg/L standard is equivalent to 240,000 mg/Kg in the initial pit sample. I say that's right, but what does it imply? We had a big discussion this morning and we got all confused, so I've tried to make this as straightforward as I can so we understand what we're talking about.

Let's do a thought exercise. If we start with a quarter liter of sample material from the pit and we add clean soil 3:1 to make this one liter -- this is now what the rule allows -- we then leach that with 20 liters of water and the yield is 3,000 milligrams of chloride in every liter of the water that comes out. The total chloride extracted is 60,000 milligrams.

And that's where this number 60,000 comes from. It comes from a quarter liter volume of original pit sample. So if one liter of pit sample weighed crudely one kilogram per liter, you multiple that by four, you get the 240,000 mg/Kg of soil that Mr. Hansen expected.

If the trench material were 25 percent porous -- I believe that was his number -- and if all the pores were filled with water, the pore water would have 60,000 milligrams in a

quarter liter full of water. And that's the kind of stuff that's draining through, unless it's possible for leak water to have a concentration greater than 20 times that of the extract. By extracting, we diluted it down by 20 times. This is why it's possible to have 60,000 or even greater in the concentration coming out in the leachate.

We want to remember the saturation limit of water is about 212,000 milligrams of chloride per liter.

CHAIRMAN FESMIRE: That's the surface temperature, isn't it?

THE WITNESS: I can't remember the temperature of where that is, whether that's a 15- or 20-degree centigrade.

The OCD modeling has predicted that the waste with the proposed concentration will contaminate the aquifer beyond use in approximately 140 years with a good liner -- obviously, I have no argument with that. That's essentially the same number I calculated -- and in 2,000 years, with very little liner.

So our question, then, is not whether such burial will contaminate the aquifer. The questions are when it's going to occur and whether or not the ground surface will be contaminated.

For question one: When? What I'm trying to show is the model is unrealistic. It does not correspond to reality.

For number two: OCD acknowledges they have no

answer; they didn't think about it.

So there are faults with this double model system of the OCD. Upward transport was neglected. This might be the most immediate and most damaging effect of multiple burial units scattered around the land. Modeling the downward release from the trench neglected the variability of soils. They did not use realistic estimates of installation defects in the trench liner. It neglected the effect of multiple burial units on the same aquifer.

I'll get back to this estimate of installation defects. This is key. The model propagation of release neglected the dominant dynamics of moisture diffusion into the plume due to the reduction of vapor pressure by salt. This is that colligative effect I was talking about. The model, therefore, artificially increased the delay of contamination arrival at the aquifer.

Let's go back. Why do I say this? There's a large and significantly -- significant literature on the calculation of leakage from landfill liners. I uncovered this liner starting with the material provided in Mr. Hansen's testimony. This literature documents the release from burial units of varying quality in various situations, and it shows you can't predict the result by one simplistic calculation.

For example, a leak rate varies greatly with the liner and the underlying soil. If you have a liner with a

fault in it, and you have clay immediately under that and pressed hard against the liner, the leak will be greatly reduced. You'll have a better situation with either a liner alone or the clay alone, and that's why people make smooth clay and roll liners onto smooth clay.

The modeling neglected the variation of soil matters. A reasonable porosity range might be .25 to .5, and hydraulic conductivity varies by factors of ten. Now, the situation isn't so simple as just multiplying an answer by a factor of ten. This is from the HELP literature; it's from the engineering documentation from HELP. Their porosity for the varying soils they show is usually around .4, but there's a variability -- there's a large variability in field capacity and quite a variation in hydraulic conductivity.

Mr. Hansen used the hydraulic conductivity somewhere in the middle of the 10^{-4} range. That's reasonable. It's right in the middle of everything. He wasn't kidding anybody. But the range over which you can expect to find things is here, and you need to explore that kind of range when you are looking for the broad impact of a rule.

Q. (By Ms. Belin): When you say "here," could you just for the record say --

A. Let me get my arrow back. Somewhere between the 10^{-2} and 10^{-5} range. These are some impervious soils that range from fine sands over to well-sorted sand down to loam. You

might have some clay or peat.

So a range of the soils that we experience in everyday life are in this range. And you need to -- doing a systems study, you need to explore the range of things. Why do I accent hydraulic conductivity? It's because it's a feedback mechanism. This plots hydraulic conductivity as a function of water fraction of soil volume just for two characteristic soils. And what we see is as you add water to the soil, the conductivity increases greatly.

So if you change the saturated conductivity, THE conductivity that occurs when the soil is full of water, you've changed the conductivity all along. You've changed the characteristic of the soil. As you begin adding water -- and if water flows faster and you get more water in the soil -- that increases the conductivity, and the water flows even faster.

So you can't sit and do one pencil and paper calculation on the back of an envelope and come up with what the answer is going to be. You have to model. That's why it's done with computers. But what we notice is if, say, for this soil we just double the moisture in the soil, you've changed the hydraulic conductivity by a factor of a million. And that would change your problem.

Suction is the energy by which water is bound to the soil particles, those particles I pictured a little while ago.

The energy or the binding of the water depends, again, on water fraction we have in the soil volume. I show it here plotted for sandy soil and clay soil, and other soils will be in between. But what you see is the binding of water to the soil. Again, varies over a range of interest by at least a factor of 100. How can that affect us? We'll get back to the colligative effect. But the presence of salt will alter the surface tension, and surface tension is what's doing the binding.

Landfills and trenches are not the same. The HELP model is really designed for landfills. We heard this morning, particularly from Mr. Hiser, a landfill often has a drainage layer, a high permeability layer, say, sand on top that is sloped. And when moisture gets in from the surface like rainfall, it gets drained off.

Often under that there's a layer of clay because the plastic liner on clay is much better than either the plastic or the clay alone. Then there's the waste. And, finally, usually on the bottom, you have again a drainage layer which leaves anything that gets through into pipes where it's piped off to be collected in some collection system, and then a secondary liner.

This is typical of a hazardous waste landfill. What we're considering is a trench where the sidewall is probably as high, maybe higher than the width of the trench. The liner is

wrapped around it. The liner is wrapped across the top. An additional liner is laid across the top. There may or may not be in imperfection on the bottom through which water can drain. There may or may not be imperfection in the top. There may or may not be an imperfection in the sidewalls. We don't have nice smooth sand or nice smooth clay that's been rolled on which to put our liners. We have whatever happened when we dug the trench.

Why do I say that? Why did I ask this morning whether one could get inside and inspect a trench? When I was in charge of a crew -- let me back up. When I was in charge of a crew doing investigations of these kinds of things, I had OSHA training that told me that I could not put my people in a trench unless the sidewalls were shored.

And one of my colleagues had his people in one when an inspector came and all kinds of trouble occurred. He has his people yanked out. It turned out he was right because he was in solid rock and he had it engineering-approved not to need shoring. But, in general, with alluvial soils, you've got to have sidewalls.

All right. Vapor diffusivity of the membrane, the sidewalls, the HELP model neglected it. There's nothing you can do. There is vapor diffusivity in the membranes. I'll toss that aside in a minute.

We talked about the density of pinholes and the

density of defects and installation quality. The words, as I can get them out of the HELP literature, are:

"Perfect" meaning you have actually sprayed a liquid seal on the walls and made a liner with the straight-on liquid seal.

"Excellent" means contact typically achievable only in the lab.

"Good" means prepared smooth soil surface and wrinkle control. Note the wrinkle control. I don't think we can do that in trenches, particularly with sidewalls.

And "worst" means contact between the membrane and the soil and does not limit the drainage rate. In other words, that means wrinkles.

I think more reasonable for us would be worst cases. Vapor transport through the sidewalls of the trench -- you don't need to read it -- this is where I thought the biggest problem would be. We have large sidewalls.

MR. HISER: Mr. Chairman, considering that we qualified Dr. Neeper in soil physics and we're now going through the technical distinctions of liner construction and liner materials and all that, I think we're a little bit afield from what he's qualified in.

THE WITNESS: Might I re-qualify myself?

CHAIRMAN FESMIRE: Well, let's see if Ms. Belin can qualify you.

MS. BELIN: I was going to ask Dr. Neeper -- may I ask him his experience and basis of his knowledge of the topics that he's just been talking about?

CHAIRMAN FESMIRE: You may. And what are we call this field that we're seeking to qualify him in?

Q. (By Ms. Belin): Well, do you know what the name --

A. Operable Unit Project Leader for a RCRA facility investigation.

Q. RCRA facility expertise, I would say.

CHAIRMAN FESMIRE: You ought to have seen the look on your face.

I'm beginning to think that Mr. Hiser has a pretty legitimate objection here.

MS. BELIN: Might I just ask Dr. Neeper to set forth what the basis of his expertise in this area is?

CHAIRMAN FESMIRE: Okay. That would appropriate.

THE WITNESS: Mr. Hiser is correct because I had one time planned to put this in the qualifications, and I slipped that by. It is in my -- in some previous papers that are probably filed here -- at one point, I was the so-called Operable Unit Project Leader for a RCRA facility investigation of a site, very large site, contaminated with hazardous and radioactive waste, both vapors, liquids and solids.

For that job I had to go through the OSHA training.

I had to go through hazard waste operations training. I had to be able to wear a level -- what is called a Level Class A protection -- which means you are in a moon suit on a tank to breathe because it's assumed you're handling stuff so dangerous that you can't do that. And I had to supervise crews to be sure they met whatever requirements we were going to get into.

CHAIRMAN FESMIRE: How did those requirements compare to the requirements you're proposing in the rule?

THE WITNESS: The relevance of that to the rule simply has to do with the trench. And where my expertise comes in is when I'm talking about the vapor transport -- at the moment -- into the trench. And vapor transport -- subsequently I'll talk about vapor transport into the descending plume of liquid. Both of those are entirely within my expertise in soil systems.

CHAIRMAN FESMIRE: Okay. Doctor, why don't you make that as quick as possible, because --

THE WITNESS: This was intended to be quick. It was a giveaway to the industry.

Vapor transport through the sidewalls of the trench is not the problem. And I spent a week figuring that out thinking that was the big problem. It is not.

CHAIRMAN FESMIRE: Mr. Hiser, we'll note your running objection to this part of the presentation.

Doctor, go ahead and proceed.

THE WITNESS: I provide a quote out of the HELP literature. One hole per 4,000 m^2 -- make that an acre -- should be considered a hole size of 1 cm^2 recommended for calculations conducted to size the components of the lining system. If you're designing a rule, you're trying to size components.

The above hole size frequency has been selected with the assumption that the intensive quality assurance monitoring will be performed. A frequency of 25 holes per hector or 10 holes per acre or more is possible when quality assurance is limited to an engineer spot-checking the work done. I will leave it, then, to other authorities as to whether an engineer will be down in the trench spot-checking.

Materials have improved since this was written. Our materials are better than this now. But I say there's a realistic suggestion I would make. The one-dimensional model assumes you have a large area, and it averages whatever leakage you would get from one hole per acre into the output of this large area. I say it would be realistic to consider you might have one hole per trench.

I think what the model does is say you have one hole per acre, as we heard this morning. And if the trench is 1/25 of an acre, it then just calculates at 1/25 of a hole, which is not realistic. You either have a hole or you don't.

So what is a hole? This is from the literature, G&B

original literature. For a 2 millimeter hole, their leakage rates with .01 foot of head on it -- which is what Mr. Hansen used this morning, a thin film of water -- is 40 liters per day. It's amazing a hole can transmit that much. That is what's back in there.

Now, if that 40 liters is scattered over an acre, you won't hardly notice it. But if you have a 160 square meter trench bottom, this is equivalent to 3.5 inches per year of infiltration, which is larger than the .09 inch per year of the OCD model. I'm not telling you 3.5 inches is what's going to leak. What I'm telling you is you have the answer. The modeling has not been done correctly.

There was discussion of whether a decayed liner would provide some continuing protection. The answer is no. Because one small hole in the liner at the kind of flow rates we are considering can induce a flow larger than the total leak calculated by OCD. A slightly damaged liner or a liner that has degraded in time might thereby provide you almost no protection. The analogy to this is a small hole can drain a bucket if the bucket is not being filled up faster than the drain leaks out.

Can a trench liner be intact? I'm quoting the literature. It may seem appropriate to use a geotextile cushion between the membrane upper component and the lower permeability soil. By that he means the soil underneath the

liner, composite liner, which means he's got clay under it.

I'm quoting the literature here. And he says, "Lateral flow in the geotextile increases the rate of leakage."

Why am I concerned with this? It's because our rule says if the bottom of the trench is irregular, you should put down a geotextile. That's in the rule. That's probably good practice, but bear in mind it means it's going to increase the leakage.

Why am I concerned? If I look at a trench being dug, I see there are rough edges, rough corners, and I see the materials that come out of the trench, and I say the bottom of the trench is going look something like this material, and it's rough.

This is not a burial trench. This is just a drilling trench. This is here to show that when the ground is irregular, you get stresses on the liner, whatever kind of liner it is. Those kinds of the stresses in the sidewalls where you have vertical sidewalls can lead to tears.

When the task force called the Geotechnical Institute and asked questions about liners, I asked the question: What about the durability? What about the lifetime when a liner is stressed at a point such as I point out here?

The answer was, "Oh, that's entirely different."

That's as much an answer as we got. Sometimes dates aren't perfect, I point out, when you're burying. You are

likely to have a wrinkled liner and, therefore, a hole. It's not backed up by a carefully laid layer of clay as it would be in a constructed landfill.

Well, why worry about this when, if we weren't going to worry about 250 mg leak standard, why worry about the 3,000? It's because the integrity of the liner is more than 12 times as important when the concentration is increased by a factor of 12. And that's because of the increased salt concentration actually increasing the rate of transport of chloride to the aquifer.

How can that happen. I mentioned before there are these colligative effects, fluid properties, that change when the concentration of the salt changes. What changes? The surface tension increases; that increases that potential. For those who deal with potential for 60,000 milligrams, it's equivalent to 83 bars or 2700 foot head of water. That isn't a thing we usually deal with. It's amazing.

Vapor pressure decreases, which is the thing we are considering now, and the viscosity increases, and the density of the liquid increases. As the density increases, it tends to flow faster because it's flowing under gravity. All of these effects interact together, and you can't come up with a simple answer with a back-of-the-envelope calculation. You have to do the modeling.

This is a complicated problem. You don't need to

really understand the graphs. What I'm trying to demonstrate is I have some expertise in this. I spent months on this problem. The water vapor in the soil actually diffuses faster in the soil than it does in the air. This is called the Philip-deVries enhancement, and that enhancement actually increases with the salt content. If you naively take some number, you could say, "Oh, it's running 20 times faster."

You have to work out the whole problem, as Mr. Hiser pointed out, including those engineering numbers like the porosity and the tortuosity and whatnot to come up with a more realistic factor which is going to be somewhere near three kinds of saturations we deal with in the salt.

I take that out off my own notebook from whatever year it was, 1907 -- 2007 -- to illustrate --

CHAIRMAN FESMIRE: It sure took you-all long enough to argue with him on that one now.

THE WITNESS: Okay. To illustrate, you have to be careful. If water vapor is trying to diffuse across here, it needs only come to this point and evaporate another molecule from that side. And that hops over here and evaporates from that side. And that's why water vapor goes faster in the soil and than it could in just straight air.

Let us consider that you have a slug of water moving down from the trench burial unit. It's 60,000 mg/L, and it's moving down very slowly, 2 millimeters per year. This is one

way to picture it. We have vapor diffusion coming in because the vapor pressure is lower in here due to the salt.

So I draw off a square meter here in my imagination and I back off and say -- for doing back-of-the-envelope, I'll say it's coming from 2 meters away, that we've kind of extended this gradient out 2 meters. The estimated flux to the face of that plume, I come up with about 1.4 kg/m^2 per year.

Well, if you have a plume that's 40 meters by 4, something like the size of a burial unit, the addition to the plume from two faces -- neglect the ends -- is about 458 kg a year. Is that right? No. That's a back-of-the-envelope number.

But what it tells you is this number is bigger than the total downward flux. It tells you you have a big effect from doing a back-of-the-envelope calculation, and you should, therefore, pay attention to it. It is difficult to do this modeling, I admit. OCD was not neglectful.

MR. HISER: Mr. Chairman, for the benefit of those of us who are not in Dr. Neeper's head, could you have him specify what is it that's fluxing and being added since it doesn't state on the slide?

CHAIRMAN FESMIRE: Doctor, would you be so considerate as to elaborate on that?

THE WITNESS: I simply don't under the question, but I would love to elaborate. The trouble is, I love too much.

Never ask a scientist about his work. He'll talk all night.

MR. HISER: I guess I'm just trying to figure out if you're taking about water moving in or salt or what it is that flux is.

THE WITNESS: The flux is water vapor moving toward the face of the plume --

MR. HISER: Thank you.

THE WITNESS: -- and condensing in there because it is being sucked, essentially, by the saltwater in the plume. The saltwater in the plume would just love to grab more water, in a sense, when you go into these kinds of concentrations.

Conclusions: Diffusion through the membrane is negligible, and that includes the walls. Diffusion into the plume below the trench will have a dominant effect on the motion of the plume because it adds liquid. You add liquid, you get it more saturated. That's raising the hydraulic conductivity, and it moves faster. It dilutes the concentration but it greatly increases the speed.

The MULTIMED model, the thing that treated this problem down below the burial unit neglected this major dynamic of chloride transport below the trench. It had no choice.

So we're back to a review of what did I consider to be defaults. We lost the upward transport. We didn't model the downward release in a variety of circumstances so we could see the general pattern. And finally, we neglected the

dynamics that are caused by this high concentration of salt in the water.

Q. (By Ms. Belin): When you say "we," are you referring to OCD? Or who are you referring to?

A. That's careless of me. It's the imperial we. It would say the body as a whole or OCD neglected it in the proposal of the rule. These things were neglected is the best way to say it.

Q. I have just a couple more questions, Dr. Neeper. Dr. Neeper, do you recall asking Mr. Hansen about any problems relating to burrowing animals or gophers?

A. Oh, yes. That question came about because of the result of my experience on hazardous waste landfills; in this case, a radioactive waste landfill, which was made very nicely and enclosed with these nice little humps so the water would drain and with clay layers underneath the soil. And all around were holes.

Whoever the burrowing animals were, gophers, there were just holes everywhere and around the holes were white. And I asked the guy in charge of the site, "What's the white stuff?"

He said, "That's the clay. They just love to dig that up."

Well, I walked around the edge and, eventually, the water drained off to one side. It came down the one hole and

went into the hole. A good part of the site was draining right down into the pit, disposal pit. So it's made me a little questionable.

Once we create a nice place with nice soft soil, it may be that burrowing animals wouldn't just preferentially love it. They sure did in that place.

Q. Also, did you ask Mr. Hansen about the reply of Dr. Coyner of the Geosynthetic Institute regarding the longevity of a stress point in the liner?

A. Yes, I did bring that up. Maybe it wasn't clear. But Dr. Coyner had just said, under stress, that's a totally different circumstance in terms of figuring the lifetime.

Q. Is there anything else you want to say by way of rebuttal?

A. No. I think that concludes my rebuttal testimony.

MS. BELIN: Mr. Chair, I'm sorry. I'm also going to have to leave. But, obviously, Dr. Neeper can handle whatever questions come his way.

CHAIRMAN FESMIRE: Okay. Why don't we go ahead and take a 13-minute break and reconvene at ten minutes to 3:00.

[Recess taken from 2:36 p.m. to 2:54 p.m., and testimony continued as follows:]

CHAIRMAN FESMIRE: Okay. Let's go back on the record. Again, this is the continuation of Case No. 14292.

The record should reflect that Commissioners Olson, Bailey, and Fesmire are all present. We, therefore, have a quorum.

I believe we were about to start with the cross-examination of Dr. Neeper by Mr. Brooks. Mr. Brooks, do you have any questions of Dr. Neeper?

MR. BROOKS: I do, Mr. Chairman. Because of the lateness of the hour, I'll try to make it as short as possible.

CROSS-EXAMINATION

BY MR. BROOKS:

Q. Good afternoon, Dr. Neeper.

A. Good afternoon.

Q. I'm going to ask you a number of questions on your initial presentation. With regard to your rebuttal presentation, we can probably appreciate it was difficult for to prepare it since you had only a week after you got our materials. But whatever cross I had to come up with I had to come up with in 15 minutes after I saw yours.

A. Will, I spent most of that week calculating that indeed the vapor transport to the walls of the trench through the membrane is insignificant.

Q. Well, we're glad to hear that.

Now, you didn't say a lot in your presentation this afternoon about upward movement. You did allude to it, but there's a lot in your materials about upward movement, correct?

A. Yes. What's in my materials really stems out of the first Pit Hearing.

Q. And the first several -- a number of the slides in the first several pages seem to be devoted to the proposition that at a salt concentration of 3,000 mg/Kg, plants won't grow, right?

A. That's correct.

Q. But, of course, you do understand that we're talking about 3,000 mg/Kg of waste that is buried under a geomembrane liner, not in the topsoil itself?

A. That's certainly correct.

Q. And --

A. May I elaborate on that?

Q. You may.

A. The point of this being that if you have buried a concentration that is greater than what the surface life, living surface, can tolerate, it's possible you can damage the living surface. If what you were burying was below the threshold for damage to the surface, then I probably should worry about it because it's only going to get less as it moves towards the surface.

Q. Correct. Now, you would certainly agree that the geomembrane liner over the top of the trench will retard whatever upward movement might occur.

A. Oh, it certainly should.

Q. And you also understand this is under four feet of soil on top of the geomembrane liner.

A. That's correct. That's required by the rule.

Q. Right. Now, in the previous Pit Hearing, as I recall, you said that your studies, your modeling, that you did on the upward movement did not take into account of what was going on in the top 20 inches of the soil cover; is that correct?

A. That is correct for a reason.

Q. And that is still true of what you are representing to us today, correct?

A. Because what I'm representing to you today comes from that. It is that same day, that same graph, same --

Q. That's what I assumed was the case, and I just wanted to clarify that.

A. The reason for that 20 inches is not total neglect. One can put in rainfall and then try to deal with whatever happens to the rainfall, as the HELP model does, and that's guesses and correlations put in and averages.

My way was to take an actual measured number of the moisture of the 20-inch depth and let that drive the problem. So it was a way for me to use measured data to drive the problem.

Q. Okay. And then you go over here on -- well, your slide number 16, you compare the extent of upward movement in

sandy loam. And in your slide number 17, you compare the extent of upward movement in clay soil or tight soil, correct?

A. Yes. For the purposes of this hearing, I just took the two extreme examples out of the previous hearing.

Q. And in the sandy loam, it looks like at ten years you're showing it will be a little bit of upward movement, but you don't show anything at depth zero, which would be the surface; is that correct?

A. Depth zero in this model is the 20-inch depth.

Q. Okay. But you show a little bit of upward movement at ten years, but you don't show it going up to depth zero, which is 20 inches, you say, below the surface, if I read this graph correctly.

A. Yes. The red line at one year you see some --

Q. Oh, I'm sorry. I was reading the red line as ten years.

A. Yes.

Q. I'm sorry.

A. And this is because when you have a low amount of chloride coming up, it'll wash back and forth with the rainfall.

Q. Yeah.

A. So what you see when you take a snapshot at the end of the year, it may have been washed down or may be washed up.

Q. These graphs are based on no intervening liner; correct?

A. Theres's no liner.

Q. But in ten years -- ten years is the green line, right?

A. Ten years is the green line.

Q. At ten years in the sandy soil, there won't be any -- you show no salt above the top of the waste.

A. Yes. And as I can tell you, that can go up and down.

Q. And you get out to 40 years, which is your gold line, and -- or yellow line -- and that salt has gone on down below the bottom off the waste. You don't show any coming up.

A. Right.

Q. Okay.

A. The result that you take from that is that in those conditions, predominantly your motion is downward.

Q. And at least the way you show it here, it's never going to get to the surface because it doesn't even get to the 20-inch level.

A. Well, you may see some intermittently at the surface, and then you'll see it disappear again. I've personally observed that. I've seen white salts accumulate on the surface, and the rain comes, and it goes away.

Q. Okay. Now, you go over to your clay salt. And,

of course, there you show most of the salt coming to the surface over a lengthy period of time.

A. Well, most of the salt. It's not a large faction of what might have been in the original pit, but it is a significant concentration of salts.

Q. It goes quite high on your --

A. It becomes even more concentrated than it was in the pit.

Q. Your 40- and your 100-year graphs. Again, this is no liner --

A. No liner.

Q. -- between the waste and the surface?

A. That's correct.

Q. Now, Dr. Neeper, I assume you're quite familiar with New Mexico soils; is that a correct assumption?

A. I don't think you can say that I am an expert on New Mexico soils. I don't deal with soil mechanics. I haven't been out studying all the various horizons of soils in New Mexico, no.

I'm familiar with what we might find in terms of moisture potential in different areas of the soil. That's a physics problem. So you'll have to get to your --

Q. So my question is, as a broad generalization, do not the sandy soils predominate in most places in New Mexico?

A. I cannot answer that. I can only give you my

experience. I walk around the southeast and I find a lot of limestone.

Q. And limestone you would characterize how?

A. It's hard, thick stuff. It probably has most of it's transport by preferential pathways through fractures. You move off the Caprock, and you will be in quite sandy surface soils. But what's below those sands near Mescalero sands, I don't know.

Q. Okay. Thank you. And you did not do any modeling work on upward movement through a liner; is that correct?

A. I didn't do any modeling through liners. And one short week or less of preparation for this, I looked at the literature, numbers of penetration of liners, liner faults, by liquids. And I looked up the diffusion of vapors through liners, which can give you frightening results if you happen to get the wrong numbers.

Q. Well, going then to your slide numbers 20 -- or slides 19 and 20 -- where you talk about your empirical work.

A. Okay. Maybe for the audience -- there are copies of that testimony up here. But maybe we should get this up on the screen.

Q. That's fine.

A. Would that be helpful?

Q. That would be helpful.

A. The second testimony is up here.

Q. I thought I remembered you having pictures of these empirical locations, but that must have been in the presentation of the prior case.

A. In the original testimony, I had pictures of the locations. I saw no need for --

Q. Okay. You said in the Caprock you looked at two pits, one of which had been closed 31 years and one 11 years; is that correct?

A. That's correct if that's what's on the slide. Which slide is that?

Q. This is page number 20.

A. I don't want to verify something unless I'm looking at it. All right.

In the Caprock, I said the pits were 31 and 11 years after closure at the time I was doing the sampling.

Q. Okay. Did you indicate that you saw no evidence of a liner in the older of the two pits?

A. I'm trying to picture which pit was which. On the Caprock, one of them -- and I think it was the 11-year pit -- had a liner, and the liner had been destroyed and was coming up out of the ground. The other pit there was no evidence of a liner.

Q. And you don't actually know in the one where there was a liner, how that liner was constructed; is that

correct?

A. You may be -- are you sure that you want to talk about the Caprock? Because in the Loco Hills, there was a definite lined pit that was known to have been lined by history of the people who did it, and the nature of the closure was known. Is that the one you're talking about?

Q. Which one was this? Was this the Caprock or the Loco Hills?

A. That's Loco Hills.

Q. Okay. Well, I was talking about the Caprock.

A. Okay.

Q. And my notes, which were taken from your previous testimony, indicate that you said there was evidence of liner material, but you didn't know how the liner was constructed.

A. I will have to go back to my notes that I took in the field and see what I saw. We did continuous coring, but I don't remember.

Q. Now, in the Loco Hills, you had looked at two pits, one 30 years -- one had been closed 30 years, and one had been closed six years.

A. Yes.

Q. Okay. Now, the older of the two, did it have a liner? Did you have --

A. No. My memory is that it was the younger one that had a liner.

Q. Okay. And you said in that one you had definite information about how that liner was constructed; is that correct?

A. Yes, the operator said they had left the liner in place and then folded over the top of the pit when they closed it --

Q. Okay.

A. -- and we hit the liner at the top of the pit.

Q. It was not a deep trench burial in the sense that it was a wrapped enclosure?

A. Yes.

Q. Okay.

A. And the surface was not, obviously, showing any damage there.

Q. Okay. So in that one, the surface was not showing any damage?

A. Give credit where it's due.

Q. The ones where the surface was impacted with chlorides, do you know whether or not those chlorides were buried, or whether they had simply been left at the surface at the time?

A. I have no way of getting at the history of the site. The only thing I could do was note that on one site there were two new monitoring wells, and I sampled the wells and found something like 3,000 ppm of chloride.

Q. Yeah. But you don't know where that had moved from?

A. No. That's why I'm so sorry I ran out of money and quit drilling at 15 feet. Because if I had drilled all the way to the groundwater, I would have had a continuous core, and I would have been able to trace the chloride.

Q. Okay. Now, going then to your page number 24 -- and you were talking about the liner subsiding, the pit subsiding -- if I did understand what you said, and correct me if I'm wrong -- that what you interpreted that as being as evidence for moisture on the surface had found a way down into the pit. Is that what you indicated?

A. One year when I was out there, I noticed no such surface manifestations. Another year when I was out there, I noticed a little depression, linear depression, like a little tiny stream bed, very shallow, leading over and eventually coming to these tracks in this hole.

And it was evident from looking at it that water had run down the little -- it had gathered water in some significant area, and the water had gone down the hole, and the soil had cracked and dropped there.

Q. But you did not drill into it to see where it had gone?

A. I did not drill that spot, no.

Q. Okay. Do you know how that pit was closed?

A. No information.

Q. Okay. Thank you.

As I said, I'm not going to ask you very much about your rebuttal materials due to the short period of time we had to prepare them and to look at them, but I will ask a few questions?

A. Well, I apologize for the short time, but you'll notice the time stamp on the file was something like 12:36 this afternoon.

Q. I certainly understand that. I'm not faulting you for that.

You know, I'm accustomed to an environment in which you take the expert's deposition months before the trial, and then if he's going to supplement, he has to do it at least a week to 30 days before the trial. That enables one to be much more thorough. But we don't operate here in that environment.

You said something in your testimony, I believe -- at least Mr. Hansen picked up on it -- about a 25 percent soil porosity. Were you assuming that the application that the OCD modeling was based on that assumption?

A. It's a number that I picked up off the HELP -- or MULTIMED printout. And so I couldn't find any other specification of porosity in there. I meant to ask Mr. Hansen about it, and so I'll stand corrected.

But it didn't influence any of the conclusions I drew

because the conclusions I was trying to make is you need to cover a range of soil parameters when you're doing a system study.

Q. Okay. So if, actually, the assumption that the OCD made was 47 percent porosity, then that would not change any of your conclusions?

A. It wouldn't change my conclusions, because I would be back asking him, saying, I think you should also run a 25 and a 30 and a 35.

Q. Wouldn't the larger porosity result in faster flow and, therefore, be more conservative?

A. You tend to think it would, but these are nonlinear problems, and you change one thing and several other things may change. And that's why we have to do them by computer modeling.

I've been engaged in computer modeling since 1968 when the term didn't exist. And my first eight years of modeling were with thermonuclear weapons. When you're --

Q. A field in which you don't want to actually do field experiments.

A. I'm impressed with the fact when you're doing a system study you've got to go through all the parameters. Because if you have interacting parameters -- one thing makes the water flow faster, another thing makes it flow slower -- there's no substitute for doing the work and doing the

modeling. That's why I ran so many different options for that little infiltration study I did for the Pit Hearing.

Q. Now, incidentally, have you run models other than the HELP and the MULTIMED model that Mr. Hansen used?

A. I have not used those. I just read the technical literature on it.

Q. Okay. You mentioned that there are various factors that can be built into a landfill design that will retard flow further than simply putting down a geomembrane liner, correct?

A. Yes. I haven't designed a landfill per se, so I quote the literature, which says you're better off with a low permeability layer and a liner than with either the layer or the liner alone.

Q. And, of course, if you were to look at the regulations that the Oil Conservation Division adopted in the Surface Waste Management Rule for landfills, you'd find many of those features incorporated.

A. Yes, much to my gratification.

Q. But you are not suggesting, are you, that -- well, you said the HELP model was designed for that, right?

A. All right. I will say all the literature behind the HELP model says it's designed for landfills.

Q. But you're not suggesting, are you, that it's somehow built into the model such that Mr. Hansen's conclusions

are assuming the existence of further precautions that are not required under the rule, if you understand my question?

A. No. I think I understand your question, so I'm going to have to take a broader answer. I don't think anything is wrong with what Mr. Hansen did; it's just limited. And it's limited by the assumptions that are built into the defaults of the model, which was designed for landfills.

Q. But you're not suggesting that he built his conclusions on a model that assumed that you had additional precautions that we don't have here?

A. No. To the extent the model runs correctly, it modeled just what he drew, just what he showed it.

Q. Dr. Neeper, you talked a lot about colligative effect -- and I've seen this in a lot of papers, and I didn't have any idea until today what that meant. I think you kind of explained it in your testimony.

As I understand, the colligative effect is the tendency of the water that has salt in it to draw in fresh water in an effort to dilute that solution. Is that the general idea?

A. That is one of many colligative effects. In general, colligative means an influence of the solute upon the physical properties of solvent, whatever the two may be.

Q. Okay. Do you have an opinion -- and the problem with Mr. Hansen was he didn't consider the colligative

effects -- but do you have an opinion as to what the effect of colligative effects would have on the resulting concentration in the groundwater, the concentration of salts in the groundwater?

A. The opinion I can issue at the moment is that the colligative effects will increase the rate at which salts are transported toward the ground.

Q. That's what I understood you to say.

A. But I cannot tell you what the concentration would be at any particular time. There again, you have to do the problem and doing that problem with the colligative effects in it is a challenging technical task.

MR. BROOKS: One moment, Mr. Chairman.

No further questions. I pass the witness, Mr. Chairman.

CHAIRMAN FESMIRE: Ms. Foster?

MS. FOSTER: No questions.

CHAIRMAN FESMIRE: Mr. Carr?

MR. CARR: No questions, Mr. Chairman.

CHAIRMAN FESMIRE: Mr. Hiser?

MR. HISER: Just a few.

CROSS-EXAMINATION

BY MR. HISER:

Q. Dr. Neeper, thank you so much for coming and discussing this proposal with us.

I'd like to start with the modeling work that you did and presented previously at the prior hearing and then have sort of reintroduced here. This is on page 13 of your additional presentation.

I guess my first question -- I think we went through this the last time through -- is the model that you used either an EPA OR NMED model?

A. We have to come back to what you mean by model.

Q. I guess --

A. I know where you're going with this, so I want to give you a careful and complete answer.

Q. All right.

A. The code is not a model. In the case of HELP, the code is a long ways toward a model, because it pretty much assumes a landfill in situations like leaks that are characteristic of plastic liners of given sized holes in landfills.

The code I used here is the FEHM code. It is a research level code. One of its main functions is assessing the hydrology of Yucca Mountain Waste Repository. That's what I used. But it's not a thing you can just turn on, draw a picture and say, "I want these inputs."

It runs the pretty fine physics, and you have to know what it's doing with the physics to get a reasonable answer out if it.

Q. But it says here that the FEHM model -- I think I got the acronym right for that -- is not what we would commonly consider a regulatory model, one that EPA has put out on its list of models that it recommends to the various agencies that administrate environmental issues -- one that it recommends. It's one that you've used in your research and have found to be very useful to you.

A. The EPA would not recommend it for unsophisticated users, dare I say so. It is not user-friendly. It is not packaged for users. Anyone may obtain it free of charge. The Nuclear Regulatory Agency would pay attention to it.

Q. Now, when you were using your model, you were using essentially a moisture input, as understand it, at a 20-inch depth and sort of postulated that level of moisture was present in the soil column; is that correct?

A. Negative. I postulated that level of moisture was present at the 20-inch depth, at the top of where I began my calculations.

Q. And then you essentially used the one-dimensional model to move that water down through the soil column or up the soil column, as the case may be?

A. Yes, after establishing an equilibrium situation in the entire column down to the aquifer.

Q. Okay. And as a result of that, did this have the

effect of leaving moisture continuously present throughout the soil column?

A. You mean all the way between the aquifer the surface was moisture continuously present?

Q. Yes.

A. Yes, and it would be. You can't dry the soil totally.

Q. Okay. Now, the reaction that you're relying upon to bring the salt, as you say, to the surface, that's going to be a diffusion reaction of the salt traveling through the water column; is that correct?

A. Diffusion adds, but it's a minor part of it. The main thing is advective transport.

Q. Advective transport?

A. It's the moisture moving up.

Q. How does --

A. When you dry the surface of the soil, you increase the suction, the moisture moves up, and it brings the salt with it.

Q. Okay. So you're contention, then, is that there's advective transport of water which is moving in an upward direction and that's due to different -- I guess you would call it metric potentials between the different areas?

A. Any time you calculate unsaturated flow, you're calculating flow across a difference of potential. Mostly,

usually, it's metric potential.

Q. Okay. Now, this is -- as I think Mr. Brooks made clear starting at, essentially, 20 inches below, correct? And you sort of said you didn't want to deal with the surface because of the impact of advective flow from rainfall and everything else that occurs in that area.

A. It's just a complication. And if I see it getting to 20 inches, I figure the surface is impacted. That's correct.

Q. Okay. Now, is it not true that by assuming the continuous presence of moisture as you did, particularly in the upper levels of the surface, that that would tend to facilitate the movement of salt? Whereas, if that area were dry, relatively drier, that would tend to retard the movement of salt?

A. I can tell you're not a hydrologist.

Q. That may be. Neither are you.

A. There is almost always moisture present in the soil. If you take it to its very low moisture content, that's what's called residual moisture, and that appeared on the column of one of my slides.

Q. If there's residual moisture, though, is there a possibility for advective movement?

A. The residual moisture is the point where it doesn't move anymore. You've got it so dry it doesn't move

anymore.

Q. So effectively, once we've reached the point of residual moisture, there's not the possibility for salt transport through any type of advective means; is that correct?

A. That's right. If you took the holes out to the residual point, you would have advection of salt. You would have motion of water vapor, however.

Q. But water vapor cannot transfer salt itself, can it?

A. No, but it can increase the saturation to where you advection starts again. And that's why you got to watch all of these effects.

Q. But it wouldn't move the salt itself?

A. No, it's the osmotic pressure difference. The vapor is, in effect, an osmotic membrane. It doesn't transmit salt; it transmits water.

Q. But an osmotic membrane requires the presence of a membrane; does it not?

A. Negative. I said it is, in effect, an osmotic membrane. That means if you have salty unsaturated water here and pure unsaturated water here, one of them will be attracting vapor from the other. And the pressure difference -- if you want to call it that -- is the osmotic pressure.

That's the same pressure -- it's the energy difference per unit volume of water that you have between the

two situations. And that's the same pressure difference you would get if you had a semi-permeable membrane and measured the osmotic pressure across that membrane. And it becomes huge, the salt solutions.

Q. Dr. Neeper, is it not true, though, if I add water because of the vapor pressure approach that you've just spoken of, and eventually I get to the point where there is sufficient water, that gravity, once again, becomes the dominant feature and that would create convective or invective flow back downwards?

A. Gravity is always present. The liquid water will tend to flow toward the lowest potential, whether that's above it or below it. In the liquid flow, it will ignore the osmotic pressures, but will flow to basically a metric pressure, metric potential. And so it can flow downward. It can flow upward.

If you get enough water and you get a gradient where it is not sufficiently dry above a lower location, then the water will flow downward. If you get it dry above a location, it may flow upward.

Q. You did sampling at both Caprock and Loco Hills; is that correct?

A. That's correct.

Q. The did you see in either of those cases the movement of chloride upward that you could document?

A. I'm thoughtful because I'm trying to remember. I

would have to go back and look to be sure, but I'm remembering some rather extreme potentials near the surface on Caprock, not at Loco Hills.

But unless I looked at my notes or looked back at my previous testimony, I couldn't give you a guaranteed answer on that.

Q. But at Caprock we don't know how the closure was accomplished.

A. We don't know how the closure was done.

Q. So could you submit it -- there could be smearage of the content.

A. Somebody could have dumped a sack of soil on the ground. It's just suspicious that it happened in a location where there was a pit.

Q. Now, I want to look at your rebuttal testimony on slides, I think, in the arena of 19 and 20.

A. Okay. Once again, I'll get my assistant up here.

Is this the slide you wanted.

Q. It is. Thank you.

I believe you testified in your rebuttal testimony that this is from the folks that were responsible for part of the development of the HELP model, and this is a calculation that they've presented in terms of hydraulic head and the amount of water that might flow through a hole that appeared in a membrane; is that correct?

A. That's not quite correct. I testified that this is part of the literature that is behind and underlying the HELP model. But the authors of this literature are not the authors of at least the HELP engineering document.

Q. Okay.

A. This is actually an imagine out of the original literature.

Q. Okay. But the reason that you've presented this for us is what?

A. I presented it to show that the original literature shows an effect of a small hole. And the assumption in the model is that you have only one hole of whatever size it is per acre if you just choose, say, a good liner. And we need to look at what's the effect of a single hole in case we have one in our trench.

Q. And that's --

A. Because the 160-acre trench is about 1/25 of an acre, I think. And 1/25 of a hole is what might occur in a calculation, but what's reasonable is either one hole or no hole.

Q. Yes, or no hole. If I go on to page 19 of this, this is where you really, then, present the impact of this particular calculation; is it not?

A. That's right.

Q. Now, in this you're showing that we have an

equivalent of 3.5 inches per year of infiltration, and your contention is that that's larger than the .09 inches a year that was used in the OCD model; is that correct?

A. Yes, that's part of the answer. The other half of my answer was not that the 3 1/2 inches is the right answer, but it's showing you that there's a major impact if you have a small hole in that liner that is not accounted for by the assumptions that got built in automatically to the OCD calculations.

Q. Dr. Neeper, I am pleased to see that you have backed away from that because isn't that proposed infiltration rate actually about three times what's actually present if there were no pit liner at all? And we were looking at an unlined pit.

A. That's right. It's more than what you might get from trickling through all the various layers; that is, naturally you wouldn't have 3 1/2 inches of recharge in Hobbs, New Mexico, probably.

Q. Right.

A. But, what this tells you is that there may be something missing in your modeling that you need to go back to and pay attention to. You see two numbers that are way out of sorts with each other, and that's the message behind looking at what do we mean by one hole. Because the HELP model assumes there's a hole somewhere and then averages it out over a big

area.

Q. But it also shows, does it not, the importance of thinking about the geographic location that we're looking at as well and the amount of water that would be available to infiltration, period, through the area?

A. Well, this presumed leak was based on the assumed amount of the water down in the bottom of the trench that was both the lowest number printed in the literature and also the same number that Mr. Hansen used.

Q. Which also assumes, though, that that leak happens to be at the lowest point where the water is able to pool as a head over the membrane.

A. Yes. If it can't pool at that point, it'll build up until it finds a hole.

MR. HISER: No further questions.

CHAIRMAN FESMIRE: Mr. Frederick?

MR. FREDERICK: I'm kind of debating how to start here. One thing I'm just curious about, Mr. Chairman, is that you acknowledged an ongoing objection to Dr. Neeper's qualifications, and I'm wondering when we're going to get a decision on that objection and what it's based on.

So I'm just -- I want to know that. I'd rather know --

CHAIRMAN FESMIRE: It was my intention to preserve an objection to the things that she had described without having

to object every time that it came up.

MR. FREDERICK: Okay. I just want to make sure when you make your final decision, you're not going to say, "Objection sustained."

I'd like to be able to address -- if there's going to be a ruling that Dr. Neeper isn't qualified to testify on some aspect of his testimony, I'd like to know that now.

CHAIRMAN FESMIRE: I think it's implicit in the decision that the objection was overruled but that we were allowing her to maintain that objection in the record.

MR. FREDERICK: For the purpose of a later appeal, perhaps?

CHAIRMAN FESMIRE: Correct.

MR. FREDERICK: Thank you.

CROSS-EXAMINATION

BY MR. FREDERICK:

Q. Good afternoon, Dr. Neeper.

A. Good afternoon.

Q. In your professional career, I want to ask first: You've testified you've worked with numeric models, or something equivalent to numeric models, for about 40 years?

A. On and off through my career I've done numeric modeling. When I started, the term didn't even exist. We called it numerical experiment. The first eight years I was at Los Alamos we were doing numerical modeling, or I was engaged

in numerical modeling, of thermonuclear weapons and development of a code for that.

Subsequently, I was in charge of the -- for a while I was in charge of the Solar Building Research Group. And the heavy part of our effort there was numerical modeling the energy flows in buildings. From there I went on to doing some numerical modeling in an engineering, thermal engineering, group, and from there on into -- that got me interested in soils. I went on into soils.

So numerical modeling has just wandered through my career, but it's been probably intensive for 20-some years of that career.

Q. Okay. The HELP model and the MULTIMED model, you characterize those as numerical models?

A. Yes. Those are numerical models of particular things organized for particular purposes.

Q. In terms of levels of sophistication, how do they compare to models you've worked on and developed?

A. Sophistication is difficult. I'm going to explain what I mean when I use the term.

Q. Okay.

A. They contain much easier input for the user who does not want to go read for a year on the fundamental literature of how moisture diffuses through small holes, but instead wants to take some averages or things other people have

found or correlations and be satisfied they built it in; they've checked out their model; and he's willing to use their model and draw pictures and have much easier input to it so he can pay attention to his job and let the modelers do their job.

Q. Okay.

A. When I use the term "sophisticated," I'm meaning the closer you get to the actual differential equations in the model and understanding what they're doing.

Q. And you checked out the literature of the HELP model and MULTIMED model?

A. I didn't check out MULTIMED. I went back into the HELP -- the fundamental scientific literature that I've cited that was behind the HELP model -- and I used the HELP -- I had it up -- it's called the HELP technical mode, HELP Technical Users Manual.

Q. Okay.

A. I had the title copied on the slide, but it's the technical manual for HELP.

Q. Was there anything about that model in the literature that was beyond your education and experience or understanding you're dealing with?

A. No. I didn't see any words I didn't understand.

Q. As a soil physicist, you're concerned with vadose transport of water and water dissolved solids through the vadose zone; is that correct?

A. Yes.

Q. And have you worked with hydrologists before?

A. Everybody that sits around me is a hydrologist, so I'm a fish out of water.

Q. Do they necessarily know anything about vadose zone transport?

A. Half of them do that all day every day.

Q. And the other half?

A. Are doing groundwater transport.

Q. Okay. And now, when you look at vadose zone flow, is there anything special about the flow that happens through a liner versus soil material?

A. Yes. When you get to a liner, there are a lot of assumptions. The behavior of a liner, it's very different from the soil, and the literature brings that out. In one sense, in places it's perfectly sealed, and in another place there's a pinhole that's there by virtue of the manufacture.

In some cases, moisture can actually diffuse right through the linter itself, walks right through the liner material and, for instance, this is of great concern to the packaging industry who sells foods wrapped in plastic.

So there is a difference between soils and liners and soil language and soil mechanic -- soil equations have been adapted.

And so a number like a hydraulic conductivity will be

assigned to a liner. But you have to understand what it's talking about, what it means when they say that. Because it doesn't quite mean the same microscopic picture that you have of a little film of soil trickling -- water trickling through the soil.

Q. Okay. You took a picture of a subsidence in connection with a pit, correct?

A. Yes, I took a picture of something I interpreted as a subsidence because there's an opening and a depression appeared in the ground.

Q. If there's subsidence, would surface water runoff tend to collect in the subsided area?

A. Water flows downhill, so --

Q. I thought that was true.

A. -- in that case, the evidence on the ground was that it had trickled down this channel and then gone down in the cracks in the ground.

Q. How would that affect the local infiltration rate right there where the subsidence is?

A. That's the thing you really call a "fast path." Water can really move very rapidly through there. Now, would it hit when it got down two or three feet? I don't know how it's spread out.

Q. Is there anything in the Pit Rule that you can say that's going to prevent subsidence after a trench is

constructed?

A. No. My belief is that the top of the trench is to be mounded. But I don't know if there's anything there that would prevent a subsidence.

Q. And you gave us testimony earlier that there's no surface control. So if a truck drove over it or parked on it, how would that affect it?

A. I don't work in soil mechanics, so I wouldn't rule on that. But I wouldn't advise anybody to go out and park a truck on the top of a closed pit.

Q. As a matter of common sense, how would you expect a truck to affect the contents.

A. I would expect a truck to compress it if it's compressible.

Q. Okay. All right.

A. It's going to get compressible if it was once wet and the water drained out. That's where you get more compression.

Q. All right. I was going to go into colligative effects, but I think that's been brought out.

A. All right.

Q. Mr. Brooks mentioned that you didn't know how a pit was constructed when you were commenting on it; is that correct?

He brought up a couple of pits. One had a liner --

there was no evidence of a liner, and another -- and he asked whether you had any knowledge of how that pit was constructed?

A. I did some surface sampling on two old pits, neither of which I had any history of construction for.

Q. Okay.

A. I did both surface sampling and subsurface sampling on two other pits with the operator present, and I had the operator's word on construction and closing.

Q. Do you see anything in the rule, other than assuming full compliance with the rule, that would give OCD knowledge about how a trench is constructed?

A. I don't know. I can only guess OCD would assume it was constructed to obey the rule. But I'm quite concerned with whether one in a practical sense can assure the smooth bottom and smooth sides that the rule talks about.

Q. Okay. And why is it important to ensure a smooth bottom and smooth sides?

A. Because that's where you get punctures that cause faults. You raise the pressure when you drop material into the liner. And if you do not have a very firm contact between the liner with a fault, however small, and the material behind it, you may have a higher leak rate. That's why when you put a mesh behind a liner you increase the leak rate.

Q. But are the installations essentially foolproof? You just throw it in the trench, and you don't worry so much

about it?

A. I'm not an expert on all the trenches in New Mexico. I had a picture of one that showed a lot of wrinkles in the liner.

Q. Okay. How did -- strike that.

I gathered from your testimony that the use of HELP and MULTIMED coupled together are not necessarily inappropriate for assessing impact on groundwater; is that correct?

A. I feel they're entirely appropriate. It's just that they are limited. There are assumptions built in there and there are things, like the colligative effects, that the combination of codes cannot handle.

So if you were to ask me, then, what code would you use, that would be a difficult question to answer. So I'm making it clear it's not necessarily Mr. Hansen's fault that he didn't use colligative -- a code with colligative effects.

Q. No. And I'm not trying to fault Mr. Hansen at all. But what I'm trying to get at is there's been testimony -- and I'm not sure how you feel about this -- that the modeling that was done was conservative in terms of the liner and the assumptions made. Do you feel it was conservative?

A. It was neither conservative nor was it extreme. It just doesn't cover the whole range of possibilities, and one of the biggest effects are left out -- or two of the biggest

effects. It ignores the surface of the ground, and it ignores the colligative effects.

And it may have some very questionable assumptions about the quality of the liner in that I think it's assigning a fraction of a hole based on assuming one hole per acre rather than the possibility of one hole per installation.

Q. If I remember right, the conductivity through that liner that Mr. Hansen assumed was something like on the order of 10^{-13} cm/sec; do you remember that?

A. That was my memory. It was something times 10^{-13}.

Q. Do you have a feel for how many pinholes that would be?

A. That's what I mean about liners being different from soils. That's a number where someone tried to figure out how much moisture gets through this liner by whatever means; through pinholes, vapor transmission, leaks and whatnot. Now we gather that all together in a big average and assign one number to it and call it hydraulic conductivity so that people who work with solids can deal with it.

But you see, it's an artificial kind of number. There's nothing wrong with it, but you have to understand what's behind it when you use that number.

Q. Was the number appropriate?

A. Well, my theory is it overlooked the fact that you could have one hole for installation instead of one hole

per acre. You might have more than one hole per installation.

Q. Do you have any feel for how that might affect the saturation conductivity?

A. I didn't work that out. What I did was closer to what's on the screen, and that is, go back and look and see how much water can one hole deliver. And the answer is, well, pretty much all the water you could get.

It leaves you with a different problem. You start looking at holes in the liner.

MR. FREDERICK: That's all I have.

CHAIRMAN FESMIRE: Doctor, did you have anything to add by way of rebuttal to the questions that were asked?

THE WITNESS: No, I think I have taken much of the Commission's time for which I am grateful and appreciative.

CHAIRMAN FESMIRE: Does anybody have any --

COMMISSIONER BAILEY: I do.

CHAIRMAN FESMIRE: I'm sorry. I was in a hurry.

EXAMINATION

BY COMMISSIONER BAILEY:

Q. Page 5 of your original presentation indicates -- page 9. It's page 5 of my handout, but slide 9.

A. I apologize for giving you half pages. It's what happens on Saturday night when you're running out of printer ink.

Q. And you save a tree.

You indicated several varieties of native grasses that were tested as far as electrical conductivity, tolerance, and chloride tolerance.

If on-site burial in a trench has a plastic cover pushed to the center, an additional geomembrane liner on top of that, then a layer of sand on top of that to cut the capillary action of the movement of the salt, then four feet of soil, I am assuming that that would completely minimize any kind of impact of salts that may be buried within the trench on vegetation that would be planted at this surface and that the vegetation at the surface would be limited by the rooting depth and the soil characteristics of the native soil that's replaced on top of the pit. Is that a correct assumption?

A. I understand your question very much. I simply want to qualify the yes answer a little bit.

Even sand can still have a finite hydraulic conductivity, and it will move water upward if the potential gradient takes it that way. But the idea of instituting a capillary barrier, whether it be sand or gravel or what might be suitable in this circumstance, is a very welcome idea. It will definitely slow down the upward movement of salt as soon as it isn't so thick as to greatly increase the flow of water down or upset the whole problem. But certainly a capillary barrier is a good idea on a hazardous landfill.

Q. Would gravel be such a good idea because you're

putting it directly on top of that final geomembrane liner, which you showed in your picture could be punctured?

A. That's why I'm trying to be careful with how I say this. Gravel being larger particles, you probably will have a greater capillary barrier from it. But then you have to be careful how you use it and whether the soil around will infiltrate and fill it up and ruin it.

So I'm just trying to get away from the exclusive use of the word "sand" to say, in general, an idea of a capillary barrier is a good idea.

Q. A coarse material?

A. Yes, a coarse material.

Q. Which means that we would not necessarily have to change the rules in order to ensure that there is a capillary barrier. Because 19.15.17.13B, C, and D consistently uses the term "Division-prescribed soil cover."

And if the OCD were directed to ensure that a coarse material were laid down before the four-foot soil cover and mounding --

A. Uh-huh.

Q. -- then we could be fairly confident of revegetation of the area.

A. You would be confident for a longer time. Eventually, if you have faults coming out up the sides, you will have two- or three-dimensional flow, and it will get

around your pit -- or around your burial unit. But you will be better off for a longer period of time, certainly.

I am encouraging you to use capillary barriers. Thank you. I wanted those for our landfill.

Q. Well, the rule does say currently, "Division prescribed soil cover," which if the OCD district people and the Santa Fe people were directed to use coarser material, or to approve coarser material, then the area could be revegetated and used as grazing material or rangeland, as most of the southeast is already in use as rangeland; is that not right?

A. That is part of this breadth of problems in a system study that I was trying to get at. If you're going to base a rule on some calculation, you need to do some calculations that include the capillary barrier in different qualities and see how good that is for you.

You can do that. The HELP model may be able to do upward transport -- at least of the water -- or something else can do that. So I think that's a great thing to look at, and I think you run a good chance of it showing you a lot of safety, but I don't want to tell you how much.

Q. Right. But it could go a long way in alleviating Commissioner Olson's concern about reuse of the surface if we could revegetate it to rangeland at least.

A. In a way, you're asking me to solve the problem without running the problem, and I keep saying these are

nonlinear problems. I'm saying it's in the right direction, but I can't give you the answer without running the problem.

Q. You can't promise/swear, can you?

Mounding is required for closure of the trench pit. Wouldn't that be a topographic clue that there is something different in that area if there is a mound that's 100 feet square, or whatever dimensions it is, that could help indicate -- as well as the four-foot high pipe in the middle of the reclaimed pit -- to indicate that there is something to be aware of there?

A. I didn't testify on that, but I want to answer your question out of my own experience.

I've walked a lot of back country and noticed mounds and never thought anything about them until finally I became aware that those were Indian ruins, just a little low mound on the ground.

So what will attract somebody's attention, I don't know. But I would think a four-foot pipe would get some kind of attention.

Q. And the mounding could give an idea of the dimensions?

A. It might give an idea of the dimensions. I can't foresee people's use. My own concern is not with a single burial unit; it's with the fact that we have multiple units all over the landscape, and we've, therefore, degraded the utility

of the land for whatever purpose.

Q. What are your suggestions that you show on page -- on slide number 32?

A. Okay. The modifications?

Q. One of your suggested modifications is that an operator who closes a drying pad or temporary pit by on-site trench burial should determine the depth to the soil or rock saturated with water within 200 feet below the surface and record that depth on the drilling log.

I ask, to what purpose would that be used?

A. The purpose would be so that the operator knows where the saturated region is, and he can establish that he is well within the rule of not burying something within 100 feet of the groundwater. It would relieve the problem of there ever being a controversy. It's information that we have. Somebody has it because you've drilled through, but we don't give that information away, and it's there.

It would be useful if one operator found the depth, say, to first saturated one was 400 feet, and he had already shared that information with OCD. OCD would know for the entire neighborhood. They wouldn't have to think about that part of the rule.

It's a great defense for the operator, and it gets around all of this question of OCD looking at a map, which has kind of assumed groundwater depths in it, and then trying to

argue with an operator over whether or not he can do trench burial on that site because of a presumed depth to groundwater.

This establishes it. But I hope it keeps the State Engineer out of it. And that was the reason for the language that I put in it.

Q. Thank you. I just needed clarification of that.

COMMISSIONER BAILEY: That's all I have.

CHAIRMAN FESMIRE: Commissioner Olson?

EXAMINATION

BY COMMISSIONER OLSON:

Q. Dr. Neeper, I'll just follow up on what Commissioner Bailey was asking.

So are you saying that they should be identifying this at the time of drilling the well?

A. That seems to me to be the time to do it is when you're drilling. I asked someone who does drilling, "Can you tell?" I know if you're doing dry drilling, you can tell. But you may be doing mud drilling or something here.

Can you tell? And he was an oil field engineer.

And he says, "Yes, oh, yes. We can tell."

So it was based on that that I put this, and I put the depth kind of low so that if they found it 170 feet or something you wouldn't be arguing. I was trying to make it far enough below the burial unit that everybody could be satisfied and yet not task them with yet another reportable thing and a

form to fill out and more paperwork for OCD to do.

You're going to have a drilling log anyway. You're probably keeping track of soil types at times. They don't always backlog up to surface -- and other people will have to answer that -- but I think it's possible to know that.

Q. And then the other part of your recommendation was that this be a temporary allowance until 2011. How did you come up with the time frame of 2011? What's that based upon?

A. It's just based on extending it for two years. The date of June shows up in the rule because of the original time of adoption. So I was trying to make it so there's not one more date you have to keep track of.

Q. So are you anticipating that economic conditions will change within two years? Is that what you're --

A. I can't anticipate when economic conditions will change. But I can see that the rule should have -- if it's intended as an economic benefit rule, it should have an expiration date. Now, if you come up, then, to 2011, and conditions are, worse, and you think it is still justified to take the price out of the environment rather than taking the price out of the product -- which is where it belongs -- you can extend the rule.

Q. But right now that number you picked is -- doesn't really have -- it's just an arbitrary number you picked?

A. It's arbitrary other than one fact: I was trying to make it close to other numbers that the operator might be keeping track of so he didn't have to remember yet one more date. That's all that was in this. I may have the date wrong, but I was trying to think of the operator.

COMMISSIONER OLSON: Okay. That's all I have.

CHAIRMAN FESMIRE: I have no questions.

Dr. Neeper, do you have anything else to add?

THE WITNESS: No, other than my appreciation for your endurance sitting through everything that I did today.

CHAIRMAN FESMIRE: Are there any other questions of this witness?

MS. FOSTER: No, thank you.

MR. CARR: No.

MR. HISER: No.

MR. BROOKS: No, Mr. Chairman.

CHAIRMAN FESMIRE: Bruce?

MR. FREDERICK: No.

CHAIRMAN FESMIRE: Dr. Neeper, we are going to need a copy of your rebuttal exhibits for the court reporter.

THE WITNESS: Yes. And she already has an electronic one, but do you want copies mailed? Can I mail copies to you? Is mail fast enough to get copies for the entire --

CHAIRMAN FESMIRE: Joyce, do you need anything besides the electronic version?

THE COURT REPORTER: Baca Court Reporting will provide paper copies with the original transcript.

CHAIRMAN FESMIRE: Dr. Neeper, why don't you make sure Mr. Jones has an electronic copy before you leave, and he'll see that all the Commissioners get a copy.

THE WITNESS: Yes. And I believe there are other persons here who did not get copies from me. You don't? So I'll bring the thumb drive around, and you can get what you want. And if this doesn't work, if you would please contact me, I will get it to you. But I'll be gone next week.

CHAIRMAN FESMIRE: Okay. Ms. Foster, you still have no witness?

MS. FOSTER: That's correct.

CHAIRMAN FESMIRE: Mr. Carr, I believe you had two?

MR. CARR: Yes, we have two witnesses.

CHAIRMAN FESMIRE: And would you call your first witness?

MR. HISER: Mr Chairman, we call Bruce Buchanan.

CHAIRMAN FESMIRE: Mr. Buchanan, would you take the stand, please? You have not been sworn in this case yet.

[Witness sworn.]

DR. NEEPER: Just a question, Mr. Chairman, to be sure. Do I understand correctly I am not tasked to provide paper copies? You are getting what you need?

CHAIRMAN FESMIRE: We'll send out electronic copies

and print them if we need it.

DR. NEEPER: Very well.

MR. HISER: May I approach the witness?

CHAIRMAN FESMIRE: You may, sir.

DR. BRUCE A. BUCHANAN

after having been first duly sworn under oath,

was questioned and testified as follows:

DIRECT EXAMINATION

BY MR. HISER:

Q. Dr. Buchanan, I'm handing you a copy of an attachment that was submitted with the pre-hearing statement of the New Mexico Industry Committee. Is that a copy of your resume?

A. Yes, it is.

Q. And, I guess, could you give us a statement of some of your experience and qualifications to speak to matters of soil science and reclamation here in the State of New Mexico?

A. I was a university professor at New Mexico State University from 1971 to 1991, and worked in soils as a forest soil scientist and worked extensively in reforestation. Toward the end of that career, I began work in reclamation on mine lands and disturbed lands.

In 1991, I opened up a consulting business of my own and started doing work in designing reclamation. And the last

few years I've been involved, more so than earlier but throughout my career, I've been involved with salt movement and the management of saline in sodic soils. I've had experience with reclamation most of my career.

MR. HISER: Mr. Chairman, we would tender Dr. Buchanan as an expert in soil science and reclamation.

CHAIRMAN FESMIRE: And, in fact, in the prior hearing he was so accepted. Any objection?

MS. FOSTER: No objection.

MR. BROOKS: No objection.

MR. FREDERICK: No objection.

DR. NEEPER: No objection.

CHAIRMAN FESMIRE: Dr. Buchanan will be so accepted.

Q. (By Mr. Hiser): Dr. Buchanan, based on your experience, what is the soil depth that's of greatest importance to the growth and success of the native or agricultural plants here in New Mexico?

A. Four feet would be accepted by most soil scientists. Reclamation as to agricultural would be four feet.

Q. So does the four feet of cover which is provided for in the existing OCD Rule 17, in your opinion, provide an adequate basis for successful revegetation of a pit?

A. Yes, that's right.

Q. And you've been here throughout this hearing; have you not?

A. I have.

Q. And did you hear Dr. Neeper's testimony and his concern about salt coming to the surface?

A. I did.

Q. And do you share Dr. Neeper's concern about salt coming to the surface in New Mexico?

A. I do not.

Q. Would you like to explain why you do not share that concern?

A. The mechanisms for salt movement in soils are pretty well described. We pretty much understand those, and we understand it a lot better now than we did 10, 15 years ago, or 15 or 20 years ago.

In the last 10 years, there's been a lot of breakthroughs in the understanding of salt movement. And the last 10 years I have spent quite a bit of time studying salt movement in mine reclamation situations where a spoil material that is relatively high in most agricultural standards in salts, both sodium, magnesium, and calcium. And without getting into a university lecture -- which I'd love to do -- but just simply to say that I have looked at literally thousands of soils -- I'm not exaggerating -- I've looked at hundreds of situations. I've done research in saline and soil research and published in those fields, and this is my conclusion:

Where there is a body of material that is relatively high in salt, and it is covered with material that is relatively low in salt, and the typical situation of putting topsoil, if you will, or cover soil or top dressing -- whatever it's referred to -- over a body that you're trying to keep roots from growing into because of the nature of salt in that body, that those salts migrate very small distances into that cover soil. They will move up a few centimeters.

Recently, just in the last few weeks, I've completed a two-year study on that very subject. And we're in the process of -- the study was written up, and we're in the process of sharing that with the client.

After two years under irrigated conditions, virtually none of the salt moved out of the spoil into the topsoil. And when I say salt, I'm saying that as measured as sodium content, calcium content, magnesium content. That gave us a value called SAR, sodium adsorption ratio -- that's with a D -- adsorption -- and also measured by what's measured as electrical conductivity, the conductivity of soluble salts, or the amount of the soluble salts.

In fact, what we found was that the upper part of that body, actually the salt movement, was down, and it moved in the upper 15 centimeters down deeper in the profile. That model, that mental model, has been repeated and repeated and repeated throughout my career. And as I've studied soils in

forestry and the shrub lands, grasslands, semi-arid deserts, desert soils; I've studied soils in six inches of precipitation to 30 inches of precipitation, and virtually everything in between, and this is my observation.

That model that I just described to you is very basic, and is correct and it repeats itself. Salts in most situations do not move up. They'll move very short distances. And there's other literature that has demonstrated that very idea, but it does not move to the surface.

If there is as little as 12 inches of soil over that body, those salts do not move to the surface. Of hundreds of situations that I have seen in mining, in the oil and gas industry, in the copper industry in reclamation of those areas and in the reclamation of gold fields, with that cover soil, those salts do not move up.

Now, can salts move to the surface? Of course they can. There are mechanisms for that to happen. But there has been very special conditions. Typically, the one that works best is if you have an elevated water table.

I did studies on the Holloman Air Force Base when I was a university professor, and I studied soils there for several years. The water table varies from 12 to 30 inches, electrical conductivities of 100. I don't know what the chloride concentrations were, but extreme concentrations of salt; far, far higher than sea water.

Did the salts move to the surface? Yes, in some situations, particularly where the water table was within a few inches, 12 to 16 inches of the surface. When the water table was deeper and when water tables get in the vicinity of four or five feet, on the long haul most of the situations, you can move the salts, and they will move with the water table, and they will move up some, but they don't move to the surface.

And the explanation for that is rather simple. It rains. It just simply rains. And when it rains, the salts move down. And when the soils dry, there isn't a mechanism for the salts to move in the vapor. Vapor will move up, but there isn't a mechanism. But when there is that mechanism, and it does exist in some situations but they're not common, there is a capillary -- or a conduit -- I didn't mean to say capillary -- there is a conduit, and salts will move on that conduit. And they move basically by diffusion. That's one of the mechanisms. There are some others, but that is one of the main ones.

If you can't maintain that conduit -- and most of the soils that I'm talking about, most of the situations I'm talking about, we don't maintain that conduit. And when those salts move up slightly when it rains, those salts move back down. And it's not really much more complicated than that.

And a clear majority of the situations that I have seen and I have studied and have actually done research in and

watched salt movement and watched the management of salts for reclamation clearly demonstrates that the concern that this Commission might have of salts moving from a body of salty material four feet below the surface in a situation where the water table is much deeper than 10 or 12 feet, 20, 50, 100 feet -- but certainly the water table is not at the body of where this material is being stored.

There is virtually no mechanism that will persist for salt to move to the surface. And if you have fear that that salt will move and will have damage to the vegetation on that surface, my suggestion is -- I probably didn't state this very well.

What I was going to say is you shouldn't have a fear, and I don't think that's exactly what you wanted to hear.

I don't have a fear. I haven't seen -- let me state it more scientific, I guess. I don't have a situation that I can describe to you where that has happened. And I don't think, in my opinion, based on those observations and based on that history of research that those salts will ever move to the surface with even a foot of material. I'm not suggesting a foot. I'm just suggesting that if there's four feet, it even lessens the problem, and it's virtually not a problem.

Q. And so Doctor --

A. I know that was an elaborate description, but I just wanted to make it crystal clear.

Q. So Dr. Buchanan, that's in addition to your own personal research experience. You've also looked through the literature and a couple of longitudinal studies you have looked at salt movement as well; have you not?

A. I have.

Q. And those studies concluded the same as what you've just reported to the Commission.

A. Yes, they consistently do.

Q. And would an elevated water table that might lead to such a salt rise be present where the groundwater is required to be 100 feet below the pit, as is the case here?

A. Yeah, the wear table would have no effect on that situation.

Q. So it wouldn't cause the salt to rise?

A. It would not.

MR. HISER: I have no further questions.

CHAIRMAN FESMIRE: Mr. Frederick?

MR. FREDERICK: I have nothing.

CHAIRMAN FESMIRE: Dr. Neeper?

Wait a minute; wait minute. Are you okay, Doctor?

THE WITNESS: No. I'm old, and I fell, and I fell on my shoulder, and I just pushed off on it but forgot that I had hurt my shoulder, and it hurts. But I'm okay.

CHAIRMAN FESMIRE: You're not grabbing your chest or anything?

THE WITNESS: No. No, I'm not. I'm just grabbing my arm, and that's just old age.

CHAIRMAN FESMIRE: Dr. Neeper?

DR. NEEPER: I'll try to get away here with just two questions.

CROSS-EXAMINATION

BY DR. NEEPER:

Q. In your extensive experience, have you drilled into old oil field pits?

A. I have. I've either drilled or dug, yes.

Q. And have you been into pits in the southeast where one would expect a high salt content in the original waste?

A. I haven't drilled or dug in pits in the southeast.

Q. Finally, you have explained that you find little reason for salts to come to the surface; they should be mostly transported downward due to rainfall. Do I understand that correctly?

A. That's correct.

Q. Why, then, would I sample in the southeast 30 years after a pit has been closed and find extreme salts on the surface of the ground? Why hasn't that been washed away?

A. Because possibly the salts were there 30 years ago, and they haven't gone anywhere and that the soil was

compacted. A possibility -- and unless you want to describe the situation more carefully and more exact -- I'm going to generalize and say compacted soils and soils that have a very high salt content at the surface, the clays will disperse and cause a slaking of the soil, and water will not go into the soil.

If water doesn't go into the soil, I promise you you virtually cannot grow vegetation. I know a few situations where plants grow without water. And I say that cynically, I guess.

I am saying that I could come back at a later date. And I've seen it where soils have been dispersed, water isn't going into the soil, and there would be virtually no vegetation on that site for years and years and years -- for hundreds of years, not just tens of years. We don't know the history, and it's possible that those salts were there to begin with. They were left over from the earlier -- from an operation.

But I would question if those salts are dispersed at the surface. And if there isn't water going in, then there isn't water coming back up, and I highly question whether those salts would have migrated to the surface. They will migrate to the surface. And as I said, the Holloman Air Force Base situation where I worked, they did extensively, but those were cases where the water table was within several feet, if not 12 inches from the surface. And it is very, very high salt

content at the surface, and they got there by moving upward. I don't question that.

So my explanation simply would be that it could be that it started out that way, but I question whether they would ever have migrated from any depth.

Q. And the final question, then, might help us all out:

If they cannot migrate upward, can you tell us what's wrong with the simple models that do show it migrating upward due to a pulse of water going in and water being evaporated back out?

A. I think the model is wrong. I don't think the model represents what's happening. I think the model probably has some problems with the input. And my first thought would be I don't trust the model. Because the propensity of data out there in the actual situation doesn't allow for that salt to accumulate at the surface.

DR. NEEPER: No further questions.

CHAIRMAN FESMIRE: Mr. Brooks?

MR. BROOKS: I do have some questions.

CROSS-EXAMINATION

BY MR. BROOKS:

Q. Dr. Buchanan, good afternoon, sir. I'm not going to take very much of your time, but there was one area on which you testified somewhat at the prior hearing that Mr. Hiser did

not go into. And I asked these questions of Dr. Neeper, and to some extent he has claimed expertise on the subject.

You are, I believe you said in the prior proceeding, somewhat of an expert on New Mexico soils; is that correct?

A. Yes, I am.

Q. Would you characterize the soils in Southeastern New Mexico as being predominantly loose, sandy-type soils, or being predominantly tighter clay-type soils?

A. That would be like asking me if all the apples out of Washington are red.

Q. Well --

A. I would say that there's a variety of soils in the southeastern part of the State that I'm familiar with that I've been there and mapped soils in the southeastern part of the State. And you can find about whatever -- you can find sandy textured soils and some that are developed out of sand dunes. And much of my work has been in the oil and gas area in the southern part, and most of the soils that I've encountered there were predominantly silty. They were silt loams.

But there are silt loams and clay loams and sandy loams. So you can find about whatever you'd like to find down there.

Q. Okay. Well, you gave a somewhat extended answer to a question on this subject in the previous proceeding.

A. That's probably typical of me.

Q. But it seems that you said, generally, that -- what I read from your answer is -- I can read the entire answer except that it would take a fair amount of time -- that clay soils would be found in playa areas.

A. That's true.

Q. Or -- let's see. What else did you say?

A. Hopefully, I said you'd find sandy soils in dunes.

Q. But then you said, generally, that except in certain localities, as I read it, the sandy soils tend to be more predominate in -- we're talking on a statewide basis rather than specific to the southeast. So is that a fair characterization, or is that --

A. Now, what's the question?

Q. Are clay soils typical of certain locations?

A. Yes.

Q. And are looser soils -- and you said silty, and I'm not sure totally what the difference is between sandy and silty is. I have a general idea, but --

A. Did you want me to tell you?

Q. Please do.

A. Sand is a particle size. Silt is a smaller particle, and clay is yet a smaller particle. Sands by definition are smaller than 2 millimeters and go down to .05 millimeters. From .05 to .002 millimeters, or 2 microns are

the silt-sized parcels, and those particles that we describe as being smaller than 2 microns are clay.

When those are combined in different combinations, they form different textures of soil. Sandy soils are predominantly dominated by sand. Clay soils are predominantly dominated by clay-sized particles, and of course, silty soils are predominately dominated by silt-sized particles.

Q. Okay. Well, when you were asked this question -- the question you were asked was, "And in terms of general soil characteristics where drilling activities are going on, do they tend to be more in the sandy, loamy area or more towards the heavy clays?"

And your answer was: "New Mexico is an interesting place. It wasn't called the land of enchantment for nothing, and I've said that a few times today, and I don't mean to make a big issue of it, but it is the land of enchantment.

"From a soils perspective, it has a tremendous variety of soil types. Because we have a tremendous range of elevations in this State. But one of the things that's unique about it is it tends, the soils tend, to be more sandy throughout the State.

"If you look at San Juan County the heavy-textured soils are confined to the river drainage, and there's still, even at that, not a very high clay content."

And then skipping a paragraph --

CHAIRMAN FESMIRE: Hang on, Mr. Brooks. We may have an objection.

MR. FREDERICK: I just want to make an objection. It seems to be beyond the scope of his direct testimony. I guess I'm confused. Are we able to get out, you know, the testimony from the last hearing and kind of get a direct examination here but also get the lead?

CHAIRMAN FESMIRE: Mr. Brooks, where are we going with this?

MR. BROOKS: Well, I'm not very going very far, Mr. Commissioner. I intended to finish with this question and his response to it, I think.

I would -- I more or less planned to call Dr. Buchanan -- assuming he was here, which he is -- as a rebuttal witness. But I think it would be somewhat a waste of time, given the limited nature of my characterization, to go through that.

I do realize that this was not covered on direct, and I am outside the scope of direct, and the objection is entirely proper. But if you would prefer to allow me to finish, or rather, if they would rather finish the rest of the case and have me call Dr. Buchanan back for a rebuttal for a very short period of time.

CHAIRMAN FESMIRE: Given your confession and threat there, I'll go ahead and let you do it.

Q. (By Mr. Brooks): Anyway, you go on and say, "Other than in the playas, clays have been able to -- have been transported in the Isaac Lake playa just out on the Jornada Experimental Station. Just out of Las Cruces, it has 60 percent clay. It's the highest clay I've ever actually seen in New Mexico."

And then you go on for some time about clays, about clays in the playas. And then your last paragraph is: "So we don't have but in the loams, the sandy loams, the sandy loams, San Juan County is predominantly sandy loams and sands. We have a lot of dunes. For example, soils derived from eolian, not lows.

A. Lus.

Q. Okay. I'll accept your correction.

Anyway, reading all that, what I gleaned from it was that predominantly you would find heavy soils in the playas and in the river drainages, and that predominantly you would find sandy soils in other places; is that incorrect?

A. No.

Q. It's not incorrect?

A. No, it's not.

Q. So that is a correct generalization?

A. It's a generalization, and I made it, and I'll stand by it and say it's correct.

Q. Very good.

MR. BROOKS: I'll pass the witness.

CHAIRMAN FESMIRE: Commissioner Bailey?

EXAMINATION

BY COMMISSIONER BAILEY:

Q. I heard you say at the very beginning of your testimony that the two-year study that you are just wrapping up was irrigated conditions.

A. It was.

Q. Were most of your remarks, then, having to do with irrigated conditions?

A. No. Most of my remarks are associated with non-irrigated situations.

Q. Where can we make that distinction?

A. Irrigated accelerates the process. The principles are the same. In non-irrigated, the whole process happens in a slower -- happens slower. The movement of salt down, if you have a body of salt to spoil, it moves down slower. In irrigated, it's accelerated. That would be the main distinction.

COMMISSIONER BAILEY: That's all I have.

CHAIRMAN FESMIRE: Commissioner Olson?

COMMISSIONER OLSON: I have no questions.

EXAMINATION

BY CHAIRMAN FESMIRE:

Q. Dr. Buchanan, I have just -- anecdotally, in a

previous life, I worked for the State Engineer, and we visited irrigated fields and would see salt that had concentrated on the surface that would, you know, come in and be soaked in with the water. And then -- at least I was thinking it was coming to the surface -- does that differ from the phenomena that you're describing?

A. They come up. But did you also later in that season see that those salts had moved down with the next spring, for example? For example, during the year --

Q. Well, I'm going to have to ask you to go ahead and use a -- you don't get to question me.

A. Okay. I apologize for that, Chairman.

Yes, there are mechanisms that describe the salt movement during irrigated conditions, and salts will move to the surface temporarily. And once the irrigation is stopped or even for brief periods and during a rain, those salts will move back.

And it has a lot to do with the management of the irrigated water as to how those salts will accumulate at the surface. And there are now many situations where we so understand irrigation and how we irrigate with salty water that we virtually can keep salt from ever accumulating at the surface.

And it was probably in an earlier life when you saw those. And more often now today we see less of that kind of

management.

Q. Okay. But I've always seen what I thought were salts deposits on the surface at oil and gas locations and pit locations that in one year they wouldn't be there and the next year they would. Is that a different phenomena?

A. Probably not.

Q. So isn't that the salt coming out of the soils on those locations?

A. There was a number of explanations. One is compaction, and for a temporary perched water table or a temporary situation where water isn't able to move freely down, and water will stay at this surface, and those salts in that vicinity will come to the surface temporarily, and they predominantly account for the salts in that shallow zone of soil.

And once either through frost heaving -- is one of the ways that that is remediated and the soil is able to start aggregating, and once it aggregates, now water is able to start moving down through the profile. And most of the time in those situations I've observed that that salt would then move down.

Q. Okay.

CHAIRMAN FESMIRE: I have no further questions.

Mr. Hiser, do you have any anything else for this witness?

MR. HISER: No, thank you.

CHAIRMAN FESMIRE: Thank you very much, Doctor.

MS. FOSTER: Mr. Chairman, just for the record, I didn't have any questions for this witness. You never asked me. Just for the record. Thank you. I just want to make sure the record is clear.

MR. FREDERICK: You didn't ask me if I had a recross, although I didn't cross the first time.

CHAIRMAN FESMIRE: I didn't ask you if you had any direct, so I don't know you could have crossed.

Mr. Hiser, do you have another stray witness?

MR. HISER: I do not. But I'm told that Mr. Carr does, in fact, have a stray witness.

CHAIRMAN FESMIRE: Mr. Carr?

MR. CARR: May it please the Commission, at this time we will call Gregg Wurtz.

CHAIRMAN FESMIRE: Mr. Wurtz, you have not been sworn in this case, have you?

THE WITNESS: Yes, I have.

CHAIRMAN FESMIRE: Okay.

GREGG WURTZ

after having been first duly sworn under oath,

was questioned and testified as follows:

DIRECT EXAMINATION

BY MR. CARR:

Q. Would you state your name for the record, please.

A. Gregg Wurtz.
Q. Mr. Wurtz, where do you reside?
A. Farmington, New Mexico.
Q. And by whom are you employed?
A. ConocoPhillips.
Q. What is your position with ConocoPhillips?
A. I'm the senior environment staff person there.
Q. What do your duties, generally, entail?
A. Environmentally related to hydrology, soil cleanup, spill remediation, date and transport modeling, waste management, basically all the aspects of environmental compliance.
Q. Have you previously testified before the Oil Conservation Commission?
A. Yes, I have.
Q. At that hearing, were you qualified as an expert geologist and certified hazardous waste manager?
A. Yes, I was.
Q. And is a copy of your credentials what has been marked as ConocoPhillips Exhibit No. 1?
A. Yes.
Q. And that was attached to the pre-hearing statement filed by Conoco in this case; is that right?
A. Yes.
Q. Are you familiar with the application in this

case filed by the Oil Conservation Division?

A. Yes, I am.

Q. Are you familiar with the proposed amendments to the Pit Rule?

A. Yes, I am.

Q. Are you familiar with the efforts of ConocoPhillips to comply with the Pit rule?

A. Yes, I am.

Q. What have you been asked to do in this case?

A. I was asked to look at the amendments proposed today and to make sure that they were still protective of fresh water, public health, and the environment.

Q. What particular parts of the proposed amendments have you examined?

A. I was asked to, specifically, look at the below-grade tank amendments and the chloride levels in the deep trench burial.

Q. Are you prepared to review your work with the Commission?

A. Yes, I am.

MR. CARR: We tender Mr. Wurtz as an expert in hydrology and the management of hazardous materials.

CHAIRMAN FESMIRE: Is there any objection? Ms. Foster?

MS. FOSTER: No, thank you. No objection.

CHAIRMAN FESMIRE: Mr. Hiser, I'm assuming you would have no objection.

MR. HISER: No objection.

CHAIRMAN FESMIRE: Mr. Brooks?

MR. BROOKS: No objection, Mr. Chairman.

CHAIRMAN FESMIRE: Mr. Frederick?

MR. FREDERICK: No objection.

CHAIRMAN FESMIRE: Doctor?

DR. NEEPER: No objection.

CHAIRMAN FESMIRE: Mr. Wurtz's credentials are so accepted.

Q. (By Mr. Carr): Mr. Wurtz, ConocoPhillips is the largest operator in New Mexico; is it not?

A. I believe so.

Q. Could you review briefly for the Commission ConocoPhillips' efforts to comply with the current Pit Rule?

A. With the current Pit rule, we've submitted 6,929 permits for below-grade tanks, spending approximately 20 pages per permit for roughly 138,000 pages of permits submitted at a cost of over a million dollars.

Q. And as we go through this, you may refer to Oil Conservation Commission Exhibit 1 if you need to, but I would first like to direct your attention to the portions of the proposed amendments that relate to permit transfer provisions and also design and construction specifications.

What I'd like to have you focus on are the provisions that provide for tank sidewalls that are below the ground but visible, an operator may continue to operate these until integrity fails or there is a sale or transfer of the property.

Are you familiar with that portion of the proposed amendments?

A. Yes, I am.

Q. And based on your review, what is you opinion concerning the impact of these amendments on the continued protection of fresh water or public health?

A. My conclusions are that they'll continue to protect fresh water, the public, and the environment.

Q. And could you explain the basis for that conclusion?

A. The proposed amendments under 5I, they still remain -- the integrity of the vessel still remains, that we would have to report it if we did have any loss of integrity, and we would still have to clean up that spill if it did occur or close the tank if we lost integrity if it was one of the tanks that was grandfathered in, I guess, is the right term.

Q. You testified at the prior hearing about the movement of chlorides from these tanks; did you not?

A. Yes.

Q. In your opinion, would there be movement of sufficient concentrations of chloride to pose a threat to

groundwater without the detection liner?

A. No.

Q. The provisions on below-grade tanks also require that an operator shall keep records of written monthly inspections for the life of the tank. Do you have an opinion on that recordkeeping activity?

A. Yes. ConocoPhillips considers those -- we really don't see the value in them. We consider them unnecessary.

The tank itself, if it does have an integrity issue, we are required to report them. If we do have a spill, we're required to report that. So we would be on record with the OCD for any integrity issues for spill issues related to that tank and would be required to either close the tank or remediate the spill.

We'd also be developing a record with the OCD that they could see. If we had continual problems with that tank, they would have that information.

Q. Can you see any real reason to keep the data that would be required by the proposed amendment?

A. No, it's not clear to us.

Q. Have you considered the impact of increasing the chloride limits for waste contained in deep trench burials?

A. Yes, I have.

Q. And what are your conclusions concerning this change?

A. ConocoPhillips concludes that those are still protective of fresh water, public, and the environment.

Q. And explain the basis for that conclusion.

A. It's a combination of things. One, the siting requirements still remain in place. The design and construction and the reclamation are all still in effect in the current rule and would remain so.

We also have soil profile studies that we've conducted as we presented in previous hearings that did not show that chlorides would transport very far or in significant quantities.

Q. In your opinion, will approval of the application of the Oil Conservation Division and the amendment of the Pit Rule as proposed be in the best interests of conservation, the prevention of waste, and the protection of correlative rights?

A. Yes.

Q. Do you have anything to add to your testimony?

A. I would just like to thank the Governor, the OCC, and the OCD, for acknowledging that there is issues with the Pit Rule and allowing open dialogue between industry and ConocoPhillips and look forward to working together in the future.

MR. CARR: Mr. Chairman, that concludes Mr. Wurtz's testimony.

CHAIRMAN FESMIRE: Mr. Hiser, do you have any

questions of this witness?

MR. HISER: No, thank you.

CHAIRMAN FESMIRE: Mr. Frederick?

MR. FREDERICK: I just have a couple, Mr. Chairman.

CROSS-EXAMINATION

BY MR. FREDERICK:

Q. I guess my first question is general. I take it you disagree with OCD's position in the first hearing that on-site deep trench disposal should be minimized. Do you disagree with that?

A. Yes.

Q. And is it your position that under your various leasing arrangements that the oil company or the operator has the authority to leave waste on site in these permanent deep trench disposal sites?

A. I really didn't focus on that in my preparation for today, so I'm not prepared to speak to that.

Q. But you don't know one way or the other?

A. No.

Q. Okay. Does ConocoPhillips in its practice when it leaves a waste disposal site, oil pit waste, does it fence that off?

A. I'm not familiar with all our practices in the southeast. In the northwest, we do not fence them off. We reclaim them.

Q. But there's no control over the surface after you close it and leave it, pretty much, right?

A. Yeah. I'm not totally ready or prepared to speak to that today. I didn't look at those things.

Q. Okay. Did you do any modeling of chloride transport in the vadose zone or in groundwater?

A. No, I did not.

Q. Okay. All right.

MR. FREDERICK: That's all I have.

CHAIRMAN FESMIRE: Dr. Neeper?

DR. NEEPER: I have a couple of questions.

CROSS-EXAMINATION

BY DR. NEEPER:

Q. Mr. Wurtz, you mentioned -- I heard you to mention that you had done studies of the migration of salt or chloride around pits. Did I understand correctly?

A. Yes.

Q. And were any of those studies done in the southeast?

A. No, they were not.

Q. So you haven't studied salt migration from truly high concentrations; is that correct?

A. Correct.

Q. Thank you.

CHAIRMAN FESMIRE: Ms. Foster?

MS. FOSTER: I have no questions.

CHAIRMAN FESMIRE: After all that, you have no questions?

Commissioner Bailey?

COMMISSIONER BAILEY: No questions.

MR. BROOKS: I'm sorry, Mr. Chairman, I would point out that you did not ask me, however.

CHAIRMAN FESMIRE: Mr. Brooks, do you have any questions of this witness?

MR. BROOKS: Mr. Chairman, I have no questions.

MR. FREDERICK: You can ask me if I got everything out.

CHAIRMAN FESMIRE: You can't swing a dead cat without hitting a lawyer who doesn't want to ask a question.

Commissioner Olson?

COMMISSIONER OLSON: I would like to ask a question.

Most of the properties that you operate on are on State or federal lands in the northeast; is that correct?

THE WITNESS: Correct.

COMMISSIONER OLSON: And so I guess, effectively, you do have permission from the State or federal land managers for burial of waste on those properties as part of your lease?

THE WITNESS: I can assume we do, but that's not really part of my job function.

COMMISSIONER OLSON: That's all I have.

CHAIRMAN FESMIRE: Okay.

EXAMINATION

BY CHAIRMAN FESMIRE:

Q. Mr. Wurtz, you testified that the proposed rule will still be protective of fresh water, human health, and the environment; is that correct?

A. That's correct.

Q. So when you say "still protective," the current rule was also protective. Is that a pretty good assumption from that statement?

A. Yes.

Q. And you saw -- and I'm pretty sure you were present for Mr. Hansen's chart that showed, eventually, if we go to the higher standard in the proposed rule for chlorides, then we will exceed the groundwater quality standards at a certain point in the reservoir after some significant length of time; is that correct?

A. That's correct.

Q. So maintaining the current standard would either lessen that effect or keep us below the current water quality standard. Is that a fair interpretation of the data that's been presented?

A. I'm sorry. I'm not sure I followed that.

Q. If we don't exceed the groundwater quality standard in the wastes that are buried, we probably won't

exceed the groundwater quality standard in the water --

A. Yes.

Q. -- like we will if we go to the higher standard.

A. Yes.

Q. Do you have any idea how much money it'll save your company if we go to the higher standard?

A. No, I'm not prepared to speak to that.

Q. Okay. But is it safe to say it will save them some money?

A. I'm not really sure that it will, but there's other circumstances. We have to meet the 3103 standards as well, and I didn't look at that. I looked, specifically, at the chlorides.

Q. So are we spinning our wheels here, or is this a good thing to do?

A. I think the chlorides are a step in the right direction. ConocoPhillips likes the approach being used to evaluate the chlorides, but I haven't looked at the 3103 constituent list and determine if that's something we can make.

Q. Okay. Will this change affect Conoco's behavior in New Mexico? Will they invest more money in New Mexico if we make this change?

A. With all due respect, I didn't come today -- I don't know all those answers. I really was focused on the chloride and the below-grade tanks.

Q. Okay. So you -- okay. Let's venture into the realm of theory here.

This will probably lower the operating costs, if not so much the change in the chloride standard. It has the potential to lower the operating costs for probably most of the southeast operators, including ConocoPhillips?

A. Chloride alone probably won't help. I would have to look at the 3103 constituents parameter list and evaluate those, and I didn't do that for this hearing.

Q. Okay. So I guess what you're telling me is that this may not effectively accomplish what the Governor is asking us to accomplish, is it?

A. Without really looking at those 3103 parameter lists, I'm not sure I can answer that.

Q. Okay. So does Conoco intend to come back to us later and ask for further concessions?

A. We'd certainly encourage open dialogue and looking at any issues when we look at them further, yes.

Q. Okay.

CHAIRMAN FESMIRE: I have no further questions.

Do you have anything else of the witness, Mr. Carr?

MR. CARR: Mr. Chairman, it's my witness.

CHAIRMAN FESMIRE: I realized that as soon as I said that.

MR. CARR: No, sir, I do not.

CHAIRMAN FESMIRE: Does anybody else have anything else of this witness?

Okay. Thank you very much, Mr. Wurtz.

MR. BROOKS: Mr. Chairman, I wasn't really planning on presenting a rebuttal today, but Mr. Hansen is over here chomping at the bit to explain one matter about the HELP model that Mr. Neeper's testimony may have raised some questions about. So I'm wondering if I can recall Mr. Hansen regarding this one matter.

CHAIRMAN FESMIRE: Purely on a rebuttal basis?

MR. BROOKS: Yes, sir.

CHAIRMAN FESMIRE: Okay. Mr. Hansen, why don't you take the stand. Do you remember that you've been previously sworn in this case?

THE WITNESS: Yes.

REBUTTAL EXAMINATION

BY MR. BROOKS:

Q. Mr. Hansen, Dr. Neeper said something about the leaks from liners and because of the small size of these pits, the HELP model would not be an accurate prediction of the amount of the leakage you might get from holes in the liners. Is that the way you understood what he said?

A. Yes.

Q. Do you agree with that?

A. Not entirely.

Q. Explain why, please.

A. Okay. The HELP model uses a per acre calculation for determining leaks. Of course, that's the input. The HELP model does not have an areal extend boundary. So if I have a one-acre area or a ten-acre area or a 100-acre area, the leak rate will remain the same.

It could be said that something less than an acre might leak more through the HELP model, but not less, as characterized by Dr. Neeper.

Q. Was there something else you wanted to explain about Dr. Neeper's testimony on the HELP model?

A. Well, there was one other issue that was raised in that the HELP model did not account for what might be underneath the plastic.

The HELP model could to that; however, in the spirit of being conservative, the OCD did not account for anything underneath the liner. So, therefore, it could be, say, something like a geotextile so you have a free flow through leakage through the plastic with nothing underneath to be a more conservative leakage rate.

Q. Thank you.

MR. BROOKS: That's all my questions.

CHAIRMAN FESMIRE: Ms. Foster?

MS. FOSTER: No questions. Thank you.

CHAIRMAN FESMIRE: Mr. Carr?

MR. CARR: No questions.

CHAIRMAN FESMIRE: Mr. Frederick?

MR. FREDERICK: No questions.

CHAIRMAN FESMIRE: Doctor?

DR. NEEPER: Would you believe there's a question?

CHAIRMAN FESMIRE: Yes.

REBUTTAL CROSS-EXAMINATION

BY DR. NEEPER:

Q. Mr. Hansen, you have testified that the HELP model assigns leakage on a per-area basis.

A. A per-acre basis, right.

Q. Per-acre basis. And so with a so-called "good" installation, does the HELP model assign approximately one default per acre?

A. Actually, you can adjust it --

Q. Yes, you can adjust it.

A. -- if you care to. But, yes, a default value for good, yes.

Q. Did you use the default values?

A. Yes.

Q. If one had one default and it occurred far away --

A. I'm sorry. Can I interrupt?

Q. You may interrupt.

A. Default pinholes and defaults; a little

difference; one pinhole, four defects.

Q. Four defects?

A. Right.

Q. Let us operate, then, on four defects per acre. Would the average leak rate of four defects in an acre give you four multiplied by the area 160, divide by the area of the acre, which is 4,000?

In other words, the trench is about 1/25 of an acre. If you had four defaults in an acre, is it appropriate to figure that the leak rate of a trench is 1/25 of what you would have from that acre? In other words, do defaults come in units of 1/25 each?

A. As I just explained, I could take a one-acre or a ten-acre, but if I want less than an acre, it might be assigned a hole or defect to that, something less than one acre.

Q. So in effect, did it not assume that you had the same flow out of your trench that you would with an acre with those four defaults in the acre?

A. For a leakage rate, yes.

Q. For leak rate. And so, then, it essentially averaged that. It is calculating -- when you assign that rate to it, you're assigning an average to the trench?

A. Yes.

Q. Is that not why when I considered the literature value for one single hole I wound up with possibly a much

larger leak rate?

A. I don't believe so. The leak rate is based on what the head is or what could be on that particular hole or defect.

Q. We'll assume the same head.

A. But what you testified to was not head dependent.

Q. It was head dependent. That was shown on the -- it had the head you had. But what I'm asking you is --

A. I'm sorry. I don't believe it was.

Q. But your testimony -- and the question is whether when four defects are assigned to a whole acre, can you take the average leak rate for that acre and assume you have, then, 4/25 of a default in the trench to give you the same leak rate in the trench?

A. Anybody could, but the HELP model does not.

Q. What does it assume to get the same average leak rate, then?

A. It assumes one acre, and that's the same leak rate whether it's ten acres, one ache, or 100 acres.

Q. Or 160 square meters?

A. Or 160 square meters.

Q. I'll let it go at that. Thank you.

CHAIRMAN FESMIRE: Okay. Is there anybody in the audience who would like to make a public comment? I think everybody left is a party, with maybe a couple of exceptions.

This is probably your last opportunity on this case to get to add something to the record. Looking out there, I see no takers.

So we're going to move on to the next order of business. We have a regularly scheduled Commission meeting on the 9th, but as of right now, there's nothing on that docket.

We are going to need from the parties Proposed Conclusions of Law and Findings of Fact, and if we were to ask for them on the 9th, that would give you six days, and I don't think that's long enough. We also have a special meeting on Wednesday the 15th.

So what we're going to do is continue this hearing until Wednesday the 15th. At that time, we will request the parties to have delivered, prior to the meeting, their Proposed Findings and Conclusions. And at that meeting, if there's time that day, the Commission will deliberate on the case. If there isn't, we'll continue it to a date that we can deliberate on it. Is that acceptable?

COMMISSIONER BAILEY: Yes.

COMMISSIONER OLSON: That's fine.

CHAIRMAN FESMIRE: So at this time, we're going to adjourn and --

MR. HISER: I have a question for you, Mr. Chairman.

Does that mean that the Commission will continue the evidentiary portion of that, or simply the deliberation portion

of that?

CHAIRMAN FESMIRE: We're not going to close the evidence until we get the Conclusions and Findings, but I would not plan on making a big evidentiary showing on the 15th.

MR. HISER: I just wanted to make sure that's what you were thinking.

CHAIRMAN FESMIRE: So we will -- Mr. Frederick?

MR. FREDERICK: I just want to clarify. So are the Findings of Fact and Conclusions of Law due on the 15th?

CHAIRMAN FESMIRE: They're due prior to the hearing on the 15th?

MR. FREDERICK: So does that mean they're due on the 14th?

CHAIRMAN FESMIRE: No, that means prior to the hearing the 15th. We will consider them, look at them, and decide whether or not we can deliberate then and whether we have to schedule it.

MR. FREDERICK: Is that everything that's going to be on the test?

MS. FOSTER: Mr. Commissioner, will those Facts and Findings and Conclusions of Law need to be distributed to all the parties?

CHAIRMAN FESMIRE: As with any other pleading, they'll have to be distributed to everybody who's a party to the case.

MS. FOSTER: Okay. Will you do that just prior to the hearing?

CHAIRMAN FESMIRE: Just prior to the hearing. Mr. Brooks?

MR. BROOKS: Could you ask the court reporter when the transcript will be available?

CHAIRMAN FESMIRE: Joyce?

THE COURT REPORTER: Two weeks.

MR. BROOKS: I realize that, but if we have to prepare Findings of Fact and Conclusions of Law by the 15th, it would be extremely helpful if we could get the transcript a few days before the 15th.

CHAIRMAN FESMIRE: Woe be it for me to violate a contract. We'll continue the case to the 15th, and at that point, we'll make sure when we get the transcript and we can get it to everybody, and then we'll determine when the Findings and Conclusions are due. It will be a very short period after the transcript is available.

MR. BROOKS: Thank you, Mr. Chairman.

CHAIRMAN FESMIRE: Anything else? With that, we're going to adjourn Case No. 14292 and continue it to Wednesday, the 15th of April at 9 o'clock in this room; is that correct?

Thank you all very much.

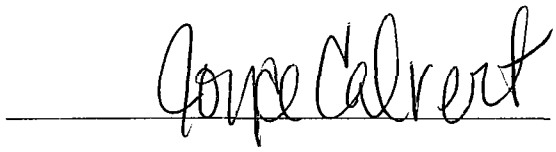
* * *

REPORTER'S CERTIFICATE

I, JOYCE D. CALVERT, Provisional Court Reporter for the State of New Mexico, do hereby certify that I reported the foregoing proceedings in stenographic shorthand and that the foregoing pages are a true and correct transcript of those proceedings and was reduced to printed form under my direct supervision.

I FURTHER CERTIFY that I am neither employed by nor related to any of the parties or attorneys in this case and that I have no interest in the final disposition of this proceeding.

DATED this 3rd day of April, 2009.



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STATE OF NEW MEXICO)
)
COUNTY OF BERNALILLO)

I, JOYCE D. CALVERT, a New Mexico Provisional Reporter, working under the direction and direct supervision of Paul Baca, New Mexico CCR License Number 112, hereby certify that I reported the attached proceedings; that pages numbered 1-235 inclusive, are a true and correct transcript of my stenographic notes. On the date I reported these proceedings, I was the holder of Provisional License Number P-03.

Dated at Albuquerque, New Mexico, 3rd day of April, 2009.

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